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INDEX TO VOLUME XLI.

GENERAL ALPHABETICAL INDEX.

NOTE.—*Entries from the Digest of Current Electrical Literature are indicated by D. (Digest) and D. R. (Digest Reference). Illustrated articles are indicated by**

A

ABNER, DOBLE CO. Tests of tangential waterwheels under 1912 ft. effective head..1071
Acetone: Acetylene dissolved in. By Hutton (D.) 703
——Electrolytic preparation of iodoform from. By Abbott (D.).......... 571
Acetylene and calcium carbide (D. R.)...... 249
——dissolved in acetone. By Hutton (D.).. 703
——Impurities in. By Keppeler (D.)........ 981
——Purification of technical. By Keppeler (D. R.).......... 841
Aeronaut monument in Paris.............. 890
Aeronautics, Aerial torpedo 36
Aerial navigation, Electricity as motive power in. By Dr. T. Byard Collins........*440
Aerial telegraphy, Branley-Popp system of. By Henry Hale..........*823
Agriculture, Electricity in, 547. By Emile Guarini *554
Air in caves, Ionization of. By Ebert and Ewers (D. R.).......... 86
——Current from.......... 36
——Electric conductivity of atmospheric. By McLennan and Burton (D.)........ 937
——Electric discharges in. By Alfred G. Dell 15
——Electric dissipation in fog. By Gockel (D.) 452
——Spontaneous ionization in. By Patterson (D.).......... 369
Airship, Wheel to run. By F. A. Shepard.. 561
Alcohol, Cheap chemical.......... 607
Alkalies: Action of iodine on. By Foerster and Gyr (D. R.).......... 530
——earth metals, Production of permanganate of. Hickmann patent. By C. P. Townsend 886
——Electrolytic, industry. By J. B. C. Kershaw (D.).......... 86
——Sodium chloride in electrolytic caustic. By Townsend (D.).......... 40
Alloys: Copper-cadmium. By Denso (D.).. 667
——of lead, tin and bismuth. By Shepherd. (D.) 166
Alphaduct Mfg. Co. Fire-proof fibre conduit. *46
ALTERNATING CURRENTS:
Alternating Currents: Changing, into two undirectional currents. By Benischke (D. R.).......... 979
——circuit, Power factor regulator. Johnston patent 976
——in coal mining.......... 397
——vs. direct, applied to iron and steel industry. By C. H. Hines..........*315
——Electrolytic dissolution of platinum by means of. By Ruer (D.)..........841
——Five-phase system. By Ehnert (D.)..... 451
——lines, Compensation for induction drop on long. Kelley patent.......... 37
——model. By White (D. R.).......... 205
——phenomena, Graphical methods for. By Orlich (D.).......... 285
——Physiological effects of. By Andriessen (D. R.).......... 842
——railway return circuit. Mordey patent... 244
——Rectification of, by means of the electric arc 883
——Rectified constant current from constant-potential. Rice patent..........1018
——Rectifying. Thomson patents.......... 526
——switches and fuses, Testing of. By Howe (D.) 1020
Alternators: (See also Dynamos, Generators.)
Alternators: By Loppe (D. R.).......... 487
——Armature reaction of. By C. F. Guilbert 32, *116
——Commutation of. By M. Latour........*977
——Compensated. By Bragsted (D. R.).... 977
——Compounding. By Boy de la Tour (D. R.) 663
——Compounding. Rice method.......... 84
——frames, Stresses in. By A. Hansson.... 282
——Governing. By De Marchena (D.) 129, (D. R.).......... 163
——Governors for engine-driving. By Parkinson (D.).......... 39
——Large three-phase (D.).......... 804
——in parallel. By Cramer (D. R.) 39. Benischke, Rosenberg, Georges (D. R.) 85. (D.) 164. Fernandez (D. R.) 487. Benischke (D.) 568. Manduit (D. R.) 568. Oscanyan 652. K. G. Dunn 836. Georges (D. R.)..... 977
——Predetermination of characteristics...... 318
——Synchronizing. By Callis (D.)........ 623
——Synchronizing apparatus for. Dow patent. 976
——Synchronous impedance and standstill impedance, 2. By F. Townsend, H. P. Freund, W. I. Reich.......... *13
——Three-phase. By Doane (D. R.)........ 892
Alumina and carborundum. Weber patent. By C. P. Townsend.......... 928
Aluminum. By Burgess and Hambuechen (D.) 286. Pitival, Sperry (D. R.) 624. By J. B. C. Kershaw (D.) 704, (D.).......... 760
——anode. By Taylor and Inglis (D.)....... 87
——as reducing agent in metallurgy. By Scholl (D. R.).......... 286
——bronze. By Sperry (D. R.).......... 704
——litigation 644
——Present metallurgy of. By J. W. Richards (D.).......... 248
——valves. By Nodon (D.).......... 624
Amalgums, Potassium, as cathodes. By Lyman (D. R.).......... 369
American Association for the Advancement of Science, volume of proceedings of Pittsburg 1902 meeting.......... 434
——Washington convention, 62. By N. Monroe Hopkins *73
American Conduit Co. Bituminized fibre conduit 166
American District Steam Co. Central station steam distributing system.......... 581
American Electric Improvement Co. Clark electric process for water purification *670
American Electrochemical Society, new membership 325, 485
——New York meeting.......600, 643, 681, 694
American Institute of Electrical Engineers, annual dinner..........190, 265, 268
——Annual meeting..........858, 963
——April meeting.......... 750
——Board of Directors' report.......... 916
——Boston meeting..........310, 312
——Boston branch officers.......... 565
——Chicago meeting..........64, 472, 832
——Chicago meeting on high tension lines... 644
——Chicago meeting on telephones.......... 925
——Chicago, season's programme.......... 436
——Discussion of central station papers..... 793
——March meeting..........*557
——Membership 862
——National Electric Code Committee meeting 245
——Niagara meeting programme 889, 926, 1040, 1042, 1085, 1088
——Philadelphia meeting ..392, 472, 684, 918, 1059
——Pittsburg meeting..........*312
——St. Louis Chapter.......... 244
——Student members.......... 548
——Students theses.......... 802
——Telephone meeting.......... 189
——Wisconsin branch.......... 527
American Street Railway Association, Mechanical and Electrical branch...... 392
American Thermo-Call Co. Push button....*898
Ammeters and voltmeters: Jewell circuit breaking *579
——Nalder & Thompson recording.......... *50
——Westinghouse alternating current long scale *708
Ampere, Portrait of.......... 84
Annunciator drop litigation, Warner......... 927
Anode: Aluminum. By Taylor and Inglis (D.) 87
——connector. Moore patent. By C. P. Townsend *928
——Disintegration of. By Wohlwill (D.).... 938
——for electrolytic work. Dow method. By C. P. Townsend.......... 159
——for electroplating. By Burgess and Hambuechen (D.) 1109
Antimony: Electrolytic preparation of. By Izart (D. R.).......... 490
——Izart and Thomas process (D. R.)...... 704
Arc: Alternating current. By Guye and Monasch (D. R.) 488, (D.)......... 805
——Electric (D. R.).......... 283
——electric, Rectification of the alternating current by means of.......... 883
——mercury, Pressure in. By Stark and Reich (D.).......... 621
——mercury, Pulsating direct currents in the alternating current. By Monasch (D.) 894
——mercury vapor, Experiments with. By Goetze (D. R.)..........978
——Speaking *319
ARC LAMPS:
Arc lamp, Columbia..........*133
——Connection of. By Kaufmann (D. R.).1107
——Division of labor in Mexico.......... 746
——Electrolytic. Dean patent.......... 976
——Enclosed 1004
——Enclosed, statistics. By L. B. Marks... 881
——fittings. Central Electric..........*170
——General incandescent enclosed.........*1027
——guard, Hamblin & Russell "Never Break" *49
——Hornsey installation (D.).......... 757
——for interior car lighting (D. R.).......1107
——Low amperage.......... 954
——Multiphase. Fleming patent *1102
——Osborn-Morgan interchangeable.........*450
——photometry 700
——regulating mechanisms (D. R.).......... 488
——regulation. Davis patent..........1017
——Small economical (D.).......... 568
——Special connections of. By Boje (D.)...1019
——Stanley "Sterling".......... *44
ARC LAMPS. (Continued.)
——suspension, Stirrup for. White Star Appliance Co..........*986
——with impregnated carbons. By Ziedler (D.) *487
Armatures, Improvements in construction, for induction motors. Thomson patent, 1017. Steinmetz patent..........1063
——sheets, Slotted. By Hundhausen (D. R.) 128
——Ventilating dynamo..........1062
Army: Electrical instruction for officers at Sandy Hook.......... 565
——Electricians for.......... 836
——Electricity in. By Chas. G. Chase...127, 835
——Wireless telegraphy in. By Prasch (D. R.) 939
Association of Railway Telegraph Superintendents, annual convention of...... 886
——Convention exhibits.......... 897
Atmosphere. What cold does 1103
Atmospheric electricity and terrestrial magnetism (D. R.) 1108
——ionization. By Rutherford and Allen (D.) 130
Atomic fog, Sir Wm. Crookes on 1006
Atwater-Kent Mfg. Works. Desk telephone set*768
——Monoplex intercommunicating telephones.*210
Autocar, Electric, in Belgium.......... 891
Auto-Igniter Company. Ignition dynamo....*899
Automatic Electric Pump Co. Pumps.......*585
Automatic Switch Co. Automatic motor starter *710
Automatic Time Stamp Co. Time stamp for telephone switchboards..........*583
Automobile Manufacturers' Association, annual dinner.......... 200
AUTOMOBILES:
Automobile batteries, American (D. R.)..... 704
——chairs at St. Louis Exposition. Electric Chair Co. 1111
——charging in Boston district.......... 992
——bus, London.......... 828
——business 242
——charging outfits, Westinghouse..........*764
——Electric 363
——and horseless carriage patents, Digest of. 282
——Kammann electric..........*497
——manufacturers' combination.......... 588
——omnibus, Petrol-electric (D.)..........1020
——show, Brussels.......... 523
——show, England 245, (D. R.) 368, (D. R.) 839
——show, New York..........143, *167, 202
——Small generators for (D. R.).......... 757
——speedway, Berlin, Germany.......... 161
——in St. Louis..........1017
——Street sprinkler in Paris.......... 802
——telephone truck. Rainier..........*532
——Trial of commercial, in New York City. 523, 890
Automobilism, Present status of electric. By Hayden Eames.......... *68

B

BALL ENGINE CO. Engine governor..... *51
Barlow's wheel for lecture purposes. By Carvallo (D. R.).......... 624
Barron, Jas. S. & Co. Cable clip..........*631
Batteries. (See Primary, Storage.)
Battleships, New.......... 510
Bay State Stamping Co. Oil cups and oil hole covers..........*631
Bearings, Electrical resistance of. By A. E. Kennelly and C. A. Adams.......... 231
Bell, Alexander Graham. Biography (D. R.) 939. By Benjamin (D.).......... 981
Biology, Dissociation theory in. By Bancroft (D.) 1067
Bismuth, lead and tin, Alloys of. By Shepherd (D.).......... 166
——Thermomagnetic properties of. By Lowndes (D. R.).......... 285
Bleach and chlorine, Apparatus for electrolytic production of. By Ulke (D. R.) ..1109
——liquors, Production of. Haas Method. By C. P. Townsend..........*159, 198
Boats, Submarine, French.......... 202
——in navy.......... 36
——Trial of Porpoise.......... 890
Bogue, Chas. J. Electrolytic generator......*256
Boilers: Oil and compound feeders for. By Hobart (D. R.).......... 328
——plant for St. Louis Exposition. Williams and Wollender.......... 375
——Robb-Mumford *767
BOOK REVIEWS:
—Alternating Current Calculating Device. By F. G. Baum.......... 842
—Alternating Current Machines. By Samuel Sheldon 453
—American Municipal Progress. By Prof. Charles Zueblin.......... 206
—Anlasser und Regler fur Elektrische Motoren und Generatoren. By Rudolf Krause 41
—Annual Report of the Board of Regents of the Smithsonian Institute, 1901..... 939
—Art of Illumination. By Louis Bell....... 370

BOOK REVIEWS. (Continued.)
—Asynchron Generatoren. By Clarence Feldmann ... 491
—Conductors for Electrical Distribution. By F. A. C. Perrine ... 807
—Design of Dynamos. By Silvanus P. Thompson ... 531
—Die Bahnmotoren für Gleichstrom. By M. Muller and W. Mattersdorf ... 981
—Die Funkentelegraphie. By C. Arldt ... 981
—Die Gewinnung des Aluminums. By Adolphe Minet ... 207
—Die Grundgesetze der Wechselstromtechnik. By Dr. Gustav Benischke ... 981
—Die Kunstlichen Kohlen. By Dr. Julius Zellner ... 625
—Die Wechselstromtechnik. Edited by E. Arnold ... 573
—Einfuhrung in die Elektrochemie. By F. Oettel ... 762
—Electrical Dictionary. English, German, French. By Paul Blaschke ... 414
—Electrical Engineers Pocket Book. By Horatio A. Foster ... 331
—Electricity as Applied to Mining. By A. Lupton, G. D. Aspinall Par and H. Perkins ... 625
—Electricity and Its Similitudes. By Chas. H. Tyndall ... 371
—Der Elektrische Betrieb von Fernschnellbahnen. By Gustav W. Meyer ... 330
—Elektrische Strassenbahnen. By Johannas Zacharias ... 981
—Elektro-Ingenieur Kalender, 1903. By Arthur H. Hirsch ... 531
—Elektromagnetische Aufbereitung. By F. Langguth ... 667
—Elektromechanische Konstruktionen. By Gisbert Kapp ... 762
—Elektromotoren fur Gleichstrom. By Von G. Roessler ... 249
—Elektrotechnik in Einzel-Darstellungen. By Dr. G. Benischke ... 572
—Elementare Vorlesungen uber Telegraphie und Telephonie. By Richard Heilbrun ... 414, 895
—Elements of Electrical Engineering. By Thomas Sewell ... 491
—Finances of Gas and Electricity Manufacturing Enterprises. By W. D. Marks ... 939
—Galvanic Batteries. Their Theory, Constrnction and Use. By S. R. Bottone ... 413
—How to Become a Competent Motorman. By Virgil B. Livermore and James Williams ... 940
—How and Why of Electricity. By Chas. Tripler Child ... 371
—Improvements in the Hungarian Telegraph and Telephone Installations ... 207
—Introduction Motor. By Henri Boy de la Tour ... 981
—Isoliermaterialien und Warme (Kalte) Schutzmassen. By Eduard Feltone.. 414
—Jahrbuch der Elektrochemie. By Dr. W. Nernst and Dr. W. Borchers ... 207
—La Traction Electrique par Contracts Superficiels du Systeme Diatto. By Dr. Julius ... 41
—Leitfaden zur Konstruktion von Dynamomaschinen. Und zur Berechung von Elektrischen Leitungen. Von Dr. Max Corsepius ... 330
—Les Theories Electriques de J. Clerk Maxwell. By M. P. Duhem ... 454
—The Locomotive: Simple, Compound and Electric. By H. C. Reagan ... 208
—Manual of Rural Telephony. By J. A. Williams ... 207
—Motor Cars. By Rhys Jenkins ... 88
—Notes on Laying, Repairing, Operating and Testing Submarine Cables. By Captain Edgar Russell ... 454
--Physico-Chemical Tables. By John Castel Evans ... 667
—Reference Library of Modern Engineering Practice: Steam, Electricity, Mechanics. By Frank W. Gunsaulus... 761
—Secondary Batteries: Their Theory, Construction and Use. By E. J. Wade.. 573
—Specielle Elektrochemie. By Dr. H. Dannell ... 842
—Successful Advertising. By J. Angus McDonald ... 207
—Technologia del Calore. By Rignaldo Ferrini ... 491
—Telephone lines. By Walter C. Owens ... 1022
—Telephone Green Book, The, for 1902. By H. H. Robinson ... 207
—Telephony. By A. V. Abbott ... 1068
—Theoretical Elements of Electrical Engineering. By Chas. Proteus Steinmetz ... 131
—The Town Trouble. By Adolph F. Hamacek ... 166
—Transactions of American Electrochemical Society ... 88
—United States Automobile Patents. Compiled by Jas. T. Allen ... 454
Brake air compressor. General Electric ... *629
Brake, Electromagnet (D. R.) ... 88
Bridge, Mersey River (D. R.) ... 368
Bridges and canal lifts, Electric operation of (D.) 283, (D.) ... 893
British Columbia, Power development of ... 25
British Thomson-Houston Co. Direct current motors ... *576
——New shops ... *42
Brush Electrical Engineering Co. English turbo-generators ... *982
Buffalo Forge Co. Steam engine tests ... *897
Bullock Electric Mfg. Co. Motor-generators. *289, *533, *941

C

CABLES, Capacity of. By Andriessen (D. R.) ... 894
——clip. Barron "H I" ... *631
——clips (D. R.) ... 574
——Standardization of conductors and (D.).. 979
Cables, Submarine: Black Sea concessions . 409
——British Pacific ... 661, 802
——Commercial Pacific, Laying *4, 64, 245, 975, 1103
——Commercial Pacific speed (D.) ... 41
——Core ratio of. By Young (D.) 530, (D.) 624
——Dutch, at Guam ... 483, 689
——Effect of Marconi's work on quotations.. 199
——Fanning Island station ... 30
——Farallon Islands, severed ... 754
——German steamship "Stephan" ... 318
——Laying ... 363
——New German ... 408, 1105
——Proposed vocabulary ... 808
——South Sea ... 61
——Testing. By Dalton (D. R.) ... 841
——Trans Pacific, 120. By McAdie (D. R.).. 572
——Wireless telegraphy and ... 950
Cables, Underground: Charging high-tension. By Garrard (D.) 489. Woodhouse (D.) 570. Partridge, Orton, Northcote, Garrard (D.) ... *622
——Conduits for. By Schmidt (D. R.) ... 285
——Disturbances on. By Schuenan (D.) ... *88
——Earthed metallic sheathing for. By Mavor (D.) ... 623
——in England ... 548
——Localizing faults in three-phase. By Janet (D. R.) ... 166
——System of Chicago Edison and Commonwealth Electric Companies ... 152
Calcium carbide and acetylene (D. R.) ... 249
——Diester process. By Caro (D. R.) ... 704
——industry in France (D.) ... 530
——Method of converting waste material. Cox patent. By C. P. Townsend... 835
Calculagraph in factories. Calculagraph Co.. 421
Calculagraph Co. Calculagraph ... 421
Canadian Electrical Association, convention..1056
Canals: Electric haulage on. By Marchant (D.) 130; (D. R.) 204; (D. R.) 702. Szasz (D.) 1020. Perkins (D. R.)..1108
——Electric power on Erie ... 36, 148, 1074
——Electric towage in Germany ... 745
——Installations on Belgian and French. By Gerard (D.) ... 130
——lifts and bridges, Electric operation of (D.) ... 283
——power, Chicago drainage ... 152, 161
Capstan, Electric (D. R.) ... 758
Carbide, Subdividing blocks of. Scales method. By C. P. Townsend ... 525
Carbon: Direct combination of chlorine with. By Bolton (D. R.) ... 704
——Conversion of amorphous to graphite. By Fitzgerald (D.) ... 165
——Electrical discharge from hot. By Child (D.) ... 86
——electrodes (D.) ... 841
——resistances, High. By Longden (D.) ... 87
Carborundum and alumina. Weber patent. By C. P. Townsend ... 928
Carnegie Institution grants ... 366
——Work of ... 237
Carpenter, J. M., Tap & Die Co. Tap and reamer wrench ... *710
Carter, Edward Tremlett. Obituary ... 879
Cathode fall, Abnormal, in vacuum tubes. By Stark (D.) ... 412
——plate. Henry patent. By C. P. Townsend ... *656
Cathode rays: Braun tube. By Wehnelt (D.) 370
——Light and. By Zehnder (D.) ... 369
——Magnetic and electric deflection of. Starke (D.) ... 369
Cathodes: Potassium amalgam. By Lyman (D. R.) ... 369
Cathodic depolarization, Diminution of, by potassium chromate. By Mueller (D.) 205
Caustic, Production of electrolytic. Le Sueur patent. By C. P. Townsend ... 562
——soda cell. Johanns patent. By C. P. Townsend ... *656
Cement works, Explosion at Edison ... 409
Central Electric Co. Incandescent arc lamp fittings ... *170
Central Missouri Telephone Association, meeting ... 447
CENTRAL STATION:
Central Stations (D. R.) ... 163
——Acetylene, in Austria (D. R.), 571. By Vogel (D.) ... 981
——Alternating and direct-current systems. By C. F. Scott (D.) ... 759
——Annual reports of Chicago Edison and Commonwealth companies ... 882
——Arrangements for operating steam railways electrically. By C. J. Spencer.. 272
——Bill to discipline dishonest companies.. 517
——Calculating net works. By Wilberforce (D.), 411 (D. R.) ... 840
——Centralized management of electrical properties, 856. By H. S. Knowlton ... 880
——Combined alternating and direct-current system. By Eleazer Darrow ... *200
——Combined water power and gas engine plant (D.) ... 488
——Design of ... 739
——Design of records and returns. By Davies (D.) ... 1108
——Discussion of A. I. E. E. papers ... 793
——Distribution of current in network of wires. By Feussner (D.), 285. Herzog and Feldman (D. R.) 529. Teichmueller (D. R.) ... 894
——Distribution of losses in supply systems. By Constable and Fawcett (D.), 623; (D. R.), 804; (D.) ... 936
——Economical and safe limits in size of ... 747
——Edison apparatus ... 51

CENTRAL STATION. (Continued.)
——Effect of grounding the neutral on an alternating current system ... 606
——efficiency ... 266
——Enclosed arc lamp statistics of thirty stations. By L. B. Marks ... 881
——Fuel consumption in. By Jos. E. Lockwood, 486. H. Lell. Smith, 661. Lockwood ... 837
——Gas engine, Franklin, Pa. ... 1030
——Hot water plant, Thermopolis, Wyo. By L. B. Cherry ... *361
——Hydraulic developments and electric installations. Jackson paper ... 436
——Hydro-electric plant in Newfoundland. By Earl E. Boardway ... *391
——Independent crane conveyor for. By E. K. Scott (D.) ... 838
——Insulation tests of networks and earthing of middle wire. Taylor method (D.) 623
——Kolben, 1,000-kw. generating units. London Metropolitan system ... *984
——Line protection devices (D.) ... *164
——Lost current ... 954
——Low rates and water power plants ... 598
——Multiple versus independent operation of ... 702, *788
——Municipal lighting. (See Municipal lighting.)
——Oiling system for. By Moock (D.) ... 1065
——Parallel operation of steam and water power plants. By Chas. Brandeis ... 318
——Polyphase work in 1903. By Eborall (D.) 411
——Progress in 1902. By W. S. Barstow ... 21
——Property rights in streets ... 182
——Protection against atmospheric discharges (D.) ... 978
——rates. By Lauriol (D. R.), 39. Bastian (D.) ... 368
——rates, Cleveland individual plan, 447. By Samuel Scovil ... *658
——rates in New York State ... 510
——rules and regulations (D.) ... 570
——Safety devices in, 738. Philip Forchio paper on ... 828
——Statistics of hydraulic stations in France. By Coignet (D.) ... 758
——Statistics of Massachusetts electrical supply systems in 1902. By Alton D. Adams ... 877
——Stealing current from ... 1004
——Stealing current in Mexico City ... 801
——Steam distribution from. American District Steam Co. system ... 581
——Steam plants ... 738
——Steam turbine plant of Manchester Corporation, England. Parsons & Co..*983
——Steam turbines in Rockland, N. Y. ... 211
——Steam versus hydraulic power. By Hecker (D.) ... 568
——Storage battery plant at Milwaukee (D. R.) ... 1108
——syndicate movement ... 470
——telephone system, Manchester, N. H. ... *962
——Tendencies of modern development ... 832
——testing, Economical value of, 221. By Prof. Geo. D. Shepardson ... 232
——Use of exhaust steam in working salt evaporators ... 1004
——Use of meters (D.) 939, (D.) ... 978
——26,000-Volt installation at Grenoble, France. By C. L. de Muralt ... *182
——Voltage regulation in networks. By Hiecke (D. R.) ... 894
——Water power plants. By Adams (D.).. 893
——Water power versus steam plants. By Jas. L. Thorne ... 245
——Wright system of charging for energy (D.) ... 204
CENTRAL STATIONS:
——Acatlan, State of Vera Cruz, Mexico ... 812
——Badorf, Germany (D.) ... 203
——Ballarat, Aus. ... 378
——Barnstable, England (D. R.) ... 570
——Bezman, Switz. By Rung (D. R.) ... 838
——British statistics (D.) 164, (D.) ... 204
——Cascade Water, Power & Light Co., Canada. By W. G. McConnon *705, (D. R.) .4 ... 1107
——Cauvery Falls, India (D. R.) ... 85
——Charlottenburg, Germany (D.) ... 1066
——Chattanooga, new ... 461
——Chicago overhead distribution. Chicago Electrical Association meeting on... 691
——Chicago. Recent development of Edison and Commonwealth systems ... *863
——Colima, Mexico ... 55
——Cordoba, Argentine Republic ... 337
——Cordoba, Mexico ... 945
——Delhi Durbar. India temporary plant ... *512
——Dominion Iron & Steel Co., Sydney, N. S. (D. R.) ... 1107
——Duluth. General Electric Company's plant, Rebuilding. By Clifford L. Higgins..*1007
——Duluth water power plant ... 291
——Erith, Great Britain, three-phase plant (D.) ... 247
——on farm near Leipzig, Germany. By Grundmann (D. R.) ... 1020
——Gaffney, S. C. ... 870
——German statistics (D.) ... 85
——Grenoble, France. By C. L. de Muralt.*183
——Norway water power plant, Halfslund. By Franz Koster ... *552
——Helena, Mont., rebuilt ... *615
——Iquitos, Peru ... 425
——Kansas City, Central avenue station (D. R.) ... 894
——Kansas City consolidation ... 943
——Lawrenceville, Va. ... 378
——London, Central Electric Supply Co. (D.) 247
——Los Angeles, Cal. By Low (D. R.) .. 569, 586
——Mount Ranier, Washington. By Mayo (D. R.) ... 1107
——Neversink Light & Power Company (D. R.) ... 1107
——New England consolidation ... 836
——New Jersey merger ... 943

CENTRAL STATIONS. (Continued.)
——Omaha improvements..........1012
——Oskaloosa Traction & Light Company's new plant..........*869
——Ouray. By Perkins (D. R.)..........1107
——Paraguay.......... 53
——Philippine Islands.......... 497
——Pontiac, Ill..........*874
——Porta Volta (D.)..........1108
——near Queretaro, Mexico.......... 811
——Red Oak, Ia..........*871
——Ross, England (D. R.).......... 39
——Santa Barbara and Santa Monica, Cal. (D. R.).......... 569
——Santiago, Cuba.......... 770
——Schenectady, N. Y.......... 426
——South Bend, 25,000-volt plant..........*919
——South Yuba. By Van Norden (D. R.).. 569
——Trafford Park (D.).......... 570
——Vienna. By Fach (D.)..........1108
——Vonvry, France. By Loppe (D. R.).... 39
——Worcester, England (D. R.)..........1020
Chemical action in liquid hydrocyanic acid. By Kahlenberg and Schlundt (D.).. 166
——and allied mineral trade statistics for 1902. By Schnattenbeck (D.)....... 131
——electric sign. Wren patent..........1061
Chemistry, Organic (D. R.).......... 40
——physical. Mineral spring waters. By Juettner (D.).......... 666
Chicago Edison Co. Electric sign and central station business.......... 49
Chicago Electrical Association, meeting on overhead distribution.......... 691
——Party line telephone service before...... 799
Chicago Storage Battery Co. Alkaline storage battery..........*421
Chicago Writing Machine Co. Telephone holder.......... 48
Chlorate, electrolytic. Threlfall method...... 37
——of potassium. Reduction of. By Tommasi (D.)..........1109
——Reduction of potassium. By Brochet (D.).......... 490
Chloride: Electrolysis of alkali solutions. By Foerster and Muller (D.).......... 759
——Titanous Spence method. By C. P. Townsend.......... 525
Chlorine, and bleach, Apparatus for electrolytic production of. By Ulke (D. R.)..........1109
——Direct combination of, with carbon, By Bolton (D. R.).......... 704
Circuit break. Daft patent..........1062
Circuit breaker. I. T. E. new type..........*630
——Simple form of. By Kintner (D. R.)..1020
——Stanley "S. K. C."..........*809
——switchboard. General Incandescent Arc Light..........*458
——for testing. Cutter Co..........*578
——Westinghouse electrically operated oil, for high-tension circuits..........*132
Clay, "Egyptianized." Acheson method.... 619
Climber, Smith & Hemenway linemen's.....*422
Clock, Electric. By Kareis (D. R.).......... 41
Clowry, Col., Dinner to.......... 684
Coal: Dynamite in.......... 35
——mine operated by electric light plant.... 833
——mining, Alternating currents in.......... 397
——Jeffrey electrical apparatus in. By S. B. Belden..........1068
Coat of Mail, Artemiev's electrical (D. R.)..1110
Coherer. By Hanchett (D.) 895. Taylor (D.) 937
——Current bridges. By Sundorph (D.).... 329
——Popoff patent.......... 448
Coleman Mfg. Co. Fan guard and deflector.*256
Columbia Electric Mfg. Co. Arc lamp......*133
Commerce, United States foreign, in 1902.... 34
Commutation. By Mawdsley (D. R.) 38, Arnold, Freund, Rothert (D. R.).... 85
Commutator segments, Casting. By Vickers (D. R.).......... 487
Compounds, Formation of insoluble. By Isenburg (D.).......... 980
Conduction, Electric. By Strull (D.)...... 894
——in electrolytic incandescent bodies. By Gradenwitz (D.).......... 39
——Electrolytic, Influence of the solvent in. By Patten (D.).......... 166
——Electrolytic, without electrodes.......... 682
——Unipolar, in electrolytes. By Isenburg (D.)..........1021
Conductivity: Electric, of atmospheric air. By McLennan and Burton (D.).... 937
——Electric, of solutions in amyl-amine. By Kahlenberg and Ruhoff (D.)..........1021
——Electrolytic, in liquid hydrocyanic acid. By Kahlenberg and Schlundt (D.).. 166
——of electrolytes. By Kunz (D.) 87. Bourfield and Loury (D. R.).......... 87
——Magnetism and thermal. By Blythe (D.) 1067
——of nickel oxides. By Marsh (D.)...... 40
Conductors: Heating of electrical, in liquid baths..........820, *831
——Manufacture of electric, in Russia..... 605
——Metallic protection of. By Prentice (D.) 329
——Nicholson aluminum-copper.......... 620
——Standardization of cables and (D.)...... 979
Conduit. "Alphaduct" fire-proof fibre...... *46
——"American" bituminized fibre.......... 167
——Couplings for unscrewed. By Munro (D.)..........*805
Connecticut Telephone & Electric Co. Telephone generator.......... *48
——Desk telephone..........*287
Consolidated Car-Heating Co. McElroy's train lighting system..........*626
Consolidated Engine Stop Co. Motor stop device..........*899
Contacts, electrical, Very brief.......... 682
Controller, Westinghouse direct current motor..........*583
Convection, Magnetic effect of electric. By Pender (D.) 205. Cremieu (D.) 329. Cremieu and Pender (D.).......... 937
Conventions: (See American Electro-chemical Society, American Institute of Electrical Engineers, National Electric Light Association, etc.)
Converters. By Verhoeck (D. R.).......... 977
——Cooper-Hewitt static..........102, *121
Converter, Rotary. Davis patent..........*320
——Lunt circuit.......... 699
——Specifications for dynamos and. By Hobart (D. R.).......... 39
Converters, Synchronous, for charging storage batteries. By Thornton, Marchant, Woodhouse (D.) 450. Karapetoff (D.).......... 623
——Experiments on..........1041
——in traction installations with stationary accumulators. By Banti (D.)...... 246
Conveyor, Link-Belt motor-driven..........*375
Cooking device, Electric. Gold patent..........1063
Cooley Cycloidal Engine Co. Engine......*628
Copper-cadmium alloys. By Denso (D.).... 667
Copper. Carmichael process. By Johnson (D. R.).......... 704
——Electrolytic plant in Canada.......... 661
——Electrolytic plant at Shawinigan Falls.. 125
——and nickel, Recovery of, from ores. Sjostedt and James method. By C. P. Townsend.......... 753
——ores (D.)..........1022
——Review of progress of electrolytic, 538. By Ulke (D. R.) 576, (D.).......... 665
——salt solutions, Decomposition curves of. By Abel (D.).......... 841
——Treating nickeliferous copper matte. By Von Kuegelgen (D.).......... 840
Corrosion, Electrolytic..........683, 690
Couch & Seeley Co. Iron box telephones....*581
Crane, Electric, installation at Manchester Ship Company's docks (D. R.)...... 528
——Independent conveyors for central stations. By E. K. Scott (D.)........ 838
Crystallization from an electrolyte. By Heyl (D.).......... 86
Crystals, Dielectric constants of. By Schmidt (D.).......... 130
Currents. Lagrange's equations and. By Day (D.).......... 937
——Pulsating. By Holden (D.).......... 328
Cutter Company. Circuit breakers for testing purposes..........*578
——New type I. T. E. circuit breaker.......*630
Cynadide of potassium, Commercial. By Whitby (D.).......... 530

D

DE FOREST Wireless Telegraph Co.
——Canadian incorporation.......... 585
Perambulating wireless telegraph plant..........*374
De Laval Steam Turbine Co. Reciprocating engine generators. By David Hall..*668
Dental Muffle. Winter patent. By C. P.
Diamagnetic separation. Gates patents.....1104
Townsend.......... 618
Diamonds, Artificial. By Ludwig (D.)...... 40
Diaphragm, Electrolytic. Rodman patent.. 366
Dieletric constants of crystals. By Schmidt (D.).......... 130
——Determining. By Billitzer (D.)........ 451
——of liquids. By Tangl (D.).......... 703
Discharges in air, Electric. By Alfred G. Dell.......... 15
——Effect of high potential, on mica insulation. By John Harden..........*651
——in an electric field. By Cantor (D.).. 285
——Electrodeless. By Davis (D.) 489, (D.).. 570
——from hot carbon, Electrical. By Child (D.) 86
——Oscillating. By Bartelli and Magri (D. R.).......... 205
Dissociation theory in medicine and biology. By Bancroft (D.)..........1067
Diverter, Westinghouse ventilated celi......*941
Docks, Electrical equipment of North German Lloyd.......... 942
Drill, Pratt & Whitney adjustable multispindle..........*584
Duncan Electric Mfg. Co. Integrating direct-current wall meters..........*288
Dusseldorf Exposition. By Danneel (D. R.) 490
Dynamics of the electric field. By J. J. Thomson (D.).......... 979
Dynamite in coal.......... 35
DYNAMOS. (See also Alternators, Generators.)
Dynamo. Auto-Igniter Co..........*899
——Design of large. By Esson and Scott (D.).......... 528
——Design of small (D. R.) 246. By Esson and E. K. Scott (D.).......... 327
——Direct-current design. By Davies (D.) 163. Drucbert (D.).......... 663
——direct-current, Failure of, to generate By Parham (D.)..........1019
——Economy in continuous-current design. By Purton (D. R.)..........1106
——electric machinery. Earthing. By Bloemendal (D.).......... 665
——Electrical driving centrifugal (D. R.)... 129
——Heating of. By Schneppel (D.)........ 487
——Hobart 2 kw..........*986
——and motors with vertical axle (D. R.)... 804
——Regulation of steam driven.......... 366
——and rotary converters. Specifications for. By Hobart (D. R.).......... 39
——Shunt regulating resistance for separate excitation. By Kinzbrunner (D.)....*663
——Size constant of. By Rothert (D.)......1019

E

EARTH-CURRENT disturbances, electric, Characteristics of, and their origin.. 310
——and telephones. By Taylor (D.)........ 413
Eck Dynamo & Motor Works. Fan motor..*898
Edison Co. Central station apparatus........ 51
——Illuminating Co., Boston, hearing........1059
Edison, T. A. Biographical sketch, with portrait (D. R.).......... 88
Education: Commercialism in universities... 927
EDUCATION. (Continued.)
——Engineering. By Dalby (D. R.) 939, (D.)..........981, 1086
——Rise of the technical graduate 782. By H. S. Knowlton.......... 960
Electric Chair Co. Automobile chairs at St. Louis Exposition..........1111
Electric Mfg. Co. Large S. K. C. transformers..........*576
Electric Storage Battery Co., annual report 534
——Chloride accumulators.......... 765
——Combination railway and lighting installation at Milwaukee..........*1023
——Twenty-ton switching storage battery locomotive.......... 844
Electrical Contractors' Association, new officers.......... 202
Electrical design, Recent.......... 916
——history, Making of. By Chas. Herman.. 162
——production in 1902.......... 1
——science, Development of, in 1902. By A. E. Kennelly.......... 18
——vibrations, Rapid. By Seibt (D. R.).... 412
Electrochemical analysis. By Moltkehansen (D. R.)..........1109
——development in 1902. By Kruger (D. R.).......... 571
——developments, Recent. By C. P. Townsend, *159, 198, *444, *483, 525, *562, 618, *656, *753, *835, 886, *928, 1014, *1058.
——equivalents, Table of. By Hering (D.).. 248
——Institute, University of Grenoble, France (D. R.)..........1110
Electrochemistry. High temperature. By Hutton and Petavel (D. R.)........ 87
——Industrial. By J. B. C. Kershaw (D. R.).......... 571
——Pioneers in (D.).......... 249
——Progress of in 1902. By Geo. P. Scholl. 19
——in United States. By Haber (D. R.).... 937
Electrodes, Bipolar. By Brochet and Barrillet (D.) 841. Dannell (D.).......... 841
——bipolar, Dr. Paul Imhoff's. By C. P. Townsend.......... 483
——Carbon (D.).......... 841
——sensible to light. By Kochan (D.)...... 530
Electrodynamics. By Schwarzchild (D.).... 979
Electrogalvanizing. By Cowper-Coles (D.).. 895
Electrolysis of alkali chloride solutions. By Foerster and Muller (D.).......... 759
——of gas and water pipes (D.).......... 85
——Residual currents. By Bigelow (D.).... 205
——from stray currents. By Moerk (D. R.).. 85
——of water..........616, 642, (D.) 938
——of water pipes. By Hawley (D.)........ 489
Electrolytes, Conductivity of. By Kunz (D.) 87. Bonsfield and Loury (D. R.).... 87
——Crystallization from. By Heyl (D.)...... 86
——Dissociation of. By Liebenow (D.) 329. Juettner (D.).......... 666
——Unipolar conduction in. By Isenburg (D.)..........1021
Electrolytic action of stray currents from tramways (D.).......... 978
——deposits, Reduction factors for. By Hering (D.).......... 571
——diaphragm. Rodman patent.......... 366
——galvanizing. Botz patent. By C. P. Townsend..........*753
——oxidation of aromatic compounds. By Sebor (D. R.).......... 938
——production of zinc, Hoepfner process for. By Guenther (D.).......... 979
——reduction of chlorate of potassium. By Tommasi (D.)..........1109
——solutions, Capillarity of (D.).......... 329
Electromagnetism. By Stine (D. R.)........ 624
Electromagnets, Lifting. By D. A. Wiley..*1009
Electro-Manganese Co. Ferromanganese plant in Canada.......... 941
Electrometallurgical production of iron and steel (D.).......... 805
Electrometallurgy. By Beadle (D. R.) 40; (D. R.) 249; (D. R.).......... 571
——of iron and steel. By Ruthenburg (D.).. 369
——Magneto-electric machines for (D. R.).. 487
Electrometer, Capillary. By Boley (D.).... 330
——Goldleaf. By Wilson (D. R.).......... 980
——Portable capillary. By Smith (D.)...... 205
——Quadrant. By Walker (D.).......... 412
Electron, Dynamics of. By Abraham (D.).. 285
——and ions. By Reinganum (D.).......... 452
——theory. By Oliver Lodge (D. R.) 205, 311, 642. W. Kaufmann, 648. Platner (D. R.).......... 979
Electroplating. By Haas (D.).......... 412
——Alloying of metals as a factor in. By Kahlenburg (D.).......... 369
——anodes. By Burgess and Hambuechen (D) 1109
——apparatus. Walter's patent.......... 408
——bath. Chicle patent. By C. P. Townsend.......... 444
Electroscope, Elster and Geitel's improved form of Exner's. By A. Frederick Collins..........*394
——scale. By Elster and Geitel (D.)........ *41
Elevators, Electric (D. R.) 85. By James (D. R.).......... 284
——controlling device. Mailloux patent...... 661
——Richmond-Carey electric lift (D. R.)....1020
Elliott Bros. Partridge "Sparklet" fuses....*493
Energy, gravitational and radioactivity. By Giegel (D.).......... 489
Engine governor, Ball.......... *51
Engineering: British standardization committee.......... 408
——Electrical, instruction at Columbia University. By George F. Sever......1100
——Fire protection course at Armour Institute 961
——Heavy electrical.......... 103
——department, University of Cincinnati.... 448
——education. By Dalby (D. R.) 939, (D.) 981, 1086
——Mechanical features of building.......... 522
——Wisconsin University summer school for artisans.......... 658
Engineers, Electrical, in the modern city.....1049

E[illegible] (Continued.)
——English [illegible] (D.) .... [illegible]
——[illegible] of electrical. By [illegible] (D.) [illegible]
Entropy, Discussion on .... [illegible]
Equitable Construction Co. Telephone switchboard equipment at Bloomington, Ill. *[illegible]
[illegible] *43
Europe, Electrical [illegible] 812
——Outlook of electrical [illegible] in 1903. By H. L. [illegible] .... [illegible]

F

FACTORIES, Electrical driving in. By [illegible] (D.) 1107
Fahnestock Electric Co. Battery telephone transmitter *421
Fan guard and deflector, Coleman *250
Fan motor and battery, [illegible] .... *[illegible]6
——development 221
——Eck universal .... *[illegible]8
——for 1903 (D. R.) .... [illegible]
——Lundell .... *240, *54[illegible]
Fans, [illegible] Alternating current ceiling *843
——Western Electric .... *41[illegible]
——[illegible] revolving [illegible] .... *41[illegible]
Ferro-manganese plant in Canada 941
Field coil terminals. By Thorburn Reid *826
Fire alarms, [illegible] 417
——Wireless 409
Fire hazard of electrical apparatus, [illegible], 604. By Devereux (D.) 623
——protection engineering 961
Fluorescence, Mr. Hammer's lecture on *698
——of living human tissue, Artificial. By Wm. Jas. Morton, M. D. 1018
Fritz metal .... [illegible]99, 684
Fuel, California petroleum as. By Hunt (D.) 978
——consumption in central stations. By Jos. E. Lockwood, 486. H. Lett Smith, 661. Lockwood 837
——Liquid. By Schmidt (D. R.) 529
——Refuse as 935
Furnace, Electric. By Wright (D.) 1109
——as means of research 223
——Bradley patent. By C. P. Townsend 562
——Calcium carbide. Maxim patent. By C. P. Townsend *278
——Carbide. Nicolai patent. By C. P. Townsend 887
——Conley patent. By C. P. Townsend *1058
——de Laval patent. By C. P. Townsend *1014
——Hervult patent. By C. P. Townsend *144
——Dr. Julius Tafel patent. By C. P. Townsend 835
——Kjellin steel. By Becker (D. R.) 704
——Laboratory equipment, Owens College, Manchester, England *549
——Method of heating material. Acheson patent. By C. P. Townsend, 198, *562
——New method for heating. By Rasch (D.) 530
——Shade invention. By C. P. Townsend *483
——Steel production in (D.) 571
Fuse blocks, Johns-Manville "Noark" branch. *134
——Westinghouse *287
Fuses. By Hundhausen (D. R.) 86. Sachs (D. R.) 165, (D.) 840
Fuses. By Hundhausen (D. R.) 86. Sachs
——Large current plug. Wirt patent 1104
——Partridge "Sparklet." Elliott Bros. *493
——Testing of alternating-current switches and. By Howe (D.) 1020
——11,000-volt oil. By Garrard (D.) 759

G

GALVANOMETER: Construction of D'Arsonval mirror. By Cerny (D. R.) 286
——Construction of sensitive 346
——Damped ballistic. By Stewart (D.) 938
——Electrolytic. By Heilbrun (D. R.) 624
——mirrors, Construction and attachment of. By Watson (D.) 1067
——Movable coil. By Volkmann (D.) *286
Galvanizing, Electrolytic. Botz patent. By C. P. Townsend *753
Garton-Daniels Co. Telephone extension closer *256
Gas engines. By Graham (D. R.) 368
——Westinghouse *372
Gas, Paris interests 612
——power plant in cement works 903
——Price of, at Peoria, Ill. 828
——and water pipes, Electrolysis of (D.) 85
——works electrically operated, Milwaukee. Westinghouse installation 808
Gases: Electric properties of gaseous mixtures. By Bouty (D.) 703
——furnace, Measuring the temperature of. By Price (D.) 666
——Magnetic friction in. By Pellat (D.) 369
——Thermomagnetic phenomenon in. By Aschkinass (D.) 247
Geipel & Lang. Electric printing plant *574
Geis, Wm. V. & Co. Shade holder *50
General Electric Company, annual report 737, 740
——Car air braking system *629
——Core type transformers *709
——Finances of 241
——Incandescent lamps for street car headlights *535
——Motors for New York Subway *495
——New line of switchboards *1025
——and Stanley combination 182, 336
General Incandescent Arc Light Co. Enclosed arc lamp *1027
——Switchboard circuit breakers *458
Generators. (See also Dynamos, Alternators.)
——Alternating current. Bradley patents 162
——alternating-current, Stresses on frames of, 144. By P. J. Frenell, *148, 620. By F. W. Knopfe 755
——Bogue electrolytic *256
——Brush English turbo *982
——Bullock, for Massena *941
——Dangerous rise of voltage due to resonance. By Finckh (D.) 570
——De Laval reciprocating engine. By David Hall *668

Generators (Continued.)
——[illegible] of asynchronism, by means of static condensance. By A. S. McAllister *119, 145
——K[illegible] kw., London Metropolitan central station system *984
——[illegible] motors, Bullock *533
——[illegible]. By [illegible] (D.) 977
——[illegible], on automobiles (D. R.) .... [illegible]
——Three-phase, with small voltage drop. By Kolbe (D.) 977
German [illegible] .... [illegible]
German electrical industries, 1903. By Howe (D.) 1022
German Electrotechnical Association, [illegible] 598
German tariff, Digest of 240
German, Industrial efficiency of 231
Germany, Trusts in .... 191, 2[illegible]
Gibbs, Prof. J. Willard. Obituary 749
Gilbert, Dr. Wm., Prof. Thompson on 618
Glass, Electrostriction of. By Wuellner and Wien (D.) .... [illegible]4
——Mechanical and electrical properties of. By [illegible] (D. R.) .... [illegible]61
Gold, Deposition of. Kendall patent. By C. P. Townsend 618
——dredging equipment, Westinghouse *474
——Electrolytic refining of. By Tuttle (D.) 2[illegible]
——Signal corps discoveries in Alaska 566
Goulds Mfg. Co. Plunger pumps .... *[illegible]
Governor, Woodward water wheel .... *2[illegible]
Gramme ring, Theory of. By K. R. Johnson (D.) 203
Graphite, Conversion of amorphous carbon to. By Fitzgerald (D.) 165
——Artificial. By Fitzgerald (D.) 703
Gravity. How to produce, experimentally. By Robert Stevenson, *[illegible]. Townsend Walcott, 801. Robert Stevenson 935
Grounding low tension circuits 265
——the neutral on an alternating current system, Effect of 606
——secondary distributing circuits, Importance of .... [illegible]
Gun, Birkeland electromagnetic 282
Gutta-percha in German New Guinea 449
Guy anchors, Matthews *535

H

HAMBLIN & RUSSELL MFG. CO. "Never Break" lamp guard *49
Heating, Electric, apparatus (D.) 453
——Loss, Peck and Randall patents .... [illegible]
——Polar, produced by sparks. By Villari (D.) 529
Heating and ventilating Hope Cotton Mills, N. C. 903
——railway and other shops 763
Hemingray Glass Co. Provo insulator *255
Henry D. Carl. Axle lighting system *419
Hewitt, Peter Cooper, Degree conferred on .. 1042
Hobart Electric Mfg. Co. 2-kw. dynamo *986
Hoist, Hunt electric *582
Holtzer-Cabot Electric Co. Telephone receiver *942
Hunt, C. W. Co. Electric Hoists *582
Hydra Battery Co. Dry Batteries *579
Hydrochloric acid, Action of, in various solvents upon metals. By Patten (D.) 938
Hydrocyanic acid; electrolytic conductivity and chemical action in liquid. By Kahlenberg and Schlundt (D.) 166
——New synthesis of. By Guszkiewicz (D.). 530
Hydro-electric development in Connecticut .. 118
Hydrogen, Magneto-optics of liquid. By Harms (D.) 40
——and oxygen, Electrolytic preparation of (D.) 530
——peroxide, Catalytic action of potassium iodide on. By Bredig and Watson (D. R.) 530
Hydroscope, Preparations to test Signor Pinos's 161
Hysteresis. By Guye and Herzfeld (D.) 937
——loss, Effect of temperature on. By Mills (D.) 247

I

IGNITERS, Gas engine. By Armagnat (D. R.) 667. Salomons (D. R.) 705
——Carlisle & Finch Co. *942
Illumination, Determining. By Lansingh (D. R.) 450
——Engineering of 280
——Linolite system (D.) 621
Incandescent Lamps:
Incandescent lamps. By Swinburne (D. R.) 203. (D. R.) 1107
——American and English practice. By Yorke (D. R.) 568
——fittings, Central Electric *170
——"Hylo" *421
——Low voltage carbon. By Weissmann (D.) 804. Zacharias (D. R.) 1107
——Mean spherical candle power. By A. J. Wurts 84
——Mercury pump for manufacture of (D.) .. *327
——New. By Hammer (D. R.) 892
——Sirius (D.) 1019
——Skelly adjuster *90
——"Sterling" spiral filament *253
——for street car headlights. General Electric *535
Independent Telephone Association, convention 956
——of Maine, Meeting 482
India, Electric legislation in (D. R.) 759
——Transmission of power in. By Thomson (D. R.) 450
Indian Durbar, Electrical installation at 84
Indicators at a distance. By Hentze (D.) .. 249
——Gavotti and Semi-Guidotti device (D.) .. *702
——Power factor (D.) *980
Inductances, Measuring small. By Fleming and Clinton (D.) 666
Induction coil. By Jas. Edmund Ives *513

Induction Coil (Continued.)
——Balanced circuit. Alexander patent 37
——[illegible] for large. By Ives (D.) 413
——Operation of 643
——Simple current interrupter. By C. Francis Jenkins *495
——Theory of. By Armagnat (D. R.) 40
Inductance, Ohmmeter for measuring (D.). 166
——Molecular. By [illegible] (D.) 370
Industrial trusts. By Wm. Stanley .... [illegible]19
Inertia of motor, Electrical 103
Institute of Electrical Engineers (British) in [illegible] (D.), [illegible] (D.) 807
——New president (D.) 705
——Student members visit Sheffield (D.). 1022
Instruments, Recording. Kelvin & Jas. White, Ltd. *45
Insulating paint for electric machines. By Farrington (D.) 701
Insulation. Effect of high potential discharge on. By John Harden .... *6[illegible]1
——faults, Measuring. By Muellendorff (D. R.) 41
——High tension 599
——tests of networks and earthing of middle wire. Taylor method (D.) 623
Insulator brackets and fastenings. Peirce .. *[illegible]4
——Hemingway "Provo" *255
——Locke high potential *169
International Telephone Mfg. Co. Telephone receiver *335
——Telephone transmitter *255
——Telephone *580
Interrupter, Cooper Hewitt 309, 323
——French (D. R.) 530
——Theory of the Wehnelt. By Klupathy (D.) 88
Iodine, Action of, on alkalies. By Foerster and Gyr (D. R.) 530
Iodoform from acetone, Electrolytic preparation of. By Abbott (D.) 571
Ionization, Atmospheric. By Rutherford and Allen (D.) 130
—— Atmospheric in caves. By Ebert and Evers (D. R.) 86
——of salt vapor. By Moreau (D.) 86
——Spontaneous, in air. By Patterson (D.) 369
Ionizing power of organic liquids. By Di Ciommo (D.) 666
Ions, Charge of. By H. A. Wilson (D.) 805. J. J. Thomson (D.) 624
——and electrons. By Reinganum (D.) 452
——Positive. By Townsend (D.) 805
——in solution. By Kohlrausch (D.) 895
Iowa Electrical Association, convention, 641, 652
——Convention exhibits 670
Iowa Telephone Association, meeting 561
Iron: Edison method of producing, in electrolytically active state. By C. P. Townsend *835
——Electrometallurgy of. By Ruthenburg (D.) 369
——powders. By Maurian (D. R.) 840
——and steel, Electrometallurgical production of (D.) 805
——and steel industry, Alternating vs. direct current as applied to. By C. H. Hines *315
——industries, Electric power in. By Walsh (D. R.) 1107
——and steel processes. By Simpson (D. R.) 704
——Testing magnetic properties of sheet. By Brion (D.) *571. Richter (D.) *980
Irrigation, Electric, in California 1027
——Mesa, Ariz. 538
——Utah plant *606
Isolated Plants:
Isolated Plant. By Laffargue (D. R.) 39. Moses (D.) 130
——Amoskeag Mfg. Co., Manchester, N. H. *349
——Big Canal, Dover, O., locomotive plant .. 633
——Care of equipment. By W. E. Witter .. *71
——Claypool Hotel, Indianapolis 992
——Cheney Bros. 1,000 H. P. water power plant, Manchester, Conn. *313
——El Oro District mines, Mexico 378
——Farmers' Deposit National Bank, Pittsburg *785
——Hotel Astor. Western Electric Co. 763
——Locomotive and Machine Co., Montreal. 500
——Motive power for small. By Lombard (D. R.) 1107
——Office buildings, Pittsburg 325
——Osaka Military Arsenal, Japan. Westinghouse equipment 334
——for smelter works of Cerro de Pasco Copper mines, Peru 337
——Société Ardoisière d'Anjou (D. R.) 1065
——Steamer Kronprinz Wilhelm. By Richard (D. R.) 39
——Sturgeon Falls Pulp Co., Ontario, Can. .. 93
——Sultan's Palace, Malay Peninsular 173
——Wells Building, Milwaukee (D. R.) 489
——White House 126

J

JEFFREY MFG. CO. Electrical coal mining apparatus 1068
Jewell Electrical Instrument Co. Circuit breaking ammeters and voltmeters .. *579
Johns-Manville Co. "Noark" branch fuse blocks *134
Jones, J. & Son. Fan motor and battery *766
——Soldering iron and blow torch *134

K

KAMMANN MFG. CO. Electric automobiles *497
Kellogg Switchboard and Supply Co.'s status of telephone interests 1070
Kelvin & Jas. White, Ltd. Electro-static voltmeters *581
——Recording instruments *45
Kennedy, Wm., Jr. Turbine installation at Ottawa & Hull Power & Mfg. Co., Hull, Can. *47

Kinsman Electric & Railway Supply Co. Gain cutting saw.....*898
Kolben & Co., 3,000 Kw. generating units for London Metropolitan central station system..... 984

L

LABORATORY: Electric furnace equipment, Owens College, Manchester, England.....*549
—— for electrolytic analysis. By Richard (D. R.)..... 40
—— Mass. Inst. of Tech. and Univ. of Penn. (D. R.).....1110
——Munich testing. By Uppenborn (D. R.). 88
——Niagara research, Incorporation of...... 771
——State electrical.....202, 387, 517
Lamps. (See Incandescent, Nernst, Osmium, Vapor.).....
——Photometry of electric. By Fleming (D.) 131, (D. R.)..... 203
Lathe. Seneca Falls "Star".....*765
Lead, Cathodic deposition of. By Elbs and Rixon (D.)..... 841
——tin and bismuth, Alloys of. By Shepherd (D.)..... 166
Library, Rowland memorial.....325, 483
Light and electricity, Law of..... 202
——Preliminary study for new standard of... 821
——Standard of. By Petavel (D.).....*760
Lighting, Aldershot Camps (D.)..... 978
——Fort Riley..... 890
——Hoho method, 508. By Paul Hoho, *517. J. B. Hall..... 662
——interests of Paris, American absorption of..... 26
——Municipal. (See Municipal lighting.)
——new theater, London (D.) 568, (D.).... 804
——Problem of electric. By Swinburne (D.). 128
——projects for Auckland, N. Z..... 994
——Ship. By Broadbent (D. R.) 368; (D.). 411
——system, City of Westminster (D. R.).... 804
Lightning arrester. Bell patent.....1105
——Vacuum tubes as, for telegraphy. By Kinsey (D.)..... 205
Lightning explodes submarine torpedoes....1017
——Genesis of. By Walter (D.)..... 413
——Vortex. By Klingelfuss (D.)..... 286
Lindsey, H. E., Electrical Supply Co. Pillsbury alternating current ceiling fan.*845
Line calculations. By Koenig (D. R.)...... 451
Link-Belt Engineering Co. Motor-driven conveyor..... 375
Liquids, Dielectric constants of. By Tangl (D.)..... 703
——Ionizing power of organic. By Di Giommo (D.)..... 666
——Magnetization of. By Piaggesi (D.).... 165
Locke Insulator Mfg. Co. High-potential insulator..... 169
Locomotives, Electric. (D. R.)..... 489
——Large three phase (D.)..... 284
——Magnetic traction. Honey patents *1102
——20-Ton storage battery. Electric Storage Battery Co.....*844
Lombard Governor Co. Electric control for water wheel governors.....*133
London, Transportation in..... 282
Louis Mfg. Co. Express-call system........ *43
Lunkenheimer Co. mechanical oil cup.......*212

M

MACHADO & ROLLER. New combination ohmmeter.....*768
Machine shops. Tests of electric equipment. By Moore (D.).....1065
Machine tools, Direct-driven, with Storey motors.....*333
——electrically driven. By Flathe (D.) 450, (D.) 621, (D. R.) 978. Kimball, Lewis (D. R.).....1065
——electrically driven in engineering and shipbuilding works (D.) 1064. Andreen, Homer (D.).....1065
——Power required to drive. By Chas. P Sands 410. Geo. H. Gibson........ 527
——Power tests in locomotive shops at Du Bois, Pa., Westinghouse.....*331
——Requirements of operation with reference to motor drive. By Chas. Day..... *78
Magnetic Club dinner to Col. Clowry....... 684
Magnetic detector of electric waves. By Fissot (D.)..... 624
——effect of electric convection. By Pender (D. R.) 205. Cremieu (D.) 329. Cremieu and Pender (D.)..... 937
——flux, Measurement of. By Thornton (D.).....*249
——measurements. By Armagnat (D. R.).. 166
——moment. By Beck (D. R.)..... 937
——separators. By Danneel (D.)..... 330
——susceptibility of water. By Stearns (D.). 703
——suspension for instruments. Cox and Pratt patents.....1061
Magnetism: Electric origin of molecular attraction. By Sutherland (D.)....... 39
——Terrestrial (D. R.)..... 624
——Terrestrial, and atmospheric electricity (D. R.).....1108
——Theory of. By Joh. Zacharias 755, (D.).. 759
——and thermal conductivity. By Blythe (D.) 1067
Magnetization: Change of length and thermoelectric power by. By Rhoads (D. R.)..... 86
——Energy of. By Larmor (D.)..... 489
Magneto-bell troubles and remedies. By Hyde (D. R.).....1110
——of liquids. By Piaggesi (D.)..... 165
Magneto friction. By Pellat (D. R.)........ 571
Magnetometer, Compensation. By Corsepius (D.)..... *87
——free from disturbances. By Du Bois (D.) 131. Kohlrausch and Holborn (D.). 412
——Vibration. By Searle (D.)..... 490
Magneto-optics of liquid hydrogen. By Harms (D.)..... 40
Magnets, Changes of temperature of permanent. By Loomis (D.)..... 489
——Impromptu use of, in surgery..... 891
Manufacturing plant. British Westinghouse Works. (D. R.).....370, *414
——Gadda & Co., Brioschi, Finzi & Co., Milan (D. R.).....1110
——Queen's Engineering Works, Bedford, Eng. *765, (D. R.)..... 807
——Standard Paint Company, New Works of. 768
——Witton Works of English Gen-Elec. Co. Ltd. (D.)..... 413
Marconi and his critics..... 81
——banquet in Canada..... 231
——celebration in New York..... 187
——Italian honors for..... 244
Matthews, W. N. & Bro. Guy anchors.....*535
Maxwell's theory and metals. By Hagen and Rubens (D.)..... 703
Measuring high temperatures. By Fery (D.). 330
——internal resistance of a battery. By Oates (D.).....*806
——iron losses. By Soschinski (D.)........ 806
——small capacities and inductances. By Fleming and Clinton (D.).....1021
——very low resistances. By Rennie (D.) 939, (D.)..... 980
Measurements: Absolute, in electricity. By Henry S. Carhart.....1063
——Constancy of manganin resistances. By Lindeck (D.)..... 370
——electric devices for comparing and measuring speeds. By Benischke (D.)..*1021
——of E. M. F.'s by means of telephone as zero instrument. By Fischer (D. R.)..... 330
——of heavy currents. By P. Letheule.....*616
——of high temperatures..... 346
——Magnetic. By Armagnat (D. R.)....... 166
——of magnetic flux. By Thornton (D.)....*249
——Potentiometer for thermocouple. By Lehfeldt (D.)..... 704
——Radiation scale of temperature. By Lummer & Pringsheim (D.)........ 370
——of small capacities and inductances. By Fleming and Clinton (D.)..... 666
——of temperature of furnace gases. By Price (D.)..... 666
——Three-phase. By Leslie L. Perry *69. H. L. Wallace and Leslie L. Perry 449, 547. By G. Faccioli, 567. F. A. Fish.....*1091
——Use of differentially wound telephone receiver in 856. By H. Ho......*884, 977
Mechanical Appliance Co. Watson ball-bearing motors.....*459
Mechanical applications of electricity. By Richard (. R.).....1107
Mechanical draft. By Hubbard (D. R.).....1065
Medicine, Dissociation theory in. By Bancroft (D.).....1067
Mercury, Electric analysis of. By Glaser (D. R.)..... 530
Metallic films, Electric properties of thin. By Patterson (D.)..... 40
——hydrides, non-conductivity of. By Moissan (D.).....1109
Metallurgical method, New. By C. P. Townsend..... 198
Metallurgy in 1902. By Sohnable (D. R.)... 704
Metals: Action of hydrochloric acid in various solvents upon. By Patten (D.). 938
——Alloying of, as factor in electroplating. By Kahlenberg (D.)..... 369
——Daft and Williams system of locating.... 566
——Decay of. By Milton and Larke (D.)... 895
——Electric separation of, from their ores. By Negresno (D.) 206, (D.)........ 939
——Electrodeposited. By Johnson (D.)..... 412
——Electrolytic reduction of. Salom patent. By C. P. Townsend..... 886
——and Maxwell's theory. By Hagen and Rubens (D.)..... 703
——and minerals, Statistics of 1902. By Struthers (D.)..... 131
——Physical character of deposits. By Burgess and Hambuechen (D.)......... 412
——Polishing and plating of. By Hawkins (D. R.)..... 571
Meter. (See also Wattmeter.)
Meters (D. R.).....1110
——Davis compensating frequency.......... 320
——Maximum demand indicator. By Marxen (D. R.) 41, (D.)..... 895
——practice, American. By Reed (D.)...... 490
——Power factor. Holz patent..... 976
Metering, Multiple-rate..... 792
Metric system. 15, (D.)..... 453
——Anglo-Saxon standards.....408, 821
——Report of Society of Mechanical Engineers on.....1005
——Secretary Root's letter on..... 388
——and export trade..... 191
——in France..... 84
Micro-Magnetometer. By Cremieu and Pender (D.)..... 666
Micrometer, Electric. By Shaw (D. R.).... 939
Microscopic particles, Visibility of ultra. By Siedentoff and Zisigmondy (D.).... 330
Minerals and metals, statistics of 1902. By Struthers (D.)..... 131
Mineral waters and physical chemistry. By Juettner (D.)..... 666
Mines, Electric hoisting engines for (D. R.).1107
——Electric power in. By Nowak (D.) 663, (D.) 701, (D.) 802. Perkins (D. R.) 893. Schneider (D.)..... 936
Moberly, Frank. Monorail railway.....*495
Moisture, Extraction of, by electricity. Schwerin method. By C. P. Townsend.....*365
MOTORS:
——Action of shunt-wound, when driven by a series-wound dynamo. By McAllister (D. R.)..... 283
——Alternating current railway. Krohn patent..... 700
MOTORS. (Continued.)
——braking device. Baker patent.....1104
——Churchward alternating current.........1063
——Design of. By Esson and E. K. Scott (D.)..... 327
——Design of polyphase current. By Bergman (D.).....*128
——Development of small. By Kimball (D. R.)..... 621
——Direct current, British Thomson-Houston.....*576
——Direct current, with external armature (D.)..... 246
——driven machine tools, Requirements of. By Chas. Day.....*78, 222
——and dynamos with vertical axle (D. R.).. 804
——Edison method of operating in dust-laden atmospheres..... 620
——Gas, with electric transmission of power (D. R.).....1020
——for gas works (D.).....1107
——and generators, Bullock.....*289, *533
——Hultqvist brake for..... 661
Motors, Induction: Air-gap in. By Breslauer (D.)..... 410
——Care of in large factory. By Weeks (D. R.)..... 284
——Design for one-half H. P. self-starting single-phase (D. R.)..... 528
——Freight car driven by. By Weeks (D. R.).....1108
——in glass factory at Rosford, O. By Cravath (D.).....1019
——Heyland. By Heyland (D.) 283, (D.) 327, (D. R.) 397. Boy De la Tour *442; 470. Boy De la Tour *479. Heyland (D.).....*621, 955
——Improvements in armature construction. Thomson patent.....1017
——Method of reducing Watless current. Meyer patent.....1017
——Slip of. By Meynier (D.)..... 453
——Speed regulation of. By Osms (D.) *38, (D.) 85. Breslauer (D.) 85. Winter (D.).....*757
——Tandem connection of. By Breslauer (D.)..... 203
——Theory of the single-phase. By Cahen (D. R.)..... 892
——Westinghouse type "F".....*1111
——with commutator. By Blondel (D.) 892. Alexander and Fleischmann (D. R.) 936, (D.) 1019. Bragstad (D.) 1019 (D. R.).....1064
——with four speed variations, Oerlikon. By Dr. Hans Behn-Eschenburg....*111, 325
Motors. Lubrication (D. R.)..... 411
——New York subway. General Electric *495
——Non-synchronous. By Rosenburg (D. R.)..... 410
——Non-synchronous single-phase alternating current. By Georges (D.)......... 757
——Output of traction. By Barbillion (D.).. 977
——Phenomenon in compensated. By Heyland (D.).....1064
——Polyphase. By Hahn (D.).....1019
——polyphase, I. T. E. circuit brake for......*630
——Power factor of three-phase, for any wave form. By Dina (D.)..... 936
——Single-phase. By Girault (D. R.)....... 246
——Size of, required to drive presses. By Fladd (D.).....1065
——starter, "Automatic".....*710
——starter, "Automatic," patent litigation.. 660
——starter, Leonard "No Voltage Release"..1027
——stop, "Consolidated".....*899
——synchronous alternating-current, Prevention of hunting of. Erben patent... 976
——Testing non-synchronous. By Meunier (D.)..... 410
——tests, Prony brakes for (D. R.)......... 286
——Three-phase in factories. By Eborall (D.)..... 758
——Variable-pole, alternating-current. Dahlander and Lindstrom patent........ 700
——ventilated, Robbins & Myers..... *48
——Variable-speed. Davis patent..... 320
——Watson ball-bearing Mechanical Appliance Co.....*459
——Westinghouse, for New York subway...*532
Municipal lighting. Cleveland........325, 1099
——Detroit report........345, 354, 1085, *1094
——in New York....469, 485, 507, 641, 654, 1003
——plants, Sale of in Pennsylvania.......... 661
——plant for Yucatan, Mexico..... 773
——St. Joseph, Mich..... 660
——Stockton..... 743
——Taxation of plants in Michigan. By A. G. Moser..... 567
Municipal ownership. By Donald (D. R.)164, 598
——in Chicago.....201, 281, 661
——Dresden exposition of..... 565
——in Germany. By Heyn (D. R.)........ 702
——in Great Britain. By Donald (D.) 249, 619, 803
——Hagerstown, Md..... 243
——in Massachusetts.....245, 366, 620
——New York National Convention.....278, 401
——and public franchises..... 146
Munroe & Munroe. Booklet on Marconi station earnings..... 983

N

NAIL PULLER, Smith & Hemenway..*47, *134
Nalder Bros. & Thompson. Recording voltmeters and ammeters..... *50
National Association of Automobile Manufacturers, Board of Directors meeting..... 281
National Electric Light Association, appointments..... 35
——Chicago Convention exhibits..... 987
——Chicago convention proceedings.931, 953, 965
——Chicago convention programme.....802, 889
——Growth of.....856, 916
——New membership..... 565
National Fire Protection Association, meeting. 873

National Independent Telephone Association, Chicago convention ... 39, 1017
Navy League, United States ... 245
—Mr. Yarrow on submarine craft ... 612
Nernst, Prof. Walther. Biographical sketch with portrait ... 644
Nernst Lamp Co. Nernst lamp ... 115
Nernst lamps. By Rose (D.) 163. Stoettner (D.) [illegible], (D.) ... 568
—in Farmers' National Bank, Pittsburg, Pa. ... *753
—glower. Potter patent, 164. Hanks's patent ... 162
—Life tests of. By [illegible], Bailey, Robinson (D.) 701, (D.) ... 892
—lighting Big Ben, London ... 107
—in Madison, Wis. ... 848
—patent in Germany ... 891
—portable electric plant ... *1070
—Recent experiments on. By Wedding (D.) ... 1106
New York Central R.R. electrification ... 916
New York Electrical Society, Mr. Arnold on transportation problems ... 598
—Growth of ... 782
—Meeting of ... 930
—Members visit Edison waterside station ... 242
New York City [illegible] ... 418
New York Electrical Society, [illegible] meeting ... 1060
New York State, Relative cost of transportation in ... 486
New York State Stock Exchange new building ... *751
Niagara Falls. Breakdown from fire ... 224
—Fire at old Bury Chemical Works ... 1061
—power. Beauty of ... 1098
—power, Canadian, 111, 211, 339, 365. By Arthur B. Weeks ... 961
—power installations. By J. C. Perkins ... *601
Nickel [illegible]. By Brown ... 1067
—and copper, Recovery of, from ores, Sjostedt and James method. By C. P. Townsend ... 753
—Electrolytic refining. By Ulke (D. R.) ... 412
—industry, Canadian (D.) ... 248
—oxides, Conductivity of. By Marsh (D.) 40
Nitrogen, Fixation from atmospheric. By Rasch (D.) ... 1021
Noblett, E. J., & Co. Cabinet work for electrical purposes ... *631
Nordberg Mfg. Co. Engines installed at Cerro de Pasco copper mines ... 1111
Norden-Bittner Electric Co. Electric sign device ... *46
North Chicago Machine Co. Cylinder oil atomizer ... *584
Northwestern Electrical Association, convention ... 180, 192
—Convention exhibits ... *211

O

OHIO Society of Mechanical, Electrical and Steam Engineers, annual meeting ... 958
Ohmmeter. Machado & Roller new combination ... *768
Oil atomizer, Sargent cylinder ... *584
Oil cup, Lunkenheimer mechanical ... *212
—and oil hole covers, Bennett ... *631
Oil, Resistance of, as affected by temperature and impurities. By Prof. John W. Langley ... 745
Olivetti, Camillo. Italian recording wattmeters ... *417
Omnibuses in Paris ... 890
Optic resonance. By Kossonogoff (D.) ... 247
Ore dressing, Static electricity applied to. By Swart (D.) ... 490
Ores: Daft and Williams system of electrical prospecting for mineral ... *693
—Electric separation of metals from. By Negreano (D.) ... 206
—Electric smelting ... 399
—Recovery of copper and nickel from. Sjostedt and James method. By C. P. Townsend ... 753
Organic compounds, Dissociation constant and identity and purity of. By Scudder (D. R.) ... 938
—substances, Electrolytic oxidation of. By Salzer (D. R.) ... 205
Osborn-Morgan Co. Interchangeable arc lamp ... *459
Oscillating currents, Indicator for. By Winkelmann (D.) ... 1110
Oscillations in Gramme ring. By Johnson (D. R.) ... 804
Oscilligrams and resonance ... 1040
Oscillograph, Blondel. By Henry Hale ... *743
Osmium lamp. By H. (D.) 85. Kubes (D.) 892
—for trains lighting. By Breidensprecher (D.) ... 892
Ostwald, Wilhelm. Biographical sketch (D. R.) ... 412
Oxidation, Electrolytic, of aromatic compounds. By Sebor (D. R.) ... 938
—of organic substances. By Salzer (D. R.) 205
Oxygen and hydrogen, Electrolytic preparation of (D.) ... 530
Ozone. By Kausch (D. R.) ... 1021
—Formation of. By Warburg (D.) ... 165
—Making, for water sterilization (D.) ... 86
—Spontaneous deozonization. By Warburg (D.) ... 205
—water works, Wiesbaden, Germany. By Dr. Ig. Erlwein ... *119

P

PALMER, F. S. Method of wiring in connection with the operation of engine stops and electric motors ... *46
Paris, Electric billiards in ... 448
Parsons, C. A. & Co. Steam turbine plant of Manchester Corporation, England ... *983
Patent bill to protect foreign inventors ... 244, 385
—commissioner's report ... 282
—laws in Mexico, Proposed ... 1061
Patent office [illegible] ... 14
—regulations, French ... 201
Patents, British (D.) ... 206
—sale of Ross ... 144, 660
—[illegible] split plate, Validity of, [illegible], 477. By Wm. Stanley ... 476, 509
Peirce, C. L. Insulator brackets and fastenings ... *254
Permeameter, Universal. By Picou (D.) ... *249
Petroleum as fuel, California. By Hunt (D.) ... 978
Phase indicator, Holz patent ... 1064
—meter. By [illegible] (D. R.) ... 166
—rule. By Van't Hoff (D. R.) ... 329
—transformation. Kelly and Chesney patents ... 700
—transformer. Davis patent ... *319
[illegible] incandescent lamp ... *431
Phonograms, Electrotype reproduction of. By Azoulay (D.) ... 86
Phosphorescence, Mr. Hammer's lecture on ... *698
Phosphorus, Emanation from. By Schmidt (D.) ... 709
Photo-electricity. By [illegible] (D.) ... 405
Photography, Electric ... 842
—at twenty five miles ... 890
Photometer, Alexander Wright ... *760
—Portable (D.) ... *45
—Sector attachment ... *670
Photometry (D.) ... 412
—Arc lamp ... [illegible]
—British National Physical Laboratory. By Glazebrook (D.) ... 370
—of electric lamps. By Fleming (D.) 131, (D. R.) ... 203
Pipe covering. By Strohm (D. R.) ... 1065
Platform, Moving, between New York and Brooklyn ... 692
Platinum, Electrolytic dissolution of, by means of alternating currents. By Ruer (D.) ... 81
Polonium exhibited at Berlin Chemical Congress ... 1006
Potassium chromate. Diminution of cathodic depolarization by. By Mueller (D.) 205
—Electrolytic reduction of chlorate of. By Tommasi (D.) ... 1109
—Production of metallic, from molten potassium hydroxide. By Lorenz and Clark (D.) ... 840
Potential. Voltaic difference. By Brown (D.) ... 1109
Potentiometer. By Harker (D.) ... 704
—for thermocouple measurements. By Lehfeldt (D.) ... 704
POWER DISTRIBUTION:
Power distribution: American Pastry and Mfg. Co., New York ... 772
—Amoskeag Mfg. Co., Manchester, N. H. ... *349
—Anaconda Copper Mining Co. ... 215
—Baltic Mercantile and Shipping Exchange building (D. R.) ... 1108
—Belasco's Theatre, New York. By Irving B. Smith ... *455
—Bishop & Babcock Co., Cleveland ... 402
—Campo Santo mine, Sonora, Mex. ... 1029
—Cement plant, Ottawa, Can. ... 672
—Cleveland department store ... 712
—Cotton mill, Danville, Va. ... 1030
—Draeger Bros. printing plant. By Reyval (D.) ... 203
—for electric railways ... 267
—in Great Britain (D.) ... 246
—Great Northern Portland Cement Co., Detroit ... 425
—in iron and steel plants. By Perkins (D. R.) ... 85
—Janeway Button Co., New Brunswick, N. J. ... 500
—Jennings & Griffin Mfg. Co., Port Jervis, N. Y. ... 424
—in machine shops in 1903. By Kern Dodge ... 25
—R. H. Macy & Co. By Knox (D.) ... 284
—Malay Smelting Works, Asia ... 258
—Manchester Mills, N. H. ... *269
—Michaelis Hallenstern & Co., near Melbourne, Australia ... 587
—Milliken Bros., Staten Island ... 589
—Neutral wire balancer. Rowe patent ... 803
—in new Government Printing Office, Washington ... *34
—Susquehanna Iron & Steel Co. ... 215
—Texas Flat mines, Cal. ... 499
—White Mountain Paper Co. ... 811
Pratt & Whitney Co. Adjustable multi-spindle drill ... *584
PRIMARY BATTERIES:
Primary battery. By Mugdam (D.) ... 840
—Change of volume and E. M. F. with pressure, standard cell. By Ramsey (D.) ... 452
—Dry cells. By Zacharias (D.) ... 205
—E. M. F. of Daniell cell. By Carhart (D.) ... 285
—Hydra ... *579
—Recuperating exhausted. By W. A. Sherlock ... 367
—Tests of Roche's new standard ... *208
Printing plant, electric, Geipel & Lange ... *574
—Melbourne, Australia ... 587
Pumping, Electric (D. R.) ... 488
—engine efficiency ... 35
—plant, Gaffney, S. C. ... 870
Pumps, "Automatic" electric ... *585
—Gould's plunger ... *50
—Mercury, for incandescent lamp manufacture (D.) ... *327
—steam. Driving boiler feed. By James (D.) ... 327
Push button, American Thermo. Call ... *898
Pyrometer, An optical. By Holborn and Kurlbaum (D.) ... 453

Q

QUANTOMETER for measuring induction (D.) ... 166

R

RADIATION. Blondlot experiments ... 1086
—from the earth's surface, Penetrating. By Rutherford and Cooke (D.) ... 937
—New form of. By Blondlot (D.) ... 759
—Pressure due to. By Nichols and Hull (D. R.) ... 937
—Radio-active change, products of. By Rutherford and Soddy (D.) ... 1020
—emanation, Condensation of. By Rutherford and Soddy (D.) ... *1066
—substance from pitchblende. By Giesel (D.) ... 1067
Radioactivity. By Curie and Laborde (D.) [illegible], Crookes (D.) ... 703, 1041
—Excited. By Rutherford (D.) ... 247
—from snow. By Wilson (D. R.) ... 1021
—Mr. Hammer's lecture on ... *698
—and gravitational energy. By Geigel (D.) [illegible]. Forch and Kucera (D.) ... 570
—Induced actinium rays. By Debierne
—of [illegible]. By Rutherford and Soddy (D.) 840
(D.) ... 570
—[illegible]. By MacLennan (D.) ... 529
Radium, and [illegible] ... 1062
—Mr. Hammer's lecture on ... *698
—Heat of ... 836
—in the periodic system. By Runge and Precht (D. R.) ... 489
Radium rays, Influence of, on organisms. By Bohn (D.) ... 1020
—rays, Sensitiveness of tissues to. By Danysz (D.) ... 571
—Source of activity in ... 917
Railroads, Electric traction on steam. By Adams (D.) ... 758
—Locomotive signals (D. R.) ... 411
—Massachusetts annual report ... 155
—New York State annual report ... 153
RAILWAYS, ELECTRIC.
Railways, Electric (D. R.) ... 894
—A decade of interurban. By Bell (D. R.) 451
—Alternating current return circuit. Mordey patent ... 244
—American conservatism (D.) ... 410
—Automatic parcel system. Murray and Van Vleck patent ... 325
—Basanta signal system (D. R.) ... 1068
—Behavior of synchronous converters in installations with stationary accumulators. By Banti (D.) ... 246
—Bidwell patent litigation ... 510
—Block signals. By Pigg (D. R.) 284. Kohlfuerst (D. R.) 842. (D. R.) ... 1068
—Boosters (D.) ... *758
—Brakes (D.) ... 129
—Braking. Friction between wood and iron. By Klein (D. R.) ... 839
—Bridges. By Watson (D. R.) ... 622
—Calculating storage batteries required. By Izart (D. R.) ... 246
—Car air braking; General Electric system. *629
—Car dispatching by telephone in Buffalo (D.) ... 529
—Car hour unit (D.) ... 130
—Car shops (D. R.) ... 894
—Car speed ... 201
—Chipping ice from third rail (D. R.) ... 569
—Choice of engines for moderate stations. By E. K. Scott (D. R.) ... 529
—Coal handling equipment for Metropolitan underground, England ... 425
—Collector shoe and sleet cutter (D. R.) ... 569
—Combination sweeper and sprinkler (D. R.) ... 529
—Conduit construction and cable installation on Manhattan (D.) ... 129
Conduit Construction, English vs. American (D.) ... 1108
—Conduit systems (D.) ... 978
—Conduit system in London (D. R.) ... 894
—Control system for New York subway ... *477
—Cosmo system ... 578
—Cruvellier surface contact system (D.) ... *284
—Dangers of ... 346
—Distribution of power for ... 267
—Double-unit system on Paris Metropolitan (D.) ... 894
—Economy of rural (D.) ... 702
—Electric brake (D. R.) ... 1108
—Electricity on trunk lines ... 856, 883
—Electric-pneumatic control on Brooklyn elevated. Westinghouse ... *89
—Electrolytic action of stray currents from (D.) ... 978
—Everett-Moore properties ... 92
—Fires in cars and barns ... 803
—Freight bill in Massachusetts ... 699
—Freight car driven by induction motors. By Weeks (D. R.) ... 1108
—Freight and express on. By Adams (D. R.) 39. Cooper (D.) 410, (D.) 529. Hawks (D. R.) ... 702
—Generating plant of Montreal street railway. By Mershon (D.) ... 1108
—Grades. By Hering (D.) ... 451
—Gross earnings ... 1016
—High-speed development in Germany. By Reichel (D.) ... 1066
—High-speed trains in Prussia ... 1063
—Hooded third rail on Wilkesbarre & Hazleton Railroad ... *389
—Interurban roads. By Gonzenbach (D.) 488, (D.) 622, (D.) 663, (D.) 701, (D.) ... 758
—Inventors and the industrial situation ... 620
—Inverted third rail conductor. Walkins patent ... *447
—Labor clauses in franchise grants (D. R.) 665
—Labor saving tools in Baltimore repair shops (D.) ... 664
—Localizing faults on. By Johnston (D.) ... *203
—Locomotives (D. R.) ... 451
—Long distance. By Louis Duncan (D.) ... 163
—Management of. By Wordingham (D.) ... 328
—Map of Wisconsin interurban lines (D.) 702

RAILWAYS, ELECTRIC. (Continued.)
——Moberly monorail........*495
——Modern shop methods, Chicago City Railway (D.)........ 488
——Motor shaft straightener used in Chicago (D. R.)........ 410
——Mueller municipal ownership bill........ 802
——Multiple-unit systems (D.) 451, (D. R.) 702. By De Fraz (D. R.)........ 805
——Multiple unit system in London (D. R.) 839
——New emergency line wagon (D.)........ 936
——New shallow conduit. By Smith (D. R.) 1108
——New type of street car........ 273
——New York Electrical Society meeting on transportation........ 798
——Noiseless crossings (D.)........ 936
——Outlook in 1903. By Dr. Louis Bell.... 23
——Pavement plow car in Chicago (D. R.).. 328
——Polyphase work in 1903. By Eborall... 368
——Postal trolley cars........ 830
——Power distributions. By Gump (D. R.).. 894
——Power plant at Everett, Wash. By Burch (D. R.)........1107
——Power plant, Reading (D. R.)........1107
——Power plant, San Francisco. By Perkins (D. R.)........1107
——Power station arrangement. By C. J. Spencer........272, 366
——Present practice on interurban roads. By Brigden (D.)........ 488
——Profit sharing in Vancouver, B. C........ 326
——Protecting property against freshets. By W. B. Arthur........*155
——Rails as telephone circuit........ 162
——Recent progress in engineering (D.)....1065
——Reducing congestion. By Bell (D. R.).. 451
——Relation of interurban to steam roads. By Wyly (D.)........328, 368
——Roadbed construction. By Sattler (D. R.)........ 839
——Signals. By Harvey (D. R.)........ 805
——Single motor tram cars. By Wilkes (D. R.)........ 569
——Single-phase. By Geipel and Lanze (D.) 39
——Sleet problem. By J. B. Alexander, 202, (D. R.)........ 569
——Slot conduit system, Bournemouth, England........*225
——Snow removal (D.)........ 664
——Speed in Europe........ 126
——Standardization in working (D.)........ 529
——Station operation, Dublin (D. R.)........ 622
——Steam turbines in traction plants (D.)... 894
——Storage batteries on Bologna-San-Felice and Bologna-Modena Railways. By Bignami (D. R.)........ 805
——Storage battery installation in Bordeaux power station (D. R.)........ 451
——Storage batteries for sub-stations (D. R.) 622
——Sub-station practice on Toledo & Western Railway (D.)........ 569
——Suburban electric equipment in England. 409
——Surface-contact systems. By Bornand (D.) 664. Loewy (D. R.). Paul (D.) 1107
——Suspended road for Berlin........ 36
——Suspended road for London (D. R.).....1020
——Telephone service on. By Daniell (D.) 451. Soulier (D. R.)........ 570
——Terry trolley roller........ 566
——Third rail operation. By W. A. Anthony, 37. L. B. Stillwell, 126. G. T. Hanchett, 127, (D.) 450. Young (D.) 569. Gonzenbach (D.)........ 663
——Three-phase. By Korda (D. R.)........ 805
——Traffic conditions in New York, 30, 102. By Wheatly (D.) 246, 326, 366, 410, 482
——Traffic regulation in Leipzig........1103
——Train unit control, Berlin elevated (D.).. 129
——Transportation in large cities........ 181
——Trunk line system in Southern Ohio.... 619
——Vestibule bill signed........ 836
——Vicarino car lighting system in France..*235
——Walkins' inverted third rail system......*252
——Wattmeters on European cars (D.)...... 839
——Westinghouse train control and couplers.*843
——Wooden blocks as insulators for third rail. By Leavitt (D. R.)........ 894
RAILWAYS, ELECTRIC:
——Albany & Hudson third-rail road. By Chas. Esseltyn........ 77
——Augusta & Aiken (D.)........ 130
——Baltimore........ 135
——Berlin (D. R.)........410, 830
——Boston third-rail........*151
——Boston underground........ 81
——Bournemouth tramway system (D.)...... 204
——British tramway statistics (D.)......284, 408
——Brooklyn elevated (D. R.)........ 622
——Brooklyn inditment........ 74
——Brooklyn Rapid Transit power station...*404
——Brooklyn transportation problem........ 567
——Brooklyn third-rail methods........ 659
——Brussels, conduit construction (D.)...... 839
——Buenos Ayres........337, 462
——Central Missouri Railway........ 326
——Chicago consolidation........ 91
——Chicago transportation problem, 2. Arnold report on........ 75
——Chicago underground........ 92
——Cincinnati, Georgetown & Portsmouth Railroad (D.)........ 450
——Cleveland consolidation........ 944
——Connecticut annual report........ 77
——Connecticut high-speed........ 700
——Connecticut third rail........ 282
——Cuba, 426 (D. R.)........ 570
——Dallas merger........ 92
——Bu Bois (D. R.)........ 936
——England........ 201
——Europe (D. R.) 164, 409. Vellguth (D.) 569
——Fayet-Chamounix (D.)........ 368
——Grand Rapids, Holland & Lake Michigan shop practice (D. R.)........ 368
——Grenoble-Chapareillan three-wire system..*838
——Holland........ 242
——Ilford tramways (D.)........ 702
——Indianapolis........ 135
——Japan........426, 499, 673

RAILWAYS, ELECTRIC. (Continued.)
——Kansas City consolidation........ 943
——Lancaster (D.)........ 451
——London County Council tramways (D. R.) 1108
——London underground (D. R.) 39, (D.) 702, 799, (D.) 839, (D. R.).. 936, *1013
——London underground accident........1104
——Los Angeles & Pacific system (D. R.)..1108
——Louisville, Ky........ 257
——Manchester, Bloom Street station (D.).. 411
——Manhattan elevated. By L. B. Stillwell, 126, 145, 918
——Manhattan elevated sub-stations........ *27
——Manhattan elevated transportation problem. By Jas. E. Hewes........ 202
——Maritzburg, South Africa........ 93
——Maryland........ 54
——Mersey River Tunnel system (D.) 664, (D.) 936, (D. R.)........1020
——Mexico........ 672
——Milan, Varese, Porto Ceresio (D.)...... 839
——Mont Blanc........ 836
——New Jersey merger........ 943
——New York and Boston, Continuous route between........30, 803, 1060
——New York Central depot plans........ 358
——New York subway and "L" extensions (D. R.)........ 529
——New York subway, Mayor Low on...... 548
——Northeastern Railway, England (D.)....1066
——Ohio Central Traction system (D. R.)... 894
——Ohio interurban (D.) 368, (D.)........ 622
——Ohio report for 1902........ 92
——Ohio Valley Traction Company's new road........ 619
——Paris. By Durand (D.), 39. (D. R.).1108
——Paris-Brussels........ 350
——Paris underground, 366, 755, (D.)........ 894
——Peru........ 448
——Philadelphia. By Wheatly (D.)........ 664
——Porto Rico........ 55
——Quebec, Canada........ 843
——Richmond........ 135
——Rochester & Eastern Rapid Railway..... 292
——Rockford, Beloit & Janesville Railway (D. R.)........ 894
——Scotland (D. R.)........570, 995
——Seattle-Tacoma (D.)........ 839
——South Africa........1052
——Sweden. By Arvid Westerberg, 162, 471. Westerberg, *481, 566, 662. H. W. Leonard, 757, (D.)........ 839
——Switzerland........ 801
——Valtellina three-phase. By Pietro Lanino, 37, (D. R.) 839. Cserhati (D.) *893. Hammer (D. R.), 984. (D. R.)....1108
——Washington, Baltimore & Annapolis Road (D. R.)........ 894
——Western Ohio. By Tell (D. R.)........ 39
——Yokohama, Japan........ 55
Rainer Company. Automobile telephone truck........*532
Rankine. Poem on metric system........ 924
Rays. (See Cathode, Radium, Rontgen, etc.)
Rectifier, Electrolytic. By Guthe (D. R.) 87. Hospitalier (D.) 248, (D.) 285, (D. R.)........1106
——Grisson. By Grisson (D.)........*1106
——Hewitt and Nodon (D.)........ 328
Refuse destructor. By Broadbent (D.)...... 328
——Cleckheaton Works (D.)........ 39
Resistance of bearings, Electrical. By A. E. Kennelly and C. A. Adams........ 231
——comparator. By Lehfeldt (D.)........ 704
——Comparison of small. By Jaeger, Lindeck and Diesselhorst (D. R.)...... 806
——Measuring very low. By Rennie (D.) 939, (D.)........ 980
——of oil as affected by temperature and impurities. By Prof. J. W. Langley... 745
——sets. Northrup patent........1104
Resonance in electric circuits. By Field (D. R.) 571, 682, (D.)........ 701
Rheostats, Regulating. By Koenig (D. R.).. 165
——Stanley novel form of cast grid........*1026
——Water-cooled........ 546
Rhodes scholarships........ 180
Richardson Scale Co. Automatic scales.....*170
Robb-Mumford Boiler Co., Inc. Internally fired boiler........*767
Robbins & Myers Co. Ventilated motors.... *48
Roche, W. A. New standard dry battery tests........ 208
Rontgen rays. By Rollins (D. R.)........1109
——Diffraction of. By Haga and Wind (D. R.)........ 412
——Field surrounding a Crookes tube......1004
——Improved forms of support for tubes. By Rollins (D. R.)........1109
——Intensity and wave length of. By Holtsmark (D.)........ 665
——in medicine, 35. By Grummach (D.) 206. Cleaves (D. R.) 206. Lowe (D.) 330, 699
——Nature of. By Rayleigh (D.)........ 665
——and others........ 783
——photographs, Stereoscope for (D.)...... 841
——Use of quinine in connection with. By Wm. Jas. Morton, M. D........1058
——Velocity of. By Blondlot (D.)........ 329
Rotary Engine Co. Rotary engine........*334
Russia, Electrical developments in. By Heenan (D.)........ 760
——Manufacture of electrical conductors in.. 605

S

ST. LOUIS Exposition. Edison at........ 956
——Educational Building wiring........ 188
——Electrical exhibits........385, 398
——and export trade........ 737
——International Congress at......348, 648, 1006
——Intramural railway........ 409
——Italy at........1103
——lighting........436, 700
——rules........ 148
Safety clothes for workmen. By Artemieff (D.)........ 572
Sal-ammoniac. By Rosset (D.)........ 666
Salt evaporation by exhaust steam........1004
Saw, Kinsman electric gain cutting........*898
Scales, Richardson automatic........*170
Science Abstracts........ 363
Science. American appointment for Prof. J. J. Thomson........ 64
——Bureau of Scientific Information, Paris.. 126
Scientists, Award to........ 924
Searchlight, Heligoland, Germany (D. R.)... 804
——Woman's Magazine building, St. Louis Exposition........ 891
Seismic phenomena, Electricity and........ 832
Selenium. By Giltay (D.)........ 571
——Mr. Hammer's lecture on........*698
Seneca Falls Mfg. Co. "Star" lathe........*765
Sewage purification. By Corbett (D.)........ 131
Shade holder, Geis........ *50
Shaft end play device (D.)........ 839
Sheehy, Robert J. Cosmo railway system... 578
Shelby Electric Co. Photometer attachment..*670
Shock, Fatal, in public bath at Fulham...... 222
Siam, Electrical development in........ 84
Sidewalks, Moving, New York........ 316
Siemens Bros. & Co. Electric steering gear on English yacht........*985
Sign, electric, and central station business, Chicago Edison........ 49
——device, Norden-Bittner........ *46
Silicon, Use of carbide of (D.)........ 703
Siloxicon. Acheson patent. By C. P. Townsend, 525. Fitzgerald (D.) 979. E. G. Acheson........1103
Shelley & Co. Incandescent lamp adjuster.. *90
Sleep, Electric production of. By Leduc (D.) 206
Smith, Irving B. Modern theatre installation in New York City........*455
Smith & Heminway. Linemen's climbers....*422
——Nail puller........*47, *134
Smith Storage Battery Co. Storage battery plant, Boston........*900
Smoke and determination of its density......*752
Snow, Radioactivity from. By Wilson (D. R.)........1021
Sodium chromate, Production of. Specketer process. By C. P. Townsend....... 928
——chloride in electrolytic caustic alkali. By Townsend (D.)........ 40
Soldering iron and blow-torch, Jones'.......*134
Southern California Electro Medical Society, organization........ 567
Spain, Electrical industry in (D. R.) 369. By H. L. Geissel........ 746
Sparking of electric currents, Prevention of. Emmet and Read patents........ 37
Sprague Electric Co. Lundell fan motors.. *250, *582
Standardization (D. R.)........ 761
Static electricity applied to ore dressing. By Swart (D.)........ 490
Stanley Electric Mfg. Co. Novel form of cast grid rheostat........*1026
——S. K. C. circuit breaker........*809
——"Sterling" arc lamps........ *44
Steam engine, Cooley cycloidal........*628
——Francke four-ported........*209
——installation at Cerro de Pasco copper mines, Nordberg........1111
——Test of Belgian using superheated steam (D.)........1020
——Tests of Buffalo Forge Co........*897
——Warren rotary........*334
Steam power, Cheap, from culm........ 552
Steam turbine. By Reyval (D. R.)........ 246
——Curtis........*609, 857, *859
——vs. De Laval, reciprocating engine generators. By David Hall........*668
——installation, Ottawa & Hull Power & Mfg. Co., Hull, Can........ *47
——Parson's. By Rancour (D.)........1107
——in Philadelphia subway power plant, Westinghouse........1071
——plant, Parson's, Manchester Corporation, England........*983
——Prof. R. H. Thurston on........ 516
——Rateau........ 893
——in Rockland (N. Y.) central station...... 211
——Unit for Omaha light and power station.1012
Steamer, Electrical equipment of City of South Haven........ 619
——Electrical equipment of German Atlantic. 449
Steel castings in Ireland........ 619
Steel: Aging of sheet. By Thos. S. Allen, *1048. Stern (D.)........1064
——Electric manufacture of. By Reyval (D. R.) 87. Walsh (D.) 490. Beecker (D. R.)........ 895
——Electrical manufacture of, in Sweden. By G. Lindman........*551
——Electrometallurgy of. By Ruthenburg (D.)........ 369
——furnace, Kjellin. By Becker (D. R.).... 704
——and iron, Electrometallurgical production of (D.)........ 805
——and iron industry, Alternating vs. direct current as applied to. By C. H. Hines........*315
——industries. Electric power in. By Walsh (D. R.)........1107
——and iron processes. By Simpson (D. R.) 704
——plants. By Perkins........ 893
——production in the electric furnace (D.)... 571
——Sheet, for static transformers. By Walter S. Moody........ 608
——Stassano process. By Goldschmidt (D. R.)........ 205
——Tool, Taylor-White process........ 408
——works, Electric power in modern. By MacCoun (D. R.)........ 450
Steering gear for British yacht (D. R.)...... 39
——Electrical (D. R.)........1110
——Siemen's electric on English yacht......*985
Steinmetz, Chas. Proteus. Autobiography.... 524
Sterling Electrical Mfg. Co. Double spiral filament lamps........*253
Stevens' Institute of Technology, changes in roster and faculty of........ 125
STORAGE BATTERIES:
Storage battery, Alkaline. Chicago Storage Battery Co........*421

STORAGE BATTERIES (Continued.)
——Ampere hour capacity of lead, 266. By A. L. Marsh........*271
——on Bologna San Felice and Bologna Modena Railways. By Bignami (D. R.) 805
——Bruch patent........ 385
——charging with synchronous converters. By Karapetoff (D.)........ 623
——Chloride Electric Storage Battery Co. . 765
——Combination railway and lighting installations at Milwaukee. Electric Storage Battery Co. *1023
——Edison. By Hibbert (D. R.) 329. C. P. Townsend, 444. (D.) 489, (D.) 529. Hibbert (D.) 529. Townsend ..656, *835
——as electrolytic cell. By Reed (D.) 248
——Galvanic cells. By Mugdan (D. R.).... 606
——Hubbard control patents 326
——installation in Bordeaux power station (D. R.) 451
——installation for a laboratory. By Humphreys (D. R.).......... 412
——installation at Milwaukee (D. R.).......1108
——Lead. By M. U. Schoop (D.)......... 665
——lead, Preparation of the active mass for. By Leimer (D.) 666, 979
——Measuring the internal resistance of. By Oates (D.).........*806
——plant in Boston, Smith..........*900
——plates of slabs. By Leimer (D.) 369, (D.) 490
——practice, Determining the best conditions in. By Hering (D.)......... 40
——Problem of. By Swinburne (D.)........ 130
——required for use on street cars, Calculating. By Izart (D. R.)........... 246
——Standard cells. By Jaeger (D.)......... 667
——for sub-stations (D. R.).......... 622
——Synchronous converters for charging. By Thornton, Marchant, Woodhouse (D.) 450
——in transmission plants. By H. S. Knowlton 831
——Tribelhorn (D. R.).......... 666
——with pottery diaphragms. By George E. Hatch 1105
Storey Motor & Electric Co. Direct driven machine tools..........*333
Street railways, Statistics of American....... 801
Streets, Property rights in.......... 182
Stromberg-Carlson Tel. Mfg. Co. Telephone ringer *49
Sturgess Governor Engineering Co. Switchboard speed control of water wheel governors *844
Sugars. Electrolytic synthesis of..........1067
——Schwerin method of extraction. By C. P. Townsend 618
Superoxides, Electrolytic. By Hollard (D.).. 452
Surgery, Electricity in 1061, 1103
Switchboards. By Benischke (D. R.)....... 979
——circuit breaker, Gen. Inc. Arc Light.....*458
——Divided multiple. By Aitken (D. R.) 981, (D. R.) 1110
——General Electric..........*1025
——model. By A. B. Weeks..........*523
——speed control of water wheel governors, Sturgess' *844
Switches, High-tension (D. R.).......... 411
——Large capacity. By Hewlett (D. R.).... 570
——Motor starting. By Broadbent (D. R.).. 936
——Testing of alternating current fuses and. Howe (D.)..........1020
Switching, High-tension. By J. N. Kelman..*120

T

TANKS, Concrete. By Browne (D. R.)..... 704
Tap and reamer wrench, Carpenter..........*710
Technolexicon. Society of German Engineers. 924
Technological historian, Troubles of......... 916
Telechirograph, Gruhn, for transmission of handwriting *1054
TELEGRAPH:
Telegraph cables removed from Brooklyn Bridge 1018
——Earthquake warnings by.......... 365
——lines along railroads.......... 146
——New cable codes..........566, 607
——New column type-printing instrument (D. R.) 1110
——Property rights in streets.......... 182
——Recording. By Hopkins (D. R.)........ 491
——and telephone system combined. Gaunt patent *279
——Underground cables in England........ 548
Telegraphs: British, Loss on.......... 873
——in Brussels (D. R.)..........1068
——China 161, 162, 202, 281
——Hungarian. By P. De Szalay.......... 803
——Manchuria 754
——Persia 110
——Postal lines from Omaha to San Francisco 1016
——Postal pensions.......... 976
——St. Louis competition..........320, 348
——Western Telephone and Telegraph Co., Problems of 22
——Western Union earnings 1058
——Western Union and Penn Railroad troubles 802, 926, 1016, 1061, 1103
Telegraphone. Rosenbaum patent..........*364
Telegraphy: Alaska.......... 126
——Branly-Popp aerial. By Henry Hale....*823
——Delany invention. By Romyn Hitchcock. 492
——French 35
——History of..........101, 113
——Improvements in last three months of 1902 (D. R.).......... 760
——National Electrical Code, 1903 edition... 935
——Pollak and Virag system.......... 836
——Submarine. By Fournier (D. R.).......1068
——and telephony. Simultaneous, 566. By Chas. C. Duvall..........*1050
——Vacuum tubes as lightning arresters for. By Kinsey (D.).......... 205
TELEPHONE:
Telephone apparatus. Burke patent..........*279

TELEPHONE (Continued.)
——Designing. By Taylor (D. R.) 110
——as a zero instrument in measurement of E. M. F. By Fischer (D. R.) 340
——Atwater Kent desk set *768
——Atwater Kent monophone intercommunicating *210
——Automatic systems. Smith patent *888
——bell. Yaxley patent 160
Telephone busy test, Combination drop and jack. Ericsson patent 1016
——busy test system. Dean patent *125
——cable clip. Auxer patent 82
——cables. By Arthur V. Abbott..........*16
——cable, Opening of Anglo-Belgian.......... 408
——cable paper spacer. Hall patent 324
——cable repair apparatus. Daggett patent.. 887
——cables, Running, Pacific Coast *511
——cable terminal. O'Connell patent..........*928
——cables: Unreasonable specifications. By Frederick J. Hall.......... 362
——in car dispatching, Buffalo (D.).......... 529
——Central energy repeating coil. Currier patent *1099
——Central energy system. Fowler patent, *445. Goodrum and Lattig patents, *484. Miller patent, *834. Smith patent *1015
——Chicago branch of A. I. E. E. meeting on 925
——circuit-breaker. Stevens patent.......... *82
——circuits, Means for preventing disturbance of. Michalke patent..........*834
——circuits, Rails as.......... 162
——circuit. Sorg patent *1099
——coherer, Long distance. Clement patents..*324
——coin collector lock. Lewis patent..........*1014
——coin collector lock. Scott patent......*1015
——coin collector. Paen patent..........1015
——coin collector. Scribner patent..........*1015
——and combined fire alarm and burglar alarm system. Fox patent.......... 657
——"Connecticut" desk..........*287
——converser. By H. W. Jenney.......... 37
——Couch & Seely iron box..........*581
——counter. Long patent.......... 657
——counter, Meyer patent.......... 124
——developments in the Indiana field....... 279
——development in Philippines..........*688
——Differentially wound, as measuring instruments, 856. By Prof. H. Ho..........*884
——Earth current disturbances and. By Taylor (D.).......... 413
——in electric railway service. By Daniell (D.) 451. Soulier (D. R.).......... 570
——engineering. By Dommerque (D. R.) 330, (D. R.) 491, (D. R.) 1068
——extension closer, Garton-Daniels..........*256
——and fire alarm system. Denio patent.... 889
——for the sick.......... 515
——fuse and lightning arrester combined. Sachs patent..........*243
——generator. Connecticut T. & E. Co..... *48
——for Germany.......... 162
——holder. Chicago Writing Mch. Co...... *48
——hook switch lock. Head patent..........*753
——hook switch for desk stands. Holmok patent 658
——hook switch "lazy tongs." Königstein patent 753
——Hungarian. By P. De Szalay.......... 803
——inductance coil cable. Tremain patent...*887
——induction coil, Multiple magnetic circuit. 526
——instruments: Bell output in 1902....... 81
——insulator. Bell patent.......... 887
——"International" *580
——jack. Clausen patent, *159. McCormick patent *1059
——Kellogg switchboard and Supply Co. interests 1070
——in lighting and traction system, Manchester, N. H..........*962
——lightning arrester. Chapman patent.....*446
——line poles. By W. F. Stevens.......... 326
——line tapper. Dietz patent.......... 243
——lines, Construction of aerial. By A. V. Abbott, *123, *156, *274, *321, *359, 400, 521, *563, 617
——lines, construction of aerial, General specifications for..........*713
——lines, Inserting self-induction coils on long. By Campbell (D.).......... 624
——loaded circuit. Warren and Campbell patent *1059
——"lock-out" party line system. Pembleton patent.......... 834
——magneto bell. Thordarson patent....... 324
——Magneto box clamp casting. Holtzer patent 834
——meeting of American Institute of Electrical Engineers.......... 189
——message counter. Gray patent.......... 692
——messenger strand support. Neslage and Watson patent.......... 930
——meter and apparatus. Bullard and Falk patent *280
——Mexican long-distance system.......... 462
——news service.......... 244
——operators, Training of. By Herbert Laws Webb *1043
——operator's key. Burlingame patent...... 364
——pad. Van Piper patent.......... 834
——party line service, Meeting of Chicago Electrical Association on.......... 799
——party line system. Terpening patent..... 657
——party line system. Understock patent... 930
——patents..*33, *82, *124, *159, 200, 242, 279, *324, *364, *445, *484, *525, 562, *657, *692, *753, *800, *834, *887, *928, *1014, *1059, *1099
——patents, Digest of United States, issued to December, 1901.......... 84
——pay station signal. Baird patent..........1015
——pole changer. Malthaner patent, 364. Crawford patent..........1016
——progress and finality 1039
——Property rights in streets.......... 182

TELEPHONE (Continued.)
——protective apparatus. Kaisling patent, *82. Scanlin patent, 243. Bonham patent, 324. Elliott patent..........*929
——receiver arm. Knowles patent, 84. Riedinger patent, 562. Konigstein patent 562
——receiver holder. McClain patent, 125. Briggs patent, 364. Becker and Shiel patents, 562. Briggs patent...1016
——receiver, Holtzer Cabot..........*942
——receiver, International..........*335
——receiver. Miller patent, *82. Hutchison and Denio patents, 887. Wheeler patent *929
——receiver support.......... 484
——receiver, Use of differentially wound, in electrical measurements. By H. Ho. *884, 977
——ringer, Stromberg Carlson.......... *49
——selective systems. Smith patents, 888. Stone patent..........928, 1016
——service, England. By Quail (D. R.)...1110
——service in New York hotels..........*689
——signalling apparatus. Dean and Dunbar patents, *657. Green and Watkins patents *888
——speaking-tube system. Höhne patent.... 243
——special directory.......... 929
——spring jack. Scribner patent..........*754
——station circuits. Stetson patent.......... *33
——strain insulator. Claydon patent.......... 692
——subscriber's circuit. Dean patent..........*484
——subscriber's station annunciator. Jackson patent 887
——switch, Yurgae self-releasing..........*929
——switchboards, "Automatic" time stamp for *583
——switchboard, Equitable equipment at Bloomington, Ill..........*706
——switchboard jack. McCormick patent.... *33
——switchboard lamp. Whipple patent...... 929
——switchboards, Wiring strips of lamp jacks for. Claussen patent.......... 753
——systems. Parsons and Sloper patents, *760. Wood patent, 200. Dunbar patent, *364. Dean patent, *525. Russell patent, 657. Mason patent, 658. Paul patent..........*692
——systems, Automatic. By O'Brien (D.)..1067
——systems, automatic, Trouble tests for. Reeve's patent..........*446
——system, Evolution of modern. By L. A. Lindsey 150
——and telegraph system combined. Gaunt patent *279
——thermal device. Taylor patent.......... *82
——toll lines. By Wegner (D. R.).......... 330
——Train signalling in France.......... 397
——transmitter. Hutchison and Cadden patents, *160. International, *255. Wotton patent, 280. Tucker patent, *324. Fahnestock "Button," *421. Lauson patent, *445. Mellet patent, *445. Senkbeil patent, *800. Wheeler patent..........*929
——transmitter attachment. Logue patent... 160
——transmitter coil-box. McCormick patent. 160
——transmitter mouthpiece, Antiseptic. Ballard patent.......... 324
——tunnels (D. R.).......... 453
——"Vocal Guard." Donihue patent..........1016
——wall set. Miller's patent.......... 201
——War Department.......... 137
——wires, Relative disposition of power wires and.......... 546
——wood Non-corrosive *800
TELEPHONE COMPANIES:
Telephone Companies: Allied Independent Toll Co.s' organization.......... 754
——Bell annual report..........545, 556
——Bell trouble in Washington, D. C....... 323
——Connecticut Telephone & Electric Co. incorporation 589
——Cuyahoga, annual meeting.......... 280
——Everett-Moore properties 1105
——Federal Company's directors' meeting... 201
——Independent Telephone Traffic Company, Cleveland 885
——Keystone troubles..........92, 136
——Michigan Independent meeting........ 447
——New York & New Jersey annual report. 446
——Ohio independent 324
——Richmond (Va.) independent, sale...... 244
——Western, annual report.......... 499
——Western Telephone and Telegraph Co., Problems of 22
TELEPHONE EXCHANGES:
Telephone exchanges. By A. V. Abbott. *685, *796, *1010, *1051, *1093
——Ashtabula, O..........959, (D. R.)...1110
——Bellevue, O.......... 214
——Brussels, new..........*741
——Buffalo Frontier Independent, opening. By F. C. Perkins..........*473
——Dusseldorf By Kehr (D. R.).......... 206
——Kansas City, Mo.......... 538
——Le Roy, N. Y..........1030
——Modern private branch. By O'Brien (D. R.) 491
——Nebraska Independent.......... 323
——New York City. Orchard St..........1049
——New York City Plaza..........*798
——system. Binkley patent, *83. O'Connell patent *1060
——Yonkers, new.......... 885
Telephony: Automatic, at Westerly, R. I.... 443
——Berliner decision..........143, 154, 158
——Development of, in New York......101, 118
——between England and Belgium..........1103
——in England..........1006
——Improvements in last three months of 1902 (D. R.).......... 760
——Independent movement, 326. By Clausen and Hubbell (D. R.).......... 33
——Independent work in Canada.......... *3
——Independent, in Kansas.......... 28
——Independent in New York State 106
——Independent, in Wisconsin.......... 2
——Larned paper on.......... 51

Telephone Exchange. (Continued.)
——Message time limit.......... 10
——Municipal 433
——Papers on, with the A. I. E. E.......... 144
——in Paris 84
——Reconstruction of National Company's Glasgow system (D.).......... 807
——Sweden 1058
——and telegraphy, Simultaneous, 566. By Chas. C. Duvall *1050
Tesla, Nickola, Biography. By Hawkins (D. R.) 625
Testing set, Willyoung..........*253
Thermo-cells. By Horstmann (D. R.) 40; (D.) 529
Thermomagnetic phenomenon in gases. By Aschkinass (D.) 247
Thermostat, Electric. By Marie and Marquis (D.) 666
——heated and regulated by electricity. By Marie and Marquis (D.) 1067
Thomson, Prof. J. J., American appointment for, 64. Gold medal for, 245. Degree conferred on 1042
Time stamp, "Automatic" *583
Tin from scrap. By C. P. Townsend.......... 198
——lead and bismuth, Alloys of. By Shepherd (D.).......... 166
Towle, Geo. C., Mfg. Co. Revolving desk fans *422
Train controller. Westinghouse turret form of *1110
Train indicator, Electric. By Parham (D. R.) 489
Train lighting, Electric. By Dowling (D.) 283. Geo. D. Shepardson 439. Goetze (D. R.) 664. Jacquin (D. R.) 804. Goetze (D. R.).......... 838
——Axle-driven system..........386, 435
——Axle driven system; A. I. E. E. papers.. 405
——Felt axle-driven system..........*494
——Henry axle-driven system..........*419
——McElroy axle-driven system..........*626
——Moskowitz axle-driven system. U. S. L. & H. Co..........*250
Transformers. General Electric core type..*709
——Large S. K. C..........*576
——Loud speaking and singing. By Kraetzer (D.) 529
——Sheet steel for static. By Walter S. Moody 608
——Shell and core type. By Niethammer and Eborall (D.) 838
——Thickness of sheet iron. By Kamps (D.) 367
——Three-phase. By Koenig (D. R.).......... 203
——Three-phase, adopted by Chicago Edison Company 21
——Westinghouse self cooling..........*895
Transmission of Power:
——Arnold Bragstad-La Cour polycyclic system, 783. By O. S. Bragstad *786
——Bedell system of composite, 347. By A. S. McAllister *351
——Braum wireless system 245
——Break in Massena plant.......... 620
——in California. By Wright (D. R.)..........1020
——by gas. By Burstall (D.).......... 804
——High tension lines. Chicago A. I. E. E. meeting on 644
——High-tension switching (D.).......... 759
——Hydro-electric development of French Broad River, N. C. By Chas. E. Waddell *957
——Long distance difficulties, 600. By Lincoln (D. R.)..........1020
——Practical high-tension work..........1104
——Storage battery in plants. By H. S. Knowlton 831
——under direct control of operator. Buck patent 1018
——Use of high tension underground conductors. By Henry Floy..........386, 396
——vs. coal car transmission.......... 265
——22,000-Volt plant of Northern California Power Co..........*437
——30,000-Volt three-phase plant of Machienen Oerlikon. By Dr. H. Behn-Eschenburg *5
——25,000-Volt plant of South Bend Electric Co..........*919
——Water power for high-voltage transmission 199
Transmission of Power: Athens, Greece.......... 568
——Bay Counties Power Company's interruptions 493
——Boise, Idaho..........*825
——Caffaro River, Italy, 40,000-volt plant (D.) 663
——California 55
——Chaudiere Falls, Canada (D. R.).......... 893
——Clermont-Ferrand, France. Westinghouse 579
——Del Valle River, Mexico.......... 337
——Farmington River, Mass.......... 537
——in Greece (D.) 936
——from Hudson River. By Alton D. Adams*1080
——India 338
——Italy 416
——Joliet to Chicago.......... 72
——Lachine Rapids 448
——Manchester, Conn..........*313
——Materials for lines. By Adams (D.).......... 451
——New Milford Power Co., Conn.......... 708
——Oregon (D. R.).......... 758
——Shawinigan Falls.......... 273
——St. Croix River.......... 338
——Tunal River, Mexico.......... 945
——Vancouver plant, 643. By Wyatt H. Allen, *645, 820. K. G. Dunn..........*837
——Wiesburg in Tyrol. By Stoeger (D. R.).1020
Tunnel: Electric traction in Cascade, Wash.. 409
——Niagara River redwood.......... 325
——Pennsylvania Railroad..........35, 161, 745
Turbo-generators, Westinghouse..........*668

U

UNION COLLEGE, Schenectady, Electrical course at 388
Union Engineering Building...781, 784, 820, 822, 855, 858, 918, 1061, 1088
U. S. Lighting & Heating Co. Moskowitz axle-lighting system..........*250
Units. By Dompierre (D.) 841
——Abbreviations of, and dimensions of physical quantities. By H. H. Wait. 891
Uranium, Radioactivity of. By Rutherford and Soddy (D.) 840

V

VACUUM TUBES, Abnormal cathode fall in. By Stark (D.) 412
——as lightning arresters for telegraphy. By Kinsey (D.) 205
Valves, Aluminum. By Nodon (D.).......... 624
Vapor lamp, Mercury, Steinmetz investigation, 162, 309. By Chas. P. Steinmetz, *316, 362. Peter Cooper Hewitt, 366. Louis E. Walkins *486
——Mercury, for eye investigations (D.)..... 704
——Radiant efficiency of mercury arc...... 353
Vapor, salt, ionization of. By Moreau (D.).. 86
Voltage, Dangerous rise of, due to resonance. By Finckh (D.).......... 570
——regulation 236
——regulator. Rice patent 1018
Voltameters, with platinum electrodes. By Bartorelli (D.) 704
Voltmeters, Kevlin electrostatic..........*581
Voltmeters and ammeters, Jewell circuit breaking *579
——Nalder & Thompson recording.......... *50
——Westinghouse alternating current long scale *708

W

WALKINS, LOUIS E. Inverted third rail system *252
Ward Leonard Electric Co. "No Voltage Release" 1027
Water: Clark's electrical process for purification. Am. Elec. Imp. Co..........*670
——Decomposition of. Garuti and Pompili method. By C. P. Townsend...... 656
——Electric power and floods.......... 243
——Electrolysis of..........616, 642, (D.) 938
——and gas pipes, Electrolysis of (D.)...... 85
——Magnetic susceptibility of. By Stearns (D.) 703
——purification 201
——Saving the rainfall..........1086
——supply by electricity in Milan.......... 802
Water power development. By Judge (D. R.) 978
——Development of mountain. By Letheule (D. R.) 328
——in electrical supply. By Adams (D.)... 893
——Escanaba River 661
——Georgia 661
——and high-voltage transmission.......... 199
——Hoosick River 811
——Hudson River 54
——limitations 63
——Manchester, N. H., *105 (correction).... 272
——Norway 245
——Portland, Me., Electrical supply from. By Alton D. Adams.......... *65
——Puebla 54
——Santa Catirina River, Mexico.......... 378
——Small, with high heads. By Reid (D.).. 804
——South Africa. By Fose (D. R.).......... 623
——Switzerland. By Thormann (D.).......... 283
——Tlalpujahua River, Mexico.......... 258
——Winooski River, Vt. By Alton D. Adams *147
Waterwheel governor. Lombard electrical control *133
——with switchboard speed control. Sturgess.*844
Waterwheels, Efficiency tests of tangential, under 1912 ft. effective head. Abner Doble Co. 1071
Wattmeter connections, Integrating. By Weeks (D. R.).......... 491
——Duncan integrating direct current..........*288
——on European cars (D.).......... 839
——Italian recording. Olivetti..........*417
——Stanley patents 366
——Testing of recording, on consumer's premises, 470. By W. J. Mowbray *475, 527
——Thomson, Cox and Holden patents...... 803
Waves, Electric. By Chant (D. R.).......... 130
——Hertzian, Magnetic detector for. By Fleming (D.) 1109
——Magnetic detector of. By Tissot (D.).. 624
——Model of motion along single-phase alternating current line 546
——Stationary wire. By Borgmann (D.).... 452
Western Electric Co. Electrical equipment of Hotel Astor, N. Y.......... 763
——Fans *419
Westinghouse in Canada 1062
——dinner, London *238
Westinghouse Electric & Mfg. Co. Alternating current, long scale voltmeter and ammeter *708
——Automobile charging outfits..........*764
——Electric-pneumatic control on Brooklyn elevated road *89
——Electric train control and couplers..........*843
——Fuse block *287
——Gas power plant installation, Milwaukee. 809
——Gold dredging equipment *374
——Hydro-electric installation, Clermont-Ferrand, France.......... 579
——Motors for New York Subway..........*532
——Power equipment for Japanese arsenal.. 334
——Power tests of machine tools in locomotive shops *331
——Regulating and reversing controller..........*583
——Self-cooling transformers *805
——Turbo-generators *668
——Turret form of train controller..........*1110
——Type "F" induction motor..........*1111
——Circuit breaker *132
——Ventilated cell diverter *941
Westinghouse Machine Co. Gas engines....*372
Westinghouse Steam turbines in Philadelphia power plant 1071
Weston Electric Instrument Co., Employees' Club 940
White Star Appliance Co. Stirrups for arc lamp suspension *986
Williams & Wollender. Boiler plant for St. Louis Exposition.......... 375
Willyoung, Elmer G. Ohmmeter and faradmeter *253
Wind, Luminous electric. By Warburg (D.) 329
Wireless Telegraphy:
Wireless telegraphy. By Reyval, Arco (D. R.) 206. Wilke (D.) 249, 433. Fleming, Lecher (D.) 572. Arco, Wilke (D. R.) 572. Guarini (D. R.) 807. Simon and Reich (D.) *841. Righi and Dessau (D.) 842. Prasch (D. R.) 981. Guarino (D. R.) 1067. Prasch, Mayer (D. R.)..........1110
——in Alaska 890
——American De Forest Company incorporation 257
——Analysis of systems in 1902. By A. Frederick Collins *11
——in the army. By Prasch (D. R.)...... 939
——Atlantic 1088
——Bull system of selective, *227. By Bull (D.) 166
——Chess by 161
——conference 1087
——De Forest Co. of Canada incorporated... 585
——De Forest patents 37
——De Forest perambulating plant..........*374
——De Forest system. By A. F. Collins..*613
——De Forest system connecting Armour & Company's plants.......... 812
——during storm 201
——earnings. Munroe & Munroe booklet... 983
——Edison appointment 961
——in England 1006
——in fixed direction. By Braun (D.)...... 806
——in journalism, 202, 244, 281, 366, 554, 605, 619, 701
——on the Lakes.......... 975
——lecture apparatus *240
——for locating ships at sea 158, 292, 1062
——Lodge-Muirhead system.......... 409
——Marconi achievements 179
——Marconi's ocean. By Koepsel (D.)....1022
——Marconi system in England, 448, 565, 566, 661
——message from President to King.......... 161
——in the navy..........173, *241, 566, 699
——New Year's greeting across the Atlantic.. 4
——Notice served by..........1006
——and railroading. By Schmidt (D. R.)..1067
——receiving apparatus. King patent...... 976
——Recent progress in *1052
——in reporting yacht races..........1105
——Revenues of 361
——Sea coast. By Sharman (D.).......... 939
——Selective. Tesla and Stone patents...... 700
——Sir Wm. Preece on.......... 36
——situation 62
——stations for yachts 282
——stock quotations 281
——and submarine cable 956
——for submarines 661
——Syntonic. Hogg patent 244
——Tesla patent 526
——Tesla's work.......... 975
——Train service..........282, 485, 619
——Transatlantic 956
——trust 890
——Tuned circuits *393
——U. S. Wireless Signal Co., Organization of 1028
——Zickler's system. By Berthier (D. R.).1110
Wireless Telegraphy: Alaska..........448, 527, 755
——Canada 126, 172, 281
——Chicago 565
——China 1103
——Cuba 215
——English Channel 607
——English government concessions.......... 486
——France 126, 245, 325
——Germany 407, 565, 619, 699
——Government station at Cape Henry.... 392
——between Italy and Argentina..202, 282, 365
——Long Island Sound station.......... 700
——Martinique-Guadeloupe 409
——Montreal station 409
——New York City 485
——Pacific 362
Wireless Telephony. Armstrong system..... 660
——Collins system. By Dr. T. Byard Collins *1046
——Drawbaugh invention 890
——on ferryboats. By A. F. Collins..........*820
Wires, Heating of oil submerged..........820, *831
——Relative disposition of power and telephone 546
——Running telephone, on Pacific Coast....*511
——Sparks and shocks from insulated.......... 434
——Transmission. By Otto (D. R.).......... 247
Wiring. (D.) 805
——Calculation of networks. By Monath (D.) 86
——of buildings. By Falconar (D.).......... 328
——Economizing in house. By Tatlow (D.) 165
——Palmer method of, in connection with the operation of engine stops and electric motors *46
——Problems in (D. R.).......... 86
——rules in Chicago 317
——for ship lighting. By Broadbent (D.).... 411
——Three-wire direct current. By Percy (D. R.) 285
Wirt Electric Co. Equipment of Belasco's Theatre, New York.......... 455
Woodward Governor Company. Waterwheel governor *252
Wright, Alexander & Co., Ltd. Photometer.*766

Z

ZINC, Production of, by electricity, 353. Hoepfner process. By Guenther (D.) 979

AUTHOR INDEX.

A

ABBOTT, ARTHUR V. Construction of aerial telephone lines, *123, *156, *271, *313, *359, 400, 521, *563, 617
——Telephone cables *16
——Telephone exchanges *683, *796, *1011, *1051, *1091
Acheson, E. G. Data on siloxicon 1151
Adams, Alton D. Electric power from the Hudson *189
Adams, Alton D. Electrical supply from water power at Portland, Me. *65
——Statistics of the Massachusetts electrical supply systems in 1902. 877
——Water power on the Winooski *147
Adams, C. A. and A. E. Kennelly. Electrical resistance of bearings 231
Alexander, J. B. Sleet problem..... 201
Allen, Thomas S. Contribution to the subject of aging of sheet steel *1038
Allen, Wyatt H. Vancouver transmission plant *645
Anthony, Wm. A. Third rail operation 37
Arthur, W. B. Solution of a vexatious problem in street railway work *155

B

BARSTOW, W. S. Central station progress in 1902 21
Behn, Eschenburg, Dr. H. First three phase power transmission plant in Europe operating at 30,000 volts *5
Behr, Hans. Oerlikon induction motor with four speed variations..... *111
Belden, S. B. Electrical apparatus in coal mining 1068
Bell, Dr. Louis. Outlook in electric traction in 1903. 23
Boardway, Earl E. Hydro-electric plant in Newfoundland *391
Bragstad, O. S. Arnold-Bragstad-La Cour polycyclic power transmission system *786
Brandeis, Chas. Parallel operation of steam and water power plants..... 318

C

CARHART, HENRY S. Absolute measurements in electricity..... 1063
Chase, Chas. G. Electricity in the army..... 127
Cherry, L. B. Unique electric light plant..*361
Collins, A. Frederick. Analysis of wireless telegraph systems in 1902..... *11
——De Forest wireless telegraph system.... *613
——Elster and Geitel's improved form of Exner's electroscope..... *394
——Wireless telephony on ferryboats..... 829
Collins, Dr. T. Byard. Collins wireless telephone system *1046
——Electricity as a motive power in mechanical flight *410

D

DARROW, ELEAZER. Combined alternating and direct-current system..... *200
Day, Charles. Requirements of machine tool operation, with special reference to the motor drive *78
de la Tour, Boy. Heyland induction motor *442, *479
Dell, Alfred G. Electric discharges in air.... 15
de Muralt, C. L. 26,000-Volt installation at Grenoble, France..... *183
De Szalay, P. Hungarian telegraphs and telephones 803
Dodge, Kern. Electrical distribution in the machine shop in 1903..... 25
Dunn, K. G. Vancouver power plant..... 837
Duvall, Chas. C. Simultaneous telegraphy and telephony *1050

E

EAMES, HAYDEN. Present status of electric automobilism *68
Erlwein, Dr. Ig. German ozone waterworks..*119
Esselstyn, Charles. Experience with third-rail road in open country..... 77

F

FACCIOLI, G. Three-phase measurement... 567
Felt, Chas. E. Axle-driven train lighting system *494
Fish, F. A. Note on three-phase power measurement *1091
Floy, Henry. Use of high tension underground conductors 396
Francke, W. J. Four-ported engine..... *209
Frenell, P. J. Stress on frames of alternating current generators..... *148, 620
Freund, H. P., F. Townsend, W. I. Reich. Relation of synchronous impedance to impedance at standstill *13

G

GEISSEL, HENRY L. Electrical progress in Spain 746
——Outlook of electrical apparatus in Europe in 1903 4
Gibson, Geo. H. Power required to drive machine tools 527
Guarini, Emile. Electroculture ..... *5[illegible]
Guilbert, C. F. Armature reaction of alternators 13, *116

H

HALE, HENRY. Blondel oscillograph *743
——Branly-Popp aerial telegraphy system..... *843
Hall, David. Turbine vs. reciprocating engine generators..... *668
Hall, Fred'k I. Telephone cables and a suggestion to unreasonable specifications 362
Hall, Joseph B. "Water pail" electric lighting 662
Hanchett, Geo. T. Inverted third rails..... 127
Hansson, A. Stresses in alternator frames . 282
Harden, John. Effect of high potential discharge on mica insulation..... *651
Hatch, George E. Storage batteries with pottery diaphragms 1103
Herman, Charles. Making of electrical history 162
Hewes, James E. Improvement of rapid transit in New York 202
Hewitt, Peter Cooper. Mercury arc..... 366
Higgins, Clifford L. Rebuilding the Duluth General Electric Company's station. *1007
Hines, C. H. Alternating vs. direct current as applied to the iron and steel industry *315
Hitchcock, Romyn. Notable invention in rapid telegraphy..... 492
Ho, H. Use of differentially wound telephone receiver in electrical measurements *884, 977
Hoho, Paul. Principles of new method of electric lighting *517
Hopkins, N. Monroe. Washington meeting of the American Association for the Advancement of Science and of the affiliated societies..... *73

J

JENKINS, FRANCIS C. Simple current interrupter *395
Jenney, H. W. Telephone "converser"..... 37

K

KAUFMANN, W. Development of the electron idea 648
Kelman, J. N. High-tension switching..... *120
Kennelly, A. E. Progress of electrical science during the year 1902..... 18
——and C. A. Adams. Electrical resistance of bearings 231
Knopfe, Fred'k W. Parallel operation of direct-connected alternators 836
——Stress on frames of alternating current generators 755
Knowlton, H. S. Centralized management of electrical properties 880
——Some educational points 960
——Storage battery in transmission plants.... 831
Koster, Franz. Norwegian waterpower plant.*552

L

LANGLEY, PROF. JOHN W. Resistance of oil as affected by temperature and impurities 745
Lanino, Pietro. Valtellina three-phase railway. 37
Latour, M. Commutation of alternators....*977
Leonard, H. Ward. Sweden and electric railway development 756
Letheule, P. Accurate measurements of heavy currents *616
Lindsey, L. A. Evolution of modern telephone system 150
Lindman, G. Electrical manufacture of steel in Sweden *551
Lockwood, Jos. E. Fuel consumption in central stations..... 486, 837

M

M'ALLISTER, A. S. Excitation of asynchronous generators by means of static condensance *109
——Some engineering features of the Bedell system of composite transmission..*351
McConnon, W. G. Cascade Water, Power & Light Co., Cascade, B. C., Canada.*705
Marks, L. B. Enclosed arc lamp statistics. Records of thirty central stations.... 881
Marsh, A. L. Ampere-hour capacity of the lead storage battery *271
Moody, Walter S. Sheet steel for static transformers 608
Morton, Wm. Jas., M. D. Note on artificial fluorescence of living human tissue ..1038
Moyer, A. C. Taxation of lighting plants in Michigan 567
Mowbray, W. J. Testing of recording watt meters on consumer's premises by means of specially constructed portable test meter *475, 527

O

OSCANYAN, P. C. Parallel operation of direct connected alternators..... 652

P

PERKINS, FRANK C. Formal opening of the Frontier Independent Telephone Exchange, Buffalo, N. Y..... *473
——Six Niagara power installations under way — A million horse-power to be developed at Niagara Falls..... *601
Perry, Leslie L. Three-phase measurements *69, *449

R

REICH, W. I., F. Townsend, H. P. Freund. Relation of synchronous impedance to impedance at standstill..... *13
Reid, Thorburn. Field coil formulas..... *826

S

SANDS, CHAS. P. Power required to drive machine tools 410
Scholl, George P. Progress of electro-chemistry in 1902..... 19
Scovil, Samuel. Individual plan of charging for current at Cleveland, O..... *658
Sever, George F. Electrical engineering instruction at Columbia University..... 1100
Shepard, F. A. An inventor, a wheel and an airship to run to Mars..... 561
Shepardson, Prof. Geo. D. Economic value of testing 232
——Some problems of electric train lighting. 439
Sherlock, W. A. Recuperating exhausted dry batteries *67
Smith, Hartley Le Huray. Fuel consumption in central stations..... 661
Spencer, C. J. Arrangement of power stations for operating steam railways electrically 272, 366
Stanley, Wm. Inventor and the trust..... 519
——Tesla split-phase decisions..... 486
Steinmetz, Chas. P. Mercury arc..... *316
Stevens, W. F. Lime poles..... *326
Stevenson, Robert. How to produce gravity experimentally *833, 935
Stillwell, L. B. Conditions on Manhattan elevated 126

T

THORNE, JAS. L. Water power vs. steam plants 245
Townsend, Clinton Paul. Recent electrochemical developments, *159, 198, *278, *365, *444, *483, 525, *562, 618, *656, *753, 886, *928, *1014.
Townsend, F., H. P. Freund, W. I. Reich. Relation of synchronous impedance to impedance at standstill..... *13

W

WADDELL, CHAS. E. Hydro-electric development of the French Broad River, N. C..... *956
Wait, H. H. Dimensions of physical quantities and abbreviations of units..... 891
Walkins, Louis E. Mercury arc..... *486
Wallace, H. L. Three-phase measurements.. 449
Webb, Herbert Laws. Training of telephone operators *1043
Weeks, Arthur B. Canadian power development at Niagara Falls..... 961
——Switchboard model..... *523
Westerberg, Arvid. Electric roads in Sweden 162, *481, 662
Wiley, D. A. Lifting electromagnets..... *1009
Witter, W. E. Hints on the care of electrical equipment *71
Wolcott, Townsend. How to produce gravity experimentally 891
Wurts, A. J. Mean spherical candle power.. 84

Z

ZACHARIAS, JOH. Theory of magnetism. 755

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CONTENTS.

Editorial ... 1
Wireless New Year's Greetings Across the Atlantic ... 4
Landing of the American End of the Commercial Pacific Cable ... 4
The First Three-Phase Power Transmission Plant in Europe Operating at 30,000 volts. By Dr. H. Behn-Eschenburg ... 5
Analysis of Wireless Telegraph Systems in 1902. By A. Frederick Collins 11
The Relation of Synchronous Impedance to the Impedance at Standstill. By F. Townsend, H. P. Freund and W. I. Reich ... 13
Electric Discharges in Air. By Alfred G. Dell ... 15
The Metric System ... 15
Telephone Cables. By Arthur V. Abbott, C. E. ... 16
The Progress of Electrical Science During the Year 1902. By A. E. Kennelly ... 18
The Progress of Electrochemistry in 1902. By George P. Scholl ... 19
Three-Phase Transformers Adopted by the Chicago Edison Company ... 21
Central Station Progress During 1902. By W. S. Barstow ... 21
Problems of the Western Telephone and Telegraph Company ... 22
The Outlook of Electric Traction in 1903. By Dr. Louis Bell ... 23
The Fire Hazard of Electrical Apparatus ... 24
The Outlook for Electrical Apparatus in Europe in 1903. By Henry L. Geissel 24
Power Development of British Columbia ... 25
Electrical Distribution in the Machine Shop in 1903. By Kern Dodge ... 25
American Absorption of Paris Lighting Interests ... 26
Independent Telephony in Wisconsin ... 26
Manhattan Elevated Railway Substation ... 27
New York to Boston by Trolley ... 30
Independent Telephone Work in Canada ... 31
The Armature Reaction of Alternators—IX. By C. F. Guilbert ... 32
New Telephone Patents ... 35
Power Plant for New Government Printing Office, Washington ... 34
Foreign Commerce of the United States in 1902 ... 34
The Engineering of P. R. R. Tunnel ... 35
Current News and Notes ... 35
LETTERS TO THE EDITORS:
  "The Converser." By H. W. Jenney ... 37
  Third Rail Operation. By Wm. A. Anthony ... 37
  The Valtellina Three-Phase Railway. By Pietro Lanino ... 37
Digest of Current Electrical Literature ... 38
New Books ... 41
New Shops of the British Thomson-Houston Company ... 42
An Electric Express-Call System ... 43
Sterling Arc Lamps ... 44
New Recording Instruments ... 45
Electric Sign Device ... 46
Alphaduct Fireproof Fibre Conduit ... 46
A Method of Wiring in Connection with the Operation of Engine Stops and Electric Motors ... 46
Turbine Installation of the Ottawa & Hull Power & Mfg. Co., Hull, Canada ... 47
Nail Puller for Electrical Purposes ... 47
Improved Telephone Power Generator ... 48
The Chicago Telephone Holder ... 48
Ventilated Motors ... 48
A New Telephone Ringer ... 49
Electric Signs and Central Station Business ... 49
Lamp Guards ... 49
Recording Voltmeters and Ammeters ... 50
Pumps for Central Stations ... 50
A New Type of Shade Holder ... 50
New Apparatus for Lighting and Power in New York City ... 51
Ball Engine Governor ... 51
DEPARTMENTS ... 52

ELECTRICAL PRODUCTION IN 1902.

A study of the figures of electrical production during the past ten or twelve years would indicate a steady average yearly increase of about 20 per cent. in the amount, or value, of manufacturing done. In fact, such a rate, strange as it may appear, would go back as far as 1880. In that year the U. S. Census returns showed a product reported of $2,655,036. Ten years later the amount reported was $19,114,714, evidencing that a slightly higher increase than 20 per cent. had prevailed. The figures for the U. S. Census of 1900 showed, for all the concerns that should be properly included, a total just short of $105,000,000 for the year ending June 30, 1901. An industry which throughout twenty years, good, poor, and very bad, could maintain an average rate of 20 per cent. increase, or thereabouts, is entitled to consider itself pretty firmly established, with a future full of hope as to the next ten years.

There is no doubt that since the 1900 Census figures were compiled, the rate of growth in production has been kept up, on the average, while in many branches of electrical activity it has been accelerated, as, for example, in the output of motors and in the extension of telephonic work. Below is given a table of probable production in the various lines for 1902, based on the statistics of 1900-1, showing a gross estimated total of about $140,000,000 in round figures:

ESTIMATED PRODUCTION, 1902.

Dynamos	$14,500,000
Transformers	4,000,000
Switchboards, for lighting and power	2,450,000
Motors, for all purposes	27,000,000
Storage batteries	3,000,000
Primary batteries	1,250,000
Carbons	2,000,000
Arc lamps	2,100,000
Incandescent lamps	5,000,000
Lighting fixtures	3,500,000
Telephonic apparatus	21,000,000
Telegraphic apparatus	1,750,000
Insulated wires and cables	27,500,000
Conduits, interior and underground	1,500,000
Rheostats, heating and cooking apparatus	2,250,000
Annunciators	250,000
Electric clocks	150,000
Lightning arresters, fuses, etc.	750,000
Measuring instruments	2,500,000
Miscellaneous apparatus	17,500,000
	$139,950,000

There seems to be no good reason for questioning the general validity of these figures, in which the items with the largest percentages of increase are those relating to motors and telephones; while insulated wires and cables being necessary to every branch of the business, except wireless telegraphy, show an equivalent great gain, sharing also in the activity of both fields in particular. The contrast between telephony and telegraphy is most striking and actually pathetic. It has even been claimed that Chicago alone produced $20,000,000 of telephonic apparatus in 1902, but that statement cannot be substantiated. As to storage batteries, it may be noted that the total product of the largest producer for 1901 was $3,300,000; but the demand for automobile cells can hardly have been as large in 1902. However, the battery figure is decidedly conservative, as the fact just mentioned will indicate.

It will be readily understood, of course, that the output of apparatus does not reveal the whole scope of electrical industrial advance. That is but one part of the story. Upon this apparatus depends the creation of new lighting plants, street railways, telephone exchanges, etc., out of which springs a vast capitalization, based upon real estate, pole lines, tracks, franchises, etc. as well as upon equipment. The increase in street railway capital obligations for 1901-2 reached no less than $475,000,000, not estimated, but actual. No such data exists for electric lighting, but the capital in that branch easily increased $150,000,000, while it has been reckoned that the telephone art should be credited with at least $100,000,000 all told, for the year. Here we have for three branches of electricity alone close upon $750,000,000 added to the national development and investment. Moreover, while some lines of development may be less active or inert, as, for example, electric automobiles, newer ones are very busy and progressive. Such a case is that of wireless telegraphy. Another is telpherage, of which an increasing number of systems for aerial motor transportation along wires of freight, raw material, ashes, etc., are being installed. Then, again, electro-chemistry and electro metallurgy are undergoing enormous advance, whether in such old departments as refining copper or in such new ones as making graphite or obtaining nitrogen from the atmosphere.

As to export trade in 1902, there is every evidence that it was excellent, and our weekly figures may be referred to as demonstrating a steady demand all over the world. It appears that during the ten months ending October, 1902, the value of electrical instruments exported was $3,446,966 as compared with $1,322,034 in 1901. That is a very healthy showing. Of electrical machinery in the same period there was exported $2,586,754, as against $2,081,820. This again is satisfactory, and it goes without saying that such a trade is worthy of very careful and assiduous cultivation.

THE CHICAGO TRANSPORTATION PROBLEM.

The chairman of the Committee on Local Transportation of the Chicago City Council has made public a synopsis of the report of Mr. Bion J. Arnold on the Chicago urban transportation problem, a reprint of which will appear in our issue of next week. The report fully justifies the confidence placed in the engineering ability and judgment of Mr. Arnold by those who selected him for the task of devising a remedy for the intolerable transportation situation now existing in Chicago. As might have been anticipated, no remedy is offered involving radical measures, the recommendations being for gradual ameliorations, and a choice of several plans is offered. The necessity of taking into account local conditions naturally renders a considerable part of the report of merely local interest. Of the broader aspects of the question, the principle of a single fare for a city ride is unreservedly recommended, and a choice is presented between two underground systems, one involving the use of low-level tunnels—for which preference is expressed—and the other contemplating high-level subways. Either of the above plans forms part of a general one which comprises all of the present lines within the city limits, with such extensions and new lines as are necessary to form a unified, combined surface and subway system entirely adequate to the present needs of Chicago, and admitting of expansion to meet future needs. Within the thickly inhabited part of the city the recommendation is that the cable and overhead trolley systems be superseded by the slot conduit system; the use of the overhead trolley elsewhere is disposed of with the remark that is an esthetic and not engineering question. The estimated cost of the entire system, including the value of present lines on the basis of their construction anew at the present time, is $90,000,000 with deep-level tunnels, and $5,000,000 less with subways. The report makes no recommendations as to municipal operation or ownership, but offers in several connections alternate plans for the present condition of divisional ownership and operation, for joint use of tracks under divisional ownership, and for unified ownership and management.

SYNCHRONOUS IMPEDANCE AND STANDSTILL IMPEDANCE.

The article on page 13 by Messrs. Townsend, Freund and Reich describes some measurements showing the difference between the synchronous impedance and the impedance at standstill, of certain alternators. In the case of direct current generators, driven at constant speed, the fall in voltage at machine terminals which occurs under load, is almost entirely due to the armature resistance. The fall is, for all practical purposes, simply an IR voltage drop; where I is the current strength in amperes delivered by the generator, and R the total resistance in ohms of armature winding, brushes, series field and connections. In the case of alternators, either single-phase or polyphase, the drop of pressure at terminals under load, is considerably greater than that due to the resistance, r, of the armature. It is, however, such a drop as would be approximately accounted for by attributing a certain impedance, z, in ohms, to the armature and its connections. This equivalent impedance is commonly called the synchronous impedance of the generator.

The synchronous impedance contains a resistance, r, and a reactance, x. The reactance is so much greater than the resistance that the latter may usually be ignored, and the drop in the alternator, at constant speed, may then be approximately attributed to the synchronous reactance, The synchronous reactance, x, may, in its turn, be regarded as the product of an inductance, L, and the angular velocity, a, or 2 times the frequency. This virtual inductance of the alternator is sometimes called the synchronous inductance. The synchronous inductance of an alternator, or the inductance it appears to have when running at constant speed, in order to account for the terminal drop of pressure under load, is not the same as the inductance of the armature at rest; or the inductance it possesses, regarded as a choking coil, when at standstill, and traversed by an alternating current from an external source. If we call the inductance of the armature as measured under those conditions, its true inductance, then the synchronous inductance is always greater than the true inductance.

The true inductance of an alternator armature is not a rigidly definite quantity. The inductance of a coil of insulated copper wire, devoid of an iron core, is a fairly definite and accurately measurable quantity. The inductance of an alternator armature varies, however, with the angular position of the armature with respect to the field. It is, therefore, a cyclically varying quantity in regard to the revolution of the armature. It also varies to some extent with the strength of the current by which it is measured. Nevertheless, a mean value of the true inductance can be determined with a limited degree of precision. The synchronous inductance is always greater than this true inductance. The principal reason for the discrepancy between the apparent inductance of the armature at synchronous speed, or synchronous inductance, and the true inductance, is due to the armature reaction on the field; whereby the m.m.f. of the armature coils oppose the m.m.f. of the field coils and reduce the total excitation. The reduction in excitation produces a drop in voltage over and above that due to the true inductance. The synchronous inductance of an alternator may, therefore, to a first approximation, be regarded as the sum of the true mean inductance of the armature, as measurable at standstill, and a spurious or virtual inductance of demagnetization, or armature reaction on the field.

The measurements of Messrs. Townsend, Freund and Reich are shown to have been made for the purpose of determining, in the case of certain particular alternators, what share of the terminal drop of pressure under load was attributable to the true mean inductance as measured at standstill. They show, among other things, that the terminal drop in a machine at the very low power-factor of 40 per cent., would be rather more than twice as great as the true inductance would account for. That is to say, the particular 5-mw, three-phase alternator at full rated mv-amps and 40 per cent. power-factor would have an inherent regulation of about 25 per cent., or would have a terminal drop of pressure under constant speed and excitation of 25 %; whereas the drop in pressure attributable to true mean inductance would not be more than 10 per cent. The extra drop of pressure would be, therefore, mainly attributable to armature reaction. Among the points of interest elicited by the measurements is the diminution in the true inductance of the armature by the excitation of the field magnets. This brings about an approach to saturation in the magnetic circuit and diminishes the flux established by the armature current, and therefore, the armature inductance.

THE OUTLOOK.

Aside from Marconi's great accomplishment of transatlantic wireless telegraphy—which was somewhat discounted, however, by the celebrated letter "S" message of a year previous—the past year has witnessed no radical developments in the department of electricity. There has, however, been a steady and solid advance in almost every branch, and lines along which future development will proceed have been more clearly marked. In electrical science the period has been one of patient investigation of the kind that does not bring great fame, but which furnishes the invaluable material for future generalization. The most promising work with respect to probable future results has been in the fields of radioactivity and electrochemistry and in connection with the ionic and corpuscular theories. We have perhaps nearly reached the moment for the appearance of a great generalizing mind that will illuminate the existing darkness of fundamental electrical theory, which has become more and more obscured to the student by the introduction of concepts bearing a likeness to the fluid hypotheses of the eighteenth century, and the speculative theories as to matter of the Greek and Roman philosophers. The task set is indeed a difficult one and comes within the sphere of physical chemistry rather than that of electricity. The solution, moreover, will be one of general application to many branches of science. In fact, we appear to have reached a stage at which the ultimate problems of the various branches of science are becoming more and more nearly related, and their nature is such that almost all can be brought into the jurisdiction of the new department of physical chemistry, there to be considered by workers of a special training and not narrowed to the knowledge of any one branch.

In the industrial branches, the new year starts with a number of tendencies more or less marked. In electric lighting the alternating current will soon reign supreme, the foothold given it in large cities for transmission purposes having been a deadly stroke at the direct current. There is much promise that the work now being done in Europe in connection with self-starting, single-phase motors, such as the Heyland motor, will soon have successful results, and then we may expect to see the direct current relegated ultimately to electrochemical work. The recent introduction in Chicago of polyphase transformers is probably the first step toward the abandonment of multiple single-phase transformers in polyphase circuits—a much wished-for consummation. In arc lighting the enclosed arc begins the year absolute victor over the open arc, but with a new foe coming into sight—the flaming arc from composite carbons. The Nernst lamp has definitely established its claims to consideration as a factor in electric lighting, and the vapor lamp looms in the future with an evil portent for the filament incandescent lamp, which, for years remaining practically stationary in development, is handicapped by the law of progress that what does not advance, recedes. From both the commercial and engineering standpoints, the most interesting development in the central station field promises to be a great extension of district electrical supply. With 12,000 volts as practicable a pressure as 1,000 volts five years ago, it is somewhat surprising that the movement has not been more rapid toward the replacement of numerous small and struggling central stations by a single generating plant with sub-station supply to the former local circuits. Within the past year descriptions of several such systems have appeared in our columns—in one instance the supply of 35 towns from one generating plant. The engineering is so simple, and the promise of financial return so excellent, that a general reconstruction of central station supply along these lines cannot long be deferred. In the field proper of power transmission, the new year opens with 40,000 volts as conservative practice and a range of operation over a distance of more than 200 miles. It is not likely, however, that water power transmission can continue to count on unrestricted development and extension. The older steam engineers have given the water wheel a wide berth, but with the advent to its ranks of a younger generation educated in the same school as those who now dominate in every branch of the electrical industry, and to whom this industry owes its militant vigor, we may expect that the possibilities of the steam engine plant for power transmission generation will not remain much longer untried. This prediction can be made with less hazard in view of the entry as factors of the steam turbine and the forces connected therewith.

Even less than a year ago alternating-current traction was under a strict taboo in this country, yet the present year will witness the trial of three such systems—the Arnold in Michigan, the Lamme in Maryland, and the Ward Leonard-Oerlikon in Switzerland, each of these, moreover, involving the use of single-phase current. Should the trials prove successful—or even any one of them—some engineering reputations will be smirched, but interurban traction will be revolutionized, an enormous impetus given toward the electrification of the shorter steam railroads of the country and even electric trunk service rendered a possibility. Telephony during the past year has continued to benefit from the reawakening brought about by the independent movement, the result showing in improvements in detail in every part of the art and in its engineering. A recent test of the Pupin system in Germany furnished for the first time public data as to its practical merits, which data fully confirm the claims made for the system. It is to be hoped that the owners of the American patents will soon see fit to allow the public to share in the benefit which the German experiments showed may be derived from the application of the invention. Aside from the purely commercial achievement of a Pacific cable, telegraphy as practised has remained at a standstill, and it promises no advance in the present year or in the years after if it remains dependent on those who now control the situation. There has, however, been no slackening in invention, notwithstanding the almost hopelessness of proximate reward. As a consequence, when the telegraphic sleep of a half century or more has its inevitable awakening, there will be no lack of material upon which to base a complete reorganization. Another branch that has lagged is that of electric automobilism, which is equivalent to saying that the long-sought-for radical improvement in light-weight storage batteries has not yet materialized. The promise of an Edison battery is still held forth, and it is reasonable to expect that with the expiration in March of the controlling Brush patent a brighter situation will exist, not only with respect to further inventions, but in the utilization of some of the many hundreds that have rested under the ban of the Brush patent. Transatlantic wireless telegraphy having been proved a possibility, it is now on the eve of the commercial stage, and with a commercial future very difficult to forecast. The next step is that of syntonic wireless telegraphy, which involves a stride even greater than that of transatlantic telegraphy for its practical accomplishment.

Landing the American End of the Commercial Pacific Cable.

One of the most interesting and important events in electrical history during 1902 was the virtual completion of the California-Honolulu section of the Commercial Pacific Cable, and the landing the shore end last month at San Francisco. It is somewhat singular that just fifty years should have passed in ocean telegraphy before the plans to cable the Pacific were pushed to a conclusion; and not less singular that Americans and Englishmen have been engaged in a generous rivalry thus to complete the submarine cable girdle around the earth. While it was to be expected that England, with her vast colonies and dependencies, would insist on having actually or virtually a system of her own, it was not less apparent that American ambitions in regard to the Far East would be unsatisfied unless a cable system also started from the California shore stretching away to the Sandwich Islands, the Philippines, and other Asian points of deep interest to us. Through the energy and enterprise of the Pacific Commercial Cable Company, American hopes have now been realized, and we now illustrate on this page the scene of the landing of the shore end of their cable at San Francisco, on Sunday, December 14, in the presence of an enthusiastic crowd of 30,000 or 40,000 people.

The point selected for the landing of the cable lies about half a mile south of the famous Cliff House, which can be easily seen on the right background of the scene. From this landing place seven miles of underground conduit carry the cable and other wires to the offices of the company in San Francisco. Among those present on the occasion were President Clarence Mackay and Vice-President George G. Ward, the latter of whom can easily be picked out in the engraving by his tall, lithe figure and active participation in what is going forward. Governor Sage, of California; Mayor Schmitz, of San Francisco, and a number of distinguished citizens also assisted at the function. An address was delivered by the Governor, and his daughter, Lucille, christened the splice.

Landing Shore End of Pacific Commercial Cable, Near San Francisco.

During a reception at the Palace Hotel in honor of Clarence H. Mackay and others of the management of the Commercial Cable Company, Governor Gage represented the State, and Mayor Schmitz was present on behalf of the municipality. Mr. G. G. Ward said: "The length of this cable will be three and one-half times greater than any Atlantic cable. When this shall be completed our system will reach from England and France to China, three-fourths of the distance around the globe, and I venture to predict that we shall be able to beat 'Puck's' prophecy of girdling the earth in forty minutes by sending a message from San Francisco to San Francisco in one-fourth of that time." Meantime the "Silvertown," which started with about 2,200 miles of cable, laying it across an ocean nearly three miles deep, has proceeded with her task, completing the first great section to Honolulu.

The Philippine section is expected to be complete early in 1904. The Hawaiian landing is on the island of Oahu, with direct connection to Honolulu, where an office has already been prepared. It may be noted that in his recent presidential message to Congress, President Roosevelt alluded to the contract and conditions between the Government and the Pacific Commercial Cable Company, under which "an all-American line between our Pacific Coast and the Chinese Empire, by way of Honolulu and the Philippine Islands, is thus provided for." The cost of the first section to Honolulu is put at $2,250,000. Messages to that point will cost 50 cents a word for the first two years and 35 cents afterwards.

◆

Wireless New Year Greetings Across the Atlantic.

Wireless dispatches have been received, containing Christmas and New Year greetings, in Italy from Mr. Marconi, who, at Glace Bay, sent his compliments to the Italian Minister of Marine, Vice-Admiral Morin, and to the mayors of Rome, Florence, Milan and Bologna. Among the distinguished persons who have received messages are the Queen of Italy, Empress Eugenie, Sir John Lane, and Heniker Heaton.

The storms and gales of the past two months, Marconi stated, had no effect whatever on the transmission of messages. Referring to the commercial future of wireless telegraphy, he said that he expects to be ready for commercial business between Cape Cod and Table Head within a very few months. As to rates, it is expected to transmit cheaper than is called for in the contract, which specifies ten cents a word for ordinary and five cents a word for press messages. The distance from Cape Cod to Cornwall is about 600 miles greater than from Table Head to Cornwall, but Mr. Marconi has no doubt of success. "I never doubted the practicability of my undertaking after my achievement at St. John's, Newfoundland, last winter, but on November 9th, when the *Carlo Alberto* arrived in Sydney and I first visited the Table Head station, I received full confirmation of my hope, for on entering the power house I heard ticks from the receiver, three faint dots signifying the letter 'S.'

"This signal was repeated and was louder the second time. This was the signal I had agreed on with my operator at Cornwall, and it assured me of the success of the Table Head station, for as the Morse code is made up of dots and dashes, and as it is just as easy to receive a dash as a dot, it would have been as easy at that time to receive a message. My work between that day and last Sunday was chiefly installing new machinery and making improvements and strengthening signals."

In concluding Marconi stated that he expected that wireless communication would be established with South Africa soon after a station there was opened for communication. This will give the Marconi Wireless Telegraph Company communication with all parts of the world. A banquet was given to Marconi by the citizens of Sydney on December 30.

The First Three-Phase Power Transmission Plant in Europe Operating at 30,000 Volts.

By Dr. H. Behn-Eschenburg.

There has been in uninterrupted operation for the past two years, at 30,000 volts, the power transmission line of the Machienenfabrik Oerlikon, between Hochfelden and Oerlikon, which is the first installation of its kind in Europe, and was operated at 15,000 volts between the years 1891 and 1900. Now that this trial period has come to an end, it may be of interest to collect the valuable and unique experiences gained by the operation of this transmission, the first one in Europe using so high a pressure.

The total mean energy, delivered by the primary stations at Hochfelden and Glattfelden, working in parallel, is 550 k.v.a., with a power factor of 0.85. The power station at Glattfelden is located about 2 km from the Hochfelden station and furnishes about 120 k.v.a. at 5,000 volts to Hochfelden, where the current is raised to 30,000 volts and is connected in parallel with the current generated at Hochfelden. The exciters of the Glattfelden generators are regulated at Hochfelden.

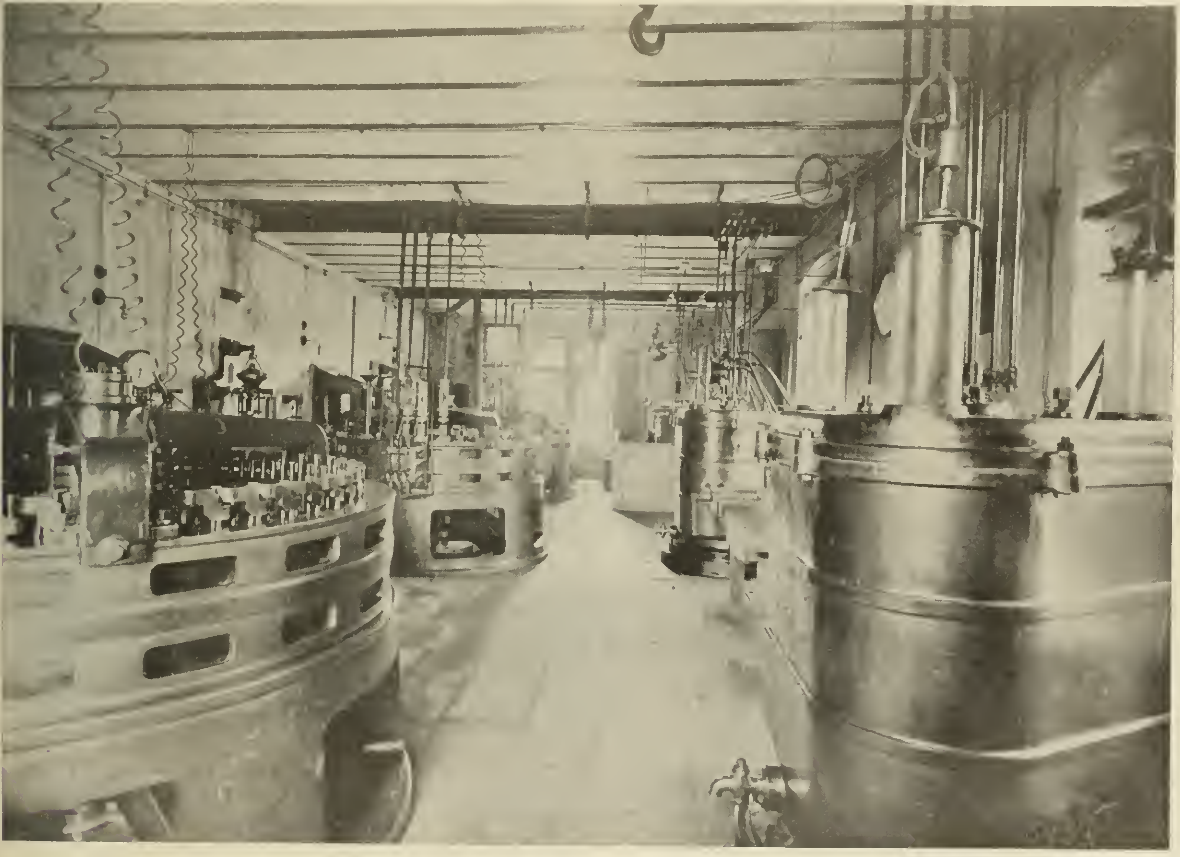

Fig. 1.—Interior View of Hochfelden Station.

The Hochfelden station, Fig. 1, contains three turbines connected to three generators of the "Lauffen" type of the Oerlikon Company, constructed in the year 1891. Each machine has a capacity of 1,200 amperes at 100 volts, at a speed of 187 r.p.m. and 50 periods. Each machine is direct-connected to a three-phase transformer of the same type as those shown at the Frankfurt exhibition in 1892 for the Lauffen-Frankfurt transmission line which has been frequently described. The transformation ratio of each transformer is 1 : 154. During normal running of the plant two generators and two transformers are operated. The high-tension winding of the one transformer is connected in star fashion, while the high-tension coils of the other transformer are separated for each phase and connected in series with the coils of the first transformer.

These transformers are, as is well known, standing in cast iron casings filled with oil. The oil is continually pumped into and out of the casings by means of a pump, being cooled during this operation by passing through coils surrounded by running cold water. The transformer which transforms the current delivered by the Glattfelden station, is an ordinary air-cooled transformer with a ratio of 1 : 6, transforming the voltage from 5,000 to 30,000. The neutral wire of the low-pressure winding is connected to the water pipes.

The line consists of four copper wires 4 mm in diameter, which are suspended about 50 cm apart on 260 poles from 8 to 10 m above the ground. Only three wires are in actual service. The resistance of one wire is 31 ohms. About 1.5 m below these wires, on the same poles, the two telephone wires (going and return), connecting the primary and secondary stations, are suspended. These two wires are crossed about 20 times along the entire distance. During the operation of the line no difficulty is experienced in carrying on a telephone communication. In case there is any fault in the insulation of the high-tension line or the telephone wires, the bells of the telephone are automatically operated on account of the disturbance in the symmetry of the electrostatic distribution and in this way the telephone is of service in case there are such defects. At the beginning, end and in the middle of the line, there have been placed for the past three years three Siemens lightning arresters (of the horn type) having a striking distance of 55 mm. These horns are operated almost every time there is a thunderstorm in the vicinity of the line, without ever having caused any interruption in the service. In fact for several years there has never been a decided service interruption, regardless of the fact that the line is run along the banks of a river and is exposed to frequent lightning discharges. There are an average of about 50 such occurrences, which strike the line, in one year. Since the plant was started no part of the transformers has ever been damaged by lightning. This certainly proves the great efficacy of high-tension lines with transformers inserted between generator and line. The much higher pressure which can be obtained by this arrangement when compared with the direct generator production, can in many cases equalize the extra cost of the transformers on account of the saving in line copper. In general this will also cause a reduction in the cost of generators, for the generator pressure may be selected at will, especially when bar winding can be employed.

The line is connected to the transformers in the primary station by fuse wire 1 m in length and freely suspended in the air. Formerly lightning rod points with copper leads were attached to each pole. Frequently during a thunderstorm lightning would strike across from the insulator support to lightning rod lead and the pole would be burnt. Two years ago all the lightning rods were removed. The 800 line insulators are of different types. About 100 of them are of the large Delta bell type, with an external rim diameter of 25 cm; there are 300 white porcelain insulators, like those used on the Lauffen Frankfurt line; also 200 brown insulators of the same dimensions and 200 smaller plate-shaped insulators. The various types are shown in Fig. 2, the three smallest ones being used for interior wiring in the stations.

The secondary station may be cut out of service at full load by means of a high pressure switch without the production of a spark. The switch is shown in Fig. 3 and is of the well-known type introduced by the Oerlikon Company in 1807. The spark distances are spanned by tubes. To prove the utility of this switch it may be stated that at 3,500 hp the three-phase circuit at 3,800 volts pressure may be opened without the least disturbance.

In the secondary station the line current is transformed from 30,000 to 230 volts. Up to about a year ago the transformation took place in four transformers of the 1891 type, similar to those in the primary station, two being connected in series on the high-tension side. The oil was circulated through water-cooled coils of pipe outside of the transformer by means of a pump. During the past year the old transformers have been replaced by 3 single-phase transformers of 150-k.v.a. capacity each, which have been connected in triangle fashion on the high and low-tension sides. These transformers, shown in Fig. 4, are also placed in oil, the latter being cooled, however, by being circulated through water-cooled coils within the transformers themselves. Without the water cooling the temperature rise at a 100-k.v.a. load is 35° C. Within a short time the transformers in the primary station will be replaced by a modern three-phase transformer of 450 k.v.a capacity with artificial air-cooling attachment. The new transformers shown in Figs. 5 and 6 are so wound and insulated that the same may be cut into and out of the circuit at 50,000 volts and tests made at this pressure. The difference between the old and new transformers gives a striking picture of the progress made in transformer design during the past decade. The following comparative table may, therefore, be of interest, but it should be remarked that the new transformers were built mainly with the intention to economize space and not to attain the highest efficiency. The efficiency of ordinary transformers of this size is between 98 and 98.6 per cent.

	Old type.	New type.	New type.
Capacity	200 k.a.v.	150 k.v.a.	450 k.v.a.
Total weight	4700 kg.	2200 kg.	3800 kg.
Copper weight	1540 kg.	200 kg.	450 kg.
Sheet iron weight	900 kg.	680 kg.	*2500 kg.
Oil weight	500 kg.	650 kg.	...
Oil tub weight	1700 kg.	560 kg.	...
Efficiency	97%	97.2%	97.6%
Iron loss	3400	2200	6500
Copper loss (measured at short circuit	3000	2000	4800
Maximum drop of pressure	17%	3%	3%

* The high sheet iron loss is due to the employment of standard size sheets intended for greater capacities.

The low-tension terminals of the secondary transformers are connected to busbars in parallel with the leads from a 600-kw generator, direct-connected to a Sulzer steam engine, making 97 r.p.m. The generator, Fig. 9, has an externally revolving field ring, with 64 poles and coils, which also serves as a fly-wheel and driving wheel around which the ropes pass. The efficiency of the generator is 95 per cent. The ropes are connected to two direct-current generators, producing current for lighting. In order to insure an efficient parallel working of the current delivered by the line and that of the generator, the construction of the latter had to be such as to permit of a comparatively large drop of pressure of the generator current, as the total variation of pressure of the transmission between no load and full load is about 100 per cent. Without any variation in the speed of the turbines and generator excitation, the pressure at the low-tension terminals in the secondary station was twice as great at no load as at full load, as long as the old transformers were in operation in the two stations. With the new transformers the variation in pressure will be about 30 per cent. less. The generator, coupled to the steam engine, has a pressure variation of 40 per cent between an inductive full load and no load. The paralleling works without difficulties under these conditions. The pressure regulation is extremely simple, because neither the generator excitation nor the speed of the turbines need be regulated in the primary station, the only thing regulated being the shunt current of one of the steam engine driven exciters by means of an automatic Tury type pressure regulator. Although the three-phase current at the busbars is supplied to about 200 asynchronous motors in the factory, 60 of which are for crane operation, the pressure is kept within ± 2 per cent of the normal within 10 seconds, by means of the automatic regulator placed in the shunt circuit of the exciter. As the motors were nearly all installed about 5 to 10 years ago, their power factor is comparatively small, being on an average about 0.5. The total power factor of the transmission is raised to about 0.8 by means of 3 larger synchronous motors with a total capacity of about 400 k.v.a., which are overexcited, and can furnish a considerable leading current component. It is remarkable that these synchronous motors only get out of step during only about one third of the lightning storms which strike the line and were referred to above.

The excellent pressure regulation, which has been accomplished here under the most favorable conditions, in an antiquated station with very poor internal pressure regulation, by means of a simpler automatic regulator, which can, without any difficulty, be connected to each exciter and generator, and the operation of which is independent of the speed, phase-shifting and load variations, appears to be far superior to all systems of compounding of alternators, which require complicated exciter connections or commutator devices, and which naturally cannot keep the terminal pressure constant, but can only react on the regulation of certain magnetic fields, when the load variation is comparatively small. The automatic regulator, which consists essentially of a pressure relay, can be over- or under-compounded at will, the relay itself also being provided with a suitable compound winding. Having now described the most interesting features of the installation, a few results of experiences and tests with this high pressure may be of interest.

When the operation with the 30,000-volt pressure was started in the summer of 1900, a large number of the smaller insulators on the line had to be gradually replaced, which, while they were satisfactory during all weather conditions with the former pressure of 15,000 volts, and even during clear weather at 30,000 volts, caused frequent short circuits at 30,000 volts, during rain and wet snowstorms, although only few of the insulators were actually destroyed. At first the operation could only be continued during inclement weather by paralleling the transformers, which were operated at 15,000 volts. The possibility of such an arrangement may be of great value for the uninterrupted operation of high-tension installations. After all the suspicious insulators had been replaced, the new transformers, which were wound for a maximum pressure of 50,000 volts, were placed in service, and it is now no longer necessary nor desired to reduce the pressure to 15,000 volts. Before the 30,000 volts service was started a series of experiments were undertaken, which were to determine the influence of the charging current on the pressure and current conditions of the installation and all extraordinary losses on the line. These effects are most pronounced at no load, when only the magnetizing currents of the transformers and the charging currents of the line are brought into action. It is to be pointed out that comparatively large pressure variations in the generators and transformers, referred to above, without doubt increase the effect of the line capacity and the danger of an increase in the pressure to a certain degree. Three series of tests at no load were made; in the first only two transformers in the primary station were operated by one generator without connecting the line; in the second the line was connected to the transformers, without including the transformers in the secondary station; in the third series the line and the four transformers in the secondary station were connected. Further tests were made at normal loads as well as with the original paralleling of the transformers operating the line at 15,000 volts and under about the same operating conditions and about the same water supply to the turbines with the transformers connected in series and a line pressure of 30,000 volts. In columns 4 and 5 of the table several mean values of the results of these tests are given. These figures are not very accurate, on account of the unavoidable load variations due to the factory motors. But they

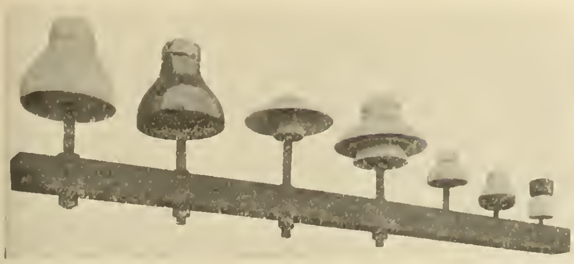

FIG. 2.—VARIOUS TYPES OF INSULATORS.

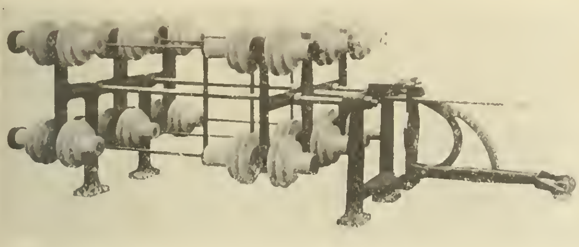

FIG. 3.—HIGH-TENSION SWITCH.

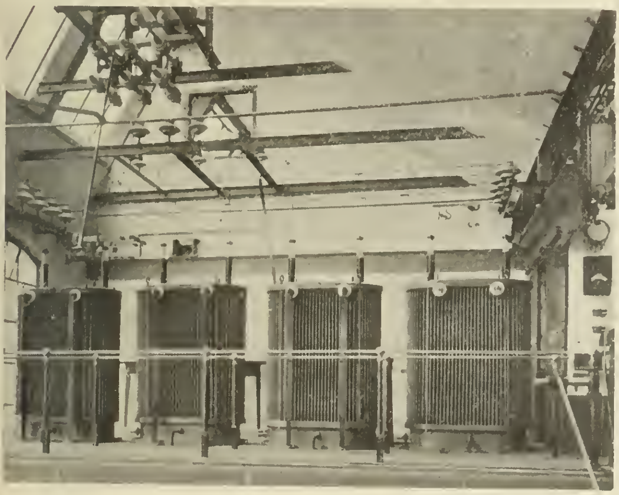

FIG. 4.—OIL-INSULATED WATER-COOLED TRANSFORMERS.

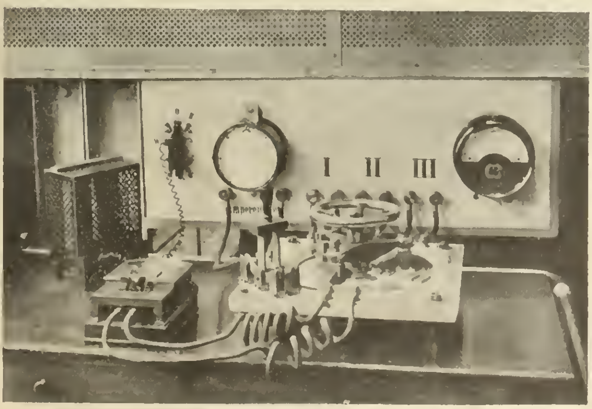

FIG. 7.—SPECIAL SWITCHBOARD AND TESTING SET.

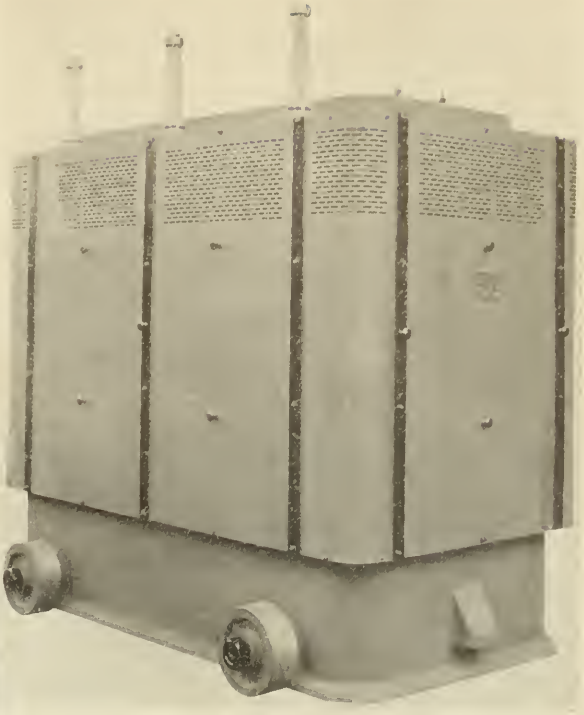

FIG. 5.—VIEW OF A THREE-PHASE TRANSFORMER.

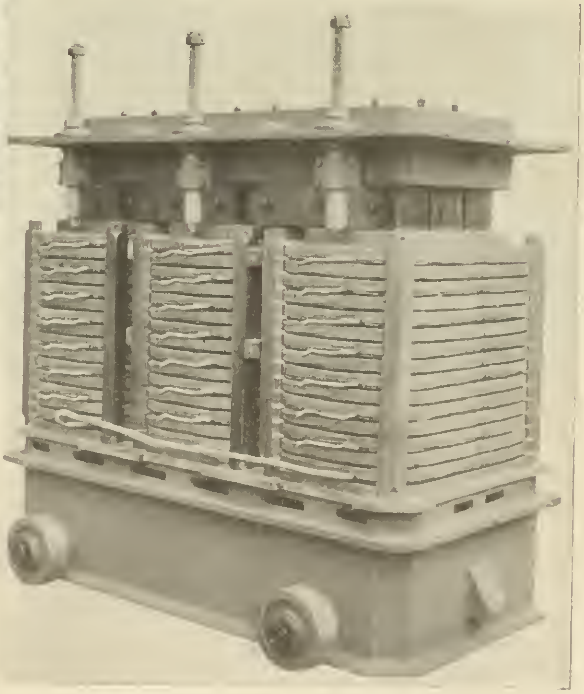

FIG. 6.—COILS OF THREE-PHASE TRANSFORMER.

FIRST EUROPEAN 30,000-VOLT TRANSMISSION PLANT.

show, nevertheless, that at full load the effect of the line capacity is no longer distinctly discernible, and that the only effect which can be noticed is the decreased conductivity loss at 30,000 volts, as compared with 15,000 volts. These experiments will shortly be repeated with an artificial, non-variable load.

In conclusion, the final results of this series of tests are given. The letters refer to the following: Generator speed N, exciter current in amperes e, combined pressure in volts E_1, current in amperes J_1, kilowatts W_1, cos ϕ_1; current strength at beginning of line J_1 and at end of line J_2, also the tertiary low pressure E_3, and the tertiary current J_3, the watt delivery W_3 cos ϕ_3 of the transformers in the secondary station.

Series	N	e	E_1	J_1	W_1	cos ϕ_1	J_1	J_2	E_3	J_3	W_3	cos ϕ_3
[illegible]	[illegible]	[illegible]	[illegible]	25	[illegible]	[illegible]	[illegible]	..				
	[illegible]	[illegible]	[illegible]	40	[illegible]	[illegible]	–	[illegible]				
	[illegible]	[illegible]	[illegible]	48	3.6	0.66						
	[illegible]	[illegible]	[illegible]	53	5.4	0.71	...	[illegible]				
	[illegible]	[illegible]	[illegible]	68	7.0	0.61	..					
	[illegible]	[illegible]	[illegible]	80	9.2	0.57	..					
2	[illegible]	[illegible]	[illegible]	115	0.54	0.13	0.25					
	[illegible]	[illegible]	[illegible]	140	0.9	0.11	0.4	[illegible]				
	[illegible]	[illegible]	[illegible]	200	[illegible]	0.13	0.6	.				
	[illegible]	[illegible]	[illegible]	265	4.3	0.14	0.8	[illegible]				
	[illegible]	1	83	331	7.5	0.16	0.9	[illegible]				
	[illegible]	1	99	382	11.7	0.18	1.25					
	[illegible]	[illegible]	116	449	16.4	0.18	1.45					
3	[illegible]	[illegible]	[illegible]	110	5.4	0.82	0.2		[illegible]			
	[illegible]	[illegible]	[illegible]	210	15.3	0.60	0.6		[illegible]			
	190	3.0	[illegible]	312	32.6	0.57	0.85	.	339	....	...	...
4	190	23.7	100	3200	...	...	18.5	20	233	1010	315	0.77
5	190	23.6	100	3220	...	...	9.6	10	242	1100	375	0.81

1. Series 1 and 2 reveal the important fact by observing the difference in watt losses; that the loss on the line rapidly increases as the pressure is increased, being 1 kw at 20,000 volts, 4 kw at 30,000 volts, 10 kw at 40,000 volts. How much this loss may be reduced by increasing the size of the insulators, has not yet been determined by experiments.

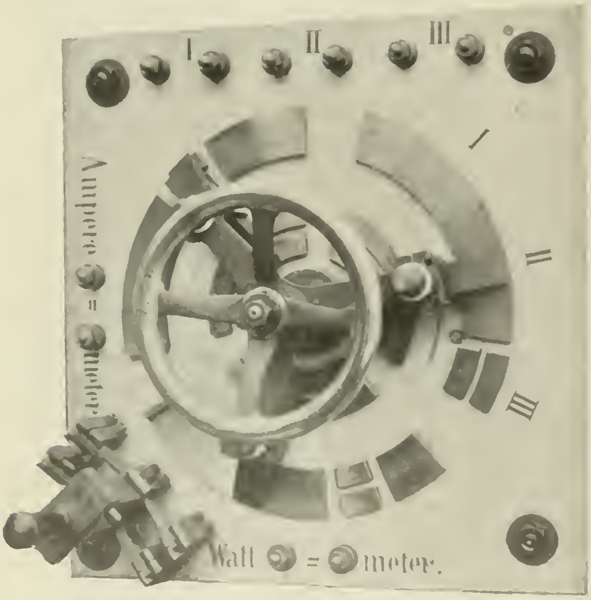

FIG. 8.—FRONT OF SPECIAL SWITCHBOARD.

2. The charging current of the line, shown in column 2, agrees with the calculated current, when the capacity C of one phase of the line condenser is calculated by the well-known formula,

$$C = \frac{l \cdot 10^{-5}}{18 \; log. \; nat. \frac{d}{r}} = Microfarad,$$

in which d is the distance between wires, l the length of the wires in cm, and r the radius of the wire in cm. Making $l = 22.10^5$, $d = 50$, $r = 0.2$, then

$$C = \frac{22}{18 \; log. \; nat. \; 250} = 0.22 \; Microfarad.$$

From this the current, J_2, at the pressure E_2 and 50 periods is:

$$J_2 = \frac{E_2}{\frac{1}{\omega C}} = E_2 \cdot 2\pi \cdot 50 \cdot 0.22 \cdot 10^{-6} = 69 \; E_2 \cdot 10^{-6}.$$

The line pressure, E_2, must be calculated from the primary low pressure, E_1, of the transformers according to the transformation ratio of the transformers connected in series, which is 1 : (2 × 154). In consequence of the negative phase difference between the charging current strength and the pressure, there is an increase of pressure in the transformers. This increase was determined by a separate series of tests with the aid of a test transformer. In the third series of the tests, in which the line pressure may be determined from the tertiary pressure, E_3, in the secondary station, according to the transformer ratio at that place, i. e. (2 × 33.6), there is a pressure increase in the primary transformers due to the charging current alone, up to 12 per cent. of the primary pressure. In series 2, therefore, the line pressure, $E_2 = 1.1 \times 308 \; E_1$. For $E_1 = 100$, $E_2 = 34,000$. J_2 was observed as 1.25 amperes, and was calculated by the above formula to be $J_2 = 1.36$ amperes. Series 1, 2 and 3 clearly show the effect of the negative phase difference between charging current and pressure on the magnetic field of the generator, as for the same generator pressure in series 2 and 3 a much smaller exciter current was required. The generator pressure in series 2 was for the same excitation as that in series 1, from 1.5 to 2 times as great. The extent of this value naturally depends primarily upon the pressure variations of the generators when loaded and upon the relation between the charging current to the normal load current of the generators, which was very unfavorable in these no-load tests in which only one generator was used for charging. Series 3 clearly shows the magnetizing current of the transformers has the opposite direction from that of the charging current of the line, because in spite of the addition of the four transformers in the secondary station the total generator current, J_1, is smaller than in series 2, in which the line pressure was considered without the secondary station. This effect is also evidenced by the large difference between *cos* ϕ in the series 2 and 3. As the charging current at normal pressure is small in comparison with the normal line current at full load, it is to be expected that its effect cannot be observed at normal load conditions. Also the conductivity losses at the high pressure of 30,000 volts, which are shown in series 2 and 3, cannot be eliminated with certainty at normal loads. The ohmic resistance of the line is 31 ohms for one phase, the conductivity loss at 500 k.v.a. and 15,000 volts, is 37 kw and 9.3 kw, at 30,000 volts, so that, after deducting 3.5 kw, which are the losses due to discharges, etc., there is a gain of 24 kw in favor of 30,000 volts over 15,000 volts. The large difference of 375-315 kw in W_3 in series 4 and 5 was probably due to the fact that the service conditions were not exactly alike. The instruments used to determine currents J_1, J_3 and i are not very accurate, and the results are, therefore, not strictly correct. The main pressure was not increased from 15,000 to 30,000 for purely economic reasons, and it matters little to the Oerlikon Company how many kw more are now transmitted from Hochfelden to Oerlikon than formerly, but the object was to gain experiences and data with transmissions at very high pressures, in order to be able to undertake to install and guarantee with a commercial certainty installations operating at 30,000 volts.

The above-described investigations served to give a general survey of actual working conditions of this installation, but very soon effects were noticed which required an extension of the experiments. In testing a number of three-phase motors, which were connected to the line in the test room of the factory, it was noticed that there appeared very undesirable unsymmetry in the three phases. There is perhaps no more sensitive device for the detection of the smallest amount of deviation from symmetry in a multiphase system than an absolutely symmetrically wound induction motor operating without a load, and in which the watt and current consumption are measured in every phase. At the slightest disturbance of the symmetry, which no commercial instrument can detect, there is a decided difference in the watt consumption in the various phases of an empty running motor, which frequently even varies the sign, while, for example, the magnetizing current of the motor at rest with open rotor circuits is practically absolutely symmetrical. After all generators and transformers of the installation were found to be practically symmetrical alone and together at all pressures, because a connected empty running induction motor took the same energy and current in all three phases, it was shown that when the line was connected the energy consumed by the three phases of the motor began to vary, and the variation was greater at 30,000 volts than at 15,000 volts, and greater at no load on the installation than with a load. The unsymmetry of the line appears, furthermore, greater, the greater the drop of pressure of the generators and transformers to which the line is connected. It was greatest, for example, when the 30,000-volt line was connected to a generator and two transformers in the Hochfelden primary station connected in series, when the distributing circuits and the steam-driven dynamo in the Oerlikon secondary station were disconnected. An empty-running, 190-volt, three-phase motor, of a normal capacity of 12 hp, connected to the transformers, showed, during clear weather and at a combined pressure of 230 volts, the following results:

	Current.	Watts.
Phase I	10.7	—18
Phase II	6.5	+303
Phase III	11.6	+627
Total		912

Smaller motors showed similar results and preferably a small ½-hp controller motor was used. In testing the three-line wires, the charging current and watts were about the same in all three phases. The disturbance of the symmetry of the installation to which an empty-running motor was connected must, therefore, have been due to the unsymmetry of the line, which could not be detected with ordinary measuring instruments.

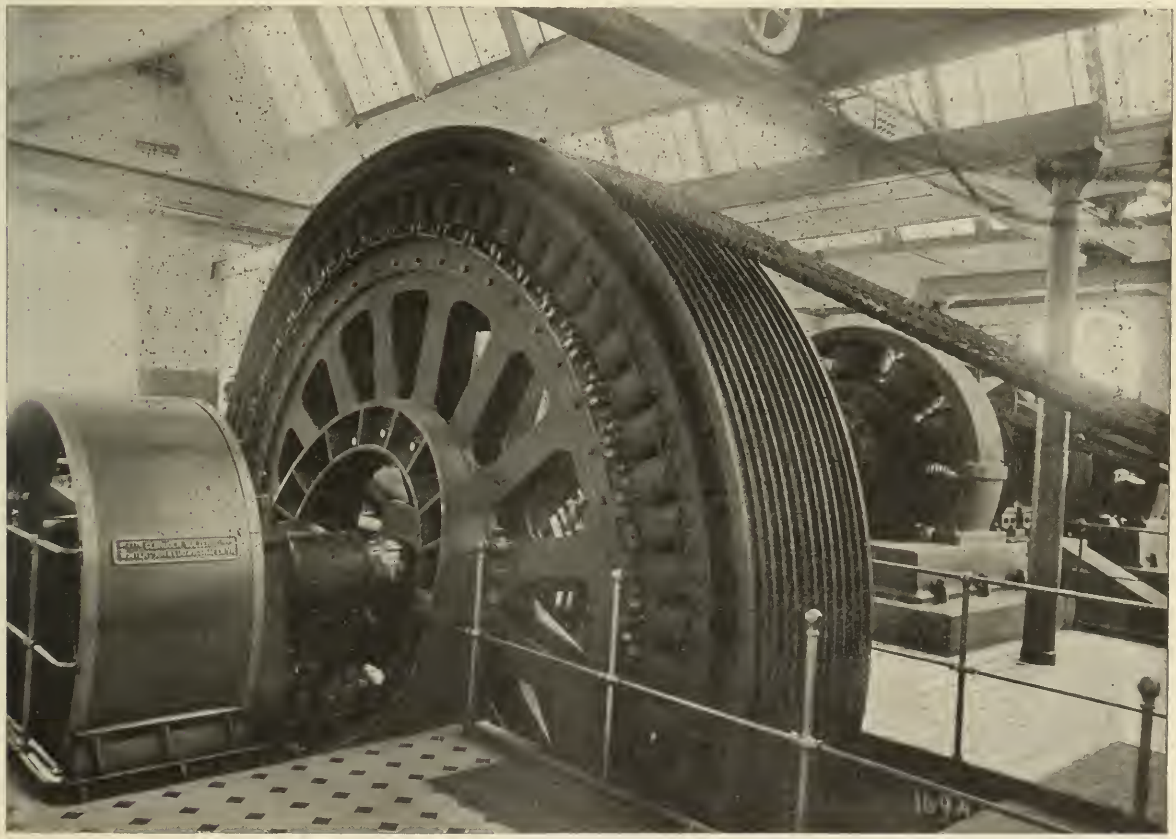

Fig. 9.—External Revolving-Field Generator, Rope-Driven.

As the three wires form the corners of a right-angle triangle, two wires being suspended horizontally next to each other, and the third one vertically below one of the upper wires, this disturbance of the symmetry could only be due to this unsymmetrical arrangement. It was finally shown that by exchanging the connections of two-line wires to the generator terminals, to which the motor was connected, the watts were changed in the phase in which the line wire was not changed, so that the difference in the motor phases could be varied at will by making various line-phase variations. The next step was to so suspend the three wires, that the line was divided into three sections of about the same length, and the three wires of any one section were connected to the wires in the adjoining one in cyclic order. The division into sections could not be carried out very perfectly for commercial reasons. After this change had been made, the same motor was tested under similar conditions, there being a rainfall in this case, and at a combined pressure of 230 volts, the following results were obtained:

	Current.	Watts.
Phase I	10.2	+417
Phase II	9.0	+138
Phase III	8.1	+360
Total		915

Comparing this table with the previous one, it is seen that there is a decided improvement in the symmetry. It should be stated again that the symmetry of the three phases, by connecting the same motor to the several generators and transformers without connecting the line, and also the symmetry of the motor at rest with open rotor circuit with the line connected, was absolutely accurate, as far as measuring instruments could determine it, and as the following tests will show, the insulation and capacity of the three-line wires measured by themselves showed no appreciable deviations. In the main pressure also no variations of the three phases could be detected with certainty.

From this the lesson may firstly be drawn that in testing three-phase motors the symmetry of the entire system should be carefully investigated, although the ordinary instruments may not indicate any disturbance. Tests to determine the extent of the various phase differences and the relation between these probably very small deviations and the behavior of the motor, have not been concluded.

Already during the preliminary tests there were noticed at times large variations in the data regarding the energy loss on the line, which led to a repetition of the experiments, until the relation of this energy loss to the weather conditions could be definitely determined. Finally a regular testing table was set up in the Oerlikon station, in order to test the line losses during the noon hour, when the power load was taken off. The steam-driven dynamo at Oerlikon, with the transformers in the secondary station, served as a source of current, the transformers at the Hochfelden primary station were taken out of the circuit, and then the energy consumption of the secondary transformers without the line was measured at different pressures, and then the same measurements were made with wattmeter and ammeter, with the line connected. The difference gives the various losses on the line, after the small ohmic losses have been deducted. As the line loss is generally but a small proportion of the transformer losses, the measurements must be made with great care, and above all the generator must be evenly regulated. The series coil of the wattmeter and the ammeter may be inserted into each phase without breaking the circuit by means of a special switch board, and the shunt coil can be inserted either between the neutral point of the generator and the various circuit phases or watt measurements by the two-wattmeter method, between two circuits. By means of a special switch the wattmeter reading may be reversed. This board is shown in Figs. 7 and 8. The watt measurement with or without line for each point may be made by the two wattmeter method and subsequently in each separate phase. In the following table the results of two sets of tests are given with the four old three-phase transformers, the first set having been made on February 4, 1902, during a light snow fall and a temperature of 1.5°, the second set on March 11, with a clear sky and a temperature of 5°, but after a night frost of —4°. The current was measured in the same circuit, in which the series coil of the wattmeter was located. The number of periods in each test was 50.

TEST ON FEBRUARY 4, 1902.

(Slight Snow Fall. Temp. +1.5°.)

Pressure 1000 volts ×			Current Amp.			Watt meter read'g			K.W. Total	Remarks
16.3	16.8	16.8	23	25	25	7.7	10.1	10.2	6	Dithout
20.3	20.3	20.3	30	30	30	14.1	15	14.9	8.8	line.
24.1	24.1	24.1	38	39	38	18.9	20	19.8	11.7	
26.6	26.6	26.6	41	43	43	22.3	24.9	24.9	14.4	Four old
28.6	28.6	28.6	43	47	47	26.2	28.7	28.8	16.7	transformers.
30.1	30.1	30.1	47	49.5	49.5	29.1	31.2	31	18.2	Wattmeter
32.4	32.4	32.4	49.5	51	50.5	32.7	35.1	34.7	20.4	constant:
33.5	33.5	33.5	50	52.5	52.5	34.5	37.1	36.8	21.6	200.
17.0	17	17	60	60	60	5.6	5.9	5.9	6.6	
19.6	19.6	19.6	75	76	77	7.3	8.1	8.6	9.6	With
23.8	23.8	23.8	103	104	104	11.2	12	12.1	14.2	line.
27.3	27.3	27.3	129	130	130	15	16.2	16.3	19	
29	29	29	143	144	145	16.8	18.2	18.5	21.4	Wattmeter
31	31	31	163	157	157	20	20.2	20.1	24.2	constant:
32.5	32.5	32.5	182	180	182	22.1	23.7	24	28	400.
33.8	33.8	33.8	194	195	196	23.8	25.7	25.9	30.4	

TEST ON MARCH 11, 1902.

(Cloudless Sky. Temp. + 5°. Preceded by Night Frost of —4°.)

Pressure 1000 Volt ×			Current Amp.			Wattmeter Read'g			K.W. Total	Remarks
I.	II.	III.	I.	II.	III.	I.	II.	III.		
12	12	12	18	18	18	4.9	5.6	5.4	3	Without
14.7	14.7	14.6	20	20	20	7.7	8	8	4.7	line.
17.3	17.3	17.2	23	23	24	10.8	11.4	11.3	6.6	
20.1	20.1	20.2	25	25	25	13	14.8	14.9	8.5	Four old
23.3	23.3	23.3	28	30	30	17.9	19.4	19.7	11.4	transform-
25.3	25.2	25.3	30	32	32	19 9	21.8	21.5	12.6	ers.
27	27	27	35	37	36	23.9	26	25.8	15.1	
28.6	28.6	28.6	40	42	42	26.2	28.3	28.2	16.5	
30.1	30.1	30.1	43	45	45	28.8	31	30.8	18.1	
32.2	32.2	32.3	47	49	49	31.8	34.5	34.5	20.2	
34.9	34.9	34.9	49	50	50	34.5	37.3	37.1	21.8	
13.4	13.4	13.3	30	38	38	7	7.8	7.3	4.4	With
14.7	14.7	14.7	43	45	44	8.4	9	9	5	line.
17.3	17.4	17.5	56	..	..	11.1	12.3	12.2	7.1	
20.8	20.8	20.9	72	75	76	15.4	16.9	17.8	10.1	
23.3	23.3	23.3	91	91	91	19	20.3	21.1	12	Wattmeter
25.3	25.3	25.3	107	108	108	22.5	24.9	25.9	14.6	constant:
27	27	27	116	116	115	24.6	26.7	27.5	15.8	200.
29.5	29.5	29.5	144	145	145	30.7	33.3	34.2	19.6	
30.5	30.5	30.5	153	154	154	15.9	17.1	17.7	20.3	Wattmeter
32.3	32.3	32.4	147	176	176	17.9	19.4	20	22.7	constant:
34	34	34	200	204	206	19.8	21.5	22.1	25.6	400.

Similar experiments were made under various weather conditions. The current and energy are graphically plotted as a function of the high tension with and without line and the difference between the two ordinate values is obtained for each pressure value. From this difference the small copper losses in the transformer and line are subtracted.

The following table is compiled from the various tests made:

TABLE OF WATT LOSSES.

Weather	Air Temp. °C.	Loss in kilowatts			
		20,000 volts	25,000 volts	30,000 volts	34,000 volts
Cloudless sky; quite dry	+25°	0.6	0.75	0.9	1.0
Cloudless sky; frost during previous night	+5°	0.68	1.05	1.8	3.1
Snow fall with small flakes; temp. below 0°.	—4°	2	1.4	2.2	3.5
Clear air, cloudy; several hours previous light rain	+7°	1.3	2.0	3.0	4.2
Snow fall with light flakes; temp. above 0°	+1.5°	1.5	2.7	4.9	8.7

The remarkable feature of these tests is the connection between the charging current and the line watts. The current increases more quickly than the pressure, so that the quotient obtained by dividing current by pressure, which was employed above in the calculation of the line capacity, is not constant, but increases rapidly with the pressure. That the measured current strength in the low pressure winding of the transformers is nearly proportional to the high tension current in the line, except for the small influence of the magnetizing current, was determined by separate measurements of the line current. It should be stated that the current measurements were not very accurately made, because the ammeter scale was not sufficiently accurate for all values of the current. In all tests, however, the same errors are present. If, for example, the apparent capacity is figured in the above tests with the power factor (*cos φ*) from the quotient obtained by dividing current by pressure, we obtain the following table:

TEST I—WITH LINE.

Pressure 1000 ×	17	19.6	23.8	27.3	29	31	32.5	33.8
Cos.	0.4	0.39	0.355	0.33	0.32	0.30	0.29	0.28
Cap. M. F.	0.21	0.23	0.24	0.28	0.29	0.31	0.33	0.34

TEST II—WITH LINE.

Pres. 1000 ×	13.4	14.7	17.3	20.8	23.3	25.3	27	29.5	30.5	32.3	34
Cos.	0.55	0.47	0.43	0.40	0.35	0.33	0.31	0.28	0.27	0.25	0.23
Cap. M. F.	0.16	0.16	0.19	0.21	0.23	0.25	0.25	0.28	0.29	0.32	0.35

These tests, using the new transformers, gave considerably different results.

Comparing these tests with those shown in the first table in this paper, in which one generator and two transformers of the primary station at Hochfelden were used as a source of current, it will be seen that in series 2 of that table the power factor gradually rises with the increasing pressure, while the apparent capacity remains almost constant. The last tests, in which the Oerlikon steam-driven dynamo is used as a source of current, therefore show that with increasing pressure, the current curve of the generator is changed, the peaks being higher with higher pressures. The Hochfelden generator varies from the Oerlikon generator by having its e.m.f. curve follow very closely the ordinary line curve. The Oerliken generator has well-defined peaks of triple the periodicity. These effects are generally known, but for this case, having been observed in actual practice, some originality may be claimed. The curves shown herewith show the variations of the terminal pressure of the generator, (1) with line at 34,000 volts, (2) with line at 18,000 volts, (3) without line at 34,000 volts.

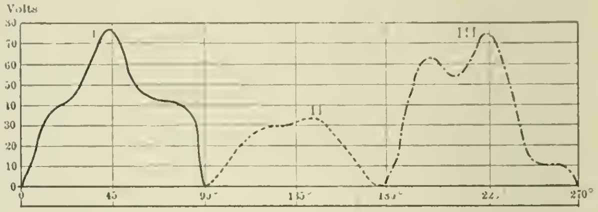

FIG. 10.—CURVES SHOWING RELATIVE VALUES OF THE THREE PHASES.

It is to be expected that to these data which cover the two-year experimental period, further information will be added as time goes on, and new experiences will be gained by the operation of the 50,000-volt line, which will soon take place. The possession of such a transmission line is of great value to the Oerlikon Company, which must be evident to all who have read the above and other articles on the same installation.

Message Time Limit.

At the Interstate Independent Telephone Association, Mr. H. E. Ralston, of Maitland, Mo., read a paper which strongly argued in favor of enforcing the message time limit in toll-line business, and condemned any system of flat-rate charges. He said that the more he has to do with telephone business, the more he thinks that measured service should be adopted for all cases, even to the smallest exchanges; and that if he could begin over in his territory, he would only place telephones on these terms. Those who would object are of the type who are after something they do not want to pay for, and they should not be encouraged. He suggested that if the majority of messages are of three minutes' duration, the minimum of three minutes should be adopted, or if five minutes is the average, that should be the limit; in either case there would be no real cause for complaint on the part of the public.

Analysis of Wireless Telegraph Systems in 1902.

By A. Frederick Collins.

In former articles in the Electrical World and Engineer I described a number of foreign and domestic system of wireless telegraphy and have pointed out, in so far as possible, the difference in the theories upon which they are based, as well as those apparent in the electrical and mechanical construction of the apparatus.

In view of the recent litigation in Germany, in which the Braun and Slaby-Arco systems figured so prominently, and that now pending between the Marconi and De Forest companies in the United States, it would seem of interest to compare the various methods and appliances and show wherein a similarity exists between them. In a comparative analysis of this nature, it may be necessary to delve occasionally into the history of the art and to classify the types of instruments employed, as both will have a vital bearing on the ultimate decision which may be handed down by the courts.

The various hypotheses advanced by inventors to account for phenomena or apparatus constructed upon theoretical data which cannot be proven to be based on fundamental and well-established facts, will not play very important parts in the coming wireless suits. And the construction of the instruments will form the principal object or argument in which the question of discovery and invention will be centered on a very limited number of component parts—perhaps only two or three—of those on which rests the problem of transmission without wires.

In classifying the different systems in order to compare them, it is evident that the start must be made with the first operative wireless telegraph, designed by Marconi in 1896. This treatment will embrace the work of Marconi, Lodge, Slaby-Arco, Braun, Fessenden, Guarini, Ducretet and De Forest, and may be divided into two general classes—namely, *A*, syntonized wireless telegraphy, and *B*, non-syntonized wireless telegraphy; and these into two sub-classes: *C*, oscillators and resonators having grounded arms, and *D*, oscillators and resonators which are not grounded. Subdivisions of these classes resolve the transmitting apparatus into (*a*), generators of the induction-coil type; (*b*), generators of the transformer type; (*c*), oscillators connected in series with the antennæ and ground; (*d*), oscillators operating through transformers; (*e*), oscillators of the open-circuit type; (*f*), oscillators of the closed circuit type; (*g*), oscillators of the compound-circuit type; (*h*), transmitters having tuned internal circuits, and (*i*), transmitters which are non-tuned.

The electric wave system, or resonator, is usually similar to that of the oscillator, though the function of the former is diametrically opposite to that of the latter in that electric oscillations set up in an emitter radiate electric waves, and the waves impinging on the electric wave resonator are transformed into electric oscillations. Receivers may be sub-classed as follows: (a^1), receivers with tuned internal circuits; (b^1), receivers with non-tuned circuits; (c^1), open-circuit resonators; (d^1), closed-circuit resonators; (e^1) compound-circuit resonators; (f^1), electric wave detectors connected in series with antennæ and ground; (g^1) electric wave detector operated through transformers; (h^1) receivers employing coherers; (i^1) receivers employing anti-coherers; (j^1), receivers employing magnetic wave detectors; (k^1), receivers operating Morse registers, and (l^1), receivers operating telephones.

The first Marconi apparatus involves the fundamental principles of wireless telegraphy, and belongs to the *B C* classes of non-synchronized instruments having grounded oscillator and resonator arms. It consists essentially of a transmitter having for its generator an induction coil, (*a*); but the specifications in Marconi's patent do not limit its operation to a coil, but state broadly that it may be replaced by any other source of high-tension electricity (*b*). The oscillator is in series with the antennæ and ground (*c*), and is of the open-circuit type, (*e*). It is not tuned to any periodicity of oscillation except that it is in natural tune with any other receiver which may be grounded, as referred to in my recent article[1] in these columns.

The meaning intended to be conveyed by a non-tuned circuit oscillator, or resonator, is that the apparatus is constructed without regard to the period of oscillation set up in the emitter, the length of the waves propagated or the frequency of oscillation created in the resonator by the incoming waves. A tuned internal circuit refers more especially to circuits of more or less complex apparatus of recent origin relating, especially to syntonic devices in which there are two circuits, both of which must be in tune with the other, or in which the oscillations are transferred before emission from the oscillator or after reception by the resonator.

The Marconi receiver forming the opposite part of the above transmitter is necessarily of the *B C* and the b^1 sub-class, having a non-tuned resonator; it operates by means of an open-circuit resonator, c^1, the antennæ and ground of which are in series with the coherer f^1, thus conforming with h^1 k^1. The apparatus is shown in the diagram, Fig. 1, the letters corresponding to those preceding the classes and sub-classes.

The Lodge system of syntonic wireless telegraphy was the first which aimed at selective signaling, and, therefore, represents a new distinctive class, which we shall call *A*, and likewise establishes a precedent in the art by eliminating the earth from the oscillator and resonator, which fulfills the sub-class *D*. The transmitter operates by means of an induction coil, (*a*), the oscillator system is of the open-circuit type, (*e*), and to preserve the uniformity of the oscillator system that the wave emitted may follow a sine-wave law, both arms have the same values of induction and capacity, which is not possible when so great and unequal damping coefficient as the earth is loaded on one arm of the oscillator. The great advantage of this arrangement is to permit true selective tuning between instruments, and the great disadvantage in this case of eliminating the earth as a resonant factor is that the distance over which it is operative is exceedingly limited.

The tuning is accomplished by varying the capacity areas and the inductance coils, shown in Fig. 2. But the greatest point of interest in the Lodge invention lays in the construction of the resonator system of the receiver. It will be observed by referring to the diagram that the resonator is of the compound-circuit type, (e^1), and in the sub-class, (a^1), having a tuned internal circuit—connected with the coherer—and, (g^1), which is operated through a transformer. This device renders the actions of the oscillations set up in the resonator independent of the instability of the coherer through its varying changes of resistance and capacity. This is, in my opinion, one of the greatest improvements in the original resonator, and upon this point legal complications will undoubtedly ensue, since the Slaby-Arco, Marconi, Braun, Guarini and De Forest apparatus employ this transformer device; yet there are in these systems a certain difference which may or may not make them amenable to the claims of Lodge, according to the interpretation of the patent claims of each. The receiver operates a Morse register.

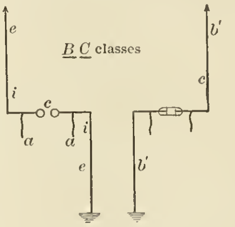

FIG. 1.—FIRST MARCONI WIRELESS TELEGRAPH.

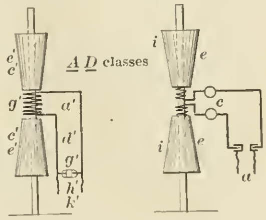

FIG. 2.—LODGE TUNED SYSTEM WITHOUT GROUND.

The Slaby-Arco system, shown in Figs. 3 and 4, has two forms of transmitters and a receiver. The transmitter, 3, was designed to send out waves of a prearranged definite length, but both from theoretical and practical considerations it was supplanted by the type 4. It is well known to those versed in the art that electrical resonance is extremely difficult to obtain by means of high-frequency, high-potential currents in the resonator when there are only two or three swings in the radiator system; but as the oscillations become more and more persistent, resonance in the sending and receiving systems is the more and more easily effected. Since persistent oscillations are a characteristic feature of closed-circuit systems, (f d^1), it follows in natural sequence that the 3 type of Slaby-Arco transmitter operates as such by means of the circuit formed through the earth, as by the grounded terminals of the antennæ and vertical wire. Whether or not this thought was uppermost in the minds of the inventors when they designed the transmitter 3, it produces this effect. It is postulated that all oscillations of a frequency capable of emitting waves four times the length of the wire, will propagate them through space, but when the periodicity of the oscillations is not in tune with the antennæ through which they travel, they are dissipated in the induction coil or find their way to the earth through the second grounded vertical wire, and in either case no waves are radiated, or if any, they are very feeble. This transmitter does not seem to infringe upon the Lodge form, but it evidently encroaches upon the Marconi type, in that it employs a grounded wire leading from the oscillator and an antennæ connected to the opposite side, (*c*). This forms the first closed circuit oscillator system, but as its function was primarily described to emit waves of a definite length and not to increase the number of oscillations per discharge across the spark-gap, it will probably have little effect on the validity of claims made for apparatus in which this is the express purpose.

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[1] "Hertzian Waves and Wireless Telegraphy," September, 1902.

The Slaby-Arco transmitter of the Fig. 4 type is the first of the compound-circuit oscillators, class *A*, sub-class *C*, and sub-division *g* and having a tuned internal circuit, *h*. The arrangement produces complex phenomena, the theory of which is easy to attack but difficult to disprove. There are some clever devices for obtaining harmonic effects between the wave-emitting antennæ and the high-frequency current set up in the oscillator system. The inductance, 1, consists of a few turns of heavy copper wire, wound around a heavy pasteboard box containing a number of Leyden jars,[2] by which the periodicity of the oscillations may be varied within certain values, as well as by increasing or by decreasing the resistance by means of the spark-gap, 3. If it is proposed to include the oscillator defined by 1, 2, 3, 4, 5, 6 and 7, a closed oscillator system results, and persistent oscillations will be produced. If the antennæ includes the open circuit formed by 5, 6, 7, 8, then the oscillator and emitter will each have the good qualities of the open and closed circuit, *i. e.*, the persistency of oscillation of the closed circuit and the wave-emitting qualities of a damped open-circuit oscillator. The inductance coil, 6, serves to obtain and maintain a greater accuracy of adjustment of the coefficients of inductance and capacity between the antennæ and the tuned internal circuit, *h*, making the frequency of oscillation correspond in both circuits. The transmitter includes an ordinary induction coil, a key with a magnetic spark blow-out and mercury turbine interrupter.

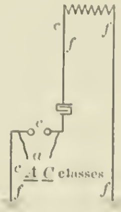


FIG. 3.—SLABY-ARCO CLOSED-CIRCUIT TRANSMITTER.

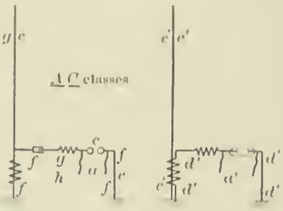


FIG. 4.—SLABY-ARCO MULTIPLE-TUNED CIRCUIT SYSTEM.

The Slaby-Arco receiver is, Fig. 4, constructed upon similar lines to the transmitter, being a compound-circuit resonator, (c^1), of the *A C* type, having the internal closed circuit in tune with the external open circuit, and these syntonized with the transmitters, in so far as additional inductances and capacities can be made to a grounded resonator with a grounded transmitter, the object, of course, being to produce a selective syntonic system. A coherer, (h^1), is connected in series with the antennæ and ground, although, according to the Slaby theory, it does not follow the sub-class, f^1, since he postulates the two circuits are separate and distinct. A Morse register operating through a polarized relay and actuating the decohering device makes it amenable to the k^1 class.

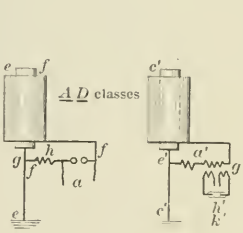
The element of similarity between the Slaby-Arco and the previously described system of Marconi is that of employing a vertical wire in both the transmitting and receiving instruments, and providing grounds oppositely disposed to the antennæ with the spark-gap and coherer intervening—although this statement is open to criticism insomuch as in the case of the receiver the antennæ and closed circuits are grounded at the same point.

The Slaby-Arco resembles the Lodge system in the use of inductances in tuning the individual instruments and syntonizing the two station sets collectively. A further resemblance to the Marconi and Lodge instruments is in the fundamental principle utilized in producing the oscillations by a Ruhmkorff coil, (*a*), and a spark-gap, and receiving the waves by means of a coherer, (*h*), and by translating the impulses into Morse dots and dashes by a register, (k^1), acting through the desired circuit of a relay.

The syntonic wireless transmitter of Marconi is in a few features like that of the Slaby-Arco. One is evidenced in connecting one side of the oscillation to the antennæ, which is grounded precisely as it is in the Slaby-Arco, but the Marconi is not a compound oscillator, neither may it be said to be an open or closed oscillator, but rather a cross between them. The system is of the *A C* class, and consists of two concentric cylinders, Fig. 5, of large dimensions, which serve as the antennæ. This is intended to and would give persistent oscillations, were it not for the inner one being weighted with the capacity of the earth, when it would resemble a magnified edition of the Lodge syntonic jar emitter which has a closed circuit. But Marconi evidently does not consider it as such, since he was the first to point out the defect of Slaby's first transmitter which formed a closed circuit. Assuming that it has wave-emitting properties greater than a closed-circuit oscillator, it must follow that the air core separating the two cylinders is considerably greater in proportion to its size than the proportional thickness of the dielectric separating the coatings of the Leyden jar, or that the earth has a tendency to damp out the oscillations to a certain extent, or both; but taking this for granted and crediting the logical deduction that such an apparatus will give persistent oscillations, it follows as a natural sequence that it is a combination of devices for producing a compound effect of *e. f. g.*

The syntonic wireless receiver of Marconi is constructed upon the same plan, the inner cylinder forming the antennæ with direct grounding. It is like the Lodge receiver in that the oscillations set up in the resonator by the incoming electric waves are transformed by a small coil having a primary and secondary winding; and it is like the Lodge and Slaby-Arco receiver in using inductance coils as a means of obtaining a given periodicity of oscillation. It belongs to the *A C* class and the a^1 c^1 d^1 c^1 (anomalous-circuit resonator), g^1 h^1 and K^1 sub-classes.

Dr. Slaby has devised a portable system of wireless telegraphy in which the question of syntonization does not enter seriously, the transmitter following the *B C* classes. The transmitter is identical with the first Marconi form, the antennæ being suspended from kites. The resonator is based on the principle of that described in the Slaby syntonized system, with the antennæ grounded direct and one terminal of the coherer likewise grounded, joining an open and closed circuit of the compound type; but instead of an ordinary coherer, a self-righting one is substituted, and a telephone receiver takes the place of the Morse register, tapping device, complex circuits and relay. This receiver is arranged in accordance with Dr. Slaby's theory for obtaining an approximate resonance with a non-syntonized transmitter, and may be designated by the class letters, *A*, *C*, a^1, c^1, h^1 and l^1. What was said of the previously-described Slaby-Arco receiver is likewise applicable to this form.



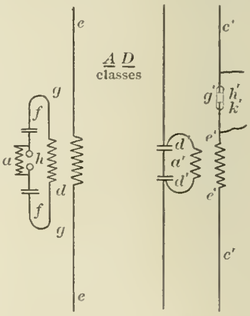


FIG. 5.—MARCONI SYNTONIC SYSTEM. FIG. 6.—BRAUN COMPOUND CIRCUIT SYSTEM.

The Braun syntonic system (Fig. 6) appears to be based upon principles which are absolutely sound, theories which have been proven by experiment and practice, and compound circuits which are clearly defined. The Braun transmitter, like the Lodge, is modeled after the original Hertz emitter, in that it is not grounded, and, being eminently adapted to selective wireless telegraphy, it is in the *A*, *D* classes. It consists of two circuits, sharply cut, one a closed oscillator in which high-frequency and high-potential currents are set up, and these are stepped-up or stepped-down by a transformer, the primary of which is included in the closed circuit, and acts as a variable inductance for tuning the said circuit so that it will have the same frequency of oscillation as the natural period of the open circuit which receives its oscillations through the secondary of the transformer, and connecting in series with two wires, both having a length equal to one-fourth of the length of the wave to be emitted. One of these wires serves as the antennæ, and the opposite is coiled loosely or connected to a plate of metal having the proper amount of capacity.

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[2] Slaby-Arco Wireless Telegraph Apparatus, ELECTRICAL WORLD AND ENGINEER, May 1, 1902.

As in the systems described, the Braun receiver is a duplicate, as nearly as may be, of the transmitter. It has a tuned internal circuit resonator, (a^1), one arm including the coherer, (h^1), a compound-circuit resonator, (e^1), the closed circuit connected in series with the antennæ, (a^1), and an opposite wire of equal length, but not grounded, (D), connected thereto, and this operating the open-circuit resonator, (c^1), through a transformer. The receiver proper is a Morse register tapper, relay and other accessories, (k^1).

The tuning, internal (a^1) and selective (A), is done by means of condensers, usually Leyden jars, and the inductance coils shown in Fig. 6. The points of similarity between the Braun and the first Marconi system lay in the use of a vertical sending and receiving wire, a spark-gap and a coherer; it resembles the Lodge in employing a transformer in the receiving apparatus which is virtually the equivalent of a compound circuit resonator, and the use of condensers and inductances to regulate the tuning coefficients. It is like the Slaby-Arco system only in the use of antennæ, which equals one-fourth of the emitted and received wave value.

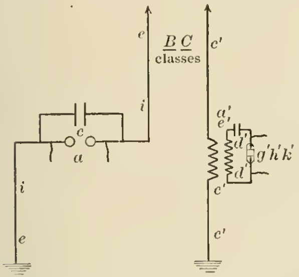


FIG. 7.—GUARINI REPEATER SYSTEM.

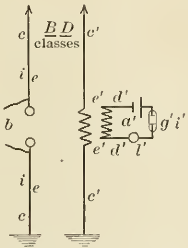


FIG. 8.—DE FOREST WIRELESS TELEPHONE SYSTEM.

The recent patents granted to Fessenden show some important advances in the art of tuning were they not handicapped by the earth terminals of the oscillator and resonator. In this system the transmitter derives its energy from the generator, (a), the oscillator of which is connected in series with the antennæ and ground, (c), but has a tuning grid composed of straight wires immersed in oil and having a combined inductance and capacity, also in series with the antennæ, oscillator and ground, the whole forming an open-circuit oscillator of (e). The receiver is in series with the antennæ and earth, (f^1), and consists of a magnetic wave detector, (j^1), of novel construction, and a head telephone receiver, (l^1). It is an open-circuit resonator, and with its oscillator is like the Marconi system, in that it requires a vertical sending and receiving wire connected in series with an oscillator and resonator, as the case may be, which then leads to earth. It follows the law governing the Lodge, Slaby-Arco, Marconi and Braun system in striving for resonance by means of inductance and capacity, but unlike theirs, Fessenden's variations of these coefficients is not done through inductance coils and condensers, but by means of straight wires immersed in a medium having a large specific inductive capacity. The magnetic wave detector takes it out of the sub-class of coherers and places it in a new class by itself.

Guarini's wireless telegraph repeater is not related in any way to syntonic systems, but its features of similarity to those preceding it will be described. Its generator is an induction coil, with the opposite terminals of the spark-gap in series with the antennæ and earth, forming an open-circuit oscillator of the B C type, like the first Marconi apparatus. There are no tuned circuits, but the coherer is actuated by the oscillations set up in the resonator through a transformer, thus producing a compound-circuit resonator, in accordance with the specifications of Lodge, Marconi and Braun. See Fig. 7.

Like the above, the De Forest system mades no claim to syntonic methods, but introduces several novel features. It is the only system using a generator of the transformer type, (b); current from engine-driven alternator having a potential of 500 volts is stepped-up by a commercial transformer to a voltage of 20,000, or higher. The oscillator is connected in series with the antennæ and earth, and is of the open-circuit type. The resonator is also of the B C type, and operates an anti-coherer, (i^1), through a transformer, as in the Marconi, Braun and Guarini receivers; the impulses are translated into Morse by head telephones, through the responder like that of the Slaby-Arco portable system. (Fig. 8.)

The equipment of Ducretet follows closely the first Marconi apparatus, though sometimes substituting the telephone receiver and a self-restoring coherer for the ordinary coherer and Morse register, as in the Slaby-Arco portable sets and the De Forest systems.

These are the principal systems in use to-day, and show wherein there is a marked likeness of operative devices. In the Braun-Slaby-Arco suit, the alleged infringement of rights involved the similarity of theory and priority of invention of the compound oscillator circuits, with a special reference to that portion treating of the antennæ. However, the Braun patents were sustained by the court's decision, which ruled that the systems were different so far as the contested principles were concerned.

In the Marconi-De Forest suit, brought by the former company against the latter, the question of infringement is based upon claims which refer to the use of an imperfect electrical contact for detecting the waves. In the Marconi system, the well-known coherer is employed, whilst in the De Forest system a device, termed a responder, which increases the resistance of the local circuit, is used.

The final decision of the courts will be awaited with interest, as the case will determine largely whether or not Marconi is to have a monopoly of electric wave wireless telegraphy in the United States, and whether or not his patents are as broad and far-reaching as the waves his instruments send forth.

The Relation of Synchronous Impedance to the Impedance at Standstill.

By F. TOWNSEND, H. P. FREUND, W. I. REICH.

THE method in general use in this country for predetermining the regulation of an alternator is to find the synchronous impedance of the machine from the open-circuit saturation curve in connection with the short-circuit characteristic, which is the relation between the field amperes and the corresponding values of armature current at short circuit. The synchronous impedance is given by the ratio, open-circuit volts divided by short-circuit armature current for any given excitation, and it is found that this fraction is very nearly constant for all excitations which correspond to the straight part of the magnetization curve. In Fig. 1 the relation between the induced volts OE_0, the synchronous impedance drop OE and the terminal voltage OE are shown diagrammatically, the main discrepancy between the relations shown and those in an actual machine being that the resistance drop is generally relatively unimportant, so that the angle ϕ is very nearly 90°, and $\cos(\phi - \theta)$ is practically the same as $\sin\theta$. It is plain from the diagram that the difference in length between OE and OE_0, or the armature drop, is therefore very nearly given by the equation

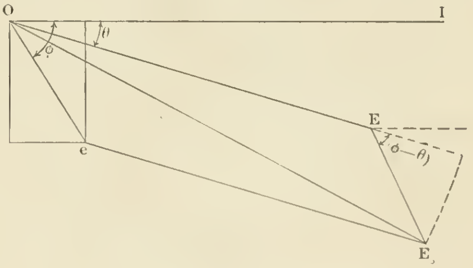


FIG. 1.

$$\Delta E = oe \cos(\phi - \theta) = Z I \sin\theta$$

Now the constant Z is determined at short circuit and takes into account not only the demagnetizing effect of the armature current, which, below saturation, is very nearly proportional to $I \sin\theta$, but also the counter e.m.f. due to the leakage flux, which is not cut by the conductors on account of their mechanical motion, but on account of the variation of the current, and therefore produces a counter e.m.f. which is always regarded as the true inductance drop.

Since the diminution of voltage due to this inductance is also nearly proportional to $I \sin a$, it is evident that no appreciable error is involved in combining the two factors of proportionality into a single constant called the synchronous impedance.

The object of the experiments about to be described was to compare the values of impedance obtained at standstill with those of synchronous impedance determined in the usual way.

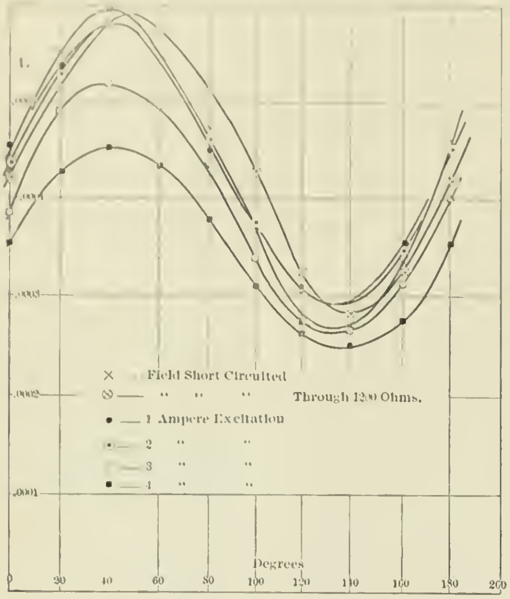


FIG. 2.—INDUCTANCES AT STANDSTILL—MACHINE (*a*).

The machines tested were as follows:

(*a*) 10-hp, double-current generator.
2-phase—60 cycles—77 to 110 volts—1,800 r.p.m.
(*b*) 60-kw alternator—smooth core.
Single-phase—125 cycles—1,000 volts—1,070 r.p.m.
(*c*) 5,000-kw alternator.
3-phase—25 cycles—11,000 volts—75 r.p.m.

All the values of inductance determined with the machine at standstill were obtained by passing current through one phase of the armature, and noting volts, amperes, watts and frequency; the value of L was then calculated from those readings by the equation,

$$L = \frac{\sqrt{E^2 I^2 - W^2}}{I^2 \omega}$$

It was found, however, that the wattmeter reading was so small that W^2 could be neglected in comparison with $E^2 I^2$.

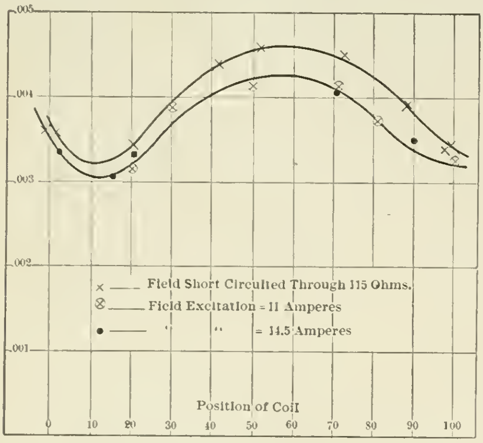


FIG. 3.—INDUCTANCES AT STANDSTILL—MACHINE (*b*).

Figs. 2 and 3 show the effect of the field excitation on the value of L, and it appears from them that the average value is diminished some ten or fifteen per cent. by the saturation of the iron.

In order to show that this diminution was due to saturation and not to a transformer action on the part of the field circuit, the series of tests shown in Figs. 2 and 4 were made with the field winding short-circuited on itself. These results indicate that in the particular machines tested there was little or no transformer action between the armature and field circuits.

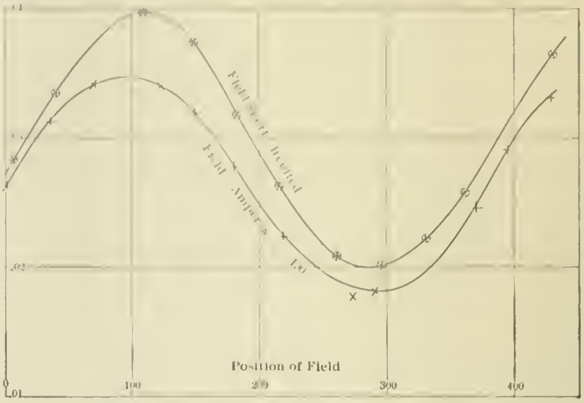


FIG. 4.—INDUCTANCES AT STANDSTILL—MACHINE (*c*).

The effect of a variation in frequency on the value of L was found to be very slight. This is brought out in Fig. 5, where the observations show a very small diminution in L produced by a change in frequency of 50 per cent. L varies inversely with the frequency, because the eddy currents act in the same manner as the secondary current of a transformer, and diminish the apparent inductance of the primary as the frequency rises; the "primary" in this case is the armature circuit of the machine tested.

Between zero and full load it was observed that the values of L appeared to be independent of the armature current at which they were determined; this is owing to the fact that, in the machines tested, the armataure current was not sufficient thoroughly to saturate the leakage paths.

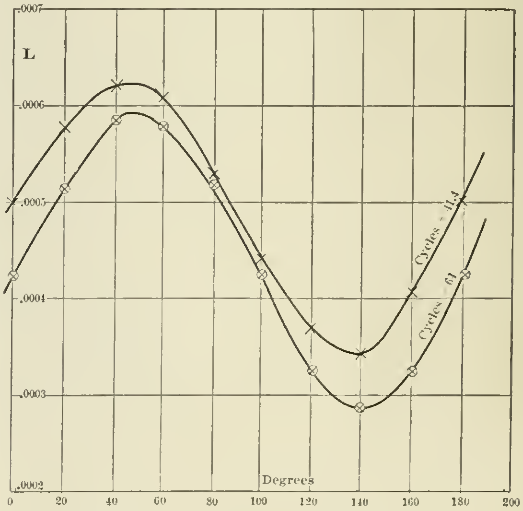


FIG. 5.—EFFECT OF FREQUENCY ON INDUCTANCE AT STANDSTILL—MACHINE (*a*).

Fig. 7 shows two external characteristics for the 5,000-kw alternator. Each curve is calculated for a power factor equal to .4, but as indicated in the diagram one is derived from the measurement of impedance obtained at standstill, and the other from the synchronous impedance obtained in the usual manner from the curves of Fig. 6. Of these two calculated curves, the lower one is presumed to give a near approach to the actual performance of the machine under load; the other, however, gives us merely a somewhat rough approximation of the drop in the armature when in actual operation due to the rate of change of the leakage flux, exclusive of armature reaction. This particular machine, in addition to heavy copper bridges between the poles, had also heavy short-circuiting collars on the magnets; it may, therefore, be assumed that the flux due to the armature current during the measurement at standstill did not pass far into the field magnets, but corresponded to some extent to the stray field due to the armature current under load conditions. That this is merely an approximation is plain from a consideration of Fig. 4, where *L* is seen to vary nearly 100 per cent.

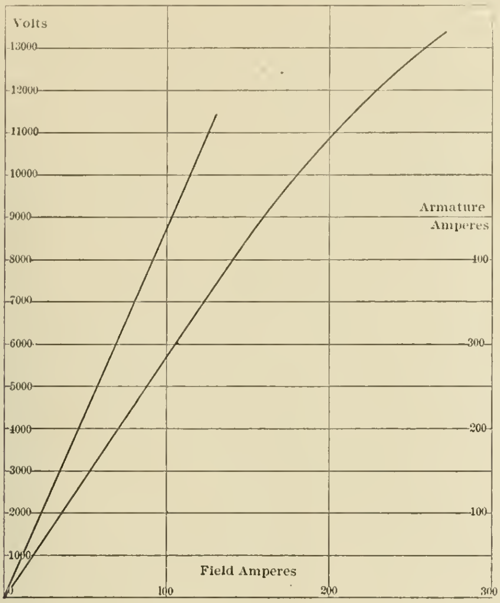


FIG. 6.—CHARACTERISTIC CURVES OF MACHINE (*c*).

In obtaining the curve in question, shown in Fig. 7, the value of *L* which was used in the calculation was the average value at an excitation of 190 amperes, found from Fig. 4.

These calculated curves of regulation shown in Fig. 7 are a fair sample of what an alternator will give at extremely low power factors. They are interesting in that they show that in this particular case the diminution in volts due to armature reaction indicated by the difference between the two curves is greater than the inductance drop, which is approximately given by the upper curve. Under true load conditions this would be more pronounced than in the results shown, inasmuch as the true inductance drop when the machine is in operation is in all probability less than that obtained from a measurement of the armature impedance at standstill.

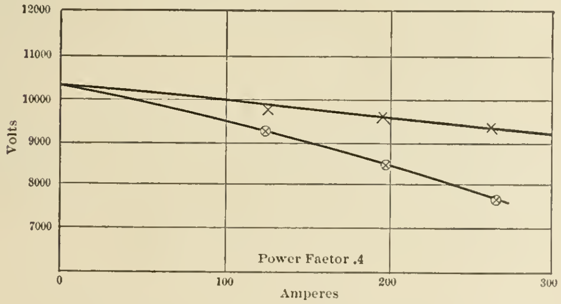


FIG. 7.—CURVES CALCULATED FROM THE MEASUREMENTS MADE ON MACHINE (*c*).

Electric Discharges in Air.

By Alfred G. Dell.

In the following I will give a few ideas formed in experimenting with high potential discharges in air, which can be taken for what they are worth. It appears that the impulses from an induction coil and all high potential machines have a tendency, if no other attraction is present sufficient to hold them, to rush to the extreme limits of all conductors connected to the poles of the machines used in their production.

Suppose there is a point to one pole of an induction coil, and an opposite large sheet of metal without any point attached to the other pole. In this case the discharge rushes as near the point as possible, but the other side of the impulse spreads over the plate with a small accumulation opposite the point; when the spark is made, the charge on the plate being spread all over a flat surface, does not succeed in reaching the spark-gap all at once, but follows in streams in all directions, and as a consequence the spark occupies a longer time than otherwise, which action shortens the spark obtained from the plate side, as compared with the case when two points are used.

It has always been a mystery to me why some think lightning rods should be thin and have a perfect ground connection. Now it is well known that wires when connected to high-potential machines show in the dark more lateral radiation than thicker ones, and as a consequence when lightning rods are thin there should be more danger of lateral discharge than if thicker. I do not consider a perfect ground connection at any time, where a ground is needed, an objection, but do not consider it absolutely necessary with a lightning rod. I would think a moist earth would be sufficient. Consider for a moment the great length of lightning discharge, and the ease with which tall trees are torn to pieces by the discharge passing down the sap of the tree. It is not necessary to go into the action of the discharge producing heat, steam, etc., as that is well known. A moist ground connection would certainly be a far better conductor than the tall tree. A discharge that can pass through miles of such a high resistance as air, and then down the sap of a tree, could certainly pass with ease down a metallic conductor into moist earth.

The Metric System.

President Pritchett, of the Massachusetts Institute of Technology, in criticising the recent attack on the metric system by certain members of the American Society of Mechanical Engineers, says that the statements made as to the survival of old standards in various countries have significance, not in showing the fitness or unfitness of the metric system, but as showing the strength of conservatism, even among an intelligent people. The testimony quoted of an American superintendent of motive power to prove that the English standards of weight and length are used in Mexico, is met with the remark that the Mexican railroads are practically American roads and their equipment is received from the United States. That they should use our standards is as natural, even as necessary, as it would be to use those measures for railroad equipment in the United States. If one were to go outside the mechanical department of these American roads he would find it impossible to do business, except in the metric system. In reply to a statement that nearly all St. Louis real estate is now measured in arpents, because the early French settlers used that unit of measurement, President Pritchett said: "Not only is no piece of real estate in St. Louis measured in arpents, but I question whether among the 600,000 inhabitants of St. Louis a score could be found who even know what is an arpent. As an actual unit of length, it has absolutely disappeared." The argument for the preservation of old and inconvenient standards rests, he said, on no other basis than inertia of the general mass of mankind, and he asked the attention of engineers to the real questions, which, briefly stated, seem to be these: 1. Is a common system of weights and measures for the whole civilized world a desirable thing? 2. Are the benefits to be gained by a universal system of weights and measures sufficient to justify a country in surrendering its present system to adopt such a world system? 3. Is the metric system one fitted to the needs of the civilized world, and has it already gained such general adoption as to make it available as a world system? In conclusion, he said that action by the United States in adopting the metric system would soon lead to similar action by England, thus bringing about a world system.

Telephone Cables.

By Arthur V. Abbott, C. E.

COST OF CABLE WIRE PLANT.

The expense of telephone cables will vary with the prices of lead and copper, the materials of which they are chiefly composed, and with the electro static capacity of the completed cable. As different manufacturers use slightly different thicknesses of lead sheath, and as cable for aerial lines is often made with a thinner armor and lighter conductors than that intended for underground service, aerial cables are usually slightly cheaper than those designed for underground lines. Cable prices will also vary, depending upon freight charges from manufacturing centers to the point of consumption.

It is further necessary to allow for cost of splicing and erecting cable either in the ducts, or upon pole lines, and for the cost of terminals. Experience shows the cost of splicing and installing to vary from about 3 cents to about 10 cents per foot, for it is more expensive to splice and erect large fine wire cables than medium-sized, coarse wire ones, and again small cables are more expensive than medium-sized ones. The conductor sizes for all telephone cable are in B. & S. gauge.

Based upon the prevailing prices for copper and lead for 1902, including splicing and erecting expense, the tabular curves shown in Fig. 1 at *B* are plotted. The lower horizontal axis is devoted to the number of pairs, while the left-hand scale is the price per foot in dollars. Three curves are shown, one for No. 19 gauge, from 10 to 275 pairs, one for No. 20 gauge, from 10 to 400 pairs, and one for No. 22 gauge, from 200 to 400 pairs.

For No. 19 gauge cable the electrostatic capacities assumed are .080 m.f. per mile for sizes from 10 to 150 pairs inclusive. From 150 to 275 pairs, .110 m.f. per mile. For No. 20 gauge cable the capacities taken are .085 m.f. per mile, from 10 to 150 pairs, and .110 m.f. per mile from 150 to 250 pairs, and .115 m.f. per mile from 150 pairs to 400 pairs. For all No. 22 gauge cable .120 m.f. per mile is predicated.

By turning the sheet of Fig. 1 around four more curves are found, three on the left hand at *A* and one on the right hand at *D*. The curve on the right hand at *D* expresses the percentage relation between the copper cost, and the total cable cost. The right-hand scale is in per cent., while the horizontal axis gives the number of pairs, the curve showing for the varying number of pairs, the per cent. that the copper cost is of the total cable cost. On the left-hand side three curves are given, showing the weight per foot of the various sizes of cable conductor gauges, Nos. 19, 20 and 22. The left-hand scale is weight per foot, while the horizontal scale gives the number of pairs.

In the nature of telephone business it is impracticable to utilize all of the cable wire which is laid. As the cable extends away from the exchange some wires will be utilized by subscribers nearer to the office than others, thus involving more or less loss of cable conductors beyond. It is impossible for the very best estimate to state exactly the number of conductors needed to serve a given district, moreover from time to time subscribers move from one place to another, thus vacating cable wires in one place and demanding additional facilities at other points. It is in addition always essential to provide a certain surplus of facilities over and above the exact demands of the business, so with the most skillful planning and the best generalship it is impracticable to utilize more than 75 per cent. of the cable conductors laid. Thus in estimating the cost per circuit mile of cable wire, allowance must be made for that which is dead, and while it is sometimes possible to utilize three-quarters of the conductors installed it is pretty safe to assert that to-day not over 50 per cent. of all the cable wire laid is active.

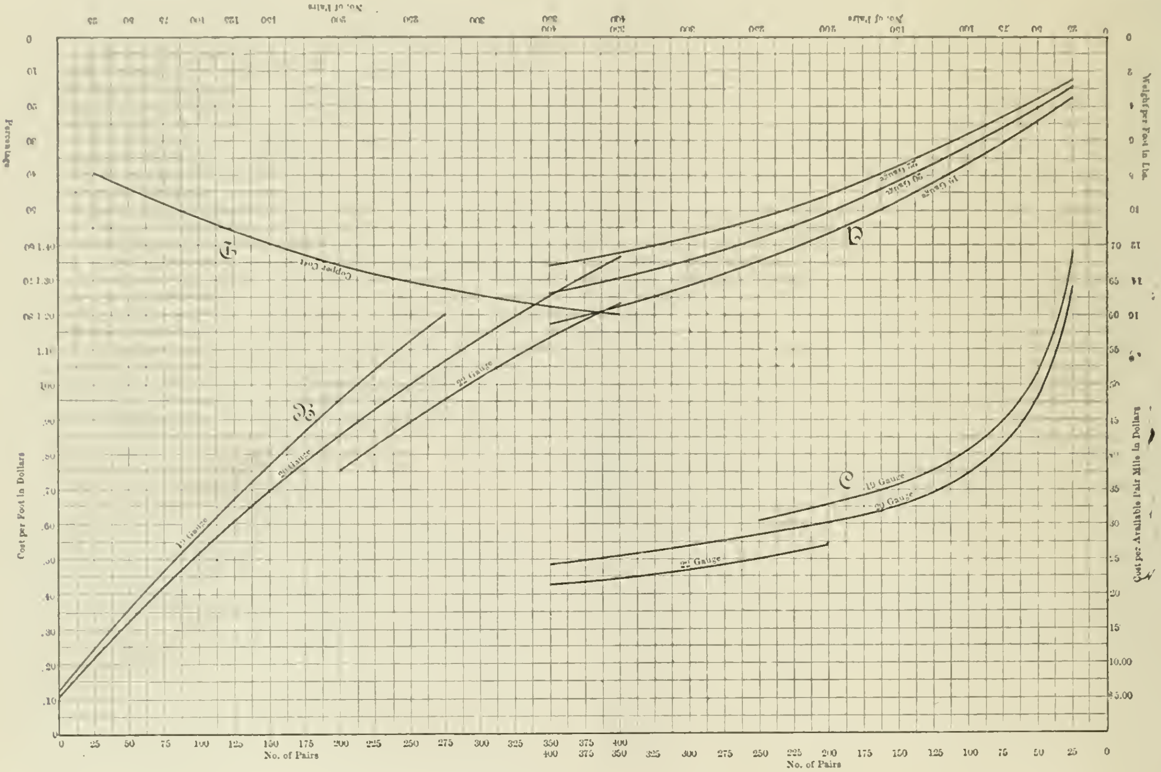


Fig. 1.—Curves Showing Cost of Cable Wire Plant.

In Fig. 1 three curves are given on the right-hand side of the sheet at *C* to facilitate estimating the cost of wire plant, by giving the probable cost per active pair mile of cable wire, based upon the previously specified percentage of working wires. Three curves are given—one for No. 22 gauge, one for No. 20 gauge and one for No. 19 gauge. These curves are the reciprocals of the curves upon the left-hand side of the sheet, divided by 75 per cent.

To estimate the gross cost of cable plant it is desirable to know the total expense per mile of cable laid in place. By a similar train of reasoning to that just given for the existence of inactive cable wire, a certain allowance must be made for dead conduit space, and it is usually estimated that not over 70 per cent. of all ducts laid are actually available.

Fig. 2 gives graphical data showing the total cost per mile of cable of various sizes installed in conduit, costing from 10 cents to $1 per foot, assuming 30 per cent. of dead ducts. For each gauge of wire, viz.: Nos. 19, 20 and 22 a curve is given for each size of cable. The horizontal scale shows the varying cost per duct foot, while the vertical scale is the total cost per mile of cable in place exclusive of terminals.

In Fig. 3 a similar set of curves is prepared, showing the cost per active pair mile. The sheet contains three sets of curves. That at *A* giving the cost per pair foot for No. 19 gauge cable from 5 to 50 pairs installed in ducts, costing 50, 60, 80 cents and $1.00 per foot. This table is valuable in calculating the cost of laterals and terminals, where a cable is taken from the main conduit line and extends to a terminal placed either in a building or on a pole. Usually these lines are short and consequently costs are given per foot of pair circuit. Such lines are always isolated ones and the expense of conduit is very great. The curves at *D* give the cost per active pair mile, for 200, 300 and 400 pair No. 22 gauge cable laid in conduits costing from 10 to 50 cents per lineal foot, as shown on the lower horizontal scale. The curves at *B* give costs of 25, 50, 100, 150, 200 and 250 pair cable No. 19 gauge cable laid in similar conduit. Finally the curves at *C* are similar expressions for cost of cable from 25 pair to 400 pair No. 20 gauge. By means of these three tables an estimate of cost of cable placed under all ordinary conditions of telephone practice, may be readily made, and it is easy to interpolate new rates for any number of pairs between those for which curves are given.

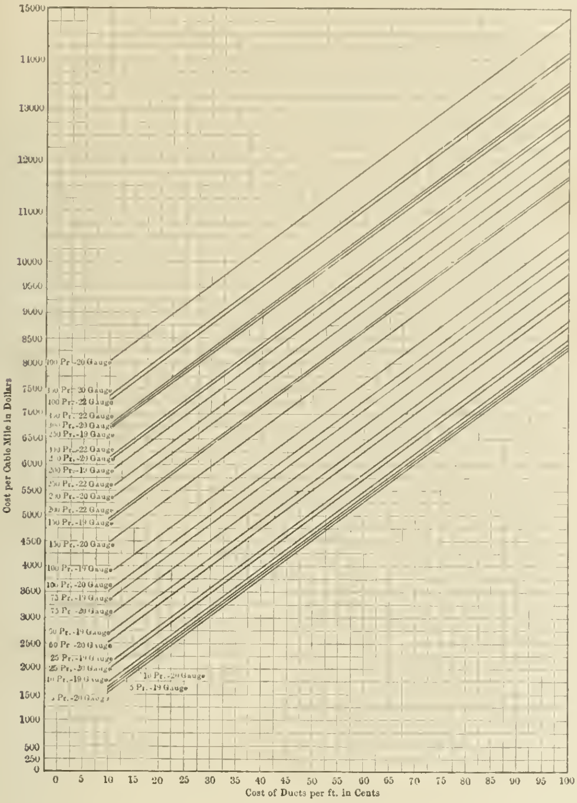


FIG. 2.—CURVES SHOWING COST OF CABLE PER MILE.

To the costs thus found must be added the necessary expense for terminals. If plain cable heads be used the cost of the head and splicing will vary from $1.00 per pair for small sizes to 20 cents for large ones. Cable heads equipped with protectors (lightning and sneak current arresters) cost from 20 cents to 50 cents per line in addition. Pot-head splices cost from $2.00 per cable for small sizes (25 pair to 50 pair cables) to $5.00 for the large sizes (50 pair to 400 pair). This includes labor and all materials excepting the flexible terminals. Okonite wire for terminals costs from 2 to 4 cents per pair foot. Silk and cotton switchboard cables, 20 pairs, from 15 to 25 cents per cable foot, while wool cable costs from 75 cents to $1.25 per cable foot for 50 to 100 pairs. The cost of forms for cable heads, distributing board terminals, etc., may be taken at 1 cent to 2 cents per wire. The cost of messenger wire for aerial cables, cable boxes, bridle wires, etc., connecting open wire lines, properly belong to aerial construction and will be considered thereunder.

ANNUAL EXPENSES.

The enemy of the paper cable is moisture. Even with the utmost care and in spite of the apparent protection offered by conduit and sheath, underground cables gradually fail. In some cases life is very long, but from one cause and another, owing to extension, necessary re-arrangement of plant, etc., a thousand and one causes operate to injure the cable insulation and deterioration is inevitable and must be provided for, in the depreciation account.

For underground main cable from 5 per cent. to 7 per cent. is a fair annual charge, while for laterals from 8 per cent. to 10 per cent. is essential. Aerial cable is much more exposed to injury than underground lines, for it is a constant prey to all sorts of additional destructive forces—sleet and wind storms, lightning, crosses with high potential wires of all kinds; the small boy with a shot gun or rifle and hundreds of other influences constantly attack it. Moreover, aerial lines have a shorter life than underground ones, as being chiefly erected in districts which are growing rapidly, they are soon superseded by conduit work. For these reasons an allowance from 10 per cent. to 12 per cent. for depreciation for aerial cables is none too great.

MAINTENANCE.

The maintenance to which cable wire is subjected will depend very largely upon the rate of growth in the exchange. Where this is rapid there is a constant necessity for re-arranging and re-modelling cable plant. Under such circumstances maintenance charges will vary from 2 per cent. to 5 per cent. on the cost of installation. For where growth is slow, and there is but little change in districts, maintenance may fall as low as from 1½ per cent. to 3 per cent. With aerial cables 5 per cent. for maintenance is the least charge which should be considered. Combining the charges for both depreciation and maintenance the annual expense for underground wire plant should be taken at from 5 to 10 per cent. for main cables, from 10 to 15 per cent. for laterals, and from 12 to 16 per cent. for aerial cables.

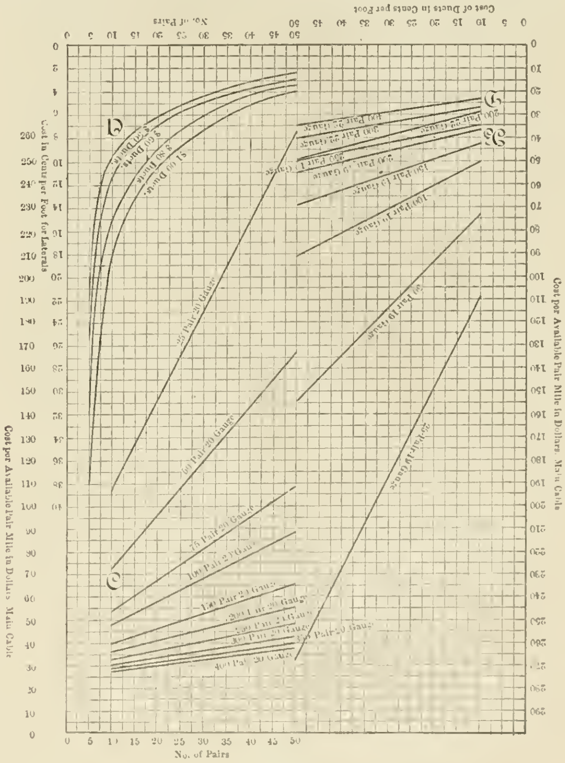


FIG. 3.—COST OF ACTIVE PAIR PER MILE.

The Progress of Electrical Science During the Year 1902.

By A. E. Kennelly.

THE year 1902 has witnessed great development in electric science and in its applications. As a result of experimental research, the ionic hypothesis has steadily gained ground. According to this hypothesis, all electrifications are due to the presence of free or unsatisfied electric charges on atomic masses, in which atomic masses electric charge permanently and inherently resides as a fundamental physical property. Some atomic masses are essentially positive, others essentially negative. The union of the two is atomic combination and accompanies chemical combination. Their disunion effects electrification. Similarly, all electric discharges in fluids and conductive electric currents in solids or liquids are referred, on this hypothesis, to ionic movements in the conducting mass.

As a development of the ionic theory, the corpuscular theory of J. J. Thomson also appears to have gained ground from the experimental research of the past year. On this hypothesis, negative ions are corpuscles, or quantities of matter much smaller than atoms; while positive ions are atoms denuded, or deprived of, corpuscles. A body which becomes negatively electrified without any other change in condition, is a body which has gained in mass by the addition of corpuscles; but the actual addition in mass would be regarded as so excessively minute as to evade all experimental observation.

According to this hypothesis, the fundamental nature of electricity, not yet determined, is essentially enrolled with the fundamental properties of every chip of matter of which each atom is built.

A large amount of research has been conducted in radiography and radio-activity. This science practically owes its existence to the experiments by which Röntgen x-rays were discovered. Radio-activity is a branch of physical chemistry, and, on the corpuscular theory, involves sub-atomic chemistry.

In electro-chemistry much research has been carried on, mainly in connection with practical applications. In fact, the industrial demand for application of electrical energy to electro-chemistry may be said to have created the demand for the application of intellectual energy to the study of that science. A large number of new electro-chemical processes have been devised, and some have already been put into operation. In Nature, chemical change is the sequel of local superabundance of energy, and the art of industrial chemistry naturally develops where energy is cheap and abundant. With the aid of engineering, waterfalls are becoming hives of electro-chemical industry.

A process has already been initiated for electro-chemically producing nitric acid from air, and hence the nitrates which enter into the development of food products. Perhaps this is the furthest existing attempt in the direction of artificial food production by electro-chemical means. Food may be regarded as assimilative substance produced by solar energy acting on non-assimilative substance. Each inland human being needs, on the average, a certain considerable area of soil upon which the solar energy machine can work, during the year, for the production of the food products that he consumes either directly or indirectly through the consumption of some other animal that he finally consumes. The solar energy costs nothing, but the engine in the form of the recipient soil, plants, agriculture, transportation, etc., has very definite expense. The same amount of annual incident solar energy would be enormously expensive to produce artificially; but so inefficient is the solar energy from a pure food-production viewpoint; that is to say, so little of the incident solar energy is actually utilized in the food-engine, that if we only knew how to accomplish the same result simply and conveniently, the necessary energy could probably be delivered to the raw material artificially, at lower final cost than that which agriculture and transportation involve. Nevertheless, the solution of the artificial food problem appears so remote that we must remain content with our thousands of square miles of solar food-engine and our millions of peripatetic food-storing quadrupeds. Every new fact and application of electro-chemistry, or energy-chemistry, may, perhaps, bring us nearer to an ultimate solution of the problem.

Some discussion still continues as to whether a moving electric charge does create a magnetic field in its vicinity. The phenomenon should occur according to orthodox electro-magnetic theory. It is claimed to have been observed by various physicists. It is claimed, on the other hand, not to have been observed, by a few. The weight of the evidence seems to be in favor of the fact. By the same token, the converse proposition should follow, that a moving magnet creates an electric field. This phenomenon does not appear to have been yet recognized.

In the treatment and expression of alternating-current theory, complex quantities, and their geometrical substitutes—plane vectors—have continued to make headway in general appreciation. The algebra of the complex quantity is, *par excellence*, the natural and simple algebra of the alternating current circuit. If it be discarded, simplicity vanishes and complexity reigns supreme.

Although a great number of direct current generators and motors have been built and installed during the past year, yet the direction of most rapid advance has been in connection with alternating-current machinery. Pressures are rising steadily, and as the pressure rises, the distance within the vision of supply increases, so that, when the price of fuel in a city is sufficiently high, power can be transmitted thither electrically from falling water at distances that have hitherto been impracticably great. The existing commercial limit is now set in California at 220 miles with 60 kilovolts, and the final limits are not yet encountered. This application of electricity is turning much attention to the study of commercial forms of insulators. The cost of insulation per mile of high-pressure circuit comes into appreciation, together with the cost of conductors and conduction. In a certain sense it may be already said that the range of economical transmission used to be set by the cost of conduction; but now begins to be set by the cost of insulation. Whereas, however, the art of conduction has reached scientific limits that for the present cannot be overstepped, so much conductance calling for so much investment, according to stereotyped rules, the art of high-pressure insulation is much younger, and has not yet apparently reached any definite limit.

In steam power transmission by electricity, the advent of the steam turbine has created some stir during the past year. When harnessed to the steam turbine, the alternator visibly shrinks in dimensions. Already, large sizes of stationary steam turbines are being constructed, and if their performance is as good as their projectors anticipate, we may look for a revolution in central station steam engine construction.

In electric railways, great development has taken place along the standard American lines of the 500-volt, direct-current system. Efforts have been made to break through the monopoly which practice has established for the direct-current system in this direction, and to introduce the alternating-current, long-distance, high-speed railroad motor. The great advantage of such a step, if successful, will be the suppression of the converter sub-stations. The exigencies of long-distance, high-speed railway traffic are such that nothing should revolve save the prime generator at the central station and the motor and wheels on the cars. The cost of equipping and maintaining adequate converter sub-stations heavily handicaps the long-distance electric railway.

While the alternating-current motor has been striving to obtain a foothold in railway work, improvements have been made in the induction motor, whereby its power-factor has been increased and its magnetism has become capable of being produced locally, instead of being produced by dephased alternating currents sent over the transmission lines all the way from the generating station. How fully this advantage can be practically secured yet remains for the future to determine; but there can be no doubt that if the wattless component of currents supplied to induction motors can be conveniently eliminated, the result will be a marked gain in alternating-current distribution. It should be no business of the transmission lines to carry the existing currents of the motors. They should only carry the energy of excitation.

An interesting and significant feature of the times is that the sciences, physics and chemistry on the one hand, and electrical engineering on the other, are growing closer. Engineering depends every day more closely upon these sciences, whence it draws its supplies. On the other hand, physics and physical chemistry are being daily more fully applied to the arts of life under the title of engineering. Consequently the enormous national, industrial and commercial importance of these sciences is becoming more clearly apparent year by year.

The past year has seen the National Bureau of standards placed upon a firm foundation. This important bureau is destined to form yet another connecting link between science and its applications, electrical, chemical and mechanical.

The metric system has made considerable headway towards public favor during the past year, not only in America, but also in all English-speaking countries. The younger generation, and progressive men everywhere, are for introducing it into general use, as soon as public welfare will permit. In this country, the Congress Committee on Coinage, Weights and Measures has strongly recommended a bill for adopting the system, and the Conference of British Colonies has also recently adopted a resolution in favor of the system for all British colonies. Leading men in Great Britain have recently expressed similar sentiments. Under these circumstances we may reasonably hope for such joint action among English-speaking peoples, in the near future, as will discharge the present incubus of a shamefully unscientific medley in weights and measures. for the simple metric system that has been found to give great satisfaction to European countries. The metric system lessens national labor, dispels fog and assists civilization.

The year 1902 will be notable in electric annals, if only for the reason that it has first seen the electric girdle completed around the world by the successful laying of the Pacific cable. The task has taken practically half a century to accomplish; since the first submarine cable for commercial work was across the Straits of Dover, in 1851. The latest cable in the Pacific, from Vancouver to Fanning Island, is the longest and the deepest cable in the world.

The terrible disaster of the 8th of May last, at St. Pierre, Martinique, is perhaps without a parallel in history. The suddenness with which the city's population was asphyxiated by hot volcanic gases was the appalling feature that stands unique on our records. The disaster made itself felt in electrical circles by the destruction of the cable ship *Grappler* in the roadstead at St. Pierre, and by the breaking of six submarine cables in the neighborhood of the volcano.

The year has also seen the feat of sending messages, by Hertzian waves, over and across the Atlantic, and from Cornwall to Cronstadt on the north and to Gibraltar, Cagliari and Genoa, in the Mediterranean. Even although no industrial use were to be made in the near future of these long-distance messages, yet their achievement is something that will always signalize the year. Wireless telegraphy has made much progress during 1902. Many vessels have become equipped with the apparatus, and various shore stations have adopted the system along the coasts. It seems to be only a question of time when all large vessels will be able to communicate by wireless telegraphy, with lightships and lighthouses throughout the world.

Telephony has made marked progress during the year, and continues to ramify its connections deeper and deeper into the shops, offices and residences of the people. The telephone is becoming ubiquitous, and the saving of time to the community which is thus afforded is enormous, expressed either in money, hours or convenience. Long-distance telephone lines are being cheapened in construction, by diminishing the size and weight of conductor, while adding reactive loads, or inserting reactances at regular intervals. Telephone engineering touches the sciences at many points, and makes great demands upon knowledge and skill.

Fortunate it is that as telephone circuits multiply, they do not tend to obtrude themselves more noticeably on the landscape. In the open country, the wires certainly become more numerous and spread overhead upon poles; but in urban and suburban districts, the more wires there are the cheaper it is, per wire, to bury them underground. Long-distance transmission tends, of course, to suffer thereby, even when the circuits are loaded; but the average service is far better and securer against wind and weather with underground than with overhead wires.

Subsequent to the welcome cessation of hostilities in South Africa, practically all the forces of engineering have been devoted during the year to the amelioration of the world and the uplifting of human existence. In this beneficent joint work, the share of the electrical sciences and arts has been an important one. It means in the United States the daily occupation of more than half a million of workers.

New Electrical Course at Union College.

Mr. Charles P. Steinmetz has been given charge of the electrical engineering department of Union College, Schenectady, and will institute a new course, to go into effect early in the year. Several additional instructors in this department will be engaged.

The Progress of Electrochemistry in 1902.

By George P. Scholl.

As the field of electrochemistry is so large and the amount of work done in its various branches is so great, nothing further can be attempted in the present article than to give a general outline of the advance made during the past year. It is evident that the progress, both from a practical and scientific standpoint, has been steady and continuous and that the industry emerges more and more from its experimental stage and is placed upon a solid footing.

Of the events of the past year, probably the most interesting to electro-chemists, as such, in this country, is the formation of the American Electro-chemical Society which has started its career under very auspicious circumstances, and whose membership now is more than 400—a goodly number. It has held two well-attended meetings at which a number of papers were discussed, which are published in Volumes I and II of its transactions. A little later followed the establishment of a journal, devoted altogether to the interests of Electrochemistry, under the name of *Electro-chemical Industry*, which is published in Philadelphia.

In electrometallurgy, at present, the most important branch of electro-chemistry, the number of patents issued in the past year for processes and apparatus of various kinds, bears evidence of a continued interest in the subject. In the domain of the precious metals the electrolytic deposition of gold from the cyanide solution by the Siemens & Halske process appears to be still reigning supreme, though efforts have not been lacking to devise methods which are intended to overcome its most serious drawback, namely the large amount of electrode surface necessary for a successful precipitation of the gold. There has not been as much attention paid yet in this country to the electrolytic process as it merits, but the future will undoubtedly see the Siemens & Halske or some other electrolytic process more largely applied. It is of interest to note that the Wohlwill process for the refining of gold has proven satisfactory in the Philadelphia mint. According to a statement made to the writer by Dr. Tuttle, the chief chemist of the mint, the plant consists of 7 cells, in series, 13 in. long, 11 in. wide and 8 in. deep. The electrolyte is a solution of chloride of gold, containing 30 grammes of the chloride of gold per liter and is strongly acidified with hydrochloric acid. Electrolysis takes place at a temperature of about 50° C. The weekly output of gold is about 5,000 ounces. The voltage at the terminals of the 7 cells is about 4.5 to 5 volts, with a current of 100 amperes.

The problem of obtaining copper directly from its ores by electrolytic methods has been solved very often on paper, but has as yet not found a solution satisfactory to metallurgists. Two interesting papers in this connection have been read by Dr. N. S. Keith (*Transactions* Amer. Inst. Elec. Engrs. and *Transactions* Amer. Electrochem. Society) giving details of the process devised by him, which is said to have worked with satisfactory results on a commercial scale in a plant near New York. Electro-refining of copper, where the superiority of electrolytic over the ordinary methods was first clearly established, has grown to very large proportions, and a series of articles in the London *Electrician* of August 1st and following numbers (abstr. El. World and Eng., Vol. XL, pp. 386 and 466) by Philip, on the financial basis and design of Electrolytic Metal Refineries is a valuable contribution to the literature on the subject.

In the metallurgy of lead we find a distinct advance in the successful application of the electric current to the refining of bullion by the Betts process, in a plant having a capacity of about 10 tons daily, located at Trail, British Columbia. The electrolyte is a solution of lead-fluo-silicate, to which, according to a recent patent (U. S. P. No. 713,277, of Nov. 11th, 1902) a small amount of glycerine is added. The anodes consist of the bullion to be refined and the cathodes are thin sheets of lead. The fall of potential between tanks is stated to be only 0.2 volt. The silver slimes obtained in the process are treated at the Seattle Smelting and Refining Works. They average about 8,000 ounces of gold and silver per ton (Ulke, *Eng. Min. Journ.*, Oct. 11, 1902). The reduction of galena as carried out by the Electrical Lead Reduction Company at Niagara Falls, working under the patents of Pedro G. Salom, continues to make satisfactory progress. The process has been described in detail by the inventor in the *Trans.* Am. Electrochem. Soc., Vol. I, p. 87.

The electro-metallurgical treatment of zinc, as well as of nickel ores, has occupied the attention of metallurgical engineers to no small degree, and efforts continue to be made to accomplish it. During the past year several patents have been taken, but nothing has leaked out as to their success in practice. The production of zinc by Hoepfner's process at Brunner, Mond & Co.'s works, Northwich, Eng., is stated to be about 1,000 tons a year and the product is said to be of an exceptional degree of purity. For nickel see El. World and Eng., Vol. 39, pp. 470 and 734.

The application of the electric current to the metallurgy of iron still seems to prove an attractive field to inventors, even the name of Paul Heroult appearing among them. This fact seems rather strange, as there is probably no likelihood of the electric current ever replacing the present metallurgical method, except in countries like Italy, Sweden, etc., where coal is very expensive, and where there is an abundance of cheap water power. Of course, the possibility of producing steel or other iron alloys directly from the ores is on the other hand a strong incentive to inventors. The well-known furnace of Stassano, working at 1,500 hp, at Darfo, in Northern Italy, has been modified, and instead of showing the familiar tall stack arrangement, is now constructed in the form of a reverberatory furnace, capable of rotating about its vertical axis. Another furnace, working by the Kjellin process, is to be installed at Gysinge, Sweden, estimated to have an output of 1,500 tons per year.

The manufacture of aluminum has long since passed the experimental stage and has settled down to the slow but steady growth of a well-established industry. In accordance with their policy for years past, the management of the various works have continued their secretive policy and practically nothing about the improvements in their methods of production has reached the ears of the public. As far as the Pittsburg Reduction Company is concerned, it is to be said that some of their fundamental patents run out in a few years, and they are apparently straining every nerve to bring their methods of production to such perfection that on that account alone they will be able to outdistance any possible competitor. They have purchased a large tract of land at Massena, N. Y., where they propose to erect new factories. The demand for aluminum is steadily growing and is sure to continue. Large quantities of it are used in the Goldschmidt process, which is also being perfected on a large scale by its inventor, Dr. Goldschmidt, of Essen, Germany. It will be remembered that this is a reduction process, in which metallic aluminum in powdered form plays the part of a reducing agent, large quantities of pure chromium and manganese being obtained by its help. It is also used largely for welding purposes and repairing castings. Aluminum seems to find more and more favor as a conductor in electrical work, and a number of valuable alloys, such as partinium, etc., are manufactured and find increasing use.

Processes for the production of the alkali and alkaline earth metals by electrolysis have not come prominently to the front during the past year. Early in the year the Darling process for the manufacture of sodium from sodium nitrate, used by Harrison Bros. & Co., of Philadelphia, was described in detail by its inventor before the Franklin Institute, and a considerable amount of it is said to have been manufactured during the year. Lately (*Zeitschrift f. Electrochemie,* October 2nd, 1902) Borchers and Stockum have described a process and apparatus for the production of metallic calcium and strontium, which promises to be of considerable interest. Fused calcium or strontium chloride are used as electrolytes (El. World and Eng., Dec. 20th). Phosphorus to the amount of 30,000 lbs. per month is said to be produced at Niagara Falls by the Oldbury Chemical Company, the American branch of Albright & Wilson, of Oldbury, England.

In the processes for the manufacture of chemical compounds by the aid of the electric furnace there is also manifest a steady and progressive development. As the calcium carbide industry in this country is entirely controlled by a single company, its condition was entirely unaffected by the great reaction which took place in Europe, where everybody that could lay hold of a small water power rushed into the business of manufacturing carbide, with the result of an utter demoralization of the trade. According to a statement in *Mineral Industry,* Vol. X, p. 74, it will probably require ten years before the demand for calcium carbide in Europe equals the present manufacturing capacity. There is no doubt that the demand for calcium carbide will increase, as acetylene light is well suited for the conditions existing in many country districts, and calcium carbide is beginning to be used in increasing amount for various metallurgical reduction purposes. A significant statement is made in the London *Electrical Review* of October 10, 1902, namely that the United Carbide Factories of Nuremberg, Germany, are contemplating an action to have the Willson patents anulled in the United States, in order to obtain an outlet for their material on this side of the water.

That indefatigable worker in the field of electro-chemistry, Mr. E. G. Acheson, is to the front again with a new process (U. S. P., 711,031, October 14, 1902) for the production of graphite, an improvement on his former method. The process is based on his discovery that a perfect transformation of amorphous carbon into graphite takes place by causing metallic vapors to act upon the amorphous carbon at the high temperature of the electric furnace. The total yearly production of graphite by the International Acheson Graphite Company, is stated to be about 1,000,000 pounds.

The carborundum industry has also been making steady progress, a third block of furnaces having been constructed at the Carborundum Company at Niagara Falls, and the output of carborundum is to be increased to 1,800 tons per year.

The plant of the United Barium Company at Niagara Falls is being enlarged from 12 to 60 tons capacity for the production of barium hydrate, which is used for various purposes in the arts, such as paints, etc.

Carbon bisulphide continues to be manufactured in large amounts by E. R. Taylor in his improved electric furnace (U. S. P., No. 706,128, August 5, 1902).

In the field of the electrolytic alkali industry there have been no new developments that have been made public. Kershaw (Lond. *Elec.*, Nov. 28, 1902) states that in Europe about 28,000 hp are utilized in this industry. The severe competition in bleaching powder in Europe has caused a sharp decline in the price of that material, it being even sold as low as $20 per ton in Canada. This contingency has caused the shut-down of the Canadian Electro-chemical Company, Ltd., at the Soo, a company operating under the Rhodin patents.

One of the most interesting processes recently announced is the conversion of the nitrogen of the air into nitrous compounds, and the recovery of these, patented by Bradley & Lovejoy (U. S. P., Nos. 709,867, 709,869, Sept. 30, 1902) and carried out by the Atmospheric Products Company at Niagara Falls. Professor Richards states (*Electrochem. Ind.*, I, p. 22) that the process has worked so satisfactorily on an experimental scale, that the company has decided to start commercially with 2,000 hp. The formation of the nitrogen compounds is caused by the air being drawn through a large number of very thin and very long arcs, which are struck between a large number of stationary and revolving electrodes.

Ozone manufactured in electrical apparatus is fast coming into use as an ozonizing and sterilizing agent for water. Siemens & Halske ozone apparatus has been installed in the water works of the city of Wiesbaden, Germany, which started operation in the beginning of August, 1902, and was followed soon by a second works, of the city of Paderborn, fitted out with ozone apparatus by the same firm. The future will probably see a considerable development along this line.

The ultilization of the electric current for the purposes of electroplating covers such a large field that it is not possible to enumerate the progress made in it in detail. There is, however, a marked tendency apparent in electroplating circles to leave the old rule of thumb methods and run their business more scientifically. The apparatuses are fitted out with current-measuring instruments, so that the conditions are kept perfectly uniform even by unskilled attendants.

Analytical electro-chemistry, involving the use of the electric current for quantitative determinations and separations in chemical analysis, has also steadily advanced. The subject is brought up to date by Dr. Edgar F. Smith, Professor of Chemistry in the University of Pennsylvania, the leading authority on the subject in this country, in the third edition of his book on "Electro-chemical Analysis," which has appeared quite recently. In organic electro-chemistry, probably the most difficult branch of the subject, progress is necessarily slow and it is quite probable that methods are used by various industrial works engaged in the manufacture of organic compounds which have not been made public.

For a time it seemed as if electro-chemistry had less to do with the advances made in storage batteries than mechanical engineering, as the efforts of the constructors seemed all to be bent on perfecting the mechanical construction of the plates in the lead cell and obtaining the greatest electrical effect with as little weight of electrode material as possible. A large number of patents also in the past year have this as their object. According to a statement by

Mr. Hugh Rodman in a paper read before the American Electrochemical Society, the position of the lead cell seems secure for all stationary batteries for central station work, which at present represent 75 per cent. of all the storage batteries manufactured. Another side of the question has been prominently brought forward, however, by the increase in automobilism, for which a light storage battery is a *conditio sine qua non.* A light battery would undoubtedly control all city traffic not on rails. Two batteries which have come prominently to the front, using material other than lead as electrodes, are the Edison and the Welsbach cell. The Edison cell is stated to have been much improved and to be ready to be put on the market in a few months, but no data in regard to it are at present obtainable. The same conditions obtain in regard to the Welsbach cell, of which less, if anything, is known than of the Edison cell.

In the construction of galvanic cells the efforts have been mainly directed at constructing fluid-tight and high-capacity cells, of light weight, evidently with the object of utilizing them as motive power in automobiles.

From the facts stated above it is evident that there has been a continuous advancement all along the line of electro-chemistry during the past year, and there is every reason to believe that the advancement will continue during the year just begun.

Three-Phase Transformers Adopted by the Chicago Edison Company.

It is a matter of no little interest to note that the Chicago Edison Company has adopted for its future work the practice of using three-phase transformers in connection with its rotary converters at sub-stations, instead of the usual American practice of three single-phase transformers connected polyphase. While the use of three-phase transformers is very common in Europe, it has never become popular in America.

Among the principal reasons for its adoption by the Chicago Edison Company has been the saving in floor space and the saving in first cost effected by combining the three transformers in one. The use of a single three-phase transformer makes it possible to connect star fashion the six-phase secondaries, which feed the rotary converters. One terminal of each of the six coils is led out and connected to the rotary converter, and the other terminal is connected to a common neutral, which neutral, if desired, can be connected to the neutral wire of the Edison three-wire network. The connection of the secondary coils for six phases from a single star-connected, three-phase transformer, is much simpler as to wiring connections than three single-phase transformers, connected on a divided delta, to give six phases.

As far as possible, two standard sizes of transformers will be used for rotary converter sub-station work by the Chicago Edison Company. These sizes are 1,100 kw for the operation of 1,000-kw rotary converters, and 550 kw for the operation of 500-kw rotary converters.

With a star-connected, six-phase secondary, the voltage on the secondary is 72 per cent. of the direct-current voltage given by the rotary converter, while with three single-phase transformers, connected on a divided delta, to give six phases, the voltage is 62 per cent. of the direct-current voltage on the rotary converter. There is, therefore, some saving in the secondary wiring, between transformers and converters, with the single three-phase transformers having six-phase, star-connected secondaries.

The 1,100-kw, three-phase transformers will be of the air-blast type, transforming from 9,000 to 182½ volts. They are of the A.B.T. type; this being the abbreviation for "air-blast, three-phase," made by the General Electric Company.

The higher voltage on the secondary before spoken of enables somewhat small regulators to be used. These hexaphase induction regulators are 88 kw for the 1,000-kw units, and 44 kw for the 500-kw units.

The rotary converters for 1,000 kw are 14-pole, 1,000-kw, 214 r.p.m., 250-volt. For a 500-kw unit, the rotary converters have 8 poles and run 375 r.p.m.

Pay for Korean Trolleys.

By way of St. Petersburg, it is announced in a special dispatch from Seoul, that the United States Minister to Korea has demanded the payment of $1,500,000, due to the builders of the electric railroad.

Central Station Progress During 1902.

BY W. S. BARSTOW.

At no time since the inception of the first central station has development been so pronounced as during the past four years. The introduction of the polyphase system has so revolutionized and extended the limits of electricity supply as to bring about an era of consolidations. To the casual observer these consolidations of lighting and power interests have been consolidations in a financial sense only, and but few realize the physical changes which have taken place in the properties themselves, changes without which present financial results could never have been attained.

Up to within a few years the financier has paid little attention to the numerous electrical developments going on about him because of the one fact that he was unable to satisfactorily compute results. In the early days of the central station it was only the most modern of plants which had any idea whatever of the cost of their output. Poor and good paying customers were considered alike as a whole, and the results were for the most part unsatisfactory. It was soon seen, however, by those familiar with the growth of large industries that to be commercially successful, electricity supply must be put upon a business basis. This basis was soon reached by the adoption of central station measuring instruments, which although inaccurate as compared with those of the present, were a means of correcting existing errors, and the rapid improvements of electrical indicating and recording meters contributed largely to the financial progress of the industry as a whole. The mere fact that the station knew the cost of its output and could compute its income per unit made itself felt in public confidence (where luxury gave way to necessity), and soon electrical engineering was put to the test of supplying a public demand. Such expansion meant the enlarging of the entire central station field. New conditions of demand arose, until to-day a single generating unit represents a capacity seldom found in an entire central station of but six years ago. This means not only new design of electrical plant, but steam plant as well, although perhaps the changes in the former are more noticeable than in the latter.

The recent progress in steam engineering has been marked by increase of boiler pressure, introduction of superheated steam and improved systems of condensing. With increased boiler pressure and superheated steam there naturally arose a demand for more careful design and construction of steam piping, resulting in reduction of condensation losses, by no means a small item of central station expense. The introduction of automatic coal-handling machinery, and the increase in the size of generating units, makes it possible to-day to operate with the same force of labor a central station with fifty times the output of a station of only six years ago. The demands for larger units and the adoption of multipolar generators gave an impetus to low and medium-speed engine development, so that to-day it is the exception rather than the rule to see in a large central station units exceeding a speed of 120 revolutions, whereas, formerly, high speed was almost the universal type.

The development in the electrical plant has been marked by the abandoning of direct-current generation, but by the retaining of direct-current distribution. Machine design and the adoption of alternating-current generation has made possible an increase in generated pressure ten times what it was a few years ago. This increased pressure enlarging at once the area of supply from a common center, introduced, however, a new and important feature in central station engineering, for it became necessary not only to transmit this increased pressure, but to distribute it in much the same manner as the low-tension, direct current of the past. The means whereby such distribution could be positively accomplished brought at once into prominence that device of heretofore second importance—the switchboard.

The switchboard of the primitive station consisted of a few instruments and switches located on or at the side of the small generators with an abundance of fuses scattered throughout the plant. In the early days instruments were considered a luxury and not a necessity, and allowance for "a switchboard" was generally stricken from the estimate of the central station construction budget, while at the present time in the sub-station it necessarily forms as large an item of expense as the total transforming machinery. In the last two years the introduction of high-voltage polyphase current has made the means of control an all-important device and absolute requirement of modern central station operation. The mere thought that upon it the entire output of a large industry depends, as well as the success or failure of a large financial undertaking, makes the switchboard the heart of the power plant and shows at once its importance and the care with which it should be designed and installed.

It is perhaps in this direction more than in any other that we find the greatest progress during the past two years. The oil switch, the automatic safety devices and measuring and indicating instruments have reached such a point of development as to leave scarcely any improvement to be desired. The details of design have been so elaborated that there seems almost a complication, and yet by the use of secondary systems positive control is easily placed within the hands of a single operator. In many stations—in order to further aid the attendant, by removing possible means of confusion—the controlling mechanism is entirely closed off from the generating room, so that its quiet is comparable to that of a library.

While many changes have rapidly taken place in the generating system, the distributing system has been modified but little. In the underground work the introduction of tile conduits has given a more permanent appearance to subway construction, while extended use of paper insulation has lessened the expense of cable work. In overhead systems the progress has been noticeable in increased strength of material and improved design of fittings, requirements of high-pressure transmission lines demanding special attention in this direction. On the premises of the customer the devices for the use of electricity have multiplied to such an extent that supply of energy for lighting is almost paralleled by requirements for other service. The constant progress of meter development has already permanently removed that "bugbear" to the customer and the central station—the flat rate.

It is on account of this vast progress of the last two years that great care must be exercised on the part of the smaller central station, in that irrespective of its own local surroundings it does not blindly follow in the leadership of the larger plants and go beyond the improvements which have been made to apply to its own conditions. There are to-day many examples where stations have been extensively "modernized," only to find their operating expenses increased simply because their conditions did not call for the extensive changes.

In reviewing the past year's developments one can scarcely see a chance for improvement except in simplification in details of construction and operation, and yet in the light of past progress the central station engineer naturally looks to the future for further developments.

In the transformation of energy from the coal pile to the switchboard, the steam plant of to-day is chiefly responsible for the great losses, the greatest loss being in the prime mover itself. While improvements in the engine have been many, they have been made in detail to comply to new conditions of service and space, and the initial efficiency or reduced cost of operation has not been radically changed.

At the beginning of 1903 no one thing is more attractive as to future possibilities, and which will have more to do with the future progress of electricity supply development, than the steam turbine, which, although recent in commercial engineering, antedates the steam engine in its conception.

The conversion of thermo-dynamic energy in the chain of power transformation of a central station has always been the weak link as far as efficiency was concerned. It is true the use of superheated steam helps and will continue to improve steam engine economy, but this economy is brought about not so much in the engine itself as in the nature of its supply. Steam engine improvements since the time of James Watt have only been mechanical. No one realizes more than the steam engineer himself the little to be gained in the economy of the reciprocating engine, this line of work having been so often reviewed, so that it is no wonder that attention has again been turned to the first steam motors, the reaction turbine of Hero as well as the impact turbine of Branca, a type so familiar in modern hydraulic engineering.

In 1883 De Laval, in connection with the cream separator, developed a steam turbine, at first a reaction wheel but later one of Branca type. This machine was and is still used in cream separators. De Laval spent his energies in securing a complete and adiabatic expansion of steam, and endeavored to convert its entire static into kinetic energy.

In 1884 Parsons developed a steam turbine by allowing the steam by its expansion after admission to the turbine to convert its energy into velocity, acting and reacting on a series of movable and stationary blades. These two are exponents of extreme systems, others taking from each and possibly adding improvements thereto.

The year of 1903 will be remembered as the year in which the steam turbine began its battle for commercial supremacy. That its success will be eventual, there can be no question. It is not surprising that during all the past twenty years of electrical progress, at times almost revolutionary, any radical development in the prime mover should meet with unusual favor. When in the near future the steam turbine supplants the steam engine it will be welcomed by none as heartily as by the electrical fraternity, where small size, low cost and ease and economy of operation will be appreciated. Such a change will again revolutionize the details of construction of the central station. The generator passing from the high-speed to the low-speed type, will again pass to extreme high speed, where requirements other than electrical will govern construction.

This replacing of the steam engine will bring about with it necessary changes in boiler pressure, steam temperatures and vacuum, and will modify more or less all details of steam plant. In the meantime the development in electrical apparatus will continue, as under decreased cost of installation and operation, and the addition of new channels of demand, the whole field of the industry continues to broaden. Each new improvement makes itself felt in changed conditions, so that no one would dare at the present time to describe even prophetically the final "modern central station."

Problems of the Western Telephone and Telegraph Company.

According to reports in the New York and Boston financial organs, the Western Telephone & Telegraph shares are now quoted at about 22, which is equivalent to 16½ for its predecessor, the Erie Telephone Company, as 100 shares of Erie stock were converted into 75 shares of Western Telephone stock, besides having to pay an assessment of $25 per share for Western Telephone preferred at par. Erie Telephone shares never sold below 15, and once sold as high as 122⅜. On the reorganization, $15,000,000 of money was raised to pay off the construction debts, and put $6,000,000 more into new construction.

The Southwestern Telephone Company, the Northwestern Telephone Company, the Wisconsin and the Cleveland companies are understood to be doing a continually increasing business. The Western Telephone Company owns but 70 per cent. in these and also owns $3,600,000 stock, $2,400,000 floating debt of the Michigan Telephone Company, and these assets are problematical. This company was not taken in by the Western when the Erie was reorganized, but was left to future treatment.

The Michigan Telephone situation is rather anomalous. The property is hampered by lack of new money and by floating debt. The bondholders know that more than the face of their bonds has gone into the property and is still there. There are $5,000,000 of Michigan Telephone bonds and $650,000 of Detroit Telephone bonds. It is understood that these bondholders are willing to buy the property at foreclosure and put up new money for extensions. Expert valuation of the Michigan Telephone property shows $9,000,000.

The problem the Western Telephone Company has on its hands is how to finance the Michigan in the future and not carry the whole load. It is proposed that the bondholders shall make some concessions and that the stock interests furnish new money, but the bondholders do not receive the suggestion with favor. They say they prefer to take the property, and there the matter stands. If the Western Telephone Company could realize upon its assets in Michigan or come to some agreement with the bondholders by which new money could safely be poured into the property, Western Telephone shares would have a broader speculative future.

It is said that the Michigan Telephone Company is earning its bond interest and a margin of $100,000 besides, but this is a narrow margin upon which to carry $2,400,000 of floating debt and raise additional construction money. Besides, the constantly increasing demand for apparatus in the territory creates of itself a call for new capital in considerable volume.

The Outlook in Electric Traction in 1903.

By Dr. Louis Bell.

THE important work of expansion which has marked the year just past seems likely to continue through the coming season. There is no reason to expect any diminution of the present activity in developing interurban lines of communication unless business conditions should change materially for the worse. If one looks over the work of the past few years it is quite obvious that interurban railways have marked the direction of steady growth. There are good reasons for this state of affairs and for its continuance. Most of our cities are now pretty well provided with street railways, and while many new lines are being constructed or are in contemplation they are in the nature of minor though useful additions to well-established systems. On the other hand, the extension of electric traction to heavy railway working rests rather in abeyance. Conservative railroad men still have many doubts as to the real commercial value of a change of motive power, while freely admitting the feasibility of electric working as an engineering feat. Even were they convinced that substantial economy would result from a change they still would hesitate long before entering upon a programme which would involve changes so far reaching and an increase of investment so formidable.

Most American railways are well known to be greatly overcapitalized, so that they are enormously sensitive to comparatively slight changes in the conditions of general business, and even a change which promised definite economy would receive a scant welcome if it implied a considerable increase in the fixed charges. The merging operations now steadily under way have created a community of interests which adds largely to this natural inertia. Therefore, from a practical standpoint interurban electric traction by independent companies presents the line of least resistance along which growth naturally takes place. Moreover, interurban roads well planned and well built meet a public need, have the moral and material support of the community and have rather uniformly proceeded successfully. They are particularly likely to increase in sections of the country which have been hampered by the unwise administration of monopoly on the part of the steam roads. Hence one sees such great developments as are now in progress in Southern California. In some regions the steam roads have successfully resisted such competition by open and shameless lobbying against franchises or by themselves covertly obtaining franchises to be suppressed or to be utilized only in such way as may serve to avert competition.

On the whole, however, interurban work has a fair field and may be expected to make great headway in the immediate future. Physically, it may be expected for the present to proceed along well-beaten paths. There are, however, two factors which must be taken into account in forecasting the engineering work to be done on interurban systems. First in order of importance comes the possibility of an alternating-current motor system in one form or another. Several such are under trial in this country and abroad with results which are encouraging, but not yet fully decisive. The practical development of any one of these would prove a powerful stimulus in certain kinds of interurban work, notably that which most closely approximates ordinary railway practice.

There are in reality two rather distinct classes of interurban roads. One must be regarded merely as an extension of suburban lines, operating rolling stock which in design, speed, and general functions is not radically different from that in use on the urban systems. The interurban cars, in fact, are here intended to form an integral part of the suburban and interurban service and to share near the termini the same tracks. In such instances there is no immediate likelihood that any alternating motor system will commend itself, by reason of the obvious difficulties in the situation.

The second class of interurban roads comprises those in which uniformity of equipment and community of termini have been sacrificed for the sake of faster and more effective service on the interurban route proper. There is no rigid line of demarcation between these and the former class, but the differences are plain enough to permit of little hesitancy in assigning a given road to one or the other. In case of these larger interurban lines the development of alternating motors has much significance, and while it is as yet too early to venture predictions, it is certain that a good alternating system would greatly facilitate the growth of extensive networks of such electric roads.

On the other hand, a factor is getting to work which may have no small effect on the distribution of power for large systems. The turbo-generator is now prominently before the public, and bids fair to force its way into railway practice to a very material extent. It has three virtues which commend it strongly for use in traction plants. It is generally economical of steam; it gives a good efficiency at moderate loads; and it appears to require relatively little care. In large power stations its virtues are less conspicuous than in small ones where it is put into competition with engines of moderate output, and its best hold in railway engineering would seem to be in equipping auxiliary or distributed stations on extensive systems. Everything which tends to increase the economy of small plants tends to diminish the advantage to be gained by generating power at a single point and transmitting it to sub-stations with rotary converters. Such transmissions are now common, but unless the central station is operated by water power there is considerable room for debate as to the economy of the process. A certain class of distribution cases could certainly be treated to advantage if generating sets of two or three hundred kilowatts could be counted on for the economics which turbo-generators seem to possess. It is assuredly to be expected that turbo-generators will have their chance to make a reputation before another year has closed, and the result may have a very important bearing on future interurban developments.

Quite apart from interurban practice stands the heavy suburban and elevated road traction which is now under way. Of this there is certain to be an increasing amount, probably following rather closely the lines already marked out. Such work stands alone in the service requirements as to acceleration and the uniformly very large output demanded all along the line. At present the third rail seems the only available variety of working conductor in spite of the very serious trouble from sleet which has been most unpleasantly prominent of late. Some method of protecting the rail against this and against the really grave danger to life in case of accidental contact seems essential, but nothing of the kind has yet stood the test of experience.

Again, the complication of the third-rail system in large terminals is of the most forbidding character, and it seems probable that an effective remedy can be found only in reorganizing the current yard arrangements. It is altogether improbable that in such situations a change of motive power from steam to electricity can be accomplished without any changes in methods of operation. Hence the work of re-equipping a big suburban system for electric traction is a rather slow job requiring great caution and finesse, and thus will be undertaken with some hesitation. The next year will show progress in this direction, but probably not to any sensational extent. The policy of those who would be most interested is a waiting one, keeping watch for the results to be obtained in the several large plants already well under way.

Oddly enough, the electric high-speed railway devouring space at a hundred miles per hour or more is actually further in the distance than it was ten years ago. The engineering side of such a proposition, then involving many dubious factors, may now be said to involve no serious difficulties, but the road itself has retreated into the future in spite of the certainty that it could be made operative. The experiments at Zossen that have been so much discussed did clear the way of the one bugaboo that remained—the air resistance. But, as the writer has frequently had occasion to remark, the difficulties of the case are commercial, not technical, and these still remain. Only between large centers of population and over rather long distance would such a road give promise of large returns. Now as a matter of fact, our present steam roads are operated far below speeds that could easily be reached, and an enormous weight of influence is brought to bear against any attempts to quicken running time. To cause the construction of a high-speed electric road requires either conditions of fierce and genuine competition between existing trunk lines, or an independent organization with unlimited resources for lobbying. Neither of these contingencies seems at the present time probable. It is safe to say that if a project for a high-speed line between New York and Chicago were under way, the cost of the franchises and the subsequent litigation would wreck the scheme before a wheel could be turned. The hundred-mile-an-hour train is far more likely, so far as the present outlook indicates, to come into actuality abroad.

Another interesting branch of electric traction—the rural railway—is undergoing marked development, but by an indirect process. The value of electric railways to a rural community has long been understood, at least for the time being. The prejudice against light railways in this country is strong and it has been earnestly fostered by builders of rolling stock and car equipments who find their easiest source of profit in pressing the use of their standard types. It is practically out of the question to find proper equipment for light railways, and hence the real demand for rural roads has been otherwise met. It has, in fact, been filled so far as circumstances have permitted, by minor interurban lines connecting small cities, but gaining no small part of their traffic from the intermediate rural communities. Many roads of this class have been constructed and many more will be in the near future. The need for better rural communications in this country of bad roads is acute, and the smaller interurban roads afford no inconsiderable relief. In this class of work a freight franchise is indispensable if the rural lines are to be of much public utility, and the status of electric roads having such franchises is a matter of grave importance. The interests of ordinary railroads are strongly against freight-carrying electric roads, and the resulting opposition has been and is very determined, but the welfare of the community demands new channels for traffic and they are sure to come. The feeling which exists does, however, tend to rob the electric roads of part of their normal usefulness.

Altogether, the outlook for electric traction is a favorable one, especially as to interurban systems. These, big and little, will steadily increase in importance, albeit the larger projects fall short of the hopes for speed that have been so long current. Several of the interurban lines now built and under construction will run fast trains, but there is nothing sensational in sight as yet. And happily electric railway building is on a far sounder basis financially than used to be the case. There is less exploiting and more building; there are fewer prospectuses and more dividends, so that investors, even in times of relative stress, are more disposed to stand behind a class of enterprises that have become conservative.

The Fire Hazard of Electrical Apparatus.

A disastrous fire broke out in the power house of the Helena Light & Traction Company, at Helena, Mont., on the evening of October 20, completely demolishing the building and nearly all of the machinery, the exception being a number of oil-insulated transformers which were practically uninjured. The building originally contained a steam plant, which has gradually been abandoned, power being purchased from the Missouri River Power Company, which supplies power from Canyon Ferry, 18 miles distant, over a double 11,000-volt circuit. The effects of the fire upon the high-tension apparatus of the Missouri River Power Company installed in the station may be summarized as follows:

The high-tension switchboard, lightning arrester equipment, and, in fact, everything but portions of the six 11,000-volt, 150-kw Westinghouse transformers, were totally destroyed. However, two of the transformers were not upset and, being oil-insulated, their vital parts were protected from the fire. The oil did not burn away sufficiently to injure their coils or cores, and it is probable that it would not have ignited at all had not the covers been removed from the cases, before the fire, to facilitate cooling, the transformers being worked at a heavy overload. The four other transformers were standing on a wooden floor and as soon as the latter was burned away they were upset and poured their oil into an engine pit below.

There were also in the station two 100-hp induction motors driving, through a line of shafting, six direct-current arc light dynamos. The arc machines were totally destroyed, but, from the report of the appraisers, it appears that the induction motors were damaged only to the extent of 50 per cent. of their value. Although the marble distribution switchboard of the station was completely destroyed, there were found behind it three oil-insulated Westinghouse potential regulators in cast-iron cases, which were practically uninjured, the damage appraised being at $20 to provide handles, cable terminals and cleaning up. The results of this fire have demonstrated that oil-insulated transformers are far more immune from injury than almost any other kind of electrical apparatus. It would be necessary, however, to give them solid and substantial foundations to prevent upsetting in the manner indicated or in any other way.

The Outlook for Electrical Apparatus in Europe in 1903.

By Henry L. Geissel.

Having just returned to this country from an extensive trip abroad, I wish to call the attention of American manufacturers of electrical machinery, electrical appliances and electric supplies and novelties, to the great opportunities which exist for the sale of our goods in most of the European countries. There are several markets in Europe which are still "terra incognita" to many of our manufacturers. Though there is still felt a general industrial depression in some of the great manufacturing countries of the Continent, and though the demand for machinery in these countries is not as large and steady as it was some years ago, commerce and industries in these countries are not at a standstill, and orders are still being placed. Unfortunately, the majority of our manufacturers indulge the regrettable habit to neglect entirely and absolutely their foreign customers, when busy at home. As soon as they run short of domestic orders, however, they want foreign trade; and in this fact lies one of the principal drawbacks to the steady expansion of our trade abroad.

I visited during my trip a part of the northern coast of Africa and proceeded then, by way of Gibraltar, to Spain and Portugal. Later I went to France, Belgium, Holland, England, Luxemburg, Germany, Denmark, Norway, Sweden, Austria-Hungary, Italy, the Islands of Sicily and Sardinia, and to Switzerland. In the principal cities of these countries I called upon the leading importers of and dealers in electrical machinery and appliances. I also saw many officials of electric power stations, electric railroads and tramways, electric lighting stations and other plants. The statement which I have made above regarding the shortsightedness of American manufacturers in the way of neglecting foreign customers whilst they get plenty to do in the United States, was not only indorsed by a great number of importing merchants in cities like Madrid, Paris, London, Copenhagen, Stockholm, Berlin, Milan, Genoa and Zurich, but many of them told me, as soon as I spoke about the advantages of our machines, "What is the use of establishing connections now in your country, while your manufacturers do not care for foreign orders. We run the risk of losing our trade in introducing new American machines and creating a demand for them, when your manufacturers, a little later, will refuse to accept further orders."

On the other hand, German and British manufacturers make it a point always to take care of their foreign customers. Another chief hindrance to the development of our foreign connections lies in the fact that the great bulk of all the catalogues sent out from this country are in the English language. We shall never be able to do business of any importance abroad if we do not address the foreign customer in his own tongue, or in a language which he is likely to understand. French catalogues, for instances, can, to good advantage, be used not only in French-speaking countries like France and Belgium, but also in Spain, Portugal, Italy, Switzerland, Luxemburg, Turkey, Greece and European Russia, where the educated class of people generally speak and write French. German catalogues can be used in Germany, Austria-Hungary, Scandinavia and on the Baltic.

On the Continent of Europe the best possibilities for the sale of electrical machinery and supplies exist chiefly in countries poor in coal, like Italy, Sicily, Sardinia, Switzerland, Denmark, Norway, Sweden and Holland. While limited as to fuel supply, Italy and Scandinavia, especially Sweden and the northern provinces of Italy, i. e., Lombardy, Piedmont, Liguria and Venezia, abound in powerful waterfalls; and electricity in those regions is making steady progress. In the mining industries of the Islands of Sicily and Sardinia electricity is also coming more and more to the front. This is also the case in the industrial centers of Spain, such as the provinces of Huelva, Cordova, Asturia, on the Bay of Biscay, and in Catalonia, on the Mediterranean.

In Southern Europe, that is to say in Spain, Portugal, Italy, the islands of the Mediterranean, the south of France and in the countries on the Adriatic, we ought to be able to sell light electric machines, electric novelties and electric fans. It is much easier to introduce and sell these goods than heavy machines. These light and small articles are carried in stock by many importers and wholesale and retail dealers, while orders for heavy machinery are, as a rule, only placed when new plants or works are to be equipped and in that case the required machinery is generally ordered from the manufacturer. This is the reason why most of the great German electrical works, like Siemens & Halske, Allgemeine Elektricitäts-Gesellschaft, Schuckert & Co., the Helios Company, W. Lahmeyer & Company, Union Electric Company, and others have their own offices in the principal countries of the Continent, and in many cases have established sub-companies in foreign countries. A good deal of heavy electrical machinery, etc., is also exported by well-known Swiss manufacturers like the Oerlikon Works, Brown, Boveri & Co., and Escher, Wyss & Co. These firms, too, have branch offices all over Europe.

I have no doubt that by taking the right steps we can largely increase our sales in electric machinery in England and most countries of the Continent, but we must go after this business just as energetically and systematically as we do in this country. No manufacturer should think that he can create a demand for his goods by simply sending an English catalogue abroad. This is, in most cases, waste of time and money. Manufacturers of heavy machinery should try to arrange for local representation in each principal country of Europe. There are many American manufacturers who have an agency in London, Paris or Berlin. These offices, however, are never in a position to establish business connections on a sound basis all over Europe. The man in the Island of Sicily who wants to install an electric plant will never go to Paris to get American machinery, nor will the importer in Trieste, Fiume and Budapesth go to Berlin whenever he is in the market for American goods. I have talked these very questions over with hundreds of users of electrical machinery in the various countries of Europe, and they all prefer absolutely to buy from their own countryman who represents American firms, or from the local branch office of the American manufacturer.

Those firms anxious to establish connections on these lines should make arrangements for local representation in cities where the bulk of machinery is handled, and which are, at the same time, first-class distributing points. As those centers I would recommend in Spain, Madrid, Barcelona and Bilboa; in Portugal, Lisbon; in France, Paris and Marseilles; in Belgium, Brussels; in Holland, Rotterdam; in Great Britain, London, Birmingham and Glasgow; in Luxemburg, the city of Luxemburg; in Germany, Hamburg and Berlin for the North, Munich for the South, Breslau for the East, and Dusseldorf or Cologne for the West; in Denmark, Copenhagen; in Norway, Christiania; in Sweden, Stockholm; in Austria, Vienna; in Hungary, Budapest; in Italy, Milan, Turin or Genoa; in Switzerland, Zurich. By a network of agencies thus established there is little doubt that a successful business can be created, especially if we treat our foreign customers in the same way as our own American customers insist on being treated.

Power Development of British Columbia.

Mr. L. E. Dudley, U. S. Consul, reports to the State Department from Vancouver, B. C., on the work being done to furnish electric power for that city and the city of New Westminster, twelve miles away. The object of the company is to join the waters of Lakes Coquitlam and Beautiful by a tunnel two miles long, and provide a permanent source of hydro-electric energy for all purposes. The dam is 405 feet above the sea level, and will be 300 feet long, 50 feet high, 35 feet at the base, and 8 feet on top. In addition to doing this work the company has a gang of men employed in cutting a terrace out of the face of the rock to form a site for the power house. It will be so situated that even if the big dam did give way, the rush of the waters would not affect it. Outside of the company's force there are about 150 employed by the contractors in clearing the portion that is to be submerged, which will make the lake surface 500 acres. The intention is to keep the water always 20 feet above the outlet pipe from the big dam. From the dam down to the power house is a drop of 400 feet in 1,600. Other men are working on the tunnel which will bring the waters of Coquitlam Lake down to Lake Beautiful. In this tunnel the men are boring through solid granite. The tunnel, when completed, will be 2.5 miles long, and will have in that distance a drop of 32 feet. An electric locomotive has been ordered and should now be delivered. This will not be used on the first section of the road from the inlet up, which is a 58 per cent. grade, but will be employed above, to haul the rock out from the tunnel. The transmission line, for which two big gangs of men are now cutting through the forest, will cross the inlet at Barnet. On one side there will be a steel tower to receive the cable. The distance across is nearly half a mile.

Electrical Distribution in the Machine Shop in 1903

By Kern Dodge.

So many new shops are being erected and so many are being modernized, that the question of the best voltage or system for power and lighting, constantly comes up; and it might be well to say that the question will continue to arise for each plant, as each shop is a problem in itself and must have a solution fitting the particular case at issue.

The power required in the shop is in most cases divided into two classes, viz., constant speed and variable speed. The constant-speed motor is used to run sections of line shaft and some machine tools, such as punches and shears, which require a nearly constant speed. This class presents the least difficulty to the application of the motor.

For constant speed work, the alternating-current motor possesses some marked advantages and its use for this service is satisfactory. Among the advantages which will be gained by installing independent constant-speed motors instead of the line shaft and belt method, may be named clear head room for cranes, portability and lighter and cheaper construction of buildings. Each machine has a particular function to perform and it should be run in such a way that it will do its work in the least possible time, with the least physical exertion on the part of the operator.

Let us consider a special case, say a punch which is running from a line shaft by belt, and we wish to equip it with a motor. Taking the punch first, we find that it is capable of punching a certain sized hole through a given thickness of plate and that the work to be done on this tool is of such size that a hole may be punched at each stroke. The horse-power is determined by the work to be done, plus the friction load of the machine. The current is supplied by a plant already installed and may be either direct or alternating, as the case may be.

Now for the actual running of the machine. We have sufficient data to choose the proper motor to run the tool, remembering that it is perfectly safe to overload the motor from 30 to 40 per cent. at the instant of punching, as the actual time required in punching is but a fractional percentage of the running time, but there are other points which cannot be overlooked, namely, the size, weight and speed of the fly-wheel, for in many instances a motor which will keep the machine in satisfactory operation will not have sufficient starting torque to overcome the inertia of the fly-wheel.

The easiest and best way to determine the power required for any tool is to temporarily belt a motor to it and take careful readings of the ammeter and voltmeter in the motor circuit. But in punch work these measurements will be misleading if the testing motor is very much larger than the actual motor required, for the starting torque of the large motor will start the fly-wheel up rapidly, and this feature of overcoming the inertia of the fly-wheel may be lost sight of.

At last we have found the motor which meets all the conditions, and it must now be attached to the machine. To get the most efficient installation of the motor requires much thought and labor, for a special bracket has to be designed and made, gears or sprockets have to be cut and the motor and bracket must be placed and secured.

A punch is usually considered a constant-speed machine, but if maximum efficiency is aimed at it is certainly proper to secure efficiency in the structural shop as well as the machine shop. If a punch is driven at a speed of say 35 strokes per minute, with light work the operator may punch at each stroke, but if he gets work a little heavier, which permits of only 28 or 30 strokes, then he has to miss every other stroke, which gives the machine a capacity of only 17½ holes per minute as against 28 or 30 if the motor could be slowed down enough to give the punch this number of strokes. We have operated punches on a four-wire system with good results, although the three-top voltages were the only ones ever used, while the rest served only as starting points.

The question of a proper drive for a lathe or boring mill is more difficult and many details have to be considered, such as the class of work which the particular machine has to perform, the material to be cut, the kind of tool steel used, and the strength of the machine. All of these factors are most important because with the new high-speed tool steels, the machines are apt to suffer if they are run to the limit of the tool.

The gear strength of all the gears—and in each combination—must be figured so that the maximum pressure permissible on the tool for a given diameter of work is known for each combination of gearing. With this data it is comparatively easy to decide on the size of motor which will not injure the machine.

Assuming that a high-speed tool steel is to be used, and that the maximum cuts are to be taken on a certain material, the power required to do this work with a known feed, depth of cut and speed, can be arrived at, fixing the size of motor which will pull this cut.

We now find that we have two values for the power of the motor; one determined by the strength of the machine, and the other by the cut which we wish to take. In almost every case the power required to pull the cut is far in excess of the power which the machine will deliver to the tool post, so that it is necessary to rebuild the machine tool to a certain extent, as there are usually one or two gears which are weaker than the rest of the machine. With a certain combination of these gears, we find the pressure that can be exerted on the tool post is very small as compared with the average of all of the different combinations of gears. If the one, two or three weak gears, as the case may be, are made stronger by using a different material or a wider face, the two-hp values will approach one another, and it is often the case that with a slight modification on the machine, the cutting tool may be operated to its best advantage.

The direct-current motor has great possibilities in speed variation, and there are several different methods employed for varying the motor speed, which we will not consider here except to mention the more important ones as follows:

The two-wire system with field control alone, the two-wire system with a double commutator motor, the three-wire system with its two voltages, either of which may be used to run the motor, and the four-wire system with its six voltages, any of which may be used to operate the motor.

The lighting of the machine shop is most important and not enough attention is paid to it in most cases, no doubt because at the end of the day it is difficult to say exactly how many dollars have been saved, due to good light, or how much has been lost, due to poor light.

It is interesting to note that there is a structural shop with about twenty-four heavy tools and as many motors, which requires just three times the current to light it that is used for power. It pays or it would not be done.

There are arc, incandescent and Nernst lamps, each of which has marked advantages over the others in certain cases, and the voltages and kind of current used for lighting depend upon the choice of these lights.

The steam turbine is coming to the front on account of its simplicity and economy, and as it is best suited to alternating-current generation, the shop of the future will no doubt use alternating current for all constant-speed motors, with a motor generator for the direct-current variable-speed tools which will be operated from a three or four-wire system.

As stated above, each shop has conditions peculiarly its own, and the system best suited to it is the one which operates the constant and variable-speed motors to the best advantage, as well as giving the kind of light which is most efficient.

American Absorption of Paris Lighting Interests.

As already noted in these pages, plans are afoot for the investment of American capital in lighting in the French capital. Messrs. Anthony N. Brady, vice-president of the People's Gas Light and Coke Company, of Chicago; George O. Knapp, the president of the company, and C. K. G. Billings, the chairman of the board of directors, sailed last week for Paris, where they will investigate the problem of combining under one head the various companies that furnish gas and electric lighting to the French capital. The capital required will be more than $50,000,000, which amount, it is said, can be supplied readily by the American syndicate of which Mr. Brady is the chief representative. When seen on the steamer Mr. Brady would not deny the report that he was about to effect a consolidation of the different public utility companies of Paris, but said that it was not an opportune time just now to discuss the matter. "I am not going abroad for a vacation, though," he added. Mr. Billings said that the object of their visit to Paris was to look into the matter of taking over a Paris lighting company whose franchise will soon expire. "The proposition," he said, "came from the French company, and was made to Mr. Brady. We are going over to investigate, and shall return in the latter part of February." The gas company which now lights Paris has a monopoly, and its contract with the city does not run out until 1910. Its capital is 84,000,000f., and the quality of the gas supplied, as well as the method of testing it, is prescribed by law. The dividends are more than 13 per cent. per annum, and surplus earnings are divided equally between the company and the city.

In this connection the following rather vague dispatch from Paris of December 27 will be of interest: After a struggle for cheaper gas, Parisians have now turned their attention to cheaper electricity. In the original concessions to the electric light companies the maximum price was made at 15 centimes a hectowatt, but the companies, by charging for meters, connections, etc., have managed to create charges to the extent of a hundred francs a year. In renewing the contracts the Municipal Council proposes to get even by fixing the maximum price at 8 centimes and eliminating the incidental charges.

Independent Telephony in Wisconsin.

With regard to recent independent telephone development in Wisconsin, Mr. A. L. Hutchinson, of the State Telephone Clearing Company, of Weyauwega, Wis., president and general manager, writes us as follows:

Two companies I have incorporated the past year are not yet placed in the operating field. A third, the Interurban, with Madison as its nominal headquarters, has absorbed the North and East Bristol Telephone Company, of Dane County, the Waterloo Telephone Company, the Lake Mills Telephone Company, and the Wolf River Telephone Company, of Waupaca County. The company now has in operation exchanges at Sun Prairie, Lake Mills, Waterloo, Weyauwega and New London aggregating 600 telephones, and toll lines from Madison to Beaver Dam, and Sun Prairie via Lake Mills to Fort Atkinson, Weyauwega to Waupaca, Weyauwega to New London and Weyauwega to Tustin, aggregating 110 miles of pole line.

A fourth company, the Fox River Valley Telephone Company, of Appleton, which I promoted, and am a director in, and of which I was secretary and manager for the first year, is located at Appleton, Wis. It has an exchange in Appleton of 850 telephones, which is the most complete and up-to-date exchange in the State. The wires are laid underground in the business part of the city and there is a conduit capacity for 3,000 telephones with cables in for 2,000 telephones. This is a central energy system, with double supervisory switchboard. This company has toll lines from Kaukauna to Weyauwega, 50 miles.

I was one of the original incorporators of the Wolf River Telephone Company, one of the very first independent companies in Wisconsin, incorporated in March, 1895, now merged with the Interurban Company. I was also one of three of the promoters and incorporators of the Little Wolf River Telephone Company, which removed its headquarters and management to Fond-du-Lac, two years ago, and which has been in the hands of a receiver since last spring, and which is now being reorganized by the stockholders. This is one of the largest independent companies in the State, and its financial embarrassment was due to a failure of those who got control of the company to supply capital as fast as the demand for telephones required. It has an exchange in Fond-du-Lac of over 800 telephones, with smaller exchanges at Omro, Shawano, Clintonville, Wittenberg and Manawa, and about 500 miles of toll line.

Incidentally I may state that I am also one of the promoters and incorporators, and am at present secretary and general counsel of the Madison and Northeastern Railroad Company, which has under way the construction of an electric railroad from Madison northeasterly as per cut on this letter head. The franchises and rights of way are now being obtained. It is said by the engineers who have been over the route to be one of the best interurban propositions in the United States, as all steam roads in the locality run at right angles to its route, and the whole Fox River Valley has a long roundabout way to get to Madison, the State capital, with from one to two changes of cars. The country is thickly settled, and is very fertile, while the cities all have important manufacturing industries.

The Wisconsin Midland Railroad Company, incorporated by myself with others, to run from Berlin north, on the trolley plan, will be built as soon as financed. It also is a splendid interurban proposition, and is now in the hands of H. C. Hullinger at Berlin, Wis., to finance and build.

Manhattan Elevated Railway Substations.

THE main features of the electrical equipment of the Manhattan Elevated Railway have from time to time been covered in these columns, and in the present article an account will be given in detail of a typical substation. It will be recalled that the system is operated from a main power house at Seventy-fourth Street and East River, where three-phase currents are generated at 11,000 volts, and distributed to seven substations. At these substations the voltage is stepped down to 390 volts and the currents then transformed by rotary converters to direct-current at 625 volts for delivery to the third rail. The maximum installation for each substation is six 1500-kw. rotary converters, each with its group of three step-down transformers, a motor-generator set for starting the rotaries from the direct-current end; two boosters, for controlling the output of two floors of storage batteries, representing a 3,000-kw.-hour capacity, and the complete equipment gives a total nominal output for the station of 16,000 hp. Figs. 1 and 2 are exterior views of the substation at 110th Street, near Manhattan Avenue, in which four rotaries and their auxiliary equipment have been installed. This station also serves as a passenger station, being the only one of the seven not devoted entirely to electrical purposes. Fig. 3 is a section of the station to the east of the main tower. The tower, which is four stories high, contains the passenger elevators and stairways leading to the passenger platform and track sections. The direct-current cables lead from the small tower shown on the left of Fig. 3.

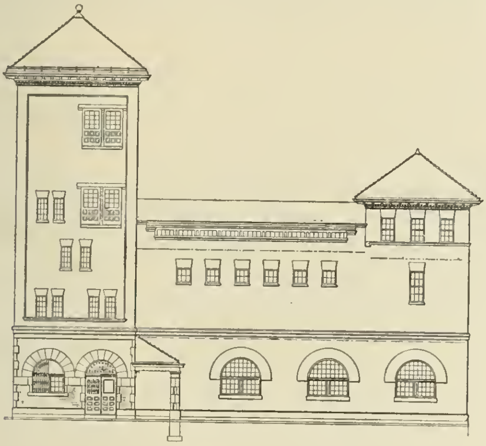


FIG. 1.—SOUTH ELEVATION.

Provision is made in this station, as shown in Figs. 4 and 5, for a storage battery of 204 cells in the sub-basement, and ninety-six cells in the basement. The west end of the basement floor is used as a blower room, and contains the motors and fans for supplying air to the transformers. Sturtevant blowers, driven by 30-hp. induction motors, are employed for this purpose. There is also in this room a small electric pump for furnishing water to the toilet fixtures on the fifth floor of the tower. At the eastern end of the basement floor there is a space 19 ft. wide, running the entire width of the building, which is used as a small machine shop. It also contains lockers for the station attendants. The division of this basement floor and allotment of space is shown in Fig. 5. Stairs located diagonally opposite each other in the front and rear of the building lead from the rotary floor to both the blower room and the workshop.

On the rotary floor provision is made for six 1,500-kw. converters and two boosters. Fig. 6 shows the southwest corner of this station, with rotaries one and three in position, and a section of the transformer gallery and the location of the transformers with respect to the converter. A ladder leads from the center aisle of the rotary floor to the gallery, as well as the spiral stairway at the northeast corner of the building. Fig. 7 shows the transformers and wiring of these machines. In the front of the building, close to the south wall, is located the auxiliary starting set, which is illustrated in Fig. 8. A plan of the first floor is shown in Fig. 9, and a plan showing the transformer gallery and rotary floor is presented in Fig. 10.

Each rotary converter is supplied with alternating current from three step-down transformers of 550-kw. each, connected in delta. The voltage of the current supplied to the transformers is not uniform throughout the system for obvious reasons, but provision is made for adjusting the ratio of transformation by means of loops brought out from the primary windings so that the potential of the direct current delivered by the rotary converters shall be equal. The transformers are air-cooled, and the necessary air is supplied by motor-driven blowers, which are installed in the basement. A comprehensive system of air ducts serves these transformers with air.

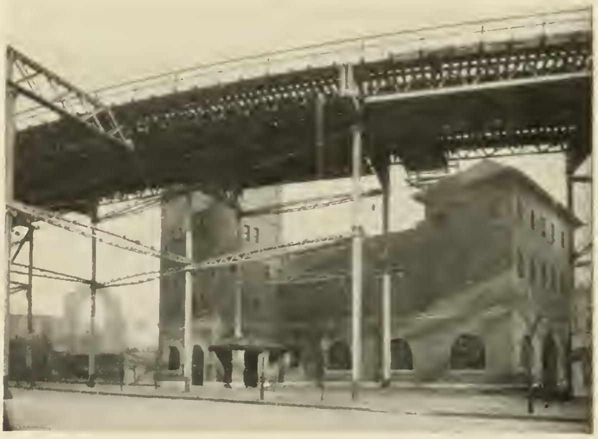


FIG. 2.—GENERAL VIEW OF SUB-STATION.

The guaranteed efficiencies of the transformers are 97.75 per cent. for full load, 97.70 for 25 per cent. overload, and 95 per cent. for quarter load. The rise in temperature for a 25 per cent. overload run for twenty-four hours is guaranteed not to exceed 450 C. In performance the transformers have far exceeded the guarantee, as have also the rotaries, whose efficiency was guaranteed at 95.75 per cent. for full load, 96 per cent. for 25 per cent. overload, and 89 per cent. for quarter load.

From the switches that are mounted on the marble panel on the front of each transformer, as shown in Fig. 7, six heavy cables are lead directly through the gallery floor from each group of transformers to the alternating-current terminals of its respective converter. The voltage of the current supplied to the rotaries from the transformers is relatively low, and 1,250,000 circ. mil cables are employed for this service.

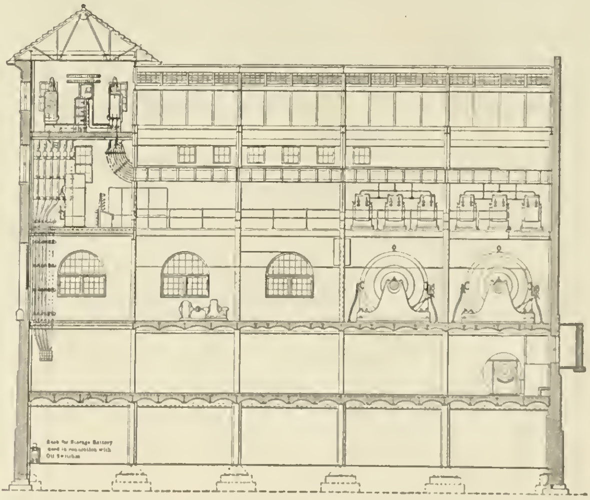


FIG. 3.—LONGITUDINAL SECTION.

The rotary converters are larger than any that have heretofore been constructed, having a nominal rating of 1,500-kw. and maximum capacity of 2,250-kw., or 3,000-hp. Each converter is a self-contained unit, the two bearings and the lower half of the field frame being mounted on a common base. The field frame is divided in a horizontal plane to permit access to the windings. They are 12-pole machines, and when supplied with an alternating current of 25 cycles per second will operate at a speed of 250 r.p.m. The field is compound wound, the shunt winding being arranged for self-excitation. The output of the converter, as stated above, is delivered at a normal potential of 625 volts. The winding is of the parallel type, forming twelve circuits, and is cross-connected by balancing rings. With a potential of 625 volts across the direct-current terminals the average difference of potential between two commutator bars will not exceed 12 volts. The converters are guaranteed to stand an overload of 100 per cent. without "hunting," and may be overloaded to several times the normal full load without falling out of step. In the construction of these converters the fly-wheel effect has been made relatively small and that of the copper damping shield is powerful enough to have the controlling effect upon the armatures of the converters. The total weight of each converter is about 53 tons; the height is 13½ feet and the floor space occupied 13 x 10 feet.

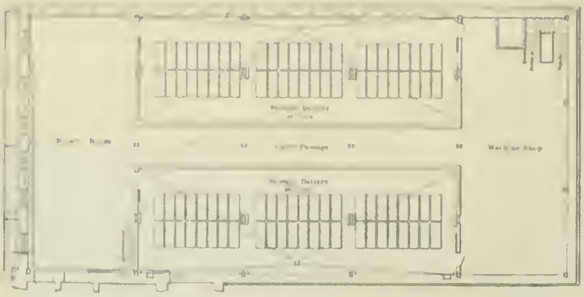


FIG. 4.—PLAN OF BATTERY PLANT IN BASEMENT.

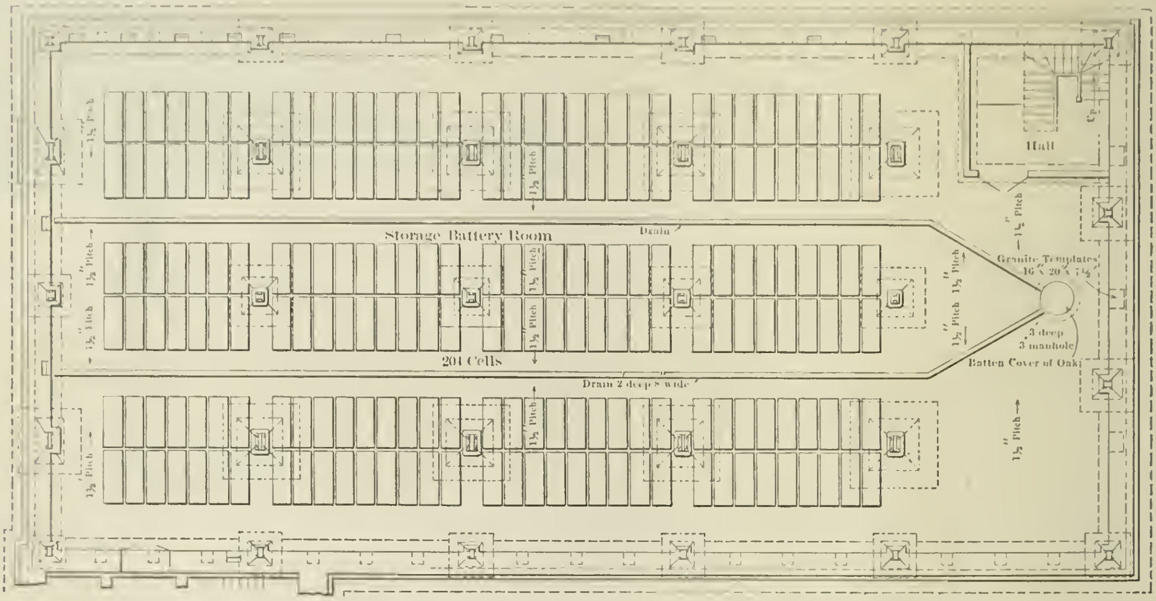


FIG. 5.—PLAN OF BATTERY PLANT IN SUB-BASEMENT.

The converters are started by direct current. A motor-generator set (Fig. 8) is installed in each substation for furnishing the current for that purpose. The method of starting by direct-current derived from these starting sets, rather than by direct-current taken from the main bus-bars of the substation, was determined upon to avoid undue magnetic and electrical strains in the converter, such as may easily result from a slight mistake of the operator, for example, in closing the synchronizing switches when the machines are not exactly in phase.

A single set of bus-bars is placed in isolated brick compartments, with incoming feeder switches to one side of the bus-bars, and outgoing rotary converter switches to the other side. The bus-bars are divided by knife switches into sections, one for each rotary converter, so that any section of the bus-bars may be shut down for repairs.

Each of the three conductor cables carrying high-potential current from the power house to the sub-stations is equipped at the power house end with an oil circuit breaking switch, with a time limit relay device, and in case of a short circuit in the cable the supply of current from the power house would be interrupted at the end of a predetermined interval. At the substation end the cable is connected to the bus-bars through a similar oil circuit-breaking switch, but in this instance the switch will open automatically in case of a reversal of the current, such as would be caused by a short circuit in the cable. Again, in each high-potential alternating-current circuit which connects the bus bars at sub-stations with a group of step-down transformers, and through them with a rotary converter, an automatic circuit-breaking oil switch with time limit relay has been placed, and in the direct-current circuit between the converter and the direct-current bus-bars the circuit breaker has been arranged to open the circuit should power exceeding a certain predetermined small amount flow back through the direct-current bus-bars into the converter. In case of a short circuit in the group of transformers, in the converter itself or in the connecting circuits between the alternating-current circuit breaker and the direct-current circuit breaker, provision is made for these breakers to act automatically and disconnect from the alternating-current bus-bars

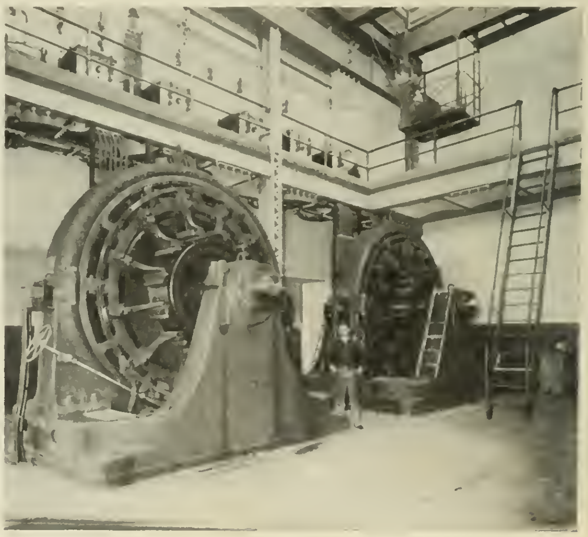


FIG. 6.—TRANSFORMER GALLERY AND TWO OF THE ROTARIES.

and from the direct-current bus-bar the converter unit affected.

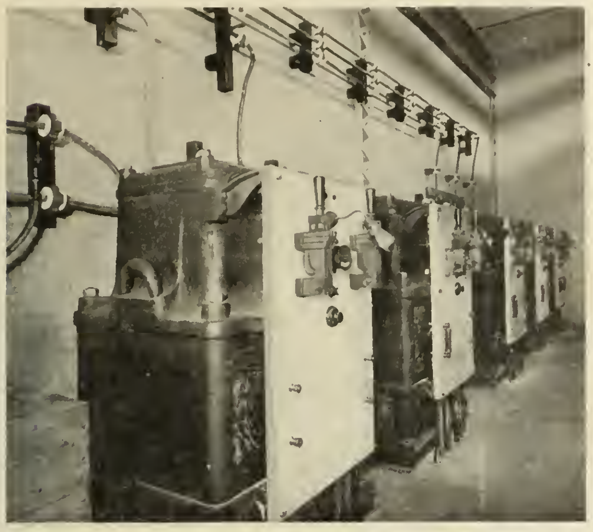


FIG. 7.—TRANSFORMERS AND WIRING

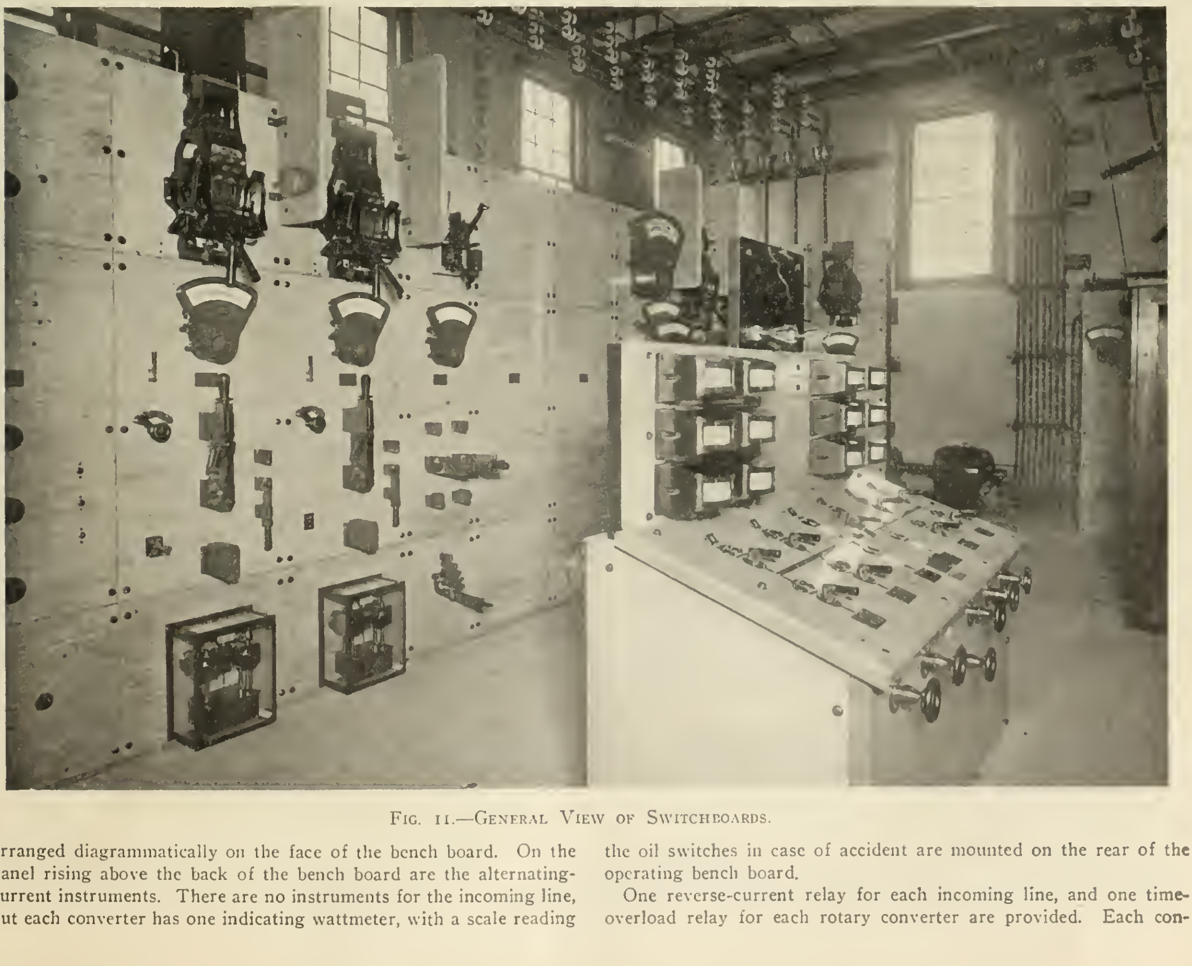


FIG. 11.—GENERAL VIEW OF SWITCHBOARDS.

The switchboard, Fig. 11, is located on the gallery at the eastern end of the station, and consists of a direct-current board of the usual type, with its end panels placed at right angles to the panels forming the central portion of the board, thus enclosing on three sides the operating bench board. The alternating panel board and the operating bench board are illustrated in Fig. 11. Each incoming feeder and each rotary converter has a controlling switch, with visual signals arranged diagrammatically on the face of the bench board. On the panel rising above the back of the bench board are the alternating-current instruments. There are no instruments for the incoming line, but each converter has one indicating wattmeter, with a scale reading up to 3,000-kw., one power factor meter and one ammeter. Over the central section of the board a higher panel carries one main voltmeter, one synchronizing voltmeter and two synchronizing lamps.

Switches are provided in the circuits between transformers and converters, and they are mounted upon marble panels carried upon the step-down transformers, as shown in Fig. 7. The panels are equipped with a synchronizer and a synchronizing lamp, and another synchronizing lamp in the same circuit is provided for the switchboard at the end of the sub-station for the convenience of the operator at that point in adjusting the speed of the converter to be synchronized. Induction recording wattmeters and the relays for automatically opening the oil switches in case of accident are mounted on the rear of the operating bench board.

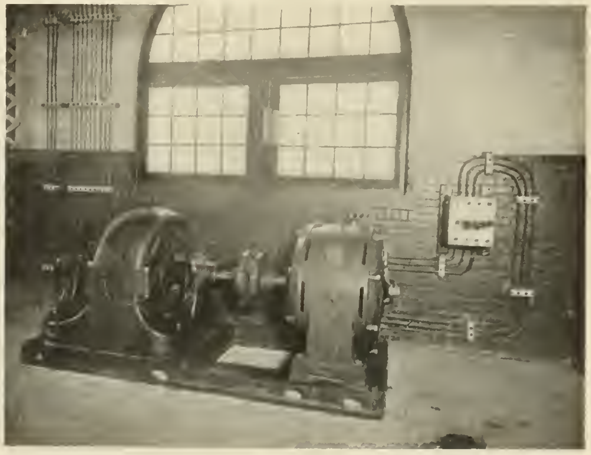


FIG. 8.—AUXILIARY STARTING SET.

One reverse-current relay for each incoming line, and one time-overload relay for each rotary converter are provided. Each converter is also provided on the switchboard with one Thomson recording wattmeter, an ammeter, reading up to 5,000 amperes, and a circuit breaker designed to carry 6,000 amperes. This circuit-breaker is of a new type, without the usual tripping coil, the magnetism for the tripping device being obtained by means of the steel bar surrounding one of the studs, which greatly simplifies the breaker. It is fitted with an easily removable cover over the secondary contacts, and attached to it is a reversal device for tripping the breaker when power exceeding a certain amount tends to flow back over the line into the converter.

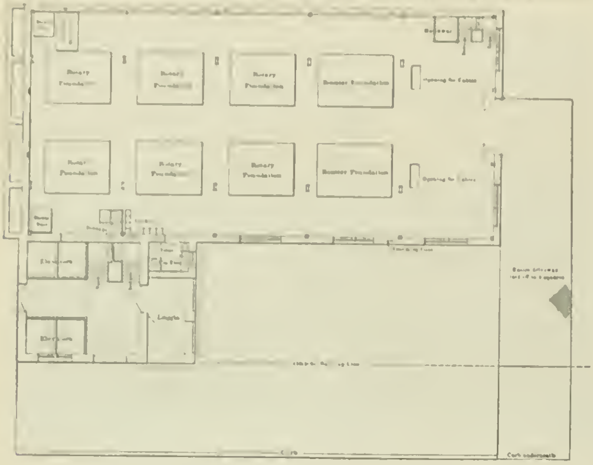


FIG. 9.—FIRST-FLOOR PLAN SHOWING ARRANGEMENT OF ROTARIES.

Reserve panels, fitted with reserve circuit breakers, one for each of the rotary converters, and outgoing feeders will also be provided. The reserve panels will be connected to auxiliary bus-bars, as indicated in the diagram of connections, so that in case a circuit breaker gives trouble a reserve panel, with its equipment, may be substituted by throwing the main switch on the converter or feeder panel into another position.

The connections for the motor-generator set for starting up the rotary converters from the direct current end, are so arranged that a converter may be thrown on to the starting bus and brought up to speed while other converters are running across the main busses. Suitable switches are provided for connecting the field of a converter to be started outside the starting resistance. The field rheostat of the starting generator is mounted on the alternating-current operating bench board, so that the attendant may accurately adjust the speed of the rotary converter while synchronizing. A switch is also provided on the bench board for tripping the circuit breaker of the starting generator the instant the converter is thrown into the circuit on the alternating-current end.

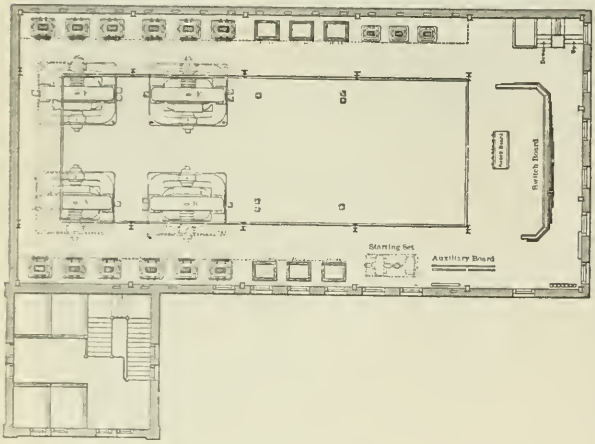


FIG. 10.—PLAN OF GALLERY WITH TRANSFORMERS AND SWITCHING APPARATUS.

The rotary converters, static transformers, motor-generating sets, boosters and induction motors for driving the blowers were supplied by the Westinghouse Electric & Manufacturing Company, and the switchboard equipment by the General Electric Company.

New York to Boston by Trolley.

Various amateur and experimental trips between New York and Boston by trolley have been made—with one or two short links left out, but now a definite plan is said to have been worked out for a continuous "all trolley" route. Plans are now completed, the companies incorporated, and the capital found for the construction of the final link in a system of trolley roads connecting Boston with New York City. This is a line from Hartford to New Haven. The backers will be Gay & Co., bankers, of State Street, Boston, and James F. Shaw & Co., another banking firm of that city. These promoters, who jointly control some $40,000,000, are the principal stockholders and have controlling interests in two proposed lines between these hitherto unconnected cities, one running direct and the other via New Britain, Plainville, Southington and Cheshire. When the charter applications are made at the next session of the Connecticut General Assembly, it is reasonably certain, the assertion is made, that one of the two will be granted. Both the Gay and the Shaw interests are already operating roads in Western Massachusetts, among others being largely represented in the line connecting Worcester with Boston.

In the make-up of the through line this Boston-Worcester road will be the terminal. Between Worcester and Rockville, Conn., a 40-mile line is rapidly nearing completion. From Rockville to Hartford are the lines of the Hartford, Manchester and Rockville Street Railway Company, making an unbroken system from the Hub to the Connecticut capital. Then comes the break which the Boston firms are now planning to span.

Beyond this, from North Haven, through New Haven to Woodmont, run the tracks of the Fair Haven and Westville Street Railway Company, and from there on the Connecticut Railway and Lighting Company, controlled by the United Gas Improvement Company, of Philadelphia, carries the line through Bridgeport, the Norwalks, and Stamford to Port Chester, N. Y. From there the New York and Port Chester Road, which has recently gained the right of way for a four-track rapid transit system from the terminus of the New York City subway to the Connecticut line, will complete the through system. This latter road will overreach the Greenwich line, owned and operated by the New York, New Haven and Hartford Railroad Company, with which the latter for some time has completely blocked the plan for a through trolley from Boston to New York.

From Boston to Hartford the Gay and Shaw interests will be the controlling factors; from Woodmont west to Port Chester, the Connecticut Railway and Lighting Company, owned in Philadelphia, and from there on into New York City the Port Chester road. The Fair Haven and Westville Street Railway Company thus far has remained independent, but it is believed to be only a matter of time when this will be absorbed by the ever-growing Connecticut Railway and Lighting Company. In Hartford also there is an independent line in the form of the Hartford Street Railway Company. Just what traffic arrangements will be made between these roads is still to be made known, but it is certain the fare between Boston and Manhattan will be materially under the steam prices.

For the entire distance the trolley will practically parallel the Consolidated Road. However, the hostility of the steam interests is beginning to wane, and it is becoming more and more apparent that the electric lines not only serve as feeders for the steam, but build up suburban populations and bring bigger returns for both classes of roads.

New York Elevated.

The New York State Board of Railroad Commissioners has been taking evidence as to the congested condition of street car and elevated traffic. President Cole states that the public protest had convinced the board of the necessity of an investigation of the traffic conditions. He has summoned the officers and directors of the "L" road, who will be put under oath and be compelled to testify as to the existing conditions. He has promised on behalf of the board that New York would be given temporary relief as quickly as possible, and then permanent relief. The development of traffic under electricity has been enormous and phenomenal.

Independent Telephone Work in Canada.

Note was made some time ago in these columns of the development of plans for a telephone exchange system of the most modern type at Port Arthur and Fort William, Ontario Province, Canada. One feature of interest is that these twin exchanges have been established by the municipalities of each town, where a system exists already, so that there is municipal competition set up. Another interesting feature is the fact that the contract was placed in the United States and was given to the International Telephone Mfg. Co., of Chicago, to whose president, Mr. Henry Shafer, we are indebted for the details now given.

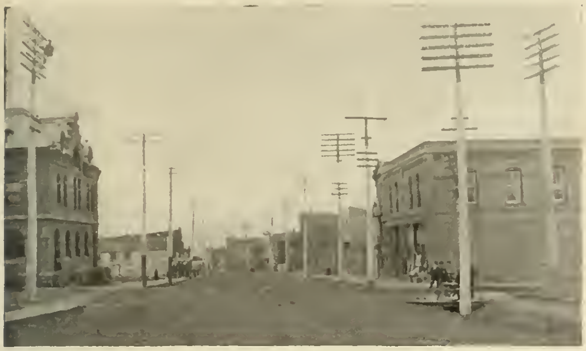


FIG. 1.—EXCHANGE BUILDING, PORT ARTHUR.

Both towns own and operate their own electric light plants, water systems, and the town of Port Arthur is operating the street railway system through and connecting the two towns. In establishing the telephone systems it was intended to place the exchanges upon a basis that would leave no profit after paying operating and maintaining expenses, interest on the cost of the plant and a proper allowance for depreciation. This was done to avoid taxing the subscribers for the benefit of non-users, so that taxpayers of the towns who were not subscribers would not be required to bear any part in the cost and expense of the plant. Considering the economy of operating and maintaining the plants in connection with the other allied systems, it was estimated that a safe basis of rental was $1 per month for residence and $2 per month for business service. Both exchanges are of the same size and equipped with same style system

The plant at Fort William is built entirely distinct from the other electric systems. The plant at Port Arthur is built with the line wires occupying the same poles as the electric light circuits and street railway lines. The first building at the right, in Fig. 1, is the exchange building at Port Arthur. The municipal pole line is seen at the right of the street. The telephone wires are placed at the top of the poles, while 2,000 volt alternating current electric light circuits are attached about eight feet below the lower telephone wires. Fig. 2 shows the trunk line between Port Arthur and Fort William. The telephone wires are placed about six feet above the 500-volt direct-current street railway feeders on the same poles. The telephone wires are transposed every fifth pole.

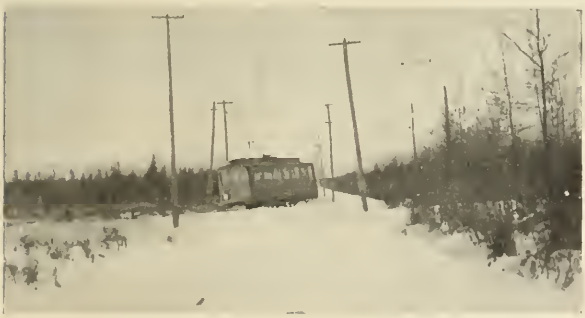


FIG. 2.—TRUNK LINE BETWEEN PORT ARTHUR AND FORT WILLIAM.

The line wire was secured from Germany, the poles and other construction material were purchased in the Dominion, and the telephones and switchboard equipment in the United States from the International Telephone Mfg. Co., which also completely installed the central office equipment. The Port Arthur exchange switchboard is shown in Fig. 3. It is a strictly central energy lamp signal trunking board, with double supervisory clearing-out signals, pilot lamps, etc. It is built in a regular multiple switchboard frame and cabinet and so arranged that when the number of subscribers increases and extensions are required above the number that two operators can handle, necessary multiple jacks may be installed and the board readily made into a full multiple switchboard without discarding the original installation. The board shown is equipped with 280 subscribers' lines. 140 to each position. It is arranged so that 60 lines, or even more, may be added to each operator's position and additional positions or selections added at any time.

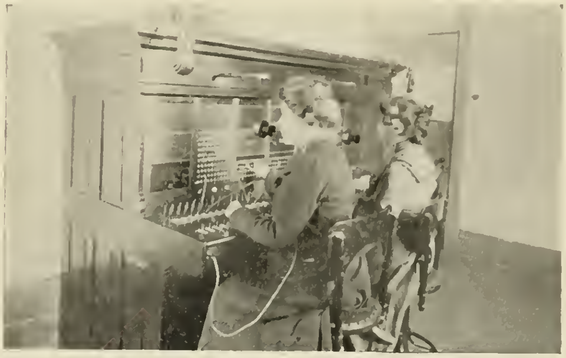


FIG. 3.—SWITCHBOARD, PORT ARTHUR EXCHANGE.

Fig. 4 shows a section of the board and the parts more in detail. The key-shelves (one of which is shown turned up) are made of a veneer of five layers of wood, securely glued together. The ringing and listening keys are mounted on the bottom of the shelf with the levers extending through nickel-plated swivel escutcheons mounted on the top. All terminals of the International key are at one end, which makes it possible to have all wires made up in one cable form, leaving the platinum contact points free and open for inspection.

On the closed key-shelf is shown one of the line signal lamps and holder. The holder is an opaque insulating tube with an opal set in a brass cap. It is provided with slots at the opposite end from the opal, leaving the terminals of the lamp exposed when inserted. The opaque tube and lamp are very easily placed in the bank of lamp jacks direct from the front of the board, as is shown in the top left bank. The lamp being enclosed, all the light is confined to the one opal, which prevents any possible chance for a mistake as to the right signal.

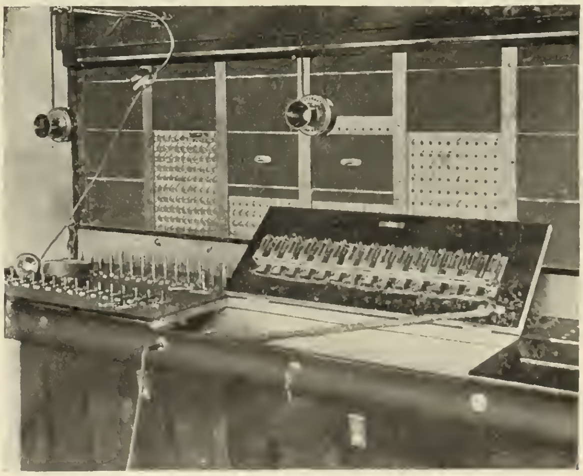


FIG. 4.—SECTION AND DETAILS OF BOARD.

The line lamps are mounted in jacks built in strips of ten. The springs of the jacks are made of the best sheet spring German silver. They are provided with a formed projection, so that they make a good point connection with the base of the lamp when inserted.

The springs are set into a hard rubber strip and firmly clamped with a brass strip insulated with mica. The spring block is fastened to the front piece with heavy brass studs. The front piece is a heavy brass rail, faced with hard rubber, with the proper holes for receiving the lamps with holders. Each end of the front rail forms a flange which is set into the iron switchboard frame and to which the banks are clamped from the front with a bolt and nut.

The spring jacks, which correspond in number with the line lamps, are also mounted in strips of ten. The front piece of the bank of jacks is made of a veneer of hard rubber, front and back, with a brass rail for its center. The holes in the brass rail are of sufficient size to receive a hard rubber bushing before inserting the jack ferule. The brass rail provides a means for firmly clamping the banks of jacks to the iron frame, and also makes the banks strong and durable.

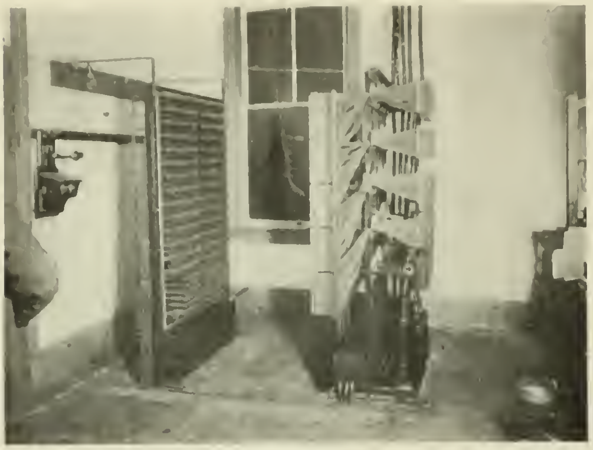
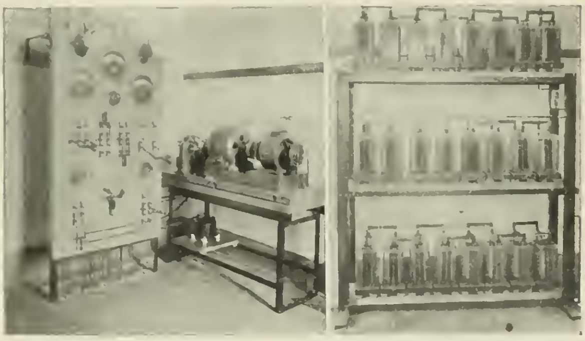


FIG. 5.—RELAY RACK, DISTRIBUTING AND ARRESTER RACK.

A pair of supervisory signals are placed in the plug board directly in front of each pair of cords. The clearing-out lamps are mounted in tubes similar to the line lamp holders. These tubes are provided with an opal holding cap on which is placed a small arched wire guard which prevents the opal being broken by impact from the plugs and also serves as a means for conveniently taking the tube, with lamp, from the socket. These are removed from the top of the plug board, as is shown in the second pair at the right.



FIGS. 6 AND 7.—POWER SWITCHBOARD AND STORAGE BATTERY PLANT.

The plug board and the pilot lamp panel located back of the plugs are covered with heavy belt leather. In the center of the board, between the two operators' positions, are mounted the trunk signals and trunk jacks connecting the two exchanges. The board is provided with a key, so that at night, when but few calls are received, the battery power ringing generator may be switched on at any time and operated only when required.

Fig. 5 shows the relay rack and the combination distributing and lightning arrester rack, with heat coil and carbon arresters. On the relay rack are mounted all the line relays, supervisory and pilot relays and coils. The relays are securely mounted on iron strips, supported on an angle iron rack. The relays are securely enclosed in a dust-proof brass shell. Fig. 6 shows the power switchboard, the charging machine with an alternating current motor, the main ringing machine, with alternating motor, and the auxiliary ringing machine. The auxiliary ringing machine is operated from the storage batteries. The marble power board is supplied with a charging circuit ammeter, a discharge circuit ammeter, a volt meter, voltmeter switch, starting boxes, field rheostat, circuit breaker, bus bars and all necessary copper knife switches for properly controlling the entire system. The power tables are made from angle iron and are strong and rigid. The top is of a thick maple slab, supported on soft rubber balls, set in a maple frame, mounted on the top of the iron rack.

The storage battery plant consists of a set of 12 cells of Chloride accumulators in duplicate, Fig. 7. The 12 cells supply all the battery current for the operators' instruments, line, supervisory and pilot lamps and all the subscribers' instruments. The battery rack is constructed of architectural iron and is strong and well braced. The shelves are heavy slate slabs.

The telephones in these systems are of the International long-distance type central energy instruments, which are well known in the telephone field as being among the most powerful, clear and distinct instruments in use. It would appear that this class of equipment practically opening the independent field in Canada will have a tendency to bring a large part of the work in this line to the United States.

The Armature Reaction of Alternators—IX.

By C. F. Guilbert.

NUMERICAL APPLICATIONS.

In the preceding articles a general method was given for the predetermination of alternator load characteristics. To terminate the study, we will now show by several numerical examples the degree of exactitude that may be attained by the use of the method. Though the author has applied the method to a large number of machines he has personally tested, one of these cannot well be chosen as the subject of a numerical example in view of the fact that the data of the tests were not intended to be made public. We shall, therefore, select a machine of which the test data have been published. Such an example is offered in Prof. E. Arnolds's "Konstruckionstafeln fur Dynamobau," in a machine made by one of the best electrical manufacturing firms in the world—Brown, Boveri et Cie, of Baden, Switzerland.

The machine is one installed by the firm at Paderno, Italy, of 1,500 kv-amp capacity, and of which Prof. Arnold gives plans and cross-sections, test data and no-load and short-circuit characteristics. Before applying the method to this machine, we will give several examples of the predetermination of short-circuit characteristics, taking as subjects alternators at the Paris Exposition (an account of which by the writer appeared in these columns in the issue of January 19, 1901, and following), which appear to have undergone reliable tests.

The predetermination of the short-circuit characteristic no longer offers other than a relative interest, as has been shown in the course of these articles, the wattless characteristic being preferable. However, since the short-circuit characteristic is easy of determination, if we know the armature m.m.f. and the e.m.f. of self-induction due to magnetic leakage, it is not without interest if merely as a simple verification of the formula of the form of the m.m.f.

At present there is no rigorous formula for the determining of the e.m.f. armature leakage of an alternator, either in short circuit or under load. All of the formulas thus far published include numerical coefficients deduced from measurements made on existing machines of the same type. We will be content to obtain the ampere-turns necessary to create a flux corresponding to this leakage under the condition of short circuit by admitting that the flux varies from 10 to 20 per cent. of the no-load flux, according to the size of the machine and the number of armature ampere-turns. Our determination of the no-load characteristic will thus be simply a first approximation, but a sufficient one, as will be seen.

1,400-kv-amp Creusot Alternator.—The armature has two slots per pole and per phase, with 6 conductors per slot. The formula,

$$F_i = .588\ N_1\ I_0\ \frac{a}{b}\ sin\ \frac{b}{a} \cdot \frac{\pi}{2}$$

gives, for $N_1 = 12$, $I_0 = 156\sqrt{2}$ and $a = b$, the value 1,550. Assume that in short circuit, $\frac{r}{R_0} = .03$. The e.m.f. being taken as 15 per cent. for the toothed armature, this corresponds to 1,050 ampere-turns, whence the short-circuit e.m.f. will be 1,600 + 1,050 = 2,650 *a t*. The test gave 57 × 44.5 = 2,540 ampere-turns.

1,000-kv-amp Frankfort-Lahmeyer Alternator.—The armature has two slots per pole and per phase, with 6 conductors per slot. We have $N_1 = 12$, $I_0 = 115 \sqrt{2}$, $a = b$, whence $Fi = 1{,}550$ ampere-turns. With a leakage e.m.f. of 15 per cent. (say 450 ampere-turns), we have 1,200 + 450 = 1,650 ampere-turns. The test gave 49 × 33.5 = 1,640 ampere-turns.

760-kv-amp Heyland Alternator.—The armature has two tunnels per pole and per phase, with three conductors per tunnel. We have $N_1 = 6$, $I_0 = 200 \sqrt{2}$, $a = b$, whence $Fi = 1{,}000$ ampere-turns. Assuming for a tunnel armature a leakage of 20 per cent. (say 1,050 ampere-turns), we have 1,030 + 1,050 = 2,080 ampere-turns. The test showed 36 × 63.5 = 2,280 ampere-turns.

1,200-kv-amp Alternator of Société l'Eclairage Electrique.—The armature has two tunnels per pole and per phase, with five conductors per tunnel. We have $N_1 = 10$, $I_0 = 138 \sqrt{2}$, $a = b$, whence $Fi = 1{,}150$ ampere-turns. With a leakage e.m.f. of 20 per cent. (650 ampere-turns) we have 1,200 + 650 = 1,850. The test gave 40 × 43.5 = 1,740.

1,760-kv-amp Brown, Boveri Alternator.—The armature has two tunnels per pole and per phase, with 6 conductors per tunnel. We have $N_1 = 12$, $I_0 = 170 \sqrt{2}$, $a = b$, whence $F_i = 1{,}700$. With a leakage e.m.f. of 20 per cent. (1,300 ampere-turns) we have 1,750 + 1,300 = 3,050. The test gave 60 × 44.5 = 2,670.

860-kv-amp Routen Alternator.—The armature has a single tunnel per pole and per phase, with seven conductors per tunnel. We have $N_1 = 7$, $I_0 = 207 \sqrt{2}$, $a = b$, whence $Fi = 1{,}250$. With a leakage of 20 per cent. (850 ampere-turns) we obtain 1,300 + 850 = 2,150. The test gave 34 × 69.5 = 2,360 ampere-turns.

2,600-kv-amp Siemens & Halske Alternator.—The armature has three slots per pole and per phase. $N_1 = 3$, $I_0 = 52 \sqrt{2}$, $a = b$, whence $Fi = 1{,}300$. With a leakage coefficient of 15 per cent. (750 ampere-turns) we have 1,350 + 750 = 2,100. The test gave 1,900 ampere-turns.

1,375-kv-amp Oerlikon Alternator.—A single slot per pole and per phase and eleven conductors per slot. $N_1 = 11$, $I_0 = 14 \sqrt{2}$, $a = b$, whence $F_i = 1{,}450$. With a leakage e.m.f. of 15 per cent. normal (600 ampere-turns) we have 1,500 + 600 = 2,100 ampere-turns. The test gave 33 × 53.5 ampere-turns.

800-kv-amp Fives-Lille Alternator.—Two slots per pole and per phase and 2.5 conductors per slot. $N_1 = 5$, $I_0 = 210 \sqrt{2}$, $a = b$, whence $F_i = 875$. With a leakage coefficient of 15 per cent. (500 ampere-turns) we have 900 + 500 = 1,400 ampere-turns. The test gave 155 × 15 = 1,160 ampere-turns.

780-kv-amp Kolben Alternator.—One slot per pole and phase and six conductors per slot. $N_1 = 6$, $I_0 = 150 \sqrt{2}$, $a = b$, whence $F_i = 775$. With a leakage e.m.f. of 15 per cent. (450 ampere-turns) we have 800 + 450 = 1,250 ampere-turns. The test gave 22.5 × 59.5 = 1,340 ampere-turns.

The relative errors are in general much less when we determine as exactly as possible the leakage coefficient instead of assuming it. In the following article the predetermination of a load characteristic will be taken up.

Rewards for Carefulness

The Pittsburg Railway Company distributed almost $30,000 to 2,400 men at Christmas, as promised six months ago by the company to motormen and conductors as a reward for carefulness in avoiding accidents during the six months ended November 30. About 80 per cent. of the motormen and conductors participate in the premium distributions. Some 300 of the 2,400 had small accident charges, which aggregated less than the amount of their premiums, and they get the difference. About eight premiums were wiped out by accident charges. Considering the number of cars (1,200) and the more than 500 miles of track operated, the company has not had many serious accidents this year. The money was paid by check, a special check being adopted for the purpose. With each check goes a premium certificate which many of the men will treasure more than the money, as it will at all times be a recommendation for employment elsewhere should the holder need it.

New Telephone Patents.

It must surely seem remarkable to the older telephone men to note the changes in switchboard jacks from the almost obsolete, individually-mounted spring jack through the various stages of hard rubber strip jacks, down to the present metal frame jack strips, with their extremely small spacing. The Patent Office issue of December 23 chronicles another step in advance in jack construction in a patent issued to W. E. McCormick, of Chicago, and assigned by him to the International Telephone Manufacturing Company. Mr. McCormick's invention is well shown in Fig. 1. In this figure *b* is a bent metal strip which is the foundation upon which the jack strip is built up. This strip is provided at its ends with suitable arrangements for securing the jack strip in the switchboard. Upon each side of the strip *b* is placed a piece of hard rubber. These have perforations to just admit the flared end jack thimbles *c*, while the strip *b* is so perforated as to clear the jack thimbles. The rear end of the jack thimble *c* is threaded, as is also the bent terminal strip d^1.

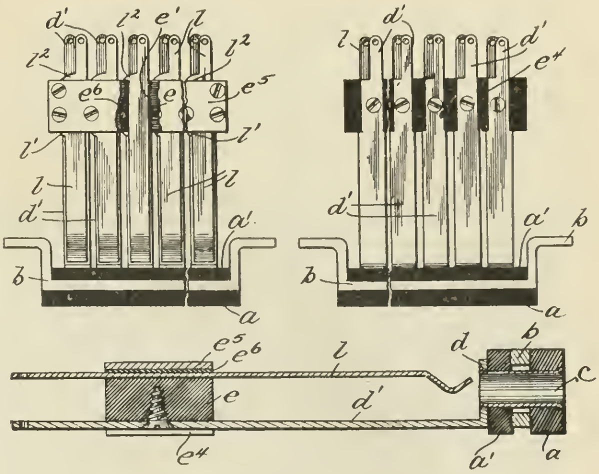


FIG. 1.—M'CORMICK JACK.

Now by screwing the thimbles into the terminal plates the whole front structure is securely bound together. The rear framing of the jack strip is a grooved hard rubber strip to which the terminal plates are attached by screws, and to which the jack springs are attached by the clamping plate e^5.. In order to prevent any motion of the springs, the ears, l^1 l^2, are provided, which engage the rear rubber strip. This should form a very cheap and serviceable jack strip.

A second telephone patent of the same issue is that numbered 716,779, granted to A. B. Stetson, of Malden, Mass., and assigned to the American Telephone & Telegraph Company. The invention consists essentially in the application of the equivalent of the old secondary cut-out button of magneto days to the Bell Companys subscriber's station circuits. The operation of the device may be understood by reference to Fig. 2. When the transmitter, *m*, is disturbed, and as its resistance changes, the potential differences across its terminals varies correspondingly the quantity of charge in the condenser *c*. This charging and discharging of the condenser sets up

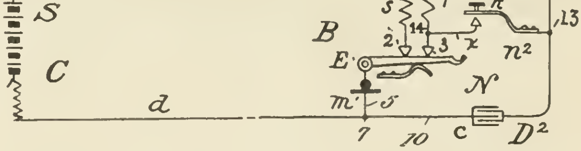


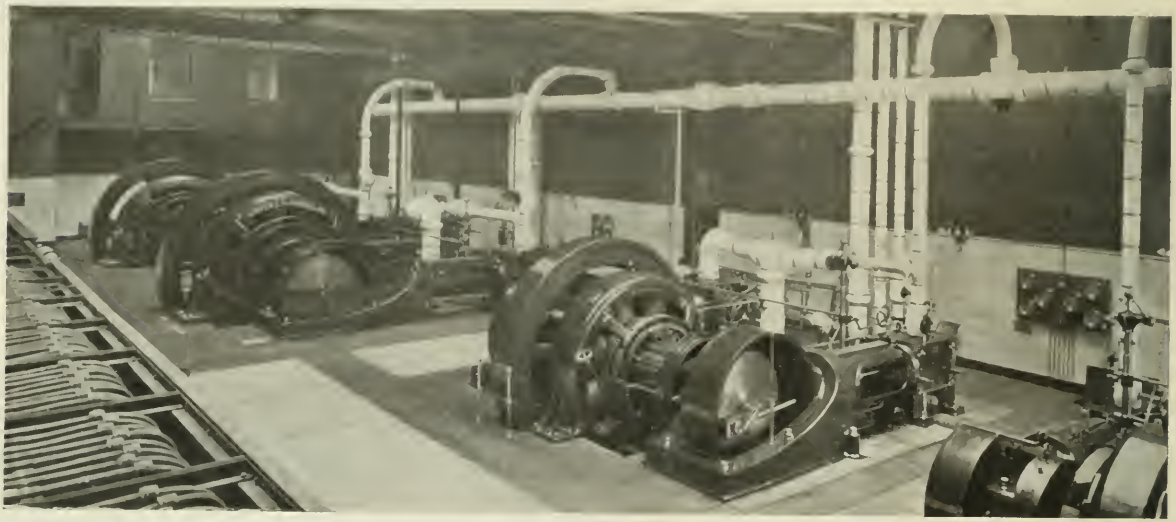
FIG. 2.—SUBSCRIBERS' STATION CIRCUITS.

current in the primary of the induction coil *p*, which in turn reacts upon the secondary *s* to send out upon the line toward the distant station the transformed electrical surgings. Now if a connection be established at *x k*, the condenser charge and discharge current will not pass through the induction coil primary, this being short circuited. Therefore the only extraneous tone existing will be that obtained from the transmitter through its direct effect upon the high resistance line circuit from the central office. It is also evident that the existence of the closed circuit, *xk*, will not affect the receiving circuit, as the induction coil primary is now in direct circuit with the receiver.

Another telephone patent of the issue of December 23 was granted to Wayne C. Wright, of Texas. The patent specification purports to describe a new automatic telephone system. Although the writer finds that all the operations described can take place, and with the results specified, he fails utterly to see what utility there is in the invention, as he can conceive of no application for it in its present form.

Power Plant for New Government Printing Office, Washington.

Although but a part of the printing machinery has been installed at the new Government office at Washington, the power plant has been completed and is being used to operate the equipment in both of the buildings, as well as to furnish heat and light for the new structure. The latter occupies the entire side of one square in northeast Washington, reaching to a height of seven stories from the ground. Its floor space comprises nearly fifteen acres, being about two and a half times the area of the old establishment, and it is expected that nearly 4,000 persons will be employed in the various departments. Nearly 130 presses will be required for completing books and pamphlets, as well as in printing the Congressional Record. To operate the new plant it is calculated that nearly $4,000,000 will be expended annually, of which 75 per cent. will represent wages.



View of New Government Printing Office Plant, Washington, D. C.

The electrical equipment is especially notable on account of its size and elaborate character. It consists of four units, all of Crocker-Wheeler make, two of them, of 600 kw capacity, being direct-connected to Allis engines. The other two units are of 300 and 150 kw capacity. The units are of the compound-wound type and are run at a speed of 100 revolutions per minute. Especial features of the machines are the internally flanged frame, giving a very smooth outside appearance and great rigidity. The brush rigging consists of a circular cast-iron ring held in place by supports bolted to the frame and holding the brush attachment. The brush holders themselves secure the brushes by means of a box, one side of which is held tightly against the brush. Four sets of copper leaves carry the current from the brush box to the arm, and their position is such that the movement of the brush on the commutator is always radial. Hence there is no necessity of changing the seating after the brush is once worn to place. The spiral spring with the thumb screw attachment secures the proper brush tension, and the copper leaves, carrying all the current, relieve the spring of any such duty. In spite of the great capacity of the apparatus, its compactness is also a notable feature. The large air gap tends to reduce field distortion and consequent sparking under heavy loads. The units have been in operation for several months and, as usual, they run very quietly and without heating.

Foreign Commerce of the United States in 1902.

Information from the United States Treasury states that the figures of the foreign commerce of the United States during the 11 months ending with November, which have just been completed by the Treasury Bureau of Statistics, indicate a phenomenal activity among the manufacturers of the country, with exportations quite as large as could be expected in view of the crop shortage of 1901-2. The value of manufacturers' materials imported into the United States during the 11 months ending with November this year is $407,603,599, against $353,417,288 in the corresponding months of last year, and forms 46½ per cent. of the total imports, against 44 per cent. of the total imports in the corresponding months of last year. Manufacturers exported during the 11 months of 1902 amount to $377,635,961, against $362,392,181 in the corresponding months of last year, and forms 31.8 per cent. of the total, against 27.8 per cent. of the total exports in the same months of 1901. The total imports are 75 million dollars in excess of those for the corresponding months of last year, and of this increase of 75 millions, 54 millions was in the class "manufacturers' materials" and the remainder manufactures and luxuries, articles of food and animals, showing a reduction of ten millions as compared with the importations during the corresponding months of last year.

Nearly all of the great articles required for use in manufacturing, with the single exception of india rubber, show a marked increase in importations. Importations of raw silk, for example, amount to $40,905,393 in the 11 months of this year, against $35,411,000 in the corresponding period of 1901; hides and skins, $53,022,521, against $50,877,797 in the 11 months of last year; tin for use in manufacturing tin-plate, $19,532,807, against $17,415,302 in the corresponding months of last year. India rubber importations show a slight falling off, the total for 11 months being $22,568,786 this year, against $25,929,985 in the same months of last year.

The most striking increase in importations is in manufactures of iron and steel, which amount, for the 11 months, to $36,766,961 in value, against $18,267,677 in the corresponding months of last year, the value of the importations having thus more than doubled this year as compared with last year. Practically every item in the list of iron and steel manufactures shows a marked increase. The export figures of iron and steel manufactures show a reduction, the total exports for the 11 months being $90,136,024 this year, against

$94,091,967 in the same months of last year, and $119,604,848 in 11 months of 1900.

The total exportation of the 11 months falls 116 million dollars below that of the corresponding period of 1901. This reduction occurs in agricultural products, of which the exportations during the 11 months of this year fall 130 million dollars below those of last year, indicating that in the other great classes, especially manufactures, there is an increase. This reduction of 130 millions in agricultural exports is due in part to the increased home demand, in part to the loss of a part of the corn crop of last year, corn exportations having fallen from $49,501,374 in 11 months of 1901 to $6,745,151 in the corresponding months of this year. There is also a considerable reduction in the value of wheat exported, due to the fact that last year's exportations were exceptionally large.

	Eleven months ending	
	Nov., 1901.	Nov., 1902.
Imports—		
Food and animals	$203,448,487	$193,133,017
Crude manufacturers' materials	274,356,147	318,110,083
Manufacturers' materials, partly manufactured.	79,061,141	89,493,516
Manufactured articles	126,055,692	149,611,848
Luxuries and articles of voluntary use	117,504,764	124,617,093
Total imports	$800,426,231	$874,965,557
Domestic Exports—		
Agricultural products	$845,678,850	$715,771,314
Manufactures	362,392,181	377,635,961
Products of the mines	37,614,960	33,207,024
Products of the forest	46,761,217	48,261,040
Products of the fisheries	6,314,222	7,863,430
Miscellaneous articles	3,999,105	4,638,695
Total domestic	$1,302,760,535	$1,187,377,464
Foreign exports	25,425,596	25,332,599
Total exports	$1,328,186,131	$1,212,710,063

The Engineering of P. R. R. Tunnel.

The Pennsylvania Company has completed arrangements for the engineering of the New York tunnel, which will be carried on independently of the company's regular engineering department by a commission. While the tunnel and the terminal facilities will be devoted to the use of the Pennsylvania system, the work of construction will be carried on by the Pennsylvania, New York & Long Island Railroad Company, an auxiliary organization formed explicity to construct, own and operate this property. The actual accomplishment of this project, however, has been subdivided under three heads, and will be entrusted to three separate organizations, which in a measure will be distinct and independent, but at the same time will work entirely in harmony. These are the commission above referred to, composed of six prominent engineering experts, the engineering department and the architectural department.

The commission will consist of the following members: Colonel C. W. Raymond, United States engineer in charge of New York harbor work, who will be chairman; Charles M. Jacobs, chief engineer of the North River section of the tunnel, which extends from west of the Bergen Hill in New Jersey to the terminal station at Ninth Avenue, in New York; Alfred Noble, chief engineer of the East River section, which will extend from Seventh Avenue, New York, to Long Island City; William H. Brown, chief engineer of the Pennsylvania Railroad system, who will be chief engineer of the terminals and track construction; Gustav Lindenthal, the present bridge commissioner of New York, who will act in a general advisory capacity, and George Gibbs, who will have charge of the traction, mechanical and electrical engineering. Mr. Gibbs is also electrical engineer of the Long Island Railroad Company, which is at present engaged in the electrification of its lines in conjunction with the Pennsylvania system, of which it is a part.

The engineering has been entrusted to Westinghouse, Church, Kerr & Co., which will have charge of all engineering problems exclusive of the construction of the tunnel proper, and will act as engineers for the Pennsylvania Railroad Company, the Long Island Railroad Company and the architects in the working out of all problems involving civil, mechanical and electrical engineering. The architectural work has been assigned to McKim, Mead & White, who will have charge of all structural details involving the terminal station and accompanying structures of the New York terminal.

The engineering department has already completed plans for the power plant in Long Island City, which will be the first one to be installed, and this plant will be utilized in the construction work. There will be another electrical power plant in New Jersey, probably near the western terminal of the tunnel, but this will not be undertaken until the work on the tunnel has progressed considerably. For the present efforts will be directed toward completing the Long Island branch of the work, including the transformation of the Atlantic Avenue line of the Long Island Railroad Company into an electric system. This will extend from Flatbush Avenue to Jamaica, and will have a physical connection with the Rapid Transit Subway system, but it has not yet been determined whether the cars of the Long Island Railway will be operated through the subway or not.

CURRENT NEWS AND NOTES.

FRENCH TELEGRAPHS.—The revenue returns in France for November show that the receipts were 1,147,700f. in excess of the estimates and 7,397,900f. more than the amount received during the same period last year. The telegraph service, which for some months had shown a decrease, has this time increased by 63,600f.

A NEW PROMETHEUS.—A cable dispatch from Milan, Italy, of December 29, says: The *Secolo* says that Signor Pansa, an engineer of Cassino, has invented a machine which converts the sun's light and heat into an alternating electric current. He believes that by the use of this machine every one will soon be enabled to manufacture his own electric power, light and heat.

X-RAYS AND TUBERCULOSIS.—A cable dispatch from Berlin of December 27 says: Interesting experiments are being made in Prof. von Leyden's clinic with Roentgen rays, with the aid of which photographs are being made in order to discover first traces of tuberculosis. If the disease exists small knots are shown in the photographs. The new method is said to be an improvement over the old.

N. E. L. A. COMMITTEES.—The following appointments have been made by President Ferguson, of the National Electric Light Association, in the new departments which were created at the last convention: Reporter for wrinkle department, Mr. J. H. Perkins, Youngstown, O.; committee on lost and unaccounted for current, Mr. L. G. Van Ness, Lincoln, Neb.; reporter department of decorative lighting, Mr. A. S. Williams, New York Edison Co.; committee on theft of current, Mr. R. L. Elliot, Chicago Edison Co.; reporter department of office methods and accounting, Mr. W. M. Anthony, Chicago Edison Co.

DYNAMITE IN COAL.—Telegrams from Buffalo of December 27 state that a catastrophe was averted in the electric light plant at East Aurora, Erie County, by the timely discovery of dynamite in a consignment of bituminous coal that had been received at the plant from Pennsylvania. The coal supply of the plant has been short and some of the coal was being shovelled direct from the cars to the fires. The workmen on the car found a stick of dynamite and notified the fireman, who found several more sticks in his barrow of coal. In all, seven sticks of dynamite were found. It is not known whether or not the dynamite was placed in the coal at the mines or since the coal left the mines.

PUMPING ENGINE EFFICIENCY.—Tests of pumping engines recently installed by the Allis Company at St. Louis and Boston direct attention to the very high efficiency attained with engines designed for pumping duty. Both are triple-expansion engines, and that at St. Louis developed an average of 801.6 hp. on a boiler pressure of 126.7 lbs. The average consumption of dry steam was 10.676 pounds per hp.-hour, the thermal efficiency 21.003 per cent., and the mechanical efficiency 96.84 per cent. This result is the more remarkable from the low steam pressure, which is below the economical pressure for a triple-expansion engine. For comparison with other pumping engines, it may be said that the above performance corresponds to a duty of 179,454,255.

FANNING ISLAND CABLE STATION.—A cable dispatch from Honolulu says: The British Cable Company, owning the All Red Line from Vancouver to Australia via Fanning Island, has made an offer to James and Henry Bicknell, of Honolulu, to purchase their half interest in Fanning Island. "King" Grieg owns the other half interest. James Bicknell will leave for San Francisco on the "Zealandia" and may close a bargain with the British company.

MESSENGERS IN JANUARY.—An unusual demand exists in New York always for messenger boys in the first two weeks in January. Some of the larger downtown banks call for the services of from ten to forty boys all day for ten to fourteen days in January, beginning with the 2d of the month, while at other times they employ none at all regularly except on call. This results, necessarily, in an increase in the force of boys at the downtown offices of the District Messenger Company, from which the boys are sent to those in need of them. To meet this demand the uptown offices of the messenger company are practically stripped of the sharpest and cleverest boys usually employed there, and the night boys have to work for several hours in the busiest part of the day. Some of the boys were so overworked this Christmas, or so overburdened with presents, they went on strike.

PREECE ON WIRELESS TELEGRAPHY.—A cable dispatch from London of December 23 says: Sir William Henry Preece, formerly president of the Institution of Civil Engineers and a well-known electrician, was interviewed to-day in regard to Marconi's latest experiments in ocean wireless telegraphy. Sir William was emphatic in declaring it to be his opinion that the wireless system would never become a serious competitor of the submarine cable. In the first place, he said, there was the want of reliability. It was possible to tap every wireless message and consequently there could be no privacy. Secondly, there was the low rate of speed of the wireless system as compared with the cables. Sir William expressed the opinion that wireless ocean telegraphy would never be practicable as an important means of communication because it could never stand comparison with the cables.

ELECTRIFYING ERIE CANAL.—It is stated that in a letter Governor Odell has received from former United States Senator Warner Miller, the latter says that the need of the improved canal to preserve the commerce of New York is conceded by all. The remedy must be one that can be made effective within two or three years. The ex-Senator says the solution is in the immediate completion of what is known as the nine-foot improvement and the adoption of electricity as the power to drive the barges through the waterway. "The 1,000-ton barge canal cannot be constructed in less than eight years," continues Mr. Miller, "and many persons competent to form an opinion believe it will take nearer twelve. In that time the danger to our commerce will have worked its evil consequences and a large part of trade will have been diverted through other channels to our rival ports, never to be recovered."

CURRENT FROM THE AIR.—We have been in receipt lately of documents relative to a scheme to get electricity in abundance from the upper air. Chicago is to be the scene of the first experiments and eight acres of land on the North side have been purchased for the erection of a plant. The scheme worked out by Albert G. Whitney is to project a wire cable 250 miles above the earth. He says that the atmosphere extends to a height of about seventeen miles. Above the atmosphere, Mr. Whitney says, the ethereal regions are reached, and at this place the force of gravitation is away from, instead of toward the earth. The projection of forty miles of cable, if Mr. Whitney's theories are correct, would cause the whole cable to recede from the earth, so that he could unwind any quantity of cable and the wire would maintain its rigidity. Mr. Whitney says that experiments have shown that the ethereal regions are surcharged with electricity and that this force will be transmitted to the earth's surface through the long wire cable. His patent specifications disclose his plan for achieving such results.

AN ELECTRIC AERIAL TORPEDO.—A telegram from Utica, N. Y., of December 27, says: Prof. Carl Myers, of Frankfort, to-day reopened his balloon farm for the manufacture of a number of war balloons for the Government and the building of several airships for various inventors who are to compete at the St Louis Exposition for the $100,000 prize. He also announced to-day the completion of an "electric aerial torpedo," a machine which promises much in the solution of the problem of aerial navigation. The aerial torpedo flies like a thing of life. It is driven by two aluminum screw blades, which make 2,000 revolutions per minute. The blades are rotated by an electric motor which obtains its power from an ordinary incandescent lighting current of 110 volts. The movements are directed by two aeroplanes acting as rudders, moving the vessel up or down, right or left, in circles, spirals or cycloids, in all directions in mid-air as freely as a bird flies. All these evolutions are under the control of a distant operator, who moves an index over contact points on a dial switchboard, to which the vessel instantly responds.

GUARDING THE KAISER.—The following is from Berlin of December 13. Some of the German papers are printing remarkable stories concerning the precautions that are taken to ensure the safety of the Kaiser when he is traveling at night. The Kaiser takes no chances. The carriages which he now uses at night are equipped with a contrivance so unique as to be worthy of mention. It is an electric lamp as big and as dazzling as an arc light, fastened to the end of the carriage pole. Of course, the lamp, like the headlight of an engine, lights up the ground for 100 feet or more ahead, and enables the postillions or the driver to see in time any bomb or canister of explosives which may be lying in the roadway, placed there with the object of blowing the Imperial equipage into the air on being struck either by the horses' hoofs or by the wheels of the conveyance. Besides this the light is so dazzling that, moving quickly as it does, it would render it very difficult for any would-be regicide to take a good aim at the carriage from the road. Of course, the Emperor's horses have to be specially trained to stand the light, and this is no easy task, for although they are behind the light, yet their sensitive eyes cannot but be dazzled by the brilliancy of the illumination before them.

SUSPENDED ROAD FOR BERLIN.—It is proposed to construct for Berlin suburbs a hanging electric road of the type already described and illustrated in these pages. The "Schwebebahn" would begin at the station Gesundbrunnen, run through the Brunnenstrasse to the Rosenthaler Thor, and from there to the Alexander Platz station, Oranienburger Platz, Kottbuser Thor, Hermanns Platz, passing through the suburb Ricksdorf, and ending at the station of the belt line at the Hermanns Platz. The managers of the proposed "hanging" road say that their system has many advantages over the existing elevated lines; less building material will be needed in the erection of the superstructure, as the cars would be suspended from a structure and would depend on only one track; sharper curves would be possible, and even at the sharpest curves trains can run at a fast speed. The high tracks would not darken the streets as do ordinary superstructures of the elevated roads. The line as proposed would have a length of about six miles. Trains will consist of three motor cars with fifty seats. Later it is hoped to run trains consisting of six cars. The road would be able to carry 9,000 passengers in an hour. The cost of operating it would, it is claimed, be much less than other lines.

WANTING SUBMARINE BOATS.—It is stated from Washington that the Secretary of the Navy has received simultaneous requests from commercial bodies in New York, Boston, San Francisco and other ports asking for more submarine torpedo boats with which to defend those harbors. The similarity of the requests and the fact that all are made at the same time, has given rise to the opinion in the Navy Department that the lobby at work here has extended its operations by creating a local demand for submarines. A number of Senators, representing seacoast States, have received urgent requests to support large appropriations for submarine vessels, on the ground that they are badly needed for harbor defence. The Senate and House Committees have been cautious in favoring submarine boats, as their efficiency in war conditions is yet to be proved. So far as the defences of New York and San Francisco are concerned, naval experts say that submarine vessels are superfluous. Both harbors are provided with mines to prevent the entrance of an enemy's craft, and the fortifications are designed to make it impossible for the enemy to even approach the harbors. If reliance cannot be placed on the big coast defence guns and submarine mines, they think little would be accomplished by the use of submarine torpedo boats. The navy is giving them a fair trial, however, and if they prove serviceable no doubt more will be allowed by Congress.

NEW YORK ELECTRICAL SOCIETY will open the new year with an interesting meeting on January 7 at the American Institute, West Forty-fourth Street, to be devoted to important questions connected with fire insurance and electricity, such as high-potential lines, fuses, underwriters' rules, etc. Among those promised or expected to speak are Messrs. Kennelly, Sachs, Forsyth, Arthur Williams and others prominent in the art.

BALANCED-CIRCUIT INDUCTION COIL.—A patent issued December 23 to John P. Alexander describes an arrangement for the conversion of direct into alternating current by means of induction coils. The primary coil is so arranged with relation to the line conductors as to form a bridge across a divided and balanced circuit, in the branches of which balancing resistances and circuit-breakers are connected. By this means a current may be sent through the coil or through the united branches of the divided circuit without interrupting the flow of the supply current, while at the same time charging and discharging the primary coil so as to secure inductive reaction upon a secondary, and from this to other circuits or translating devices. The system is applicable to railway multiple control, telephone transmitting apparatus and other uses.

COMPENSATION FOR TRANSMISSION LINE INDUCTION DROP.—A patent issued December 23 to John F. Kelley describes a means of compensation for the induction drop on long alternating-current lines, and also for the *CR* drop on the same lines. An auxiliary generator of the inductor type is operated from the main generator shaft, with its armature in series with the latter. From the secondary of a transformer of which the primary is in series with the working circuit, current is passed to a rectifying commutator on the shaft of the auxiliary generator and thence to the field of the latter. The auxiliary generator is so constructed as to permit of adjustment of the relation between the stator and rotor. By a proper adjustment, the auxiliary generator sets up an e.m.f., one component of which is equal and opposite to the line e.m.f. due to the line inductance, thus neutralizing it; another component is in phase with the working e.m.f. and compensates for the *CR* drop, the field of the auxiliary generator increasing in strength with increase of main current output.

BREAKING ELECTRIC CURRENTS.—Three patents of the issue of December 23 relate to means for avoiding sparks upon the interruption of electric currents, one being granted to W. L. R. Emmet and the others to Robert H. Read. The Emmet patent covers a fuse which is kept in tension by springs; when the fuse blows the separated parts are instantly drawn by the springs through narrow enclosed passages, at the same time a current of air being passed to expel the gases. The two Read patents relate to a method of passing a current of air across the arcing points, which serves to remove the arc gases and to cool the contacts. The arcing points are hollow and confined within an air-tight chamber in communication with a source of compressed air which is put in communication with the chamber just before the electrodes part. The stream of air removes the arc gases, cools the contacts and stretches the arc until it breaks. The hollow of both electrodes communicate with the open air, and when in contact form an air-tight joint within the air chamber.

ELECTROLYTIC CHLORATE.—Mr. Richard Threlfall, of Birmingham, England, proposes an interesting method for the production of chlorates by electrolysis of solutions of the chlorids of the alkali metals. The method is based on the well-known fact that solutions of hypochlorous acid are less stable than those of its salts; and from this the conclusion is drawn that the course of electrolysis should be such as to maintain at all times in the electrolyte a certain proportion of free hypochlorous acid. To this end a certain disproportion is maintained between the anodic and cathodic reactions, by diverting about one-twentieth of the total current from the principal cathode to a supplemental cathode in a compartment distinct from the main cell, but having electrolytic connection therewith. The supplemental cathode may be contained in a porous cup immersed in the main body of the electrolyte, or it may be in a compartment of the cell separated in any convenient manner, as by a porous diaphragm, from the principal electrolyte. The concentration of the caustic formed in the supplemental compartment should be kept low by continual replacement. The reactions, as stated by the patentee, are based upon the assumption that an amount of free chlorine corresponding to the excess current at the anode reacts with hypochlorite existing in the bath to form hypochlorous acid and chloride; and that the hypochlorous acid so formed oxidizes spontaneously to chloric acid, and that the latter, by simple interchange with further quantities of hypochlorite, yields the chlorate of the alkali metal.

DE FOREST WIRELESS TELEGRAPH PATENTS.—Among the patents of December 16 were three issued to Dr. Lee DeForest and E. H. Smythe, covering the principle of the electrolytic anti-coherer or responder, which is employed by the DeForest Wireless Telegraph Company. The principle involved, first discovered by Neugschwender, is that when between two closely opposing electrodes of soft metal, as silver, moisture or some electrolyzable fluid is deposited, minute chains of metallic particles or bridges are torn off from the anode and built into conducting chains across the gap. When electric waves traverse these bridges, electrolysis suddenly occurs in the minute films of liquid lying between the links of these "chains," with explosive generation of gas, which suddenly ruptures the bridges, resulting in a large increase of resistance of the gap. Upon cessation of the waves the bridges reform under the electrostatic stress from the local battery and the normal conductivity of the receiver is instantly and automatically restored. But when water alone is the medium, the gap is soon rendered nonsensitive and inoperative. Too great an amount of metallic particles is torn off from the anode, the hydrogen gas accumulates among the chains, and a spark will cause an actual coherence with complete clogging of the gap. The patents referred to disclose means whereby the device is rendered constantly sensitive. In one form the electrodes are separated by from two to five-thousandth of an inch by an interposing medium consisting of a mixture of glycerine and lead oxide.

LETTERS TO THE EDITORS.

"The Converser."

To the Editors of Electrical World and Engineer:

Sirs: A good name is much wanted for the movable combined transmitter and receiver now so much used, which is connected to the telephone call box by cords. It has been called "the transmitter," "the receiver," "the hand combination," "the microtelephone," and various other barbarous names.

I would suggest: "The converser," as being the apparatus by means of which the user converses with his distant correspondent.

Government Telegraph Office, H. W. Jenney,
Melbourne, Australia. *Chief Electrician.*

Third Rail Operation.

To the Editors of Electrical World and Engineer:

Sirs.—I notice in a recent issue some reference to the difficulties met with on the elevated road in this city, on account of ice and snow on the "third rail." Why could not this third rail have been installed upside down, trough and all, the shoe making contact from below? It seems to me that such a disposition would effectually prevent the accumulation of snow and ice on the contact surface, and I do not see that there could be any insurmountable difficulty in supporting it in this way. Wm. A. Anthony.

New York City.

The Valtellina Three-Phase Railway.

To the Editors of Electrical World and Engineer:

Sirs: Referring to certain criticisms in the article in your issue of November 8 on the Valtellina Railway, I beg to say that the Italian government without any hesitation accorded permission for the use of 3,000 volts on the trolley line where crossing highways, and the special commission appointed to inspect the line before it was opened to the public confirmed this permission. In view of this I cannot see reason for the assertion that the Ganz Company found in Italy many discouraging conditions, especially when its work was favored in every manner by the Rete Adriatica Railway Company.

I notice that in your first article on the Valtellina Railway you do not mention the Societa Italiana per la Trazione Elettrica Sulle Ferrovia, which really assumed financial responsibility for the project, thus making the construction of the Valtellina Railway possible, and besides took over all the hydraulic and power house work—that is to say, the largest part with respect to the cost of the Valtellina Railway's electrical equipment. The Rete Adriatica Railway Company assumed responsibility for all of the general expenses, amounting to about one million, and all the risk in the case of an economical failure of the experiment, the responsibility of the Ganz Company and that of the Soc. It. per la Traz. Elett. being only technical.

PIETRO LANINO,
Formerly Chief Electrical Engineer Rete Adriatica Railway Company.
BOLOGNA, Italy.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Speed Regulation of Induction Motors.—OSNOS.—An illustrated article in which, after a brief critical discussion of the various methods proposed for the speed regulation of induction motors, he expresses his opinion that the use of a direct-current dynamo commutator is the only proper means for this purpose. If resistances are inserted in the secondary, their action is that, at constant primary voltage, the current is diminished in the secondary, without change of the phase difference; the ohmic voltage drop consumes energy; if, instead of this, a counter e.m.f. is introduced into the external circuit of the secondary, the same result is obtained without loss of energy. For a decrease of speed of the induction motor, an external e.m.f. is required which, like the ohmic voltage drop in series resistances, is opposite to the e.m.f. of slip; this e.m.f. must also have the same frequency, as the e.m.f. of slip. For an increase of speed above the normal, the external e.m.f. must have the same direction as the e.m.f. of speed. For generating such an artificial e.m.f., the direct-current dynamo commutator is the best means, as with its aid it is easy to get alternating current of any phase and frequency. As by this means it is possible to adjust the phase of the secondary voltage, one is enabled not only to introduce the secondary e.m.f. required for speed regulation, but to supply also an e.m.f. of different phase to the secondary for compensation of the phase difference. The only difficulty is sparking at the commutator and this can be avoided. He first gives a general mathematical theory of this method of speed regulation and shows that the slip of such a motor equals the slip of the same motor under ordinary conditions (without speed regulation) minus the ratio of the secondary to the primary voltage multiplied by the cosine of the angle between both voltages. If the same set of brushes is used for speed regulation and compensation of the phase difference, the primary current must lead the e.m.f. in phase at speeds below synchronism and must lay at speeds above synchronism. He discusses in detail the Goerges series motor of this type and shows its weak points. For a good speed regulation it is necessary to transform economically the exciting current from the frequency of the network to the frequency of the slip; it is further necessary that the ratio of the primary to the secondary voltage and the phase difference between both be adjustable within wide limits. An arrangement for this purpose is shown in Fig. 1, in which p represents the primary of a bipolar induction motor provided with a direct-current winding, w, and commutator, k, analogous to the armature of a rotary converter. On the commutator there are sliding four brushes, connected to four symmetrical points of the secondary, s. The frequency of the current between two brushes equal the frequency of slip, while its phase depends upon the position of the brushes and the voltage upon the distance between the brushes. The voltage is greatest if b_2 and b_4 are at the points in the figure in which they are not shown in solid black; if they are, however, at the points shown in solid black, the voltage between the points 1 and 2, or 3 and 4, is reduced to the voltage between two segments. By changing the position of the brushes on the commutator, or by changing the connections between them, it is possible to vary the value and the phase of the voltage between the brushes within wide limits. This device differs from that for pure compensation of the phase difference in so far as the total secondary current in this case flows through the commutator; this disadvantage cannot be avoided. If the connections between the three symmetrical points, 1^1 2^1 3^1, shown in Fig. 2, are provided, the current taken all along the circumference of the commutator is uniform for any position of the brushes. The greater the number of poles, the greater is the difficulty of obtaining an exact speed regulation by the shifting of the brushes alone. It is, however, possible to use, as in Fig. 3, transformers t with a variable ratio of e.m.fs. He finally makes some remarks on means of avoiding sparks and says that these machines may also be used as frequency changers.—*Elek. Zeit.*, December 11.

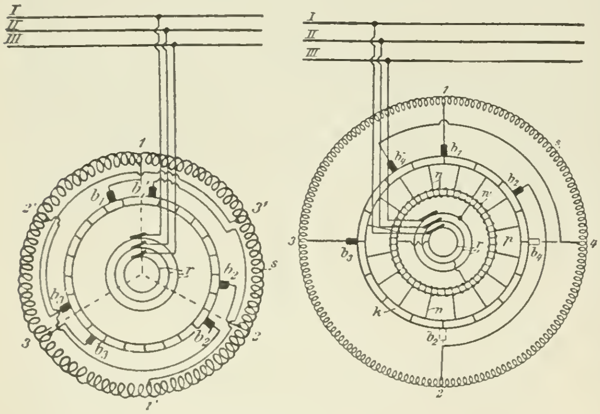


FIG. 1 AND 2.—SPEED REGULATION OF INDUCTION MOTORS.

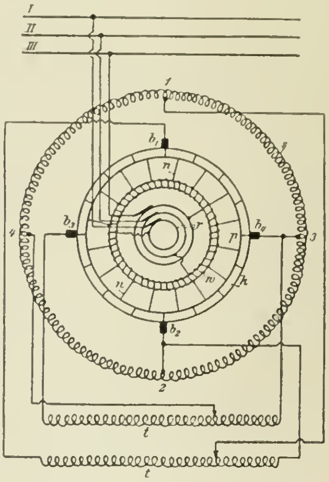


FIG. 3.—SPEED REGULATION OF INDUCTION MOTORS.

REFERENCES.

Commutation.—MAWDSLEY.—An illustrated article on obtaining good commutation in direct-current dynamos. Hobart proposes to keep the reactance voltage of the coil undergoing commutation as low as possible. The writer describes special pole constructions that he calls "equalizing poles," for neutralizing the evil effects of the cross-magnetizing power of the armature. He claims that by this means sparkless commutation can be obtained even with a large number of armature ampere-turns and high reactance voltage.—Lond. *Elec. Rev.*, December 5.

Paralleling of Alternators.—Cramer.—An article illustrated by diagrams on the use of incandescent lamps as indicators for connecting alternators in parallel.—*Elek. Anz.*, November 30.

Specification for Dynamos and Rotary Converters.—Hobart.—An article in which he gives printed specification forms prepared by him for use in designing direct-current commutating machinery; they are of the kind used by most manufacturers for recording the constants of machines. The details of these blanks are briefly discussed.—Lond. *Elec. Rev.*, December 5, 12.

Lights and Lighting.

Electric Conduction in Electrolytic Incandescent Bodies.—Gradenwitz.—An article on the nature of the electric conduction in the filament of the Nernst lamp. The Nernst lamp may be operated successfully for many hundreds of hours with direct current; if electrolysis really takes place, there must be another process which annihilates the action of electrolysis. Bose, in studying this problem, assumes that the oxygen anion is the principal agent; the oxygen liberated at the anode diffuses back to the cathode and oxidizes the pure metal which had been formed there. Some experiments of Bose, made in the vacuum, are described. The pure metal which is reduced at the cathode is not entirely oxidized back, there are fine threads of pure metal growing over from the cathode to the anode. A filament burning in the vacuum represents a system of an electrolytic conductor in shunt with a metallic conductor, with the exception of the neighborhood of the anode, where there is pure electrolytic conduction. The experiments explain some facts known to the manufacturers of the Nernst lamp. The life of a filament is greatly diminished by repeatedly changing the poles, on account of the partial reduction of the oxide and the internal tensions thereby produced. The filament gives less illumination at those parts when the metal is reduced, on account of the increased conductivity; a decrease of the efficiency results therefrom; as in direct-current lamps, a partial reduction of the filament takes place, they have a lower efficiency than alternating-current lamps.—*Elek. Anz.*, November 20.

Power.

Refuse Destructor and Electric Plant.—An illustrated description of the Cleckheaton works. The refuse destructor is of the Meldrum regenerative "Simplex" type with two furnaces; the capacity is 20 tons of ashpit refuse per day of 24 hours and an evaporation (in conjunction with Lancashire boilers) of 1 pound of water with 1 pound of refuse is anticipated. There are three 150-kw, 460 to 500-volt, direct-current dynamos, and a battery of 270 cells. The three-wire system is used. The present load is entirely lighting, but traction will be added next year.—Lond. *Elec. Rev.*, December 12.

Governors for Engine-Driving Alternators.—Parkinson.—An article on engine governors for parallel operation of alternators. He says that a suitable governor should either be very far removed from isochronous, having say 6 to 7 per cent. drop, or when sudden changes of load occur, the governor may have a smaller drop, say 3 to 4 per cent., but must not be too quick in action; this effect can be obtained by providing a spring governor with a powerful dashpot, or by using a dead-weight governor with considerable inertia in its moving parts.—Lond. *Elec. Rev.*, December 5.

REFERENCES.

French Water Power Plant.—Loppe.—The first parts of an illustrated description of the plant of Vonvry. The capacity is 2,000 hp and the electrical energy generated is used for supplying a station in the neighborhood at times of heavy loads. The hydraulic installation is described in detail.—*L'Eclairage Elec.*, December 6, 13.

Steering Gear.—A very well illustrated description of an electric steering gear for a British yacht.—Lond. *Elec.*, December 12.

Traction.

Paris.—Durand.—An illustrated description of the Nogentais traction system which supplies a part of the eastern suburbs. It is of interest on account of the different varieties of traction which are employed. From the city end, accumulator traction is used for a short distance, then comes an underground conduit which leads to the Vincennes Gate. From this point commences the suburban system which uses the trolley for the different branches. To carry out this arrangement, two types of cars are used; the first of these is equipped for accumulator, conduit and trolley, and takes passengers from the city terminus to the suburban points. The second type of car uses the trolley system alone, starting from the Vincennes Gate, where it connects with the eastern terminus of the Metropolitan and circulating through the suburbs.—*Elec. Rev.*, December 13.

Single-Phase Railways.—Geipel and Lanze.—A communication referring to a recent remark of Swinburne, who had pointed out the particular suitability of single-phase alternating currents for working long railways and had suggested using for speed regulation, speed-reducing gear on the cataract system. The writers say that this method is well known to mechanical engineers and has been tried for motor cars and other purposes, but without success. They call attention to the Ward Leonard system of varying the speed electrically.—Lond *Eng'ing*, December 12.

REFERENCES.

Freight and Express on Electric Railways.—Adams.—An article in which he says that there are now cogent reasons for the extension of electric railway business to include the transportation of local freight and express matter. Express matter carried on interurban lines may be readily transferred to the local cars in any of the connected cities, and the necessity of wagon collection and delivery thus largely avoided. Statistical data on the development in Massachusetts are given.—*St. R'y Rev.*, December.

London.—A map, with a short description, showing the underground electric railways in operation, in the course of construction, in the course of change from steam to electric power, and before Parliament in London and the suburbs.—Lond. *Elec.*, December 12.

Western Ohio Railway.—Tell.—An illustrated article on the engineering features of this railway. The company operates at present 47 miles of road and has under construction 64 miles more. Three-phase currents are used for transmission to converter sub-stations.—*St. R'y Rev.*, December.

Installations, Systems and Appliances.

REFERENCES.

British Central Station.—An illustrated description of the new electric lighting plant of the town of Ross. The two-wire system is used at 230 volts. There are two 40-kw dynamos and a battery of 130 cells, giving 390 ampere-hours at a normal discharge capacity of 160 amperes per one hour.—Lond. *Elec. Eng.*, December 5.

Steamship Installation.—Richard.—The first part of a well-illustrated description of the electric installation of the steamship *Kronprinz Wilhelm.*—*L'Eclairage Elec.*, December 13.

Isolated Plant.—Laffargue.—An illustrated article on an electric lighting plant in a cottage. A small oil engine drives the generator. There is an electric automobile which is used during the day for driving and in the evening as a reserve station to give current for lighting and various other applications.—*La Nature*, December 13.

Charging for Electrical Energy.—Lauriol.—An article on tariffs for electrical energy. He speaks in favor of the use of the two-tariff meter, different rates being charged at different hours. This system is said to be equally in favor of the central station and of the consumer.—*L'Eclairage Elec.*, December 6.

Electro-Physics and Magnetism.

Electric Origin of Molecular Attraction.—Sutherland.—A paper in which he makes an attempt to reduce molecular action to the electron theory. He starts with the conception of a neutral gaseous molecule, containing a positive and a negative electron. Such a molecule will have poles like a magnet, and will exert upon a similar molecule an attractive or a repulsive action according to whether unlike or like poles are nearest. But an attraction tends to increase itself, and a repulsion tends to diminish itself, and so it comes about that on the whole there is more attraction than repulsion. Like magnets, the molecules attract each other with a force varying inversely as the fourth power of the distance. He shows that a strong contrast is shown to the law of gravitation, and the first condition of the electron theory is satisfied, by the fact that molecular mass does not enter into the expression for molecular attraction. It may be considered that the two electrons of a molecule like Na Cl, when giving the line spectrum of sodium, revolve round one another in a circle of such size that centrifugal force and electric attraction are in equilibrium. They revolve perhaps entirely within the sodium atom.—*Phil. Mag.*, December; abstracted in Lond. *Elec.*, December 12.

Electric Properties of Thin Metallic Films.—Patterson.—An account of some experiments which he has made with a view towards elucidating the problem of conduction in metals. He deposited the films in vacuum by the cathode discharge and found that the resistivity of such films is several times greater than that of the metal from which they are deposited. The specific resistance of platinum films which have been subjected to the same treatment remains constant above a thickness of about 0.000,000,7 cm. Below this thickness the increase of specific resistance with decrease in the thickness, is very rapid. Heat diminishes the resistance of both silver and platinum films, and the thinner the film, the greater the decrease.—*Phil. Mag.*, December; abstracted in Lond. *Elec.*, December 12.

Magneto-Optics of Liquid Hydrogen.—Harms.—An account of experiments made with liquid oxygen concerning the relation between susceptibility and magnetic rotation of the plane of polarization. The angle of rotation in liquid oxygen is about one-fifth of that in liquid carbon bisulphide, and about 2,000 times that produced in the gas at atmospheric pressure. The author gives a corrected table of rotations and susceptibilities for a number of solids, gases and liquids, but fails to discover any regular relation between both properties.—*Phys. Zeit.*, December 1; abstracted in Lond. *Elec.*, December 12.

REFERENCES.

Thermo-Cells.—Horstmann.—An article on the efficiency of thermo-cells. An efficiency of 2 to 3 per cent. is thought to be the maximum that can be attained in practice.—*Elek. Anz.*, November 9.

Induction Coils.—Armaznat.—A long mathematical article on the theory of induction coils.—*L'Eclairage Elec.*, November 15.

Electro-Chemistry and Batteries.

Sodium Chloride in Electrolytic Caustic Alkali.—Townsend.—An account of an experimental investigation concerning the movement of undecomposed sodium chloride into the caustic compartment. Of the several general types of cell, one only is capable of yielding a caustic solution absolutely free from dissolved chloride; that is the cell using a "stationary septum of mercury which is pervious to metallic sodium, but not to water or compounds in solution therein"; the provision of means which should entail neither undue complications of parts nor too great expenditure of energy for producing a sufficiently rapid transfer of the dissolved alkali metal, would make this cell the ideal one for the production of pure caustic solutions. In "gravity cells," if the flow of the liquid be rapid, assuming that the maximum permissible current density is employed, the current efficiency will be high, but the cathode lye will be low in caustic and high in salt. For the withdrawal of the products and the prevention of secondary reactions, a certain minimum rate of flow is essential, and this rate of flow is, in the cell constructions which have so far been proposed, too high to admit of thoroughly satisfactory concentrations of caustic. The diaphragm in a caustic cell is said to be essentially a device for controlling and equalizing the forward movement of the electrolyte and for retarding the backward movement of the products of electrolysis, and thereby permitting the establishment of a new and lower minimum flow for their removal. It is in no sense to be considered as a septum capable of permitting the passage of the electric current, but as preventing the diffusion and recombination of the products in stationary bodies of the electrolyte. The results of some experiments with a diaphragm cell are given in diagrams. For a solution containing one gram molecule of salt per nine of water the caustic attains approximately the supposed theoretical maximum, and the undecomposed salt is present nearly to saturation of the caustic. There is apparently a strong concentration of effect, inasmuch as the sum of the salt found and the salt equivalent of the caustic is far in excess of the saturation point for aqueous solutions of salt. The results of tests with more dilute solutions are also given.—*Electrochem. Ind.*, December.

Electrolytic Alkali.—An official communication from the Electrochemical Works at Bittefeld, Germany, to the effect that Kershaw's statement, that the Aussig bell process is being used at one of the Bitterfeld works, is wrong.—Lond. *Elec.*, December 5.

Determining the Best Conditions in Storage Battery Practice.—Hering.—An article, illustrated with diagrams, describing a method for calculating by means of curves, the conditions under which the best results are obtained in storage battery construction or operation; such calculations are difficult to make in any other way, even if it is at all possible. As an illustration of a simple case, the cost of a cell of a given capacity will increase at a certain rate with an increase of the weight of the plates; the life in number of discharges which it will stand, will also increase with the weight of the plates, but at a different rate; for a very light battery the first cost will be least, but the number of possible discharges will also be least, thus increasing the cost due to renewals; while for a very heavy battery the original cost will be much greater, but the number of possible discharges will increase also, thus reducing the cost of renewals; the result of this is, that at a certain weight this total cost per kw-hour capacity per discharge, including both the original cost and the cost of renewals, will be least, and this is the point which shows the best weight which the plates should have, so that the total cost will be the least. This is one of the illustrations which he gives; in the other illustrations he shows how to find the weight of plates at which the total mileage of an automobile battery per discharge of its life, will be greatest; also how to find out at what weight of plates the cost of the automobile battery per mile of total mileage will be least, or when the total mileage per dollar of battery will be greatest; or at how many discharges the average cost per kw-hour of useful energy delivered will be least. These are given only as illustrations, the article giving the general rules for making such calculations. In general, the data from which such calculations are to be made are given in the form of two curves having the same abscissa but different ordinates, and from this a third curve, with the same abscissa and the final desired ordinate, is calculated; if then there is a maximum or minimum value, this final curve will show it, and will show at what point this will be found. The method is not limited in its application to storage batteries, and it may also be used in many other cases, and enables one to determine the most economical conditions, which determinations would be extremely difficult to make, if at all possible, in any other way. The method is quite simple and rapid.—*Electrochem. Ind.*, December.

Conductivity of Nickel Oxides.—Marsh.—An article describing some experiments showing that nickel peroxide should not be termed a non-conductor, even from a practical standpoint, but should be classed with the conductors. He does not think that the flake graphite with which Edison mixes the nickel peroxide is necessary to increase the conductivity of the active mass, especially when the compound is properly prepared, yet he thinks that it prevents the peroxide from falling out of the perforated grid.—*Electrochem. Ind.*, December.

Artificial Diamonds.—Ludwig.—An account of experiments on the transformation of carbon into diamond. He claims that under great pressure in the atmosphere of hydrogen carbon in contact with iron forms the diamond, and that carbon fused in the electric arc in the absence of iron, under the same conditions of pressure, is likewise converted into diamond. Pressures as high as 3,100 atmospheres were used; when a spiral of iron wire was embedded in powdered retort carbon, and heated by an electric current in a highly compressed atmosphere of hydrogen. Careful examination showed that on some of the pieces of carbon were brilliant, minute crystals, possessing the hardness, specific gravity, and refraction of the diamond. To produce diamonds without the use of iron, it was found necessary to use much higher temperatures and actually fuse the carbon under very high pressure, when it was found to be a non-conductor, and hence was considered to be the molten diamond; spherical masses of the size of peas were obtained. It is the intention of the author to develop the process for the commercial manufacture of diamonds.—*Chem. Zeit.*, v. 25, p. 979; abstracted in *Am. Jour. Sc.*, December.

REFERENCES.

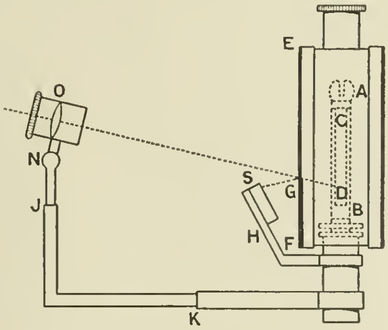
Electrometallurgy.—Beadle.—In a continuation of his serial on electrometallurgical problems he discusses the production of gold and silver.—Lond. *Elec. Rev.*, November 14.

Organic Chemistry.—Several papers on the application of electrochemical methods to special subjects of organic chemistry, by Loeb, in *Zeit. f. Elektrochemie*, October 2; by Elbs and Brand, Elbs and Wohlfahrt, and Klappert, in *Zeit. f. Elektrochemie*, October 9, by Escherich and Moest, in *Zeit. f. Elektrochemie*, November 6.

Laboratory for Electrolytic Analysis.—Richard.—The first part of an illustrated description of the laboratory for electrolytic analysis of the Electrochemical Institute of Nancy.—*L'Eclairage Elec.*, December 13.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electroscope Scale.—ELSTER AND GEITEL.—A description of a new scale for Exner's electroscope, which does away with the parallax between the scale and the leaves of the electroscope, without necessitating the presence of a scale at the leaves themselves. They do not engrave the scale on the wall of the case, but project it by means of a mirror into the plane of the leaves themselves. In the adjoining diagram *A B* is the carrier of the aluminum leaves, one of which, *C D*, is shown. The front glass wall, *E F*, is silvered from *G* to *F*. The scale, *S*, fastened to the holder, *H*, is as far in front of the glass case as the leaves are behind it. Thus an eye looking through *O* sees the scales lying accurately in the plane of the nearest edges of the leaves, and no parallax between scale and leaves is possible. Telescope tubes at *J* and *K*, as well as a joint at *N*, permit a perfect adjustment of the eye-piece. The lens enables a more accurate reading to be made. The back wall of the case is of ground glass, and the lenses are adjusted vertically by means of levelling screws.—*Phys. Zeit.*, November 15; abstracted in Lond. *Elec.*, December 12.



ELECTROSCOPE SCALE.

REFERENCES.

Maximum Current Indicator.—MARXEN.—An illustrated description of a maximum current and short-circuit indicator of Hartmann & Braun. It registers the maximum currents at different time intervals, by the length of radial lines on a revolving disc.—*Elek. Zeit.*, December 11.

Measuring Insulation Faults.—MUELLENDORFF.—An article of a mathematical nature in which he describes a new method for measuring insulation faults in three (or more) wire installations.—*Elek. Zeit.*, December 11.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Pacific Cable Speed.—A reprint of a question and answer asked and given in the British Parliament concerning the speeds obtained on the Vancouver-Fanning Island section of the new Pacific cable. In an editorial discussion it is pointed out how much the new heavy-weight cores are superior in point of relative speed to the older and lighter type of core. According to the old standards, which are based upon empirical constants derived from actual observed speeds upon the older cables, a cable of 3,458 nauts, such as the Vancouver-Fanning Island section of the Pacific, would not be expected to give a greater speed than 120×10^6 kr five-letter words per minute, or 600×10^6 kr letters per minute, with hand or plain automatic sending and simplex conditions. Working upon this basis, and taking the kr of the above-mentioned cable as 9.4×10^6, which is approximately its correct value at sea temperature, the speed would be 64 letters per minute, and for automatic curb simplex working—allowing 20 per cent. increase for curb, which is a very full allowance—say 77 letters per minute. The figures quoted in Chamberlain's answer in the House are 85 and 100 letters per minute respectively, or say, 30 per cent. faster in each case. This, of course, is not the first occasion by any means upon which these large cores have proved their superiority and exceeded expectations. Many heavy-cored cables are now in existence, and have demonstrated by their speeds of working that the old constants, as applied to them, may be regarded as obsolete, and that the rk factor, or resistance per microfarad, is a very important one in the designing of cable cores.—Lond. *Elec.*, December 12.

REFERENCE.

Electric Clock.—KAREIS.—An illustrated description of an electric clock devised by Morawetz. The main points are the electric pendulum and the minute contact apparatus.—*Zeit. f. Elek.*, November 9.

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New Books.

LA TRACTION ELECTRIQUE PAR CONTRACTS SUPERFICIELS DU SYSTEME DIATTO. By Cr. Julius. Paris: Gauthier-Villars. 66 pages, 12 illustrations.

We Americans are so prone to the vice of recognizing the existence of those things only with which we are familiar that this little volume will be found to contain much that is news even to professional engineers. This is the land of the trolley, and where it has been driven out by violence we make a mighty noise over the success of slotted conduits. It is therefore almost a shock to realize that in Paris the surface-contact system, here cast into outer darkness, is in actual use to the extent of nearly fifty miles of track. The opinions of American engineers who have seen it seem to differ widely as to its applicability to American conditions, most of them being rather pessimistic. But the pavements of Paris are nearer the surface of the soil than those of New York, and this makes a difference.

To tell the truth, one must realize that in any traction system the roadbed is as important as the arrangement of the rails, although too often neglected. The success of the surface-contact system like that of our familiar third rail system depends very largely on what lies about and under the rails, and this is just as legitimate a part of those systems as is the conduit of its system. This last failed conspicuously so long as it was too cheaply constructed. A careful perusal of M. Julius' little monograph is well worth the while for any engineer who wises to get a proper perspective of the world's progress in electric traction.

ANLASSER UND REGLER FUR ELEKTRISCHE MOTOREN UND GENERATOREN. By Rudolf Krause. Berlin: Julius Springer. 92 pages, 97 illustrations. Price, 4 marks.

This is a very useful little monograph on starting and regulating rheostats, brought well up to date and full of practical information. The subject is one which has been rather neglected in the literature, and Herr Krause has done the profession a real service in getting together a large amount of useful and otherwise somewhat inaccessible information. He sets forth briefly but very effectively the general principles of the design and construction of such apparatus, and while to the specialist the treatment seems somewhat meagre; it is nevertheless far more complete than the size of the volume would indicate. To one who has grubbed through the journals in the attempt to find something more generalized than descriptions of recently patented apparatus it will be especially welcome. The illustrations are plentiful and to the point, and altogether the volume is one to be recommended to students and to those who have casual occasion to deal with the matters described. We wish that more such handbooks were available, treating special corners of engineering.

BOOKS RECEIVED.

LOCOMOTIVES, SIMPLE, COMPOUND AND ELECTRIC. Fourth edition, revised and enlarged. By H. C. Reagan. New York: John Wiley & Sons. 604 pages, 309 illustrations. Price, $2.50.

MOTOR CARS AND THE APPLICATION OF MECHANICAL POWER TO ROAD VEHICLES. By Rhys Jenkins. London: T. Fisher Unwin. New York: James Pott & Co. 371 pages, 100 illustrations. Price, $5.00.

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Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month

Engine Builders' Association, J. P. Ide, Springfield, Ill., Secretary.

Interstate Independent Telephone Association, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

Kentucky Independent Telephone Association, Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

New Shops of the British Thomson-Houston Company.

At Rugby, England, the British Thomson-Houston Company has created and put in operation during the past year some of the finest works for heavy electrical manufacturing to be found on the other side of the Atlantic, equipped throughout with the latest and best tools and machines of American and other make. The works lie north of the London & Northwestern Railway Station, and adjoin the London & Midland Railway. They comprise some 25½ acres, of which about 10 acres are at present covered by roads and buildings. The total ground covered in square feet by buildings is 197,220, and the total floor space in square feet is 206,230. The works consist of fourteen substantial steel and brick buildings, and have been so planned that extensions can be readily added as required, and that without interfering with production. The arrangement of buildings and of machinery has been to avoid the material being carried backwards and forwards for the different operations, and as far as practicable to bring in the raw material from the warehouse direct at the first point in the evolutions of the finished product, passing it along from tool to tool in one direction to suit the various processes of machining, until it finally reaches the sections of the shops where it will be assembled, tested and erected. Standard gauge tracks are laid in the various buildings where the product is finished or stored, and are connected with the railway sidings, so that the products can be loaded directly on the trucks without rehandling.

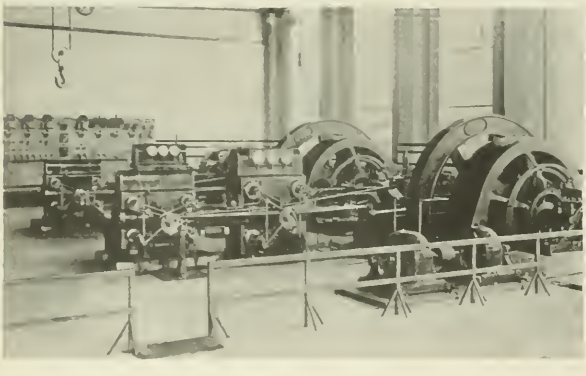


FIG. 1.—DIRECT-CONNECTED GENERATING SETS.

A notable feature of the plant is the power-house building, 110 x 110 feet. The foundations for the engines and boilers are of solid blue brickwork, built in cement, rising from the basement to the ground floor level to a height of 10 feet. The ground floor is composed of steel girders, strongly bolted together with tie-rods, and filled in with Portland cement concrete, to a thickness of 15 inches, with a top finish of mosaic. The walls of the engine house are artistically finished with glazed tile dado, with richly moulded capping and skirting; the window finishings are also richly moulded. The house contains three steam generators, two of which consist of a 200-kw. 550-volt continuous-current generator, coupled to horizontal tandem-compound Corliss-type engines. The engines, built by Cole, Marchant & Morley, Ltd., are each capable of giving a normal output of 320-ihp. when running at 120 r.p.m., with steam supplied at a pressure of 150 pounds per square inch at the engine stop valve, and with a vacuum of 25 inches of mercury in the exhaust pipe. The small set is a 100-kw. 550-volt continuous-current generator, coupled direct to a Browett Lindley horizontal tandem-compound engine running at 235 r.p.m. The condensing plant is of the Wheeler Condenser Company's "Admiralty" type, with 1,200 square feet of cooling surface, mounted on combined steam-driven air-circulating pumps.

FIG. 2.—CONTROLLER DEPARTMENT.

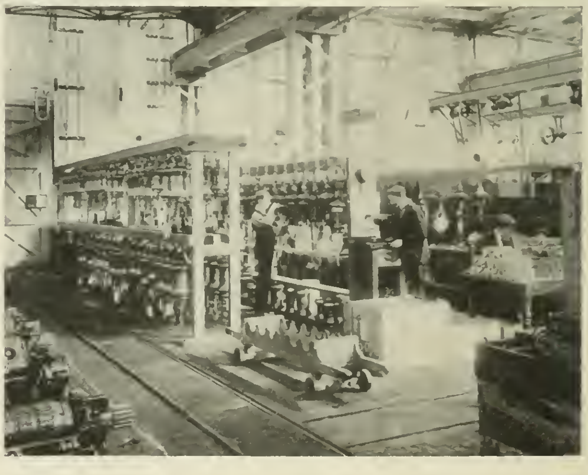


FIG. 3.—ARC LAMP TESTING DEPARTMENT.

The boiler house contains two Babcock & Wilcox units, each having a heating surface of 2,530 square feet, and fitted with superheaters capable of superheating the steam up to 100 degrees F. The working pressure is 160 pounds per square inch. The boilers are fitted with Vicars' stokers, driven through worm gearing by a 5-hp. motor running at 675 r.p.m. A third boiler is to be immediately installed. The economizer contains 320 pipes of the Clay Cross Company's make, the scraper gear being driven by an electric motor. The chimney, seen for miles around, is of steel, lined throughout with brick, and 100 feet high.

The switchboard is designed for the control of the three generators and balancer set, and of the output for lighting and power. It is provided with a duplicate set of bus-bars, so that the circuit to the testing department may be run independently of the other circuits on either of the generators, this provision being made so that the other circuits may be free from disturbance, due to short circuits in the testing department. The lighting circuits are run off the three-wire system and the circuit breakers protecting the two outer conductors are electrically interlocked so that it shall be impossible for the full voltage to be thrown on the lamps on either side in the event of a short on one side of the middle wire.

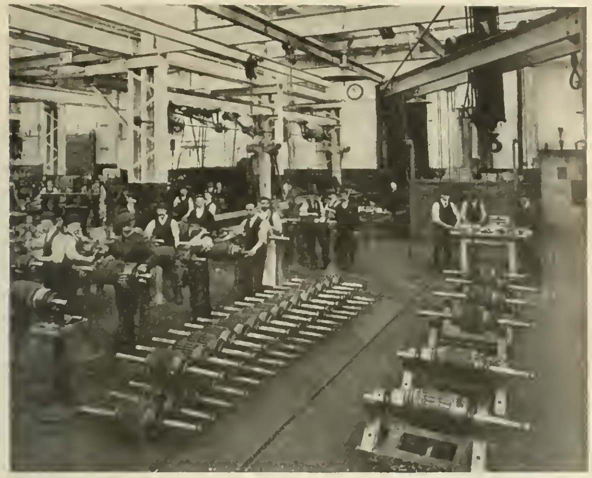


FIG. 4.—PART OF ARMATURE-WINDING DEPARTMENT.

The office building has a floor space of 15,281 square feet, and consists of three floors. In the basement are located the purchasing, publication, typing, supply and mailing departments and the office in connection with the meter department. The ground floor is occupied by the inquiry office, commercial, works and engineering departments. On the floor above are situated the offices of the designing engineers, secretarial and accountings departments, data section and draughting room. In the small section above this floor, which forms the turret in front of the buildings, are situated the blue printing and photographic departments.

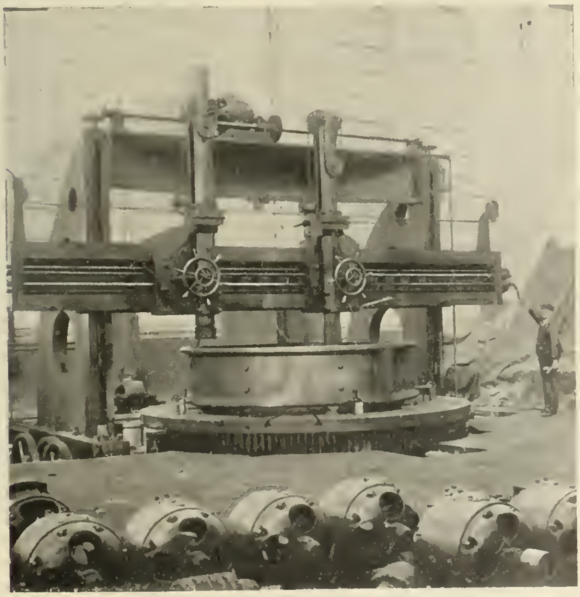


FIG. 5.—ELECTRICALLY-DRIVEN BORING MILL.

An Electric Express-Call System.

An electrical express call system has been invented by Robert J. Louis, President of the Louis Manufacturing Company, 141 West Twenty-fourth Street, New York, and is now being placed on the market; it is illustrated in Figs. 1 and 2 herewith.

The system consists of a tube or conduit running from the corridor or rotunda of the building to the top floor, and can be made either a part of or arranged alongside of the mail chute, run down the elevator shaft, or wherever most convenient, with an opening on each floor, or in each room if so desired, for the reception of a small disc, several of which, representing the different express companies, are provided for each room. These discs have the number of the room and the name of the company they represent inscribed on them. They are of slightly different sizes for the different express companies. To illustrate more particularly, suppose that tenant in room 1842, on the 18th floor of a sky-scraper, desires to make a shipment by express company A. Selecting the disc representing express company A from the several that he is provided with, he places it in an aperture of the tube whence it descends to the ground floor, slowly rolls over a distributor and drops into the box of express company A. By an electrical device, as soon as the disc has dropped into the box, an electrical contact is made with the signal displayed on the outside of the building, which signal remains set until a passing driver, representing the company signalled, unlocks the box in the corridor, thus breaking the contact and allowing the signal to display again a blank surface. With the disc then in his possession, he sees at a glance from the number upon it, exactly what room he is expected to visit. Of course, it is understood that there may be a number of these discs from different rooms in the box at the same time, only the first one, however, turning the signal. In Fig. 1 are shown a section of the chute with the distributor underneath. The discs or checks vary in diameter from about 1 in. to 2 in. and are about 3/8 in. in thickness.

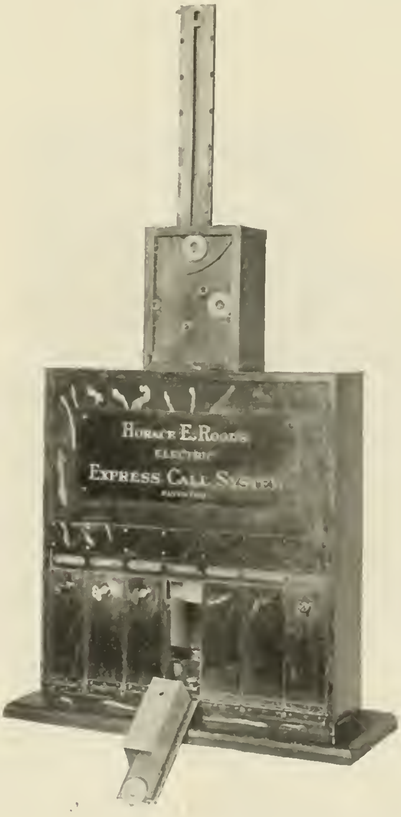


FIG. 1.—EXPRESS-CALL SYSTEM.

The means employed for the distribution of the checks to their proper boxes is interesting. When a check enters the distributor, it passes into a chute slightly lowered at one end from the horizontal. This chute is located above the individual boxes, and over each box it is perforated with an opening of a size corresponding to the size of the check belonging to the box. In order to effect the proper selection, the smallest hole is nearest to the point of entrance, the second opening being the next larger in size, and so on in regular progression to the last, which is the largest size. When a check enters the tube, it rolls along at a slow speed until it meets with the opening of its own size, when it falls into its box.

The bottom of each individual box in the distributor consists of a metal plate fastened to the arm of a balance, the other arm constituting a contact point of an electrical circuit. When a disc falls into the box, its weight depresses the movable bottom and lifts the opposite arm, which closes a circuit having a relay connected in series; the relay in turn closing a circuit which operates the call signboard by means of a solenoid in a manner to be presently described.

The call indicator (Fig. 2) has two faces and is designed to be placed on the front of a building at right angles with the wall, thus enabling the express-call driver to see it coming from either direction. Each signboard consists of an oblong box of square section, two opposite sides being blank, the other two containing the name of an express company. The sides containing the letters are of ground glass and are illuminated at night by two lamps placed within the tube, the opaque letters standing out against the illuminated background. By means of a switch, these lights are turned on after dark.

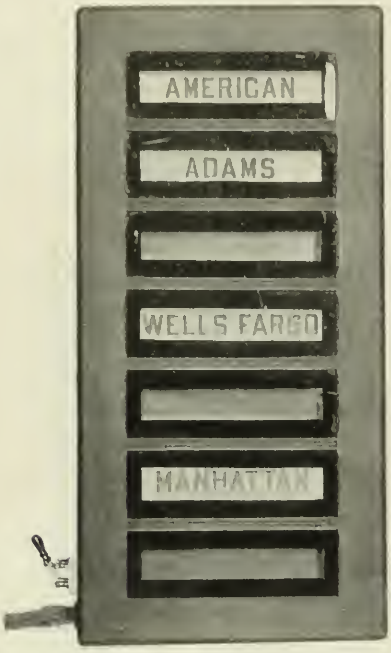


FIG. 2.—EXPRESS CALL SYSTEM.

Each signboard is pivoted at either end. At one end are located two solenoids, the cores of which are connected to a chain gear for the purpose of turning the signboard ¼ inch of a revolution. When the circuit is closed by the relay, one of the solenoids is energized and turns the signal so as to display the sign, and when the call driver opens the box and removes the checks, the other solenoid is thrown in circuit and turns the signal back to the blank position.

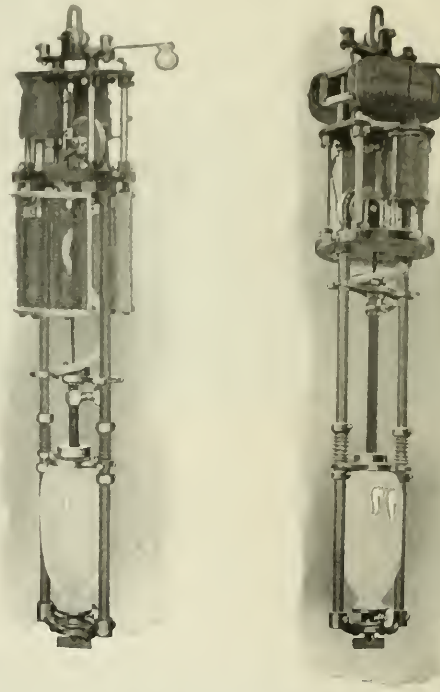
Small boxes like that shown in Fig. 1 between the section of chute and the distributing box are connected with the chute at each floor of the building. Each one contains a slot at one side into which the checks are inserted. The check drops through the side and into the chute.

Among the many advantages offered by this system are absolute accuracy, promptness and safety, and all of these features are particularly emphasized by the company. They will be duly and fully recognized and appreciated by express shippers, especially in tall loft and office buildings.

Sterling Arc Lamps.

The Stanley Electric Manufacturing Company has recently added to its products the Sterling arc lamps. The lamps are designed for operation in multiple on constant potential circuits and are made in the following types: Direct current, 100-125 volts; direct current, 200-250 volts; and alternating current, 100-125 volts. These three lamps are designed upon the same lines, so that interchangeability of mechanism is obtained to an unusual degree

Two series solenoids act upon a U-shaped core, which lifts the clutch and separates the carbon when current flows through them. In the direct-current type these solenoids are in the top of the lamp and the rheostat, consisting of easily-removable spirals of high grade resistance wire, is placed in the lower half of the lamp, separated from the working mechanism by the base-plate, as shown in Fig. 1. In the alternating-current lamp, the reactive coil is placed in the same compartment as the series solenoids, and is located above them, as shown in Fig. 2.



FIGS. 1 AND 2.—DIRECT-CURRENT AND ALTERNATING-CURRENT LAMPS, WITH CASINGS REMOVED.

The frame and working parts are not in circuit on either side; therefore much trouble due to pitting of dash pots and working joints is avoided. Both upper and lower carbon holders are provided with simple thumb screws and make reliable connections with the carbons. The gas check is so constructed that the wearing parts next the carbons, which are made of hard-pressed asbestos washers, may be easily renewed.

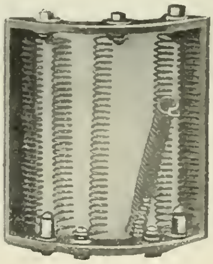


FIG. 3.—RHEOSTAT.

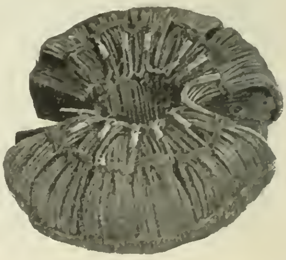


FIG. 4.—REACTIVE COIL.

In the direct-current lamp the rheostat, shown in Fig. 3, may be repaired by removing the frame from the lamp. This is done by loosening two screws and taking out one or more sections or coils. In the alternating-current lamp, the reactive coil may be removed by taking out two screws and a pair of clamps. The reactive coil, shown in Fig. 4, is wound in sections and the terminals of two adjacent coils are soldered together. By unsoldering these terminals and slipping the sections around to the slot in the iron core, any section may be removed and replaced without great difficulty.

The outer globe is firmly held in a cast-iron collar; therefore there is no danger of the globe being dropped by the bending of the globe holder, which frequently happens when sheet metal or spun holders are used. It is held in place by a bayonet lock between the globe collar and the lamp, and, for the trimming, hangs suspended by two chains.

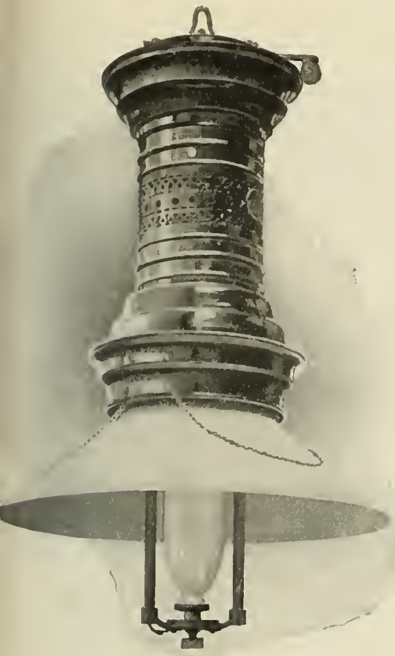


FIG. 5.—DIRECT-CURRENT LAMP, WITH REFLECTOR.

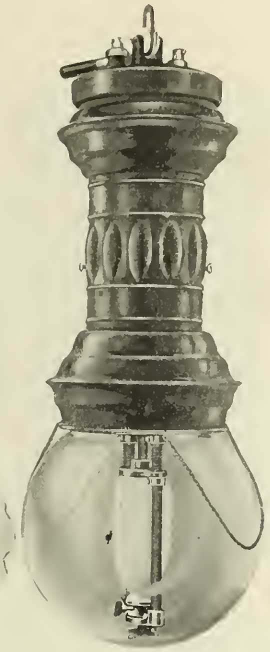


FIG. 6.—ALTERNATING-CURRENT LAMP—OUTDOOR TYPE.

In redesigning the Sterling, special thought has been given to the men who handle the lamps, with the result that inspectors and stationmen who have used lamps of the types having concealed parts will appreciate the fact that, in the Sterling, all parts are exposed when the casing is removed.

The design of the lamp is such that there are no cables which are likely to become entangled or break, no sliding contacts, no carbon tube which is likely to collect silicate from the carbon and become clogged, the upper carbon holder receiving the current by means of a strong, unrestricted cable. The lamp is strongly insulated, there are no bushings which are liable to breakage, and all parts are accessible and easily replaced. The lamp may be easily trimmed while hot without even removing the inner globe, the only action necessary being to loosen the retaining plug in the lower carbon holder.

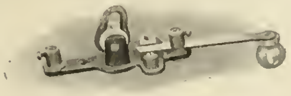


FIG. 7.—INDOOR TOP.

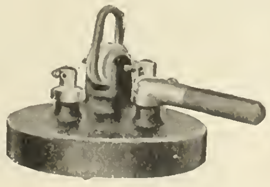


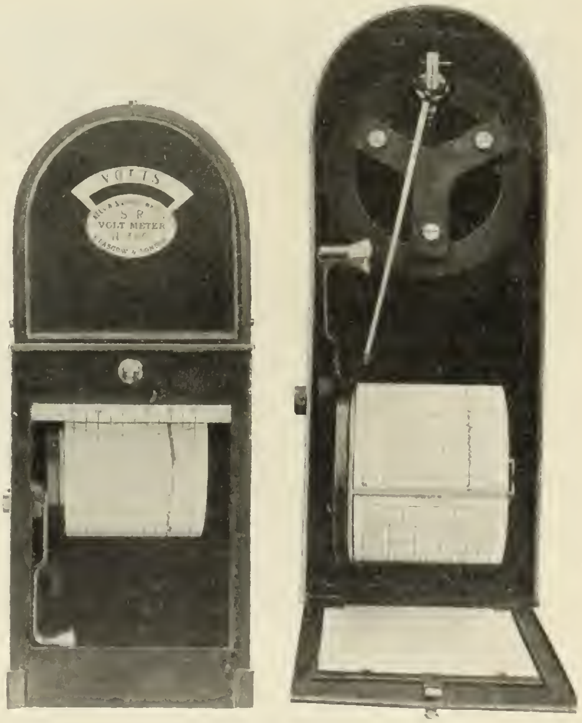
FIG. 8.—OUTDOOR TOP.

The direct-current lamps are built with two types of casings and two types of tops or hangers; one type for outdoor use and the other for indoor use. A lamp of one type may be changed to the other type by simply changing the casing and the top, or hanger, a screw driver being the only tool necessary. To change the alternating-current lamp from an outdoor to an indoor type, it is necessary to change only the top, or hanger, the casing being the same for either type. The two styles of tops are shown in Figs. 7 and 8.

New Recording Instruments.

Any improvement in the apparatus used in central station equipment which will obviate the necessity for careful manipulation and attention is welcomed by electrical engineers. The time and attention of central station operators are largely taken up by the instruments used for recording the various factors in electrical supply, and owing to the progress which is being made in station cost keeping, the demand for this class of instrument is continuously increasing, rendering necessary the employment of an instrument that can be placed in charge of an unskilled attendant. Messrs. Kelvin & James White, Ltd., of Glasgow, Scotland, have recently placed on the market a new type of recording instrument, the invention of that indefatigable veteran, Lord Kelvin, in which the method of winding the clock and the changing of the record sheets is accomplished in an exceedingly simple and ingenious manner. By a single movement of an operating handle, the clock is withdrawn from its case and simultaneously wound for the next record, the movement being such that the clock drum passes out of contact with the pen to a position in which the paper may be changed without any possibility of fouling the pen.

Another important feature of this instrument is that it is impossible to overwind the clock, even though the lever is repeatedly operated. This is accomplished by means of an automatic device which is thrown out of gear when the driving spring is fully wound. The record sheet is 18 inches long and the scale of the instrument about 4½ inches, the clock making one revolution in 25 hours, thus allowing half an hour spare at each end. On the assumption that the instrument is attended to once a day, it has been thought inadvisable by the makers to provide a clock giving a longer record, as experience has shown that it is necessary to examine the clock at least once in 24 hours. They are prepared, however, to supply an instrument giving a longer record, if required. A receptacle is provided inside the instrument for a year's supply of record sheets, and a file for completed charts accompanies each instrument. The devices above referred to are fitted to all of Lord Kelvin's recording instruments used in the measuring of watts, volts and amperes on direct and alternating, single and polyphase circuits. In the accompanying illustrations, Fig. 1 shows the instrument case closed, and Fig. 2 shows the case open and the clock withdrawn into the position for fitting a new record sheet, the clock having been wound in the operation of withdrawal.



FIGS 1 AND 2.—CENTRAL STATION RECORDING INSTRUMENTS.

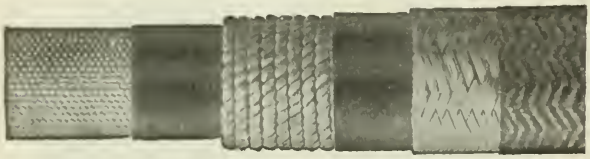
An Electric Sign Device.

ELECTRIC SIGN DEVICE.

The Norden Bittner Electric Company, 1402 Broadway, New York, is putting on the market a new form of electris sign which is interchangeable, as each monogram contains every letter and number in the alphabet, and when once installed any changes can be made at will without removing the letter from its position. The little disk behind the lamps, as shown in the cut, makes it a day, as well as a night, sign.

These are especially valuable for theatres or places where a different display sign is often desired, as with one set of letters any combination can be made. No painting is necessary, as disk, being white enamel, brings the reading out thoroughly in the day and is used as a reflector in the night.

Alphaduct Fire-Proof Fibre Conduit.



ALPHADUCT FIREPROOF FIBRE CONDUIT.

A new interior conduit has been put upon the market by the Alphaduct Manufacturing Company, of 522 West Twenty-third Street, New York City. The interior of tube is heavy canvas duck thoroughly fireproofed by approved process. This is covered with a slow-burning flexible weatherproof compound, over which is spirally wound hard twisted cable cord, thoroughly fireproofed. All interstices between the cord are then filled with a special compound, the whole forming a wall impossible to carry fire from any inside connection. Over this a protecting jacket of cotton, fireproofed as above, is then braided, and finally coated with a slow-burning flexible weatherproofing compound and dusted with a powder to prevent adhesion.

The interior of the conduit is the smooth, hard finish of the cotton duck, which is very easy to finish, but to make it perfect in this regard it is dusted with powdered soapstone, which acts as a lubricant, rendering the surface very smooth for the wire to pass by. The manufacturers state that Alphaduct will not carry fire.

It is manufactured by a patented and original process designed to combine all the most highly approved and up-to-date ideas as to what is desirable and essential in a conduit of this class for electric wires. The make-up of "Alphaduct" is carefully restricted to approved substances, so there may be no deterioration in the manufactured article. A sectional cut of the conduit is herewith shown.

A Method of Wiring in Connection With the Operation of Engine Stops and Electric Motors.

The necessity and importance of stop mechanism for engines and motors is abundantly emphasized by the extended recognition given them by manufacturers and property owners, and any system of wiring is of interest and importance which will increase their efficiency or assures a greater certainty of their successful operation. Illustrated herewith is shown a system of wiring, devised by F. S. Palmer, 100 Broadway, New York City, to meet these requirements.

Fig. 1 shows a slate board upon which is mounted a double-throw switch. A single-throw switch is also shown operated by electricity, a high resistance bell, a small single-throw switch, and binding posts 1, 2, 3, 4, 5, shown in Fig. 2. The board is to be located at some desirable place in the building where the engine or motor is to be stopped from any section or floor by the use of circuit-closers, *C C*, in Fig. 2. The double-throw switch is used to test all the wires and ring the high-resistance bell without operating the stop mechanism. The small switch is used to operate the motor switch or stop mechanism as often as desired, thus keeping them in active use.

Fig. 2 is a detail drawing of the method of wiring any engine stop mechanism, showing circuit-closers on three floors. To operate the engine stop or open the motor switch, the circuit-closer, *C C*, is used—say third floor. The current passes from battery to binding post, 5, engine stop magnets or electric switch for motors, to post 4, post *A* on the test switch to *B*, to post 3, circuit closer, *C C*, third floor, to post 2, to battery, or from battery to post 5, to stop or switch as above to post 4, to circuit closer, *C C*, to post 2, to battery. Thus it will be seen that should one or both wires connected to circuit-closer, *C C*, on the third floor, be cut, the closer will remain operative.

To test the wire and battery the test switch is thrown so that the blades rest in the knives at *E* and *F*. The wires are then in series with the magnets of the stop or motor-switch magnets by the use of any circuit-closer, while should there be any break in the wires the bell will fail to ring at test.

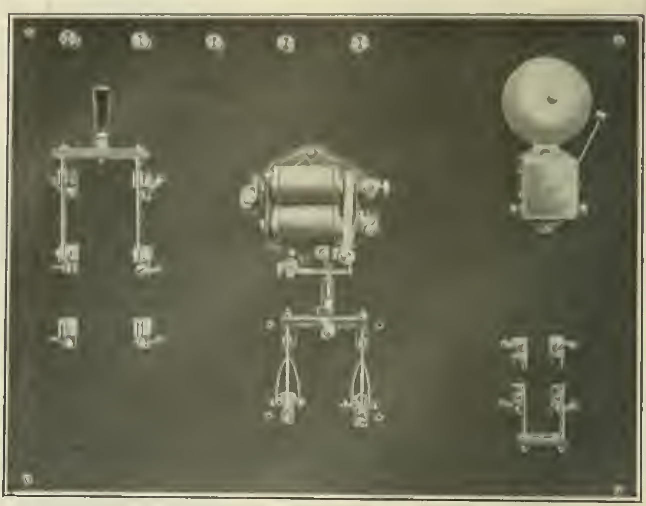


FIG. 1.—SWITCHBOARD.

It will readily be seen that the operator in charge of this apparatus would be very negligent if he permitted it to get out of order. He can use the small switch for stopping either engine or motor every day if he chooses, thus assuring himself that everything is in readiness for stopping the same from any floor in the building.

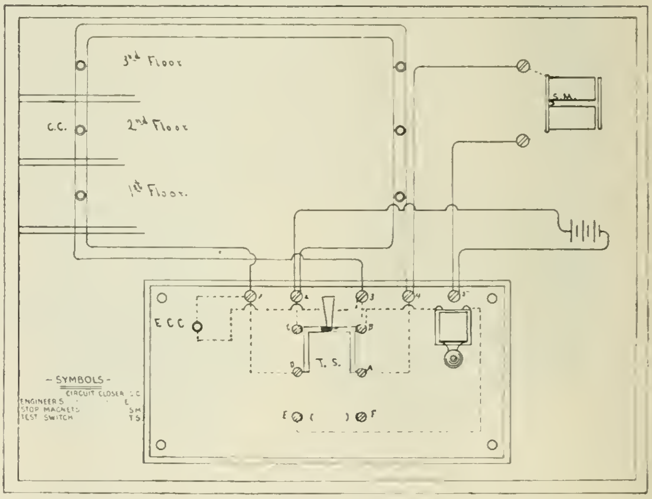


FIG. 2.—DIAGRAM OF CIRCUITS.

Arrangements can easily be made to notify outside parties of any shut-down if desired. The method of operating stop magnets is also arranged with annunciators to indicate the floor or section in which the circuit-closer has been operated, also to make record of all tests.

Turbine Installation of the Ottawa & Hull Power and Manufacturing Company, Hull, Canada.

Situated at Hull, Que., is the power house of the Ottawa & Hull Power & Manufacturing Company, in which is installed at present two generating units of 2,600 hp each, under a head of 27 feet, and two exciter units. Provision is made, however, for the installation of two more units of the same capacity. The flumes are formed of structural steel and concrete, and the I-beam foundation frames supporting the wheels and the steel bulkheads through which the shafts pass are built in. The head varies from 25 to 35 feet, with an average head of 27 feet. Each generating unit consists of a 1,500-kw, direct-connected, two-phase generator built by the Canadian General Electric Company, of Peterboro, Ont. The generators and turbines run at a speed of 138½ r.p.m. The generators are guaranteed to carry a 50 per cent. overload for two hours. The turbines for each generating unit are four in number, connected tandem, and were built by the Dayton Globe Iron Works Company, of Dayton, Ohio, and are of their latest improved cylinder gate draw-rod type. They are mounted on two cast-iron draft chests, with draft tubes 9 feet in diameter (Fig. 1). The wheels proper are of the new American type, made in one continuous casting, 51 inches in diameter, and when tested at the Holyoke testing flume gave an efficiency of 86.71 per cent. at full gate. This wheel is one of the most efficient ever tested in the Holyoke flume. The shafts are made of steel and were forged by the Bethlehem Steel Company. They are in two pieces each, with intermediate coupling flanges forged on. They are 5 7/16 inches in diameter at the remote ends, increasing in size to 10½ inches in diameter at the driving ends. The gate is of the well-known cylinder draw-rod type and has several features not usually found in this class of gate. The gate proper slides on ways similar to those on a steam engine. On these ways or guides are adjustable gibs, which can be operated by bronze set-screws, thus taking up the wear and keeping the gate from touching or rubbing the inlet chutes on the bottom. The gate rods are fastened to the gates in the center of these guides or ways, bringing the line of force and that of resistance on the same plane, thus obviating the tendency to tip and bind which is most objectionable in ordinary cylinder gates when operating horizontally. This method of operating gates has proven so successful that the manufacturers have patented it.

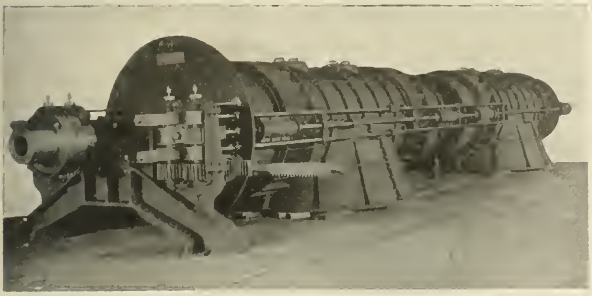


FIG. 1.—TANDEM-CONNECTED TURBINES.

Another feature of this device is that all gearing racks, etc., are outside of the flume, away from the water, and accessible at all times This entire mechanism is mounted on the main bridge-tree, as shown in Fig. 1. It consists of two vertical shafts on each side of the bridge-tree, on which are placed cut pinions to move the cut racks on the gate rods, the rods passing through the stuffing boxes in the flume head. In order to bring the line of action in the center of the gate bearings, three draw-rods are used. The upper and lower rods act in conjunction with one another and move the gate of the second and fourth wheels through yokes and hollow tubes, Fig. 1. The gate-rod on the wheel, No. 2, is a hollow brass tube so as to allow the center gate-rod which operates the gates on wheels No. 1 and 3 to pass through for a connection to gate No. 3. The two lower pinions on the vertical shafts on the bridge-tree are connected to the transverse or operating rack by an intermediate gear (not visible in the cut), thus causing all the gate-rods on both sides of the wheels to move in unison. The governor and hand-operating device is connected to the transverse racks by a pinion working into the racks shown on the end.

The gears and racks are supported by a cast-iron frame of the bridge-tree and are also stayed to the flume head by large stay-bolts, thus giving the entire structure great rigidity, and maintaining a compact design, the principal elements of which have been patented. All the bearings in the water are of lignum vitæ and are adjustable by bronze set-screws for taking up the wear. The thrust is taken care of by lignum vitæ thrust bearings on the rear end of the shaft. The governors are of the Woodward compensating type and were built especially for this installation.

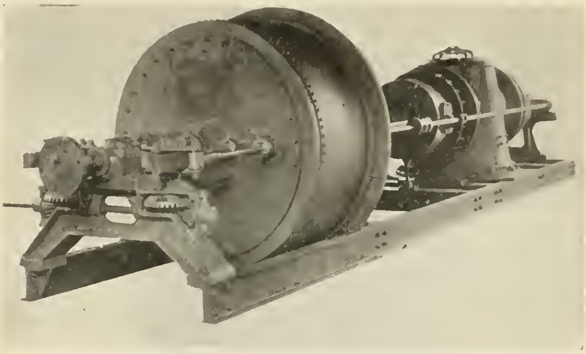


FIG. 2.—EXCITER TURBINE.

The turbines for the exciter units are shown by Figs. 2 and 3 and are of the cylinder gate draw-rod type similar to the generating units. There are two sets of two wheels each of the new American type, 22 inches in diameter, mounted on sheet steel draft chests, the whole mounted on steel I-beam foundations, built in the concrete. The gate operating mechanism is the same in principle as that of the large units, but not so complicated, as there are only two wheels in each unit to control. The governors on these units are the Woodward compensating type. Fig. 2 is a front view of the exciter unit showing the gate gearing and racks mounted on the bridge-tree, also the bulkhead ring in position. Fig. 3 is a rear view showing the connecting yoke for the gate rods. This view also shows the position of all the gate-rods on the center plane of the shaft. This installation was made under the supervision of Mr. Wm. Kennedy, Jr., hydraulic and mechanical engineer, of Montreal, Que.

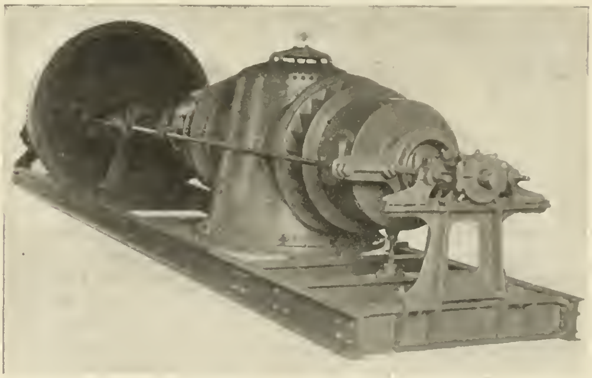


FIG. 3.—EXCITER TURBINE.

◆

Nail Puller for Electrical Purposes.

The Smith & Hemenway Company, New York, is putting on the market a very neat nail puller for electrical purposes. It weighs only 2½ ounces and is very small and can be carried in the pocket for pulling small nails with the assistance of a claw hammer. It can be used in connection with any ordinary hammer and weighs 6½ ounces. No electrician can afford to be without this, as it will assist him very materially in taking nails from strips covering insulating wires. It has been remarked that the nail puller manufacturers of the United States have heretofore overlooked the specific necessities of the electrician.

Improved Telephone Power Generator.

Power generators for telephone work have often had one serious fault, due to the poor construction of the commutator or collector. In the new machine here shown, Fig. 1, it has been the principal aim of the Connecticut Telephone & Electric Company, of Meriden, Conn., to overcome this weak point. By referring to the cut, Fig. 2, it will be noted that the commutator or collector ring is made with a taper plug hole to fit a corresponding taper plug on the end of the shaft, this plug being one terminal of the armature winding. It is held in place by means of a washer or screw on the end, and when the commutator becomes worn, it is simply necessary to remove the screw or washer and substitute a new ring, all rings being interchangeable. The brush is of the carbon pencil type, will last a very long time, and is renewed in a moment. In addition to this, they have enclosed the armature chamber, so that it is impossible for dirt or foreign substances to work into it. The bearings are all made of special bronze metal and supplied with automatic grease cups; the pole pieces are of the softest iron obtainable and are carefully bored out. The armature is of the laminated type, ground on centers, so as to make it absolutely true. Ordinarily a 1-inch face flat pulley is supplied on this machine, but a grooved pulley for round belt can be furnished when wanted. The machine is also made up with eight magnets where extra heavy output is desired.

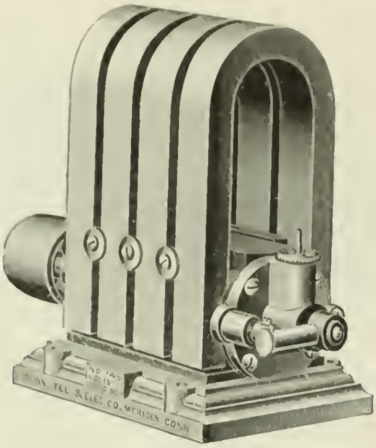


FIG. 1.—TELEPHONE GENERATOR, COMPLETE.

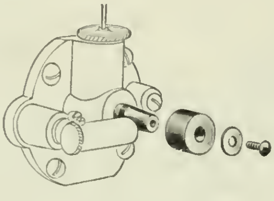


FIG. 2.—DETAILS OF BEARING.

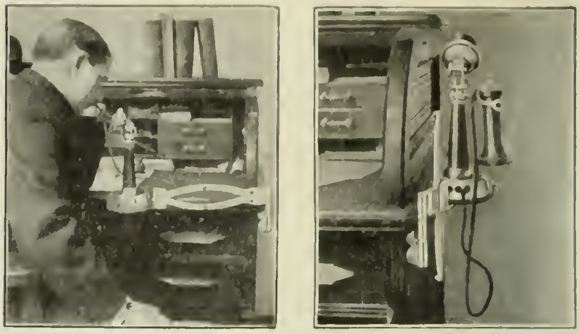
◆

The Chicago Telephone Holder.

The desk telephone is finding an increasing use, because of its greater convenience over the instrument mounted on the wall; but along with the desk telephone has come the problem of a good place to keep it, where it will be handy and quickly available at any instant, while at the same time out of the way of other matters on the desk. There is practically no place provided on a modern office desk for a telephone. The top of the desk is not suitable, because of the roll top; the leaves are needed for other purposes than holding a telephone. A shelf at one end of the desk necessitates lifting the telephone desk set every time it is used. In fact, the same might be said of almost every position in which a telephone can be put around a desk. An ordinary swinging bracket takes up considerable room in swinging and then does not bring the instrument to the position most convenient.

The Chicago telephone holder is simply a swinging bracket which can be pulled out full length or closed up instantly, and with very slight effort. The rapidity with which the telephone can be pulled out within talking distance and the small amount of effort required to do it, makes the device popular at first trial. The two accompanying engravings show the construction of the device better than any description. It practically keeps the telephone out of the way all the time when not in use, and yet places it within instantaneous reach.

Another point which should recommend it to telephone companies is that the instrument is clamped to the holder, so that it cannot fall and break. As the loss from breakage of desk sets is considerable, the use of telephone holders by any company's subscribers is sure to save much trouble and annoyance, for even if the subscriber has to pay for broken instruments, there is always a chance for complaint and hard feeling in connection with it.



FIGS 1 AND 2.—TELEPHONE HOLDER.

The Chicago telephone holder is manufactured by the Chicago Writing Machine Company, of which F. W. Pardee, 119 La Salle Street, is general agent.

◆

Ventilated Motors.

Messrs. Robbins & Myers Co., Springfield, Ohio, have added to their line of motors an improvement recently patented, consisting of an effective ventilating arrangement. As is well known, all good motors of a given rating run at practically the same efficiency. From 80 per cent. to 90 per cent. of the power consumed is delivered at the belt of the motor and at the line wires of the dynamo. The remaining 10 per cent. to 20 per cent. (this varying somewhat with the output of the machine) is used in generating heat in the machine. The readiness with which this heat is gotten rid of determines the running temperature and probable life of the machine. This objectionable heat is gotten rid of by convection and radiation. The radiation from the outside of all machines of like rating is practically alike. The radiation from the inside, where the heat is all directly generated, depends entirely upon the ventilation. The improvement above referred to relates to this latter consideration.

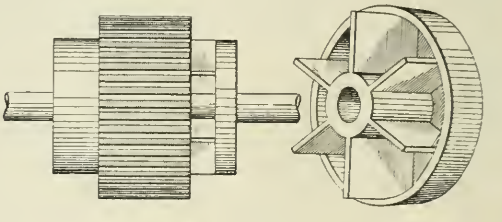


FIG. 1.—VENTILATED ARMATURE CORE.

As applied, the armature core is built up of thin discs of iron stamped like a toothed wheel having a deep rim, three spokes and a hub fitting the shaft and key. These discs when assembled on the shaft are compressed between two castings of peculiar shape, one acting as a funnel and the other as a blower fan. These castings also serve to support the machine-wound armature coils, which are placed in slots left for this purpose in the armature discs, with their ends bound to the drums on the end castings by wire bands. These coils are so placed as to overlap and to leave ventilating holes between the adjacent coils. When the armature is in motion the blower fan draws a large volume of fresh air into the rear of the motor through the funnel casting and through the tunnels left between the spokes of the discs, and blows it out through the interlaced windings, taking with it the heat from the armature core and windings, and insuring cool running, thus greatly increasing both the life of the machine and its overload capacity. The accompanying illustrations show the details of the construction.

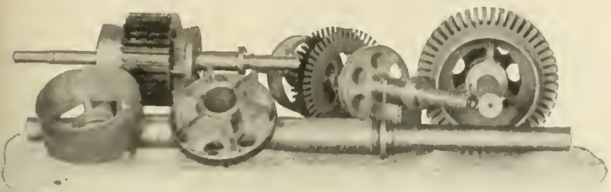


FIG. 2.—PARTS OF MOTOR.

A New Telephone Ringer.

In the accompanying illustrations, Figs. 1 and 2, is shown a new ringer, recently placed on the market by the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and Chicago, Ill. The ringer is said to embody new and simple features in the matter of adjustment. In Fig. 1 is a complete view, while in Fig. 2 is shown the armature end of the ringer, which is almost self-explanatory as regards the manner in which adjustment is made. A word of explanation, however, may not be amiss. It will be observed upon examination that a screw passes through the permanent magnet, armature, armature-frame support, and is threaded into the armature yoke. By turning this screw, a shoulder on the screw is made to engage against the frame, which supports the armature and this, being made of spring steel, allows it to be pressed downward, thus bringing the armature nearer the cores, while the turning of the screw in the opposite direction allows the distance between the cores and armature to be increased. This adjustment is very simple and requires the turning of only one screw, which may be done as easily after the ringer is mounted in a telephone as before.

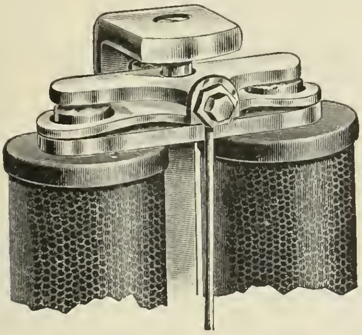


FIG. 1.—TELEPHONE RINGER.

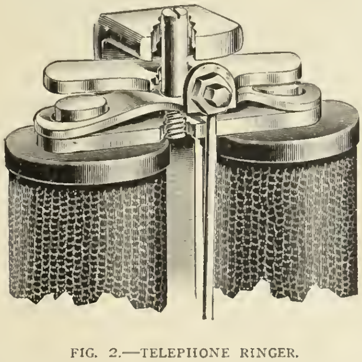


FIG. 2.—TELEPHONE RINGER.

Electric Signs and Central Station Business.

It is beginning to be appreciated by a number of central station companies that it is good policy to encourage and even to solicit electric sign business. The Chicago Edison Company has for some time made it a practice to furnish a certain type of sign free of charge to all customers who will sign contracts for the supply of electric current to such signs. As revenue-producers, these signs are second to no other branch of the electric lighting business.

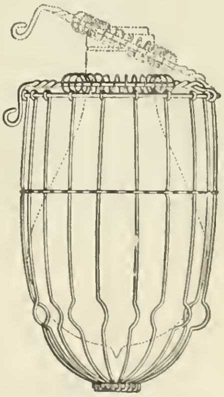
The signs adopted by the Chicago Edison Company are made by the Federal Electric Company, of Chicago. These signs have all parts so standardized that central stations can invest in them with the certainty that they will have no difficulty in changing them to suit different requirements. The Federal Electric Company owns a broad patent on the use of a hollow metal frame, surrounding a sign and containing incandescent lamp sockets. The signs made by this company are entirely of metal, and so meet the fire department requirements in any city. The principal metal going into their construction is heavy sheet-steel, enameled with an enamel baked on at very high temperature, which is extremely durable. All of the signs this company makes consist essentially of this hollow frame, into which the sign proper can be slipped. The frames are made up in quantities and the sign only is made to order.

The sign itself is simply an enameled sheet of steel, lettered according to the requirements of the user. A new form of socket will be used hereafter, which will have a heavy porcelain shell fastened directly to the frame of the sign. No screws will be required to hold the socket, and high insulation as well as great stability will be secured. Lamps of 4 cp requiring four watts per candle are on all the signs. A twenty-four-light sign, using the equivalent of ten 16-cp lamps, is maintained by the Chicago Edison Company for any customer at $2.50 per month, to be lighted from dark until midnight.

The company has an income of about $60,000 per year already from this class of signs. They are not intended to compete with the large illuminated signs, in which letters are spelled out with incandescent lamps, but are designed more especially for the smaller merchants, who wish to make a showing without the expense for current involved in the large signs.

Lamp Guards.

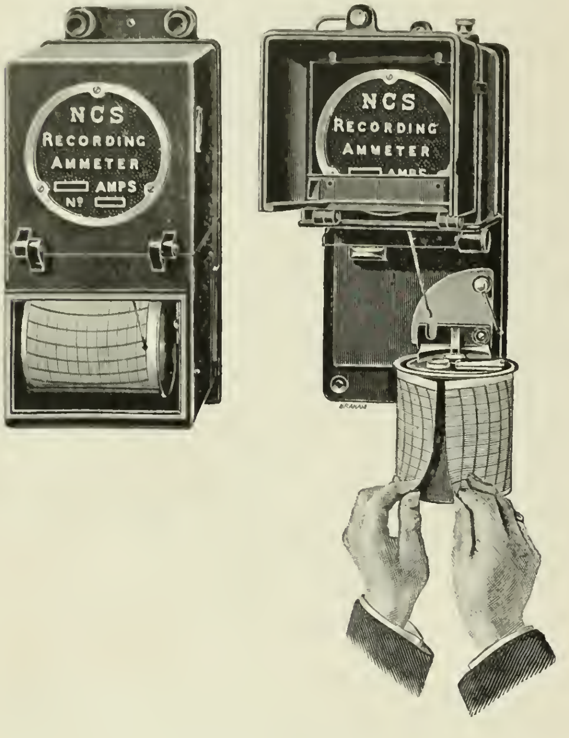
The new lamp guard known as the "Never Break," recently introduced to the trade, has several new features. The main principle is to suspend the lamp inside the steel wire cage, free from the outer protecting wire, so that the lamp is protected by the outer wires from a blow or from being dropped. The corrugated spring wires are reversed so as to engage the top and hold the lamp back from the end; and the spiral holder at the bottom forms a perfect cushion. The guard is made of steel spring wire, and the silver luster finish makes it attractive and durable. The adjustable clamp socket holder fits all regular size lamps without screws or loose wires, as used in the old construction. The illustration shows the ingenuity employed in accomplishing a very much desired result. Special grades and kinds are made. One especially useful is called a "chip" guard, which is covered with a fine steel wire gauze that prevents all flying chips and small slivers from breaking the glass bulbs in machine shops, foundries, etc. The Hamblin & Russell Mfg. Co., Worcester, Mass., is the manufacturer and owner of this guard, which has received insurance approval.



LAMP GUARD.

Recording Voltmeters and Ammeters.

The accompanying illustrations show a type of recording voltmeter or ammeter made by Nalder Brothers & Thompson, of London, which are made for both direct and alternating currents. For direct currents only a moving coil, permanent magnet, polarized type, is used, and for alternating currents a soft iron solenoid type has been perfected. This latter instrument can be used for direct as well as for alternating current. For swithboard use the apparatus is mounted either on enamel cast-iron cases or on enamel slate bases with polished mahogany glass fronted cases. A line of portable instruments is also made which are mounted in polished teak cases fitted with leveling screws and leather strap handles.



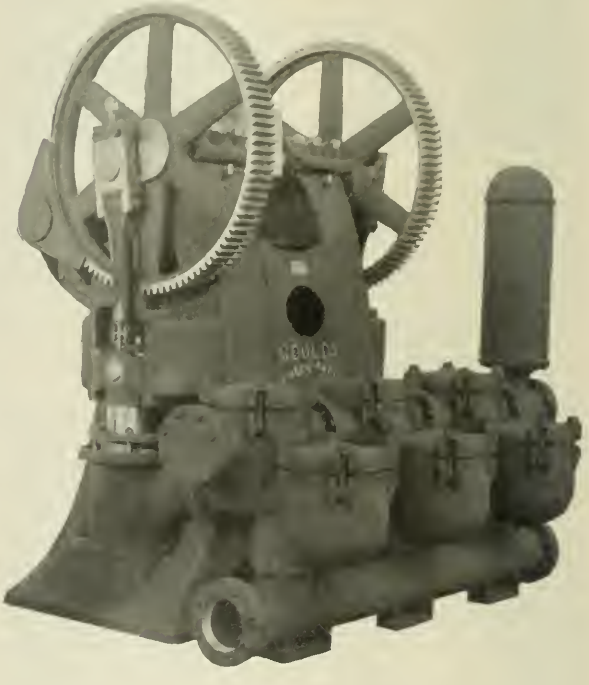
RECORDING AMMETER.

The record is make on a revolving chart carried on a drum in the ordinary type of instruments, but where it is desired to record continuous runs a strip of paper, 60 feet long, can be usde, which will give over a month's record in one length. This latter arrangement is very useful in cases where for any reason it is not possible to give the instruments daily attention, but is, of course, more complicated than a single-revolution chart. The drum is operated by clock work, having a well-made lever movement, and is capable of being accurately regulated. To prevent the movement from being strained the drum is driven through a friction coupling. The record is traced on the chart by a pen carried lightly over its surface. By an ingenious mechanical arrangement the pen presses firmly against the chart, but adjusts itself to any small irregularities which may be present on the surface. The pens are so designed and fixed that they give a perfectly continuous record under the most unsteady load and are so arranged that the ink cannot be thrown out by jerks of the pointer, caused by sudden current fluctuations. An important feature of recording instruments for rapidly varying currents is that they be correctly damped, and this detail has been carefully perfected in the type being described. If there is insufficient damping the fluctuations of the current will be greatly exaggerated, while, on the other hand, if the damping be excessive the quicker variations will not be shown on the records at all.

The illustrations show the direct-current instrument as supplied for switchboard use with black enamel cast-iron case. The lower portion is hinged and opens outward, so as to give easy access to the drum, for the purpose of renewing the chart. The drum itself is pivoted so that it can be readily removed from under the pen, and the apparatus easily recharted. This instrument may be equipped with anti-vibration cradles, which enable it to be used directly on a car.

Pumps for Central Stations.

The new power plant of the Manhattan Elevated Railway Company, New York City, has in operation six of the single acting triplex plunger pumps recently introduced by the Goulds Manufacturing Company, of Seneca Falls, N. Y., who have also sold four of them to the Tide Water Oil Company for use on their pipe line to Titusville, Pa., to work against 900 pounds pressure. This type of pump has a frame comprising two standards which carry the main bearings and the seats for the two outside cylinders; and the seats to which the outside crosshead guides are bolted. These are held together by the center crosshead and the seat for the center cylinder. The crank shaft is a steel forging and its bearings are phosphor bronze, while the pinion shaft bearings are of babbitt metal. The connecting rods have bronze boxes with strap edge and wedge adjustment at the crank end and adjustable bronze boxes, marine type, at the crosshead end. There is double gearing and in practice a gearguard covers the pinion and the adjacent teeth of the gear. The valve boxes are separate charcoal iron castings, each containing a set of suction and discharge valves. Pipe connections are made at either end of the pump. This strong and compact pump is designed to work under 200 to 1,500 pounds working pressure, or 500 to 3,500 feet elevation, for electrical plants, mining, water supply, etc.

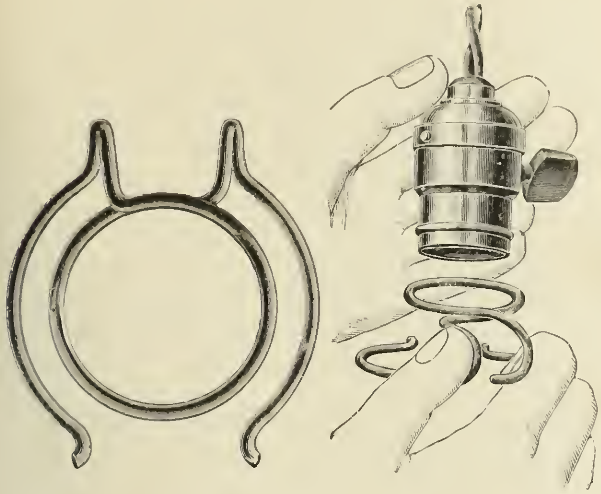


SINGLE-ACTING TRIPLEX PLUNGER PUMP.

A New Type of Shade Holder.

One of the newest time-savers for lighting is a shade holder manufactured by William V. Geis & Co., of Far Rockaway, N. Y. The old familiar form is made with a metal strap or band which fastens with a screw around an incandescent lamp socket, necessitating a tool to adjust it properly. In order that the shade might be placed in the old holder it is necessary to operate three thumb screws so that the shade may be held firmly.

The new device is made of brass spring wire and is placed in position with absolutely no tools. It may be put on a lamp socket with one hand, is rigid when in place and does all of the work that is expected of any shade holder. It is lacquered and will not tarnish. Fig. 1 shows the shade holder. Fig. 2 shows how by merely taking hold of what might be termed the back end of the holder and pressing the thumb and forefinger together slightly, the ring is opened so that it may slip over a lamp socket springing back into place when the pressure is released. This then gives two protruding ends or jaws immediately below the socket into which the shade holder is forced, the ends bending slightly to receive it and springing together, holding the shade very firmly. Fig. 3 shows the complete device.



FIGS. 1 AND 2.—SHADE HOLDER.

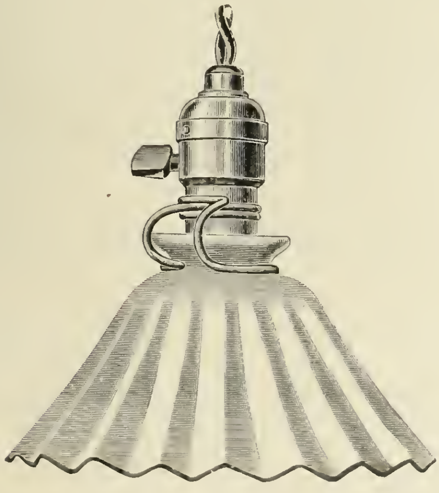


FIG. 3.—SHADE HOLDER.

This form of shade holder is a radical departure from those put on the market heretofore. It has already been well received by dealers who are prompt to realize the economy of time in installing such a fixture.

New Apparatus for Lighting and Power in New York City.

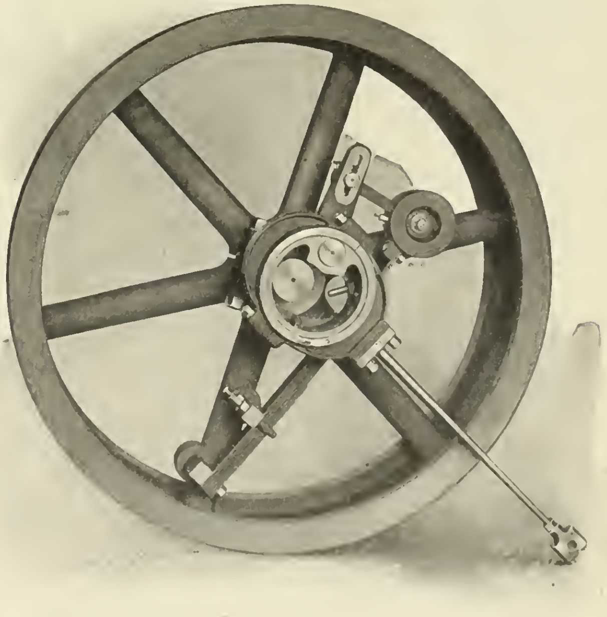
Since its reduction of the price of current, the constant growth of the demands for station power has made it necessary for the New York Edison Company to make arrangements for new generators, rotary converters and transformers. The Stanley Electric Manufacturing Company has secured, through its New York office, this important contract, which is notable not only on account of the total amount involved, but also because of the unusual size of the units. The first item in the contract is for four 2,000-kw, S.K.C. rotary converters. The transformer equipment to accompany the same consists of twelve 800-kw, S.K.C. static transformers of the air-blast type, and four auto-regulators. As is generally known, the largest rotaries hitherto built are the 1,500-kw units in the Manhattan sub-stations, and therefore the construction of those of 2,000-kw capacity marks a distinct advance in the art.

In addition, the contract calls for ten 1,000-kw, S.K.C. rotary converters with thirty 400-kw, S.K.C. static transformers of the air-blast type, and ten auto-regulators. The above apparatus is to be placed in various sub-stations of the Edison system. Furthermore, the Stanley Electric Manufacturing Company are to furnish three new generating units for the Waterside Station. The machines are to be 3,500-kw, 25-cycle, 3-phase, alternating-current generators, direct-connected to engines working at 75 r.p.m.

Ball Engine Governor.

The Ball Engine Company, Erie, Pa., has, during the past year, developed a new engine governor, which is now being used on all engines made by the company. While a true inertia governor, the inertia feature is kept in proper subordination to the centrifugal element. This in connection with a gravity balance and absence of friction makes the governor remarkably quick in action. The construction is such that the strain of the spring and the centrifugal force of the weight balance each other without transmitting any of the strain through bearings or pivots. The governor is thus practically in gravity balance, with the result that its action is extremely steady and reliable, with non-liability to derangement or deterioration from wear.

The adjustments for speed and regulation are very simple. The spring is screwed up until the proper speed is obtained; then, if the engine races, the link pin, which bolts to the eccentric arm, is moved farther away from the eccentric. If, on the other hand, the governing is not close enough, this pin is moved toward the eccentric, a row of holes being provided in the arm of the eccentric for this purpose. These adjustments are the only ones necessary to produce fine regulation at any speed within the range of the engine, and the adjustment when made is permanent; moreover, to make them an expert is not required, which often saves a trip of hundreds of miles.



ENGINE GOVERNOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a fair demand for time money, but chiefly for short periods. Rates are 6 per cent. for 60 to 90 days; 5½ a 6 per cent. for four, five and six months. Holiday dullness prevailed on the stock market, which was accentuated by the renewed seasonable firmness of call money rates. Brooklyn Rapid Transit was a feature, having a rapid advance on various indefinite but favorable reports. The steel stocks tended to recover ground on good buying, and Amalgamated Copper responded to the idea that better conditions and relations are approaching in the copper trade. Electrics closed with net gains on moderate trading. The greatest activity in tractions was, as already noted, in Brooklyn Rapid Transit, 148,140 shares of which passed hands. The closing price was 68⅛, a net gain of 3⅛ points. Metropolitan Street Railway closed at 139⅞, ex div., being a net gain at 1⅞. In the railway list Manhattan was the exception and closed with a net loss of ⅛ point, at 140¼, the total sales being 28,100 shares. General Electric made a net gain of 1⅞ points, closing at 177⅞. The two Westinghouse issues showed up with more firmness, closing at 194½ for the common and 202 for preferred, these figures representing net gains of 1½ and 2¾ respectively. Western Union made a net gain of ⅝, closing at 88. American Telephone closed at 162½, being a gain of 1½, and American District Telephone gained 1 point, closing at 37½. In Boston American Telephone & Telegraph closed at an advance of 2¼ points, and General Electric 2½ points higher. Following are the closing quotations of December 30:

NEW YORK.

	Dec. 22.	Dec 30		Dec. 22.	Dec.30
American Tel. & Cable	87	86	General Electric	178	177⅞
American Tel. & Tel.	162½	164	Hudson River Tel.	..	..
American Dist. Tel	36	37½	Metropolitan St. Ry.	140¼	140⅛
Brooklyn Rapid Transit	65⅛	67¾	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	169½	N. Y. & N. J. Tel.	160	161
Electric Boat	20	22	N. Y. E. V. T. Co.	9⅝	9½
Electric Boat pfd	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3	Western Union Tel.	88⅛	88¾
Electric Vehicle	3½	3½	Westinghouse com.	194½	202
Electric Vehicle pfd.	9	9	Westinghouse pfd	202	202

BOSTON.

	Dec. 22.	Dec 30		Dec. 22.	Dec.30
American Tel. & Tel	163	164¼	Western Tel. & Tel. pfd.	99½	99
Cumberland Telephone.	125¾	124⅞	Mexican Telephone	2	2
Edison Elec. Illum.	.	262½	New England Telephone	137½	138
General Electric.	175	.	Westinghouse	98	99
Western Tel. & Tel	23	..	Westinghouse pfd.	98	99

PHILADELPHIA.

	Dec. 22.	Dec 30		Dec. 22.	Dec.30
American Railways.	..	51½	Phila. Traction.	97⅛	97½
Elec. Storage Battery.	84	84*	Phila. Electric	8⅜	8⅛
Elec. Storage Battery pfd.	82	..	Pa. Electric Vehicle.	..	..
Elec. Co. of America.	9¼	9½	Pa. Electric Vehicle pfd.	..	..

CHICAGO.

	Dec. 22.	Dec.30		Dec. 22.	Dec.30
Central Union Tel.	.	..	National Carbon pfd.	97	97
Chicago Edison.	..	175	Northwest Elev. com.		.
Chicago City Ry.	208	205	Union Traction	14	14¼
Chicago Tel. Co	..	..	Union Traction pfd.	43	45
National Carbon	26	26			

* Asked.

FIGURES OF PHILADELPHIA COMPANY.—The Philadelphia Company and its affiliated corporations have published a report to stockholders for the month of November and for the eleven months of the calendar year, giving a comparative statement of earnings, expenses and net income of the Philadelphia Company, the Consolidated Gas Company, of the City of Pittsburg; the Allegheny Illuminating Company, the Allegheny County Light Company, the Chartiers Valley Gas Company, the Union Gas Company, of McKeesport; the Equitable Gas Company, and the Pittsburg Railways Company. The November statement shows substantial increases in net earnings as well as gross earnings, with a slight decrease in the net surplus due to an increase in the amount paid for dividends on the preferred stock and for interest on the funded debt. Gross earnings of the properties for the eleven months are $12,419,920, and net $5,371,859, a gain in net of about $400,000. The Philadelphia Company's interest in the net is $2,116,384, as compared with $1,636,906 last year.

LONG ISLAND LIGHTING MORTGAGE.—There has been filed in the office of the County Clerk of Queens County by the Queens Borough Gas and Electric Light Company, of Rockaway, a mortgage and deed of trust of $2,000,000 to the Guaranty Trust Company, of New York City, to secure an issue of 2,000 bonds of $1,000 each. The proceeds of 400 of the bonds have been used to retire two mortgages, one of $250,000 upon the property of the Queens Borough Electric Light & Power Company, and another of $150,000 upon the property of the Hempstead Gas & Electric Light Company, which was absorbed by the Queens Borough Company in May last. Another $400,000 is to be used for the acquiring of other property, and the remainder of the bonds will be disposed of from time to time as the money is needed for other projects the company has in view. The electric light company gave a simple mortgage to the Guaranty Trust Company in July, and this has been replaced by the mortgage and deed of trust, and has been canceled.

CENTRAL & SOUTH AMERICAN TELEGRAPH.—The earnings of the Central & South American Telegraph Company for quarter ended December 31, 1902 (partly estimated) compares with the estimated figures for the corresponding period a year as follows:

	1902.	1901.		Changes.
Traffic receipts	$265,000	$257,000	I.	$8,000
Expenses	93,500	99,500	D.	6,000
Net	$171,500	$157,500	I.	$14,000
Other income	5,000	3,500	I.	1,500
Total income	$176,500	$161,000	I.	$15,550
Dividends	115,884	115,884		......
Surplus	$60,616	$45,116	I.	$15,500
Previous surplus	714,962	586,858	I.	128,104
Total surplus	$775,578	$631,974	I.	$143,604

The directors have declared the regular quarterly dividend of 1½ per cent., payable January 7.

OSWEGO TROLLEY DEAL.—W. P. Gannon, president, and E. G. Connette, manager, of the Syracuse Rapid Transit Railway Company, have closed a deal with C. Sidney Shepard for the street railway system of Oswego, operated by the Oswego Traction Company. The deal is important, because of its bearing on the fight between the Syracuse Rapid Transit Company and the Lake Side and Baldwinsville Railway Company for franchise right between Syracuse and Oswego, both companies desiring to build a road between Syracuse and Oswego. The purchase includes all of the first mortage bonds of the Oswego company and all but 10 per cent. of the capital stock and second mortgage bonds. The company's capital stock amounts to $300,000, the first mortgage bonds to $97,000, and the second mortgage bonds to $191,000, outstanding. The company operates eleven and one-half miles of railway, including all in Oswego, with lines running out to Beach Oswego and Minetta.

THE MEXICAN TELEGRAPH COMPANY reports for the quarter ended December 31 (partly estimated):

	1902.	1901.		Changes.
Traffic receipts	$105,500	$110,000	D.	$4,500
Expenses	22,500	24,500	D.	2,000
Net	$83,000	$85,500	D.	$2,500
Other income	13,250	12,927	I.	323
Total income	$96,250	$98,427	D.	$2,177
Due Mexican government	5,000	5,000		......
Balance	$91,250	$93,427	D.	$2,177
Dividend	47,815	47,815		......
Surplus	$43,435	$45,612	D.	2,177
Previous surplus	1,161,094	1,004,600	I.	156,494
Total surplus	$1,204,529	$1,050,212	I.	$154,317

The regular quarterly dividend of 2½ per cent has been declared, payable January 14.

TOLEDO RAILWAYS AND LIGHT.—The statement of earnings of the Toledo Railways & Light for November showed an increase of over 12 per cent. in gross earnings, a decrease of 2 per cent. in operating expenses and an increase of over 25 per cent. in net earnings. The statement reflects the success the new president, Mr. Everett, is having. The increase in gross amounting to $12,850 accompanied by a decrease in operating expenses of $1,456, resulted in a net increase of $14,315. The net earnings of eleven months ended November amounted to $656,594, being $44,664 in excess of the earnings for the corresponding period in 1901.

INTERNATIONAL STEAM PUMP.—The proposed issue of debenture bonds by the International Steam Pump Company to the amount of $3,500,000 will be used in part for rebuilding the Worthington pump works. It is proposed to remove the works from Brooklyn to a nearby point in New Jersey. The machinery of the Worthington plant has become somewhat antiquated and in addition more room is needed than the Brooklyn property affords. A portion of the proceeds will be used to increase the working fund.

DIVIDENDS.—The directors of the Bullock Electric Manufacturing Company have declared the regular quarterly dividend of 1¼ per cent. on the preferred stock. The Consolidated Traction Company, of Pittsburg, has declared an initial semi-annual dividend of 1 per cent. on the common stock, payable January 2. The bulk of this stock is held in the treasury of the Philadelphia company. The Knoxville Traction Company declares a semi-annual dividend of 1 per cent., payable on January 15. This company's stock is $750,000, divided into shares of the par value of $100 each. The Macon Railway and Light Company's stock has declared a semi-annual dividend of 2½ per cent. on its preferred stock of $300,000. This is a recent consolidation of the street railway and lighting interests of Macon, Ga. The Lexington Railway Company has increased its semi-annual dividend from 1 to 1½ per cent. Its capital stock is $800,000. The dividend is payable on January 15. In all three companies Baltimoreans, associated with the banking house of J. W. Middendorf & Co., of Baltimore, and John L. Williams & Sons, of Richmond, are interested. The Louisville Railroad has declared the regular quarterly dividend on the common stock of 1¼ per cent. and an extra dividend of ½ per cent. It has also voluntarily increased wages of one thousand employees one cent an hour, aggregating $40,000. The Philadelphia Company directors have declared a regular quarterly dividend of 1½ per cent. on the common stock, payable February 2. A dividend of ½ of 1 per cent. has been declared on United Traction Company, of Pittsburg, common stock, and of 2½ per cent. on the preferred stock, payable January 2 and January 20 respectively.

JERSEY UNITED POWER SALE.—Control of the United Power & Transportation Company of New Jersey has been sold to the Interstate Railways Company at $75 a share, payable in forty-year collateral trust gold coupon bonds, to be issued by the Interstate Railways Company. The bonds will be dated February 1, 1903, and will bear interest at the rate of 3 per cent. for the first year, 3½ for the second year, and 4 for the third year and thereafter. The Interstate Railways Company was incorporated recently in New Jersey, with a capital of $10,000,000 for the purpose of operating electric companies and street railways in Pennsylvania, New Jersey and Delaware. The United Power & Transportation is also a New Jersey corporation, chartered in 1899. Its authorized capital was $12,500,000, of which $3,125,000, par $25, full paid, is outstanding. Among the operations controlled by the company are the following: Edison Illuminating Company, Lebanon; Schuylkill Valley Traction Company, Trenton (N. J.) Street Railway, United Traction Company, Reading; Wilkesbarre & Wyoming Valley Traction Company, Wilkesbarre; Dallas & Harveys Lake Railway;. Wilmington & Chester Traction Company, Wilmington City Electric Company, Citizens' Electric Light & Power Company, of Delaware County; Delaware County & Philadelphia Electric Railway, and several lines in the suburbs of Philadelphia.

Commercial Intelligence.

THE WEEK IN TRADE.—In commenting on trade conditions, *Bradstreet's* says: "Satisfaction with the old and confidence in the new year are the dominating features as 1902 draws to the close. The Christmas holiday trade, exceeding in most respects all records, proved to be a fitting crown to the year of almost unprecedented business and industrial activity." Industrial operations have naturally slowed down except where conditions, as in railway traffic, are such as to demand straining of every nerve to keep up with business offered to prevent a midwinter congestion, which might result in serious derangement. Not only are spring goods being ordered with freedom and confidence, but prompt delivery of the same is bing urged. Among the industries iron and steel, naturally quiet at this season of the year, continue to note the fuel scarcity which affects production of merchant furnaces east and west. Structural iron still leads in strength and demand, and some heavy orders are being placed. Plates, as well as rails, are heavily sold ahead. Railway building during the past year was the heaviest in fifteen years, showing a 12 per cent. increase in mileage over a year ago. In copper there is a better speculative feeling and talk of an improvement in the metal itself is heard. The closing quotations are as follows: Lake, 11⅝ a 11¾c; electrolytic in ignots, cakes and wire bars, 11½ a 11⅝c. Cathodes, 11¼ a 11⅜c., and casting stock, 11⅜ a 11½c. The business failures for the week ending December 25, as reported by *Bradstreet's*, numbered 166, against 225 the week previous and 219 the corresponding week last year.

NEW YORK SUBWAY CARS.—Contracts have been awarded for the copper sheathing of 500 cars to be used in the subway, and the cars are to be delivered in November, 1903, for the contemplated opening of service during the present month. Vice-President Bryan, of the Interborough Rapid Transit Company, which issued the contracts to the Metal-Plated Car & Lumber Company, states that the sheathing will be left unpainted and will present a brilliant red surface that would not require renewal. It would, he added, give protection against fire resulting from short circuits. August Belmont, president of the Interborough Company, is said to be seeking a type of car that can be used interchangeably in the tunnel and on the elevated lines. Two hundred of the new cars now ordered are to be built by the St. Louis Car Company, St. Louis, Mo.; 100 by the Wason Manufacturing Company, of Springfield, Mass.; 100 by the John Stephenson Company, of Elizabethport, N. J., and 100 by the Jewett Car Company, of Newark, Ohio. It is announced that at least 300 more cars of a similar type will be built in time for the opening of the subway in 1903.

WESTINGHOUSE ENGINE ORDERS.—Westinghouse, Church, Kerr & Company, Maritime Building, Bridge Street, New York, have just taken a contract for a 410-hp compound Westinghouse engine to be direct-connected to a Westinghouse generator for installation in the Newark (N. J.) plant of the Benjamin Atha Steel Company. The outfit will be used for general power purposes. The Colorado Fuel & Iron Company's plant at Bessemer, Colo., is to be furnished with two vertical cross-compound engines of 410 hp capacity each. Three 125-hp vertical gas engines have been ordered for general power purposes by the Marshall Foundry Company, Pittsburg, Pa. These machines will be operated by natural gas. They will be direct-connected to Westinghouse generators of 75 kw capacity each.

EUROPEAN EQUIPMENT FOR TOKIO LIGHTING PLANT.—The contracts for the additional power house equipment for the Tokio Electric Light Company will be filled in Germany and England owing to more favorable terms of delivery and better prices having been secured on the other side as compared with terms from the United States. The contracts call for 2,800 hp. The new equipment is to generate current for the railway company, which is now constructing some 20 miles. The generators will be built by Siemens & Halske, Berlin. The British electrical engineering and contracting firm of Dick, Kerr & Co., it is reported, will fill the contract for the remainder of the equipment.

PARAGUAY ELECTRIC LIGHTING PROJECT.—R. C. Treat, collector of internal revenue, American Tract Building, New York, is primarily interested in a project to construct a large electric lighting plant in the city of Asuncion, capital of Paraguay. The initial capacity of the plant will be 1,200 hp. Ultimately it will be extended with a view to furnishing energy to operate an electric traction system, it being proposed to electrically convert and extend the existing mule line, five miles in length, running from Asuncion to Villa Mora, the principal residential suburb.

2,000-HP MOTOR GENERATORS FOR TOKIO.—The American electrical engineering and contracting firm of Bagnall & Hilles, Yokohama, has secured the contract for the motor generators to be installed in the plant of the Tokio Street Railway Company, which, as mentioned elsewhere in this issue, will draw its power from the Tokio Electric Light Company's central station. The motor generators will have an aggregate capacity of 2,000 hp—five units of 400 hp each. They will be built in the United States.

AMERICAN MOTORS FOR JAPANESE ROAD.—American motors are to be used on the projected Kobu electric road, which is to be run in the vicinity of Tokio, Japan. The initial equipment will consist of 16 trains to be operated on the multiple control system. Bagnall & Hilles, Yokohama, took the contract. The Japanese house of Okura, New York offices Bowling Green Building, got the contract for the power house equipment. The generators and engines will be built by Siemens & Halske, Berlin.

BIDS WANTED.—The city lighting department of Elgin, Ill., out of $41,095 for the coming year, will spend $6,000 for a new 100-hp boiler and a new alternating-current generator. The Recorder, of Winona, Minn., Mr. Paul Kemp, will receive bids for an electric light plant, including internal fired boilers of 250 hp, 250-hp Corliss high-speed engine, 300 r.p.m.; condenser, belting, generators, etc. The city engineer is G. P. Coleman.

TRACTION BRAKES.—It is announced that the Standard Traction Brake Company, of Pittsburg, after January 1 will become the Westinghouse Traction Brake Company, controlled by the Westinghouse Air Brake Company. The brake will be made at the Wilmerding works.

WIRE FOR KOBU ELECTRIC RAILWAY.—The American Steel & Wire Company, of 71 Broadway, New York, has secured the contract, through Bagnall & Hilles, Yokohama, for 27 miles of No. 0000 wire for the new Kobu electric road, Japan.

FEED AND TROLLEY WIRE FOR SOUTH AFRICA.—The Federal Electric Company, 141 Broadway, New York, has just been allotted a large contract for feed and trolley wire for shipment to South Africa.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended December 20: Antwerp—20 pkgs. material, $674; 3 pkgs machinery, $505. Amsterdam—6 pkgs. machinery, $217. Argentine Republic—28 pkgs. material, $730, 1 pkg. machinery, $12. British Possessions in Africa—12 pkgs. material, $721. British Australia—64 pkgs. material, $2,149. British East Indies—35 pkgs. material, $1,240; 12 pkgs. machinery, $1,068. Brazil—204 pkgs material, $4,858. British Guiana—2 pkgs. material, $11. Barcelona—7 pkgs material, $1,810. Berlin—3 pkgs. material, $800. Brussels—3 pkgs. material, $155. Budapest—1 pkg. machinery, $35. British West Indies—22 pkgs. material, $471. Central America—12 pkgs material, $238. Colchester—5 pkgs. material, $549. Chili—127 pkgs. material, $3.478. Cuba—3 pkgs. machinery, $466; 147 pkgs. material, $5.512. Dutch Guiana—20 pkgs. machinery, $5,623; 3 pkgs. material, $40. Egypt—1 pkg. material, $50. Gibraltar—3 pkgs. machinery, $125. Genoa—9 pkgs. material, $163. Glasgow—19 pkgs. machinery, $940; 7 pkgs. material, $568. Havre—5 pkgs. machinery, $188; 46 pkgs. material, $2,200. Hamburg—10 pkgs. machinery, $450; 247 pkgs. material, $6,178. Hayti—8 pkgs. material, $113. Liverpool—24 pkgs. machinery, $2,874; 85 pkgs. material, $3,647. London—10 pkgs. machinery, $720; 176 pkgs. material, $9,137. Manchester—1 pkg. material, $52; 166 pkgs. machinery, $15,936. Mexico—167 pkgs. material, $3,288; 3 pkgs. machinery, $114. Marseilles—21 pkgs. material, $232. Madrid—1 pkg. material, $167. Newfoundland—7 pkgs. material, $41. Nova Scotia—30 pkgs. material, $378. New Castle—4 pkgs. machinery, $210. Peru—3 pkgs. material, $1,396. Rotterdam—11 pkgs. machinery, $1,565. Southampton—1 pkg. machinery, $75; 75 pkgs. material, $3,540. Sunderland—2 pkgs. material, $78. U. S. Colombia—13 pkgs. material, $937. Venezuela—4 pkgs. material, $276. Wigan—4 pkgs. material, $375.

MORE YANKEE LIGHTING EQUIPMENT FOR JAPAN.—The Hakata Electric Light Company, at Hakata, on the Island of Kuishu, southwest from the Japanese mainland, has placed a contract with the Japanese house of Takata & Company for duplicating its existing plant, which is of American manufacture. The generator will be Westinghouse Electric of 120 kw, single-phase, direct-connected with revolving armature, 2,200 volts, 16,000 alternations, operating at 1,000 r.p.m., and fitted with double-crown pulley, from which a 375-kw Westinghouse exciter will be operated. The engine will be an Ideal tandem compound one, 13 in. x 22 in. x 16 in., operating at 250 r.p.m., and belted to an Ideal steam separator, both from A. L. Ide & Sons, of Springfield, Ill., through F. W. Horne, of Yokohama, who represents the interests of the Ide people in Japan. The switchboard will be made in Japan. The instruments, however, are to be of American manufacture. The switches will be of the new Westinghouse oil break type, double and single-pull. The General Electric Company will furnish a Thomson recording wattmeter for the switchboard. The Knowles branch of the International Pump Company will furnish an 8-in. x 12-in. x 12-in. independent air pump and jet condensers complete, with vacuum breaking safety attachment, 4,800 pounds steam. The air pump will be brass lined and fitted with brass piston and piston rods. The valves are to be of rubber working in brass valve sets. The initial plant was put in during February, 1900.

HUDSON RIVER POWER.—As already intimated in these pages, the Hudson River Water Power Company, which has substantially completed at Spier Falls one of the largest dams in the country, will construct a second big dam at a point on the upper Hudson River six miles above the present dam and a third one near Conklingville on the Sacandaga River. Lands and privileges for the additional projects have already been acquired. It has been alleged that to carry forward these undertakings the stockholders have voted to increase the capital stock from $2,000,000 to $5,000,000. There are 50,000 shares of the par value of $100 each. President Eugene L. Ashley, of the Hudson River Water Power Company, denies the reports that the increase of capital stock is made for the purpose of developing further power resources. The stock holdings of the Hudson River Water Power Company include companies and plants in Saratoga, Ballston and Mechanicsville, and amount to over $3,000,000 and in order that the same may reflect in the holdings of the stock owners, the increase of capital was voted. It is proposed to put the stock on the market, listing it on the exchange. Already stock of the company has sold for 85. The company and its subsidiary companies now have contracts, it is said, which will yield an annual income of $1,100,000. A contract has just been made to supply the Brady lighting interests at Albany with all the power that can be spared.

PUEBLA WATER POWER SCHEME.—Press reports emanating from the City of Mexico to the effect that the British contracting firm of S. Pearson & Son, Limited, of which Sir Weetman D. Pearson is the president, had obtained a concession from the Mexican government for the generating of electricity in the mountains of the State of Puebla, which would involve an expenditure of some $12,000,000, are erroneous. American capitalists represented by F. S. Pearson, the consulting engineer of the Metropolitan Street Railway, as mentioned several months ago in the ELECTRICAL WORLD AND ENGINEER, are the parties interested in the scheme. The British concern which is at present engaged in the construction of the National Tehuantepec Railway, and somewhat similar undertakings in the Southern Republic has so far not engaged in any electrical enterprises with the single exception of some small work at Vera Cruz, where the harbor works have just been completed. Sir Weetman D. Pearson arrived in New York last week from Europe and left Saturday for Mexico.

SALES OF WESTINGHOUSE PLANT.—The New York Manufacturing Company, of York, Pa., builders of refrigerating apparatus, are equipping their works for electric power distribution, and have recently purchased from the Westinghouse Electric & Manufacturing Company a number of direct-current, 220-volt motors. The Union Abattoir Company, of Baltimore, is making large additions to the electrical equipment used for power distribution in its plant. A 200-kw, 7,200 alternations, two-phase, engine-type generator, with exciter, and two 40-hp motors have recently been purchased through Dr. W. A. Drysdale, constructing engineer, of Philadelphia, from the Westinghouse Company. This machine is an addition to the present plant, which consists of a 150-kw, engine-type generator and about twenty induction motors, ranging in size from 3 to 40 hp inclusive.

POWER IN MARYLAND.—It is stated from Baltimore that the extensive electric power plant being constructed on the Susquehanna River for supplying power to Baltimore, Wilmington and other towns in Northern Maryland and Delaware will be connected with a new railroad operated by the Tidewater & Susquehanna Company, capital $1,300,000. It will extend along the west bank of the Susquehanna River, following the old canal route from Havre de Grace, Md., to Wrightsville, Pa. It will connect with the Baltimore & Ohio and the Pennsylvania Roads at points near Havre de Grace. It will also tap the Maryland & Pennsylvania Road, as well as a branch of the Pennsylvania at Wrightsville and the main line of the Pennsylvania at Columbia, Pa. It is reported that Pennsylvania Railroad interests are connected with the new railroad project, which, it is intended, shall act as a feeder to the Pennsylvania from the numerous electro-chemical, metallurgical and other works to be established near the electric power plant.

STROMBERG-CARLSON TELEPHONE PLANTS.—The Stromberg-Carlson Telephone Manufacturing Company, of Chicago, Ill., and Rochester, N. Y., has recently closed a contract with Mr. W. A. Eckels, of Roudd, Iowa, for a fifty-capacity drop switchboard; with the Buckeye Construction Company for a one-hundred-capacity drop switchboard for Shawhaw, Ky., and a similar board of the same capacity for Centerville, Ky.; and with the Star-Line Telephone Company, Elmo, Mo., for a one-hundred-capacity drop switchboard, together with a quantity of telephones.

NORTHERN ENGINEERING WIRING CONTRACTS.—The Northern Engineering Company, 95 Liberty Street, New York, has undertaken contracts for the wiring of the recently burnt portions of the city of Paterson, N. J., which will involve an expenditure of at least $50,000. Contracts have also been taken lately for wiring the new plant of the Robins Belt Conveying Company at Passaic, N. J., and other contracts which in the aggregate will represent another $50,000.

WESTINGHOUSE MOTORS, ETC., FOR JAPAN.—Takata & Company have lately secured various orders for small motors for shipment to Japan. These machines will be of Westinghouse build. The Nagasaki Quarantine Bureau is to be lighted by a 10-kw Westinghouse, 125-volt, direct-connected Kodak generator, 390 r.p.m. The engine will be built by Robey & Co., Lincoln, England.

BALL ENGINE ORDERS.—Douglas & Co., of Cedar Rapids, Iowa, has recently purchased from the Ball Engine Company, Erie, Pa., an engine for electric service. Strouse Bros., of Baltimore, Md., are installing an electric plant consisting of 125-hp and 60-hp engines, direct-connected to Westinghouse generators. The Ball Engine Company furnish the engines.

EQUIPMENT FOR MEXICAN STEEL PLANT.—The Monterey Iron & Steel Foundry, of Monterey, Mexico, is to be furnished with a Harrisburg standard tandem compound engine, supplied through Mackenzie & Quarrier, New York, which will be direct-connected to a 160-kw General Electric generator for general power purposes.

MACHINE TOOLS FOR SOUTH AFRICA.—Young & Park, 45 Broadway, New York, have just secured a number of fair-sized orders for machine tools, to be shipped to South Africa. Several of the tools will be electrically operated.

REYNOLDS ELECTRIC COMPANY, of 221-225 Fifth Avenue, Chicago, has changed its name to Reynolds Electric Flasher & Manufacturing Company, and increased its capital stock from $2,500 to $15,000. It is doing a very large business in flashers, window signs, decorations, etc.

NEW ELECTRIC POWER TRANSMISSION IN CALIFORNIA.—The Northern California Power Company, which furnishes power to a great variety of industries in one of the most prosperous sections of California, has recently installed a 4,000 hp generating plant at the Cow Creek station, which is situated in the high Sierras and is typical of the many transmission plants which have recently been installed in California. The ultimate capacity of the station will be 8,000 hp when the demand for power reaches this amount. The company has already installed 3,000 hp at another generating station, known as the Battle Creek station, thus making the present total capacity of the company's electrical installation 7,000 horse-power. Among the industries supplied with power by this company are ore-smelters, the city waterworks at Red Bluff and Redding, and the operation of large air compressors at the Mt. Copper Company's mine at Iron Mountain. For lighting, current is also furnished to the cities of Redding, Red Bluff, and Willows, and the towns of Keswick, Cottonwood, Anderson, Corning and Vina. These towns lie along the Sacramento River and are located in one of the most fertile valleys in California. Irrigation is necessary on most of the land in this valley, and electrically driven centrifugal pumps are employed to raise the water to the irrigating ditches. This cheap method of placing in the hands of the farmer the ability to obtain water away from streams and creeks has made him independent of the great water companies and has rendered it possible to develop large areas of land which would otherwise be practically desert wastes. Many thousands of motors are already in operation in California driving pumps for irrigation work, and immense developments are yet to ensue from this application of electric power. The apparatus which the Northern California Power Company has recently installed in its Cow Creek station consists of two 1,500 kw, 3-phase, Westinghouse alternators, which will be driven by impact water-wheels supplied with water under a head of approximately 900 feet. The Company has also purchased from the Westinghouse Electric & Manufacturing Company the exciters, switchboard and raising transformers for this station. The transmission will be at 34,000 volts. The Battle Creek station is likewise equipped with Westinghouse apparatus.

C. & C. FOREIGN AND DOMESTIC ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, has obtained within the past few days various orders from Great Britain, India, Cuba and Japan. C. R. Heap, of 37 Victoria Street, London, S. W., has sent in orders for eight motors varying from 5 hp to 10 hp. An 11-kw generator has been ordered for shipment to India for lighting use. From Havana an order has come for a 25-kw belted generator to be used for lighting purposes. The American Trading Company, Broad Exchange Building, New York, has requisitioned for a small generator to be sent to Yokohama. Among domestic orders recently taken by the C. & C. people is one for a 125-kw belted generator—the second order—for installation in the Rogers Locomotive Works, Paterson, N. J., where the machine will be used for supplying power for general purposes. The Wyoming Hotel Company, Chicago, has ordered for light and power use one 60-kw and one 40-kw generator to be direct-connected to 90-hp and 60-hp horizontal engines from the Ames Iron Works, of Oswego, N. Y. A 60-kw generator and a 40-kw one have been ordered for use in an apartment house now under construction at West Fifty-fifth Street and Broadway, New York. These generators will be direct-connected to 90-hp and 60-hp engines manufactured by the Ridgway Dynamo & Engine Company, of Ridgway, Pa. The Belgravia Apartment Hotel, Philadelphia, Pa., is to have 75-kw and 50-kw generators direct-connected to 110-hp and 75-hp engines, to be furnished by the Buffalo Forge Company. The new Corn Exchange Bank Building, William Street, New York, will be equipped with three C. & C. slow-speed motors—25 hp, 10 hp and 5 hp, for operating ventilating apparatus to be supplied by the B. F. Sturtevant Company, Boston, Mass.

AMERICAN ROAD FOR JAPAN.—The American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama, whose Mr. A. L. Bagnall is now on a visit to the United States, and is making his headquarters at the New York office in the Engineering Building, 114 Liberty Street, of the New York Insulated Wire Company, have recently secured an important contract for the Kaihen Traction Company, which operates a road 11 miles in length, one section of which runs from Kawasaki to the temple of the great Japanese god Daishi. The power house equipment consists of two 150-kw direct-connected generators built by the General Electric Company. The engines are 225 hp each, from the Skinner Engine Company, of Erie, Pa. The boilers are Philadelphia vertical & Sterling build. The Carnegie Steel Company has the order for the rails—60-pound. The trucks—24 in all—were ordered from both the J. G. Brill Company, of Philadelphia, and the Peckham Manufacturing Company, 26 Cortlandt Street, New York City. The car bodies are Japanese. This also applies to the trolley poles. The trucks are each fitted with two 25-hp General Electric or Westinghouse motors. It is anticipated that the system will be extended in the near future.

PORTO RICO TROLLEYS.—A special dispatch from San Juan, Porto Rico, says: The largest single investment of capital made in Porto Rico since the American occupation is about to flow into the island for railroad construction. The Executive Council has granted to the Vandergrift Construction Company, of Philadelphia, a franchise to build and operate an electric railroad from San Juan to Ponce, seventy-three miles, and also to sell light and power along the route. The concession is the most important yet given by the Insular Government, and it is the consensus of opinion here that the results will be of incalculable benefit to Porto Rico. The franchise gives to the Vandergrift Company the Comeria water rights, which are in themselves of great value if properly utilized. The Philadelphia concern, promptly acceding to the Council's request, has deposited $10,000 cash as an earnest, and must within the next sixty days file a bond of $100,000, satisfactory to the Attorney-General of Porto Rico, as to sufficiently fulfill the conditions of the ordinance imposed.

STROMBERG-CARLSON TELEPHONE CONTRACTS—The Stromberg-Carlson Telephone Manufacturing Company, of Chicago, Ill., and Rochester, N. Y., has recently closed a contract with the Cherokee Telephone Company for a 200-line-capacity drop switchboard. It has also recently closed a contract with the New Castle Telephone Company, of New Castle, Ind., for a 1,000-line-capacity, visual-signal, central-energy switchboard, consisting of four sections; also a two-position toll board equipped with 40 lines. A further Stromberg-Carlson contract is with the Southern Electrical Construction Company, of Huntington, Ind., for a 2,400-line, full-lamp signal, central-energy switchboard, with a present equipment of 700 lines for Bowling Green, Ky. The contract includes 700 telephones, a toll board, chief operator's desk and complete power equipment.

PUMPING AND HOISTING EQUIPMENTS FOR MEXICO.—The Descubridora Mining and Smelting Company, Thos. H. Watkins, president, and New York offices at 68 William Street, has let some important contracts within the last few days for electrically operated pumping and hoisting equipments for its mines at Descubridora, Mexico. The Allentown Rolling Mills, of Allentown, Pa., have been awarded a contract for three 4-inch by 12-inch horizontal mining pumps, capable of handling 200 gallons per minute against a vertical lift of 600 feet. These pumps will be each operated by 50-hp General Electric motors. A large double-drum electric mine hoist has been ordered from the Lidgerwood Manufacturing Company. It will be driven by a General Electric motor of 100 hp.

MORE YANKEE EQUIPMENT FOR NAGOYA ROAD.—The Nagoya (Japan) Electric Railway Company, which has American equipment, is to extend its operations. The American electrical engineering and contracting firm of Bagnall & Hilles has been awarded the contract for a 200-kw extension to the power house capacity and also for some cars. The original power house equipment consists of three 100-kw generators, Philadelphia Corliss engines and Sterling boilers. Mr. Bagnall, now in New York, has already ordered some car trucks from the Peckham Manufacturing Company. The motors will be double ones of 25 hp each. They will be built by the General Electric Company.

ELECTRIC HOISTS FOR SOUTH AFRICAN MINES.—The United Engineering Company, of Johannesburg, which handles considerable electrical and other machinery for installation in South African mines, etc., has placed an order with the Lidgerwood Manufacturing Company for three double-drum electric mining hoists of 25-hp capacity each. These equipments will be operated by General Electric motors.

LIGHTING FOR COLIMA, MEXICO.—The municipal government of the city of Colima, Mexico, has just entered into a contract with Fogarty & Dickerson, an American contracting firm of San Luis Potosi, Mexico, for the installation of an electric light plant in that city. The plant will be operated by the contractors for a period of twenty years.

THE MERIDEN (CONN.) ELECTRIC LIGHT COMPANY has placed with Stuart-Howland Company, Boston, an order for a complete new equipment of Helios-Upton series alternating arc lamps and regulators, and Peerless transformers for its street lighting service. The Stuart-Howland Company is the New England agent for these lines.

YOKOHAMA TO HAVE ELECTRIC TRACTION.—A Japanese syndicate with an initial capital of about $150,000 has been formed for the purpose of constructing an electric traction system in Yokohama which will mark the introduction of the trolley in that important city.

ANDERSON WIRING MATERIAL CONTRACTS.—The Albert & J. M. Anderson Manufacturing Company, of Boston, Mass., has been allotted the contracts for the wiring material for the new Battery Park and Corn Exchange Bank Buildings.

General News.

THE TELEPHONE.

CHICAGO, ILL.—Application has been made by the Illinois Telegraph and Telephone Company for a permit to begin the construction of tunnels and subways under the streets of the West Side.

INDIANAPOLIS, IND.—The New Long Distance Telephone Company has declared its regular one per cent. quarterly dividend, payable Jan. 1.

CAIRO, IND.—The citizens of this village have formed a co-operative telephone system independent of all other lines in the farming community. J. E. Kolb is president and F. M. Buskirk secretary.

MARION, IND.—The Farmers & Citizens Telephone Company, of Sweetser, has organized and will secure long distance connections through the lines of the Central Union Telephone Company at Marion. The company will build an exchange at Sweetser.

KOKOMO, IND.—The Central Union Telephone Company has reduced its rates considerably and is endeavoring to regain the ground lost to the Citizens' Company. It is claimed that the latter has 1,500 subscribers, as compared with 300 of the Bell Company.

INDIANAPOLIS, IND.—The underground occupancy of the streets of this city has become so congested that the Home Heating & Lighting Company has been restrained at the instance of the Central Union Telephone Company from laying heating pipes close to its conduits. The matter will likely be adjusted satisfactorily.

INDIANAPOLIS, IND.—The growth of the business of the New Telephone Company, at Indianapolis, continues to be remarkable. Ever since the completion of its two new branch exchanges the company is unable to take care of the business coming to it and will be obliged to erect a new building at the rear of its main exchange.

TERRE HAUTE, IND.—The Kinloch Long Distance Telephone Company, of Missouri, has completed its pole line to Terre Haute, and will commence stringing wire at once. It expects to be ready to connect with the New Long Distance Telephone Company, of Indianapolis, at Terre Haute, for through service between Indianapolis and St. Louis, about Feb. 1.

EVANSVILLE, IND.—Judge Baker, of the Federal Court, has issued a temporary restraining order against the city of Evansville from interfering with the rights and property of the Cumberland Telephone & Telegraph Company, of Kentucky. In case the Court refuses to grant a permanent restraining order, or even if it does, it is highly probable the matter will be taken to higher courts. Mayor Covert claims that $100,000 has been subscribed for the municipal telephone plant. He estimates that $175,000 will be needed for its construction, and thinks there will be no trouble in raising the required amount. The Cumberland Telephone Company owns exchanges in seven States and claims to have acquired a perpetual franchise in Evansville in 1882. In 1887 the City Council passed an ordinance limiting its franchise to fifteen years. Last August the Council passed an ordinance rescinding the rights of the company to the streets and notified it to vacate by Dec. 17. The case will come up for a hearing on its merits the first week in April, if not raised sooner by a motion to dissolve the restraining order.

CHICKASHA, I. T.—The Bell Telephone Company and the Chickasha City Council are at war. The Bell Company was here before the city had a charter, but when it asked permission to extend its system, it was refused. Meanwhile a local company was granted a franchise. The Bell Company paid no attention to the Council, but continued to erect and string wires. At the last meeting the Council issued rigid instructions to the marshal, who, on Dec. 24, began chopping down Bell poles, destroying wires all over the town. He did a good job of it, and will continue until the entire local system is wrecked, unless stopped by injunction. The matter will be settled in the courts.

KEOKUK, IA.—Montezuma will vote on January 5 on granting a franchise to the Keokuk, Mahaska and Poweshiek Mutual Telephone Company.

AUBURN, KY.—R. M. Ray is building an independent telephone line from Stowers to Auburn.

FOREST CITY, LA.—The Great Northern Telephone Company has been organized at this place with a capital of $25,000. The intention of the promoters is to build rural and toll lines all over the county.

NEW ORLEANS, LA.—Nine of the men who were engaged in the late telephone strike were convicted of contempt of court in the United States Court in disobeying its injunction and sentenced for long terms.

COKATO, MINN.—The Cokato Telephone Company has been organized here, capital, $10,000. The company will maintain a local exchange and lines around the village.

HARTVILLE, MO.—Prophet & Johnston, owners of the Hartville Telephone Company, with lines to Mansfield, Mountain Grove and Duncan, will put in a central system here at once.

LEWISTOWN, MONT.—The Lewistown Telephone Company is installing a 200-drop switchboard.

HAMILTON, MONT.—The Bitter Root Telephone Company is about to build a line from Hamilton to Hughes Creek, Mont.

FORT BENTON, MONT.—The Benton-Highwood Telephone Company will incorporate here shortly. The members of the company are: A. D. Viddert and J. M. Burlingame, of Great Falls, Mont., and H. E. Robbins, of Fort Benton.

LEBANON, N. J.—The Lebanon Telephone Company, of Lebanon, Hunterdon County, with capital of $5,000, has been incorporated by George Clark, S. J. Shurtis and E. W. Sutton.

JAMESTOWN, N. Y.—The Chatauqua County Telephone & Telegraph Company has been incorporated with a capital of $25,000, to build a line and operate telephone exchanges and systems throughout this county. Directors, T. S. Lane, L. P. Lane, B. D. Phillips, and others.

ITHACA, N. Y.—The Board of Supervisors has decided to grant a contract to the Ithaca Telephone Company to furnish service to the county for one year. An opportunity is also given the Bell Company to share in the contract. The Bell Company offered its service for $165 a year. The Ithaca Telephone Company made a bid of $75.

PERU, OHIO.—The Local Telephone Company, of Norwalk, is planning to establish a branch at Peru.

TOLEDO, OHIO.—The exchange of the Toledo Home Telephone Company has been turned over by the construction company.

GALION, OHIO.—The Galion Telephone Company is preparing to spend about $50,000 in improvements. The exchange is being remodeled.

MANSFIELD, OHIO.—The Federal Telephone Company has authorized the expenditure of $40,000 on improvements in the plant of the Mansfield Telephone Company.

URBANA, OHIO.—The Urbana Telephone Company has elected the following officers: C. H. Marvin, president; J. I. Blose, vice-president; F. J. Brand, secretary; J. C. Powers, treasurer.

LENOX, OHIO.—The Lenox Telephone Company is making numerous improvements and an extension is being built to Sentinel. Connection has been made with the Warren & Jefferson system.

NEWARK, OHIO.—The Newark Independent Telephone Company has placed an order for an addition to its switchboard to accommodate 500 new subscribers. Other improvements will be made.

NORTH BALTIMORE, OHIO.—The North Baltimore Telephone Company is preparing to make numerous improvements and will connect with the long-distance lines of the United States Telephone Company.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Telephone Company has had a most successful year. It now operates six exchanges and has 2,500 subscribers. Improvements are being planned for next year.

TOLEDO, OHIO.—The leading stockholders of the Toledo Home Telephone Company have organized a voting trust and pooled their stock for a period of five years to prevent the purchase of stock by unfriendly interests.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association (Bell) has absorbed the Millcreek Valley Exchange system, heretofore owned by H. M. Grove. The system will be improved and the toll rates to the city reduced.

CLEVELAND, OHIO.—The city is taking steps to compel the Cleveland Telephone Company (Bell) to permit the Cuyahoga Telephone Company to use its poles in certain sections of the city. It is claimed that the Cleveland company has no franchise.

WOOSTER, OHIO.—The M. W. & O. Telephone Company is preparing to make extensive improvements. A new 1,000-drop multiple board has been ordered from the North Electric Company, Cleveland, and new cables and new instruments will be installed.

CLEVELAND, OHIO.—President Dickson, of the Federal Telephone Company and of the United States Telephone Company, has announced that the January interest on the United States and Cuyahoga bonds, together with the defaulted July interest, is to be paid at once.

OBERLIN, OHIO.—The exchange of the Oberlin Telephone Company was almost totally wrecked recently by the trolley of a car jumping the wire and striking the main telephone cable. The switchboard immediately caught fire. The board was ruined and over 150 telephones were burned out. It will be some time before service can be resumed.

CLEVELAND, OHIO.—The statement of the United States Telephone Company for the month of October shows the following results: Gross earnings, $28,555; operating expenses, $15,387; fixed charges, $7,771; surplus, $5,397. The increase over the previous month is considerable, owing to the recent connection of the Michigan lines with the main system.

CHARLESTON, S. C.—Work has been started by the Southern Bell Telephone Company on a $13,000 three-story telephone exchange building.

BETHEL, TENN.—A strong effort will be made to have extended to Bethel the telephone line proposed to be run from Pulaski to Stella and Heron.

RICHMOND, VA.—The Bell Telephone Company announces that it has purchased the Richmond Telephone Company, but will take it over only by full consent of the City Council and with public approval. The purchased company has recently put in an expensive equipment.

GREEN BAY, WIS.—Green Bay business men are considering a plan of organizing an independent telephone company to build an exchange in this city.

GREEN BAY, WIS.—The Wisconsin Telephone Company will construct a long distance line from Sturgeon Bay direct to the end of the county, to connect with the proposed cable across "Death's Door."

LA CROSSE, WIS.—The Wisconsin Telephone Company, after a fight with the local company, the La Crosse Telephone Company, of several years' standing, has decided to raise its rates to those of the independent company.

FOND DU LAC, WIS.—The Little Wolf River Telephone Company is to be reorganized. Its capital stock is to be increased from $125,000, the present amount, by probably $50,000 or $75,000. It will then be placed on a good business basis.

CHEYENNE, WYO.—The Bell Telephone Company will build a new exchange here, the contract having been awarded.

CHEYENNE, WYO.—The Ranch Telephone Company has been incorporated here. It is capitalized at $10,000. The Coal Creek Telephone Company, with a capital of $2,500, has also been incorporated here.

ELECTRIC LIGHT AND POWER.

HUNTSVILLE, ALA.—The city seems determined to build a lighting plant of its own, which, if done, will take away a main support of the electric street railway corporation. The latter threatens to remove its electric railway if the city electric light plant is established. An election will be held on Jan. 19 to vote on $20,000 electric light bonds.

DENVER, COLO.—The Queen City Foundry Company is putting in a plant for arc and incandescent lighting in connection with its new shops.

HARTFORD, CONN.—The New London Gas & Electric Company has asked for approval of an increase of its capital stock from $400,000 to $500,000.

MONTPELIER, IND.—Capitalists are negotiating for the purchase of the Montpelier water and electric light plant.

ALEXANDRIA, IND.—The electric lighting contract for this city will expire in February, and the present company will not renew it at present rates, as the cost of fuel is too high.

SOUTH BEND, IND.—Over $1,000,000 is to be expended in the construction of a water-power electric plant on the St. Joseph River near South Bend. It is stated that nearly 10,000-hp. is available.

RICHMOND, IND.—The municipal electric light plant, of this city, which has cause so much trouble in the past, is still a great source of annoyance to the city administration. The Council has named a committee to confer with the Electric Light Commission, which has full control, regarding the management.

KOKOMO, IND.—Five franchises are asked from the City Council, the petitioners being George J. Marott, of Indianapolis, and George F. McCulloch, of Anderson. Mr. Marott wants a 30-year extension of his electric street railway and electric lighting plant franchises, and Mr. McCulloch asks for a 30-year franchise for an electric lighting system and certain concessions for his interurban line, for which the city already granted a franchise.

DULUTH, MINN.—The Mesaba Light & Power Company has filed articles of incorporation. The company proposes to furnish light and power for Virginia, Minn., and is capitalized at $25,000. The limit of indebtedness is also $25,000. The incorporators are John Costin, Jr., and John D. Lamont, of Virginia, and Daniel D. Crowley, of Duluth.

HAMLET, N. C.—The Hamlet Electric Light Company, capital $100,000, has been chartered. G. O. Sanders is interested.

ARLINGTON, OHIO.—Charles Cotner, of the Arlington light plant, is planning to establish a plant at Mt. Blanchard.

COLUMBUS, OHIO.—The sinking fund trustees have accepted $110,000 electric light bonds which will make possible the erection of the long-talked-of municipal plant.

GRAND RAPIDS, OHIO.—Augustine Pilliod has completed a private electric light plant and has secured a contract to illuminate the village. He will furnish fifteen arc lamps.

MARION, S. C.—The Marion Water, Light & Power Company has been commissioned, with a capital stock of $100,000. Arthur Dunn and A. N. Walker, of Scranton, Pa., and J. W. Johnson, of Marion, are the corporators.

LAWRENCEBURG, TENN.—Granbury Jackson, of Mt. Pleasant, Tenn., has prepared for the city estimates on a combined water and light plant. A dynamo of 50-kw. capacity is provided for. The total cost will be over $20,000. Bonds will probably be issued by the town to pay for the plant.

MORGANTOWN, W. VA.—The Morgantown Electric Lighting & Traction Company has let the contract for the building of its new power house.

THE ELECTRIC RAILWAY.

HARTFORD, CONN.—These petitions for charters for electric railways have been filed: Through Naugatuck, Beacon Falls and Seymour; incorporators, George A. Lewis, J. H. Dayton and A. D. Warren. Through Branford Point, Pine Orchard, Stoney Creek, to Guilford; by the Branford Lighting & Water Company. Through North Haven, Wallingford, Meriden and Berlin; by the Meriden Electric Railway Company.

WARSAW, IND.—The Huntington & Winona Traction Company has been granted a franchise through Kosciosko County.

INDIANAPOLIS, IND.—The Wabash River Traction Company has placed contracts for two sub-stations between Peru and Logansport. L. W. Law is general manager of the company.

EATON, IND.—The general offices of the Muncie, Hartford & Ft. Wayne Traction Company have been removed from Muncie to Eaton, where the power house and office building is about completed. The completion of the road has been held up through the inability of the bridge company to furnish bridges on time. It is expected cars will be in operation early next year. The road is owned by Cleveland people, headed by S. M. Hexter and J. C. Gilchrist.

TOPEKA, KAN.—The Topeka, Lawrence & Kansas City Electric Railway Company, capital stock $2,000,000, has been incorporated by J. B. Adams, H. M. Levan, R. Levan, T. S. Salathiel, M. L. Adams and E. R. Salathiel.

LOUISVILLE, KY.—Chief Engineer Jeup, of Indianapolis, has commenced surveys for the New Albany, Paoli & French Lick Valley Traction Company's line.

MIDDLEBORO, MASS.—Articles of association have been signed for the formation of the new Sandwich, Hyannis & Chatham Street Railway Company, which is to extend the Middleboro, Wareham and Buzzard's Bay trolley system into the heart of Cape Cod. The new line will be 45 miles long, extending from Sandwich station to a point near Chatham light.

LANSING, MICH.—The Michigan Central Traction Company has been granted a franchise through town The road must be completed in the city by June 1, 1903.

DETROIT, MICH.—The Detroit, Monroe & Toledo Short Line has been incorporated with $3,000,000 capital stock to take over the Toledo & Monroe Railway and build the long-talked-of extension from Monroe to Detroit. The company has secured a right of way which will afford much shorter time into Detroit than the old route through Trenton. Of the capital, $1,000,000 will be set aside for double tracking the line later. While it is now hardly probable that the line will be acquired by the Detroit United Railway, there is strong probability that the Everett-Moore syndicate will perfect traffic arrangements for the through operation of cars from Cleveland to Detroit.

OMAHA, NEB.—A street railway consolidation has been effected here by turning the old Omaha & Florence Street Railway Company into the Omaha & Council Bluffs Street Railway Company. The capital stock of the latter was increased from $200,000 to $15,000,000. The entire project is being financed by J. & W. Seligman, of New York, who recently purchased the Omaha road.

NEW YORK, N. Y.—Mayor Low has signed the New York & Jersey tunnel franchise for the new Hudson River tunnel, which is to be operated by electricity.

LIMA, OHIO.—The Lima Electric Railway & Light Company has sold its old power plant to a company headed by Walter Parmenter.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has decided on plans for a large power station to be erected on the Muskingum River in this city.

XENIA, OHIO.—It is announced that the Xenia & Wilmington Traction Company has secured all the required right of way and that construction work on the line will start in the spring.

DELTA, OHIO.—The Toledo & Indiana Railway Company has completed arrangements with the Delta Electric Light Company to build an extension to its power house to supply current for a portion of the railway.

COLUMBUS, OHIO.—The Scioto Valley Traction Company is placing contracts for the material required in equipping the road. The power station will be erected near Reese's Station. The cars will be 60 feet in length and will be capable of a speed of 60 miles an hour.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company is installing a telephone dispatching system on its line. Cars will be operated through from Marietta to Parkersburg.

CLEVELAND, OHIO.—E. P. Roberts & Company, Cleveland engineers, are closing contracts for the equipment of the Dayton & Muncie Traction Company, the company which is building a northern extension of the Dayton & Northern Traction Company. A large power station will be erected.

CLEVELAND, OHIO.—The Cleveland, Elyria & Western Railway Company has closed a contract with the government to handle the mail between Oberlin, Birmingham, Florence, Berlin Heights, Berlinville and East Norwalk. Heretofore this has been handled by the Lake Shore (steam).

CLEVELAND, OHIO.—The recent snow storm tied up nearly all the interurban lines and many of the city lines of Northern Ohio. The Lake Shore Electric Railway succeeded in running one car through from Toledo to Cleveland. The other Toledo and Cleveland lines were in equally bad condition. Much of the trouble was caused by snow drifts at undergrade crossings.

WASHINGTON, C. H., OHIO.—Local people are planning to build an electric railway from Marysville, Ky., to this point to connect with a line to Columbus. The road will be known as the Columbus & Marysville Railway and will touch Ripley, Georgetown, Sardinia, Hillsboro and Washington, C. H. Residents along the route are being asked to raise 10 per cent of the cost of construction.

CLEVELAND, OHIO.—For the first time since President Andrews took charge of the Cleveland Electric Railway Company has an inkling been given as to the earnings of the company. It is stated that on November the receipts were $214,993, a gain of $25,552 over the corresponding month last year. For eleven months the receipts were $2,284,335, as against $2,077,012, an average gain of $10,000 a month.

CLEVELAND, OHIO.—Details of the consolidation of the Cleveland, Elyria & Western Railway with the Cleveland & Southern and the Norwalk Gas & Electric Company have been completed. The new company will probably be known as the Cleveland & Southwestern Railway. The capital stock will be $5,000,000 and as the three properties have a combined capitalization of much less than this amount, it would appear that a portion of the issue will be retained for the purchase of the Cleveland, Ashland & Mansfield and the Ohio Central Traction Company when the system is connected. Two millions of this capitalization will be preferred and the balance common stock. For the present the bond issue will be $2,100,000 covering the underlying issues of the three properties.

CLEVELAND, OHIO.—The Lorain & Eastern Railway Company has been incorporated with temporary capital stock of $1,000 by A. D. Stuber, Wm. D. Young, George L. Cooley, D. T. Miller, Frank R. Lander and Henry W. Stecker. The promoters propose to build a new line from Rocky River to Elyria and Lorain. The line would parallel and be between the Cleveland, Elyria & Western and Lake Shore Electric roads. While it would touch several towns not reached by either of the roads, it is difficult to see how it can be made to pay in competition with two strong lines. It is claimed the company will have its own private right of way the entire distance and that the running time to both Elyria and Lorain can be reduced twenty minutes. A similar project originated about a year ago, but nothing has been heard of it for some time.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN DE FOREST WIRELESS TELEGRAPH COMPANY has been incorporated at Kittery, Me., with a capital of $5,000,000. Hiram Thomson is president and R. A. Jordan treasurer.

THE TURBINE ELECTRIC TRUCK COMPANY, of Yonkers, N. Y., has been incorporated, capital, $100,000. Directors: J. D. Sullivan and H. D. Crippen, New York, F. A. Curtis, Nutley, N. J.

THE DUNKIRK POWER & HEATING COMPANY, of Dunkirk, N. Y., has been incorporated with a capital of $50,000. Directors—A. W. Cummings, Harry Durrell, and H. T. Litchfield, Dunkirk.

THE YOST ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, has been incorporated with a capital of $75,000. The incorporators are C. A. Morris, John Renner, J. Stollby, J. Bours and Louis Maudler, all of Toledo.

THE PAN ELECTRIC SERVICE & APPLIANCE CO. has been incorporated at St. Louis, with a capital stock of $7,000. H. S. Graber, P. L. Chandeysson, W. H. Schuveder, D. L. Babcock and O. L. Watt are the shareholders.

THE ELECTRIC ALUMINUM PURIFYING COMPANY has been incorporated at Kittery, Me., to make and sell machines for purifying water. The capital is $500,000. Charles C. Smith is president and C. M. Prince treasurer, both of Kittery.

THE INDIANA COMPANY, with a capital of $1,000,000, has been incorporated in New Jersey. It will construct railways and electric light plants in Indiana. The incorporators are Thos. Dolan, Randall Morgan, F. H. MacMorris, C. N. Latourette and George H. Martin.

THE HERCULES ELECTRIC & MANUFACTURING COMPANY, of Indianapolis, Ind., has incorporated, with a capital of $10,000. The company will manufacture electric generators, machinery and other electrical appliances. John A. Kurtz heads the board of directors.

OBITUARY.

PROF. FRANCIS FOWLER, a principal examiner in the Patent Office, and one of the oldest employees in the Government service, died at his home in Washington last week. Mr. Fowler entered the service in 1869 from western New York, and rose to the grade of principal examiner in 1876. He had charge of the division of steam appliances, and was well known to many inventors in the mechanical and electrical field.

MR. J. J. DICKEY.—John J. Dickey, Superintendent of the fifth district of the central division of the Western Union Telegraph Company, and one of the oldest officials in the service of that corporation, died at his home in Omaha, Neb., on Dec. 29, of pneumonia. He was born in Rushville, Ill., April 11, 1839. In 1857 he entered the law office of Judge J. D. Caton, of Chicago, where he also learned telegraphy. He was identified with a number of the telegraph companies, and served during the war as a military telegrapher. He then entered the service of one of the largest companies, which later merged into the Western Union, with which concern he has held an official position for twenty-five years. He was a promoter of the first telephone company, and at the time of his death was a director and Vice-President of the Nebraska Telephone Company and Vice-President of the American District Telegraph Company. He also was identified with financial institutions of Omaha, and was an extensive owner of real estate there.

PERSONAL.

JOHN A. STEWART.

MR. JOHN A. STEWART, well-known as a pioneer in electrical commercial development, has recently taken some important steps on his own behalf. He is now located at 430 Sycamore Street, Cincinnati, O., where he is conducting the John A. Stewart Electrical Company, with factory and warehouses at Ludlow, Ky. Mr. Stewart has been engaged in the electrical business for some fifteen years with the General Electric, Bullock, and Rossiter-MacGovern interests. He severed his connection recently with the concern last named in order to establish his new organization to deal in steam and generating plant of all kinds, motors, etc., and to carry on incidentally a repair department. The Tucker-Anthony Company, of Cincinnati; the St. Louis Transit Company; the Cincinnati & Indianapolis Street Railway, etc., have already made arrangements with him to handle apparatus from their respective power plants. Mr. Stewart has recently leased an extensive factory occupied formerly by the firm of Post & Company, of Ludlow, Ky., for warehouse purposes, and where he will engage also in manufacturing commutators and various supply parts of electrical apparatus. Mr. Stewart not only enjoys a wide acquaintance in the field, but a long and varied experience with all classes of electrical machinery.

MR. WALTER C. FISH, of the General Electric Company, of Lynn, Mass., has been elected a director in the Fore River Ship & Engine Company.

PROF. A. G. BELL is again arresting attention with his work on airships and his kite aeroplanes have lately been the subject of various articles in the newspapers.

MR. A. E. LANG has retired from the presidency of the Toledo Railways and Light Company, of Toledo, Ohio, and turned the office over to his successor, Mr. E. W. Everett, who represents the Everett-Moore Syndicate.

PROF. MORGAN BROOKS, of the Department of Electricity of the University of Illinois, has been visiting New York during the Christmas vacation and is now in New England on personal business.

MR. FRED. A. GEIER, the well-known treasurer of the Cincinnati Milling Machine Company, has an interesting article in *American Industries* on the development of internal waterways as a national movement as related to the National Association of Manufacturers.

MR. G. M. GEST, the conduit contractor, has been awarded the additional contract in Dayton, Ohio, by the Oakwood Street Railway Company and the People's Street Railway Company for the reconstruction of their tracks in that city. This contract amounts to approximately $15,000.

MR. J. L. MATTHIAS, of Camden, S. C., southern representative for Rumsey Electrical Manufacturers' Company, of Philadelphia, has secured a franchise from the town of Cheraw, S. C., for lighting that town. The "proposition," although small, is said to be one of the best in the South.

MR. J. B. ORR, of the electrical engineering and contracting firm of James Mitchell & Co., of Rio Janeiro and San Paolo, Brazil, which represents the interests in that part of the world of the General Electric Company and other prominent American concerns, is expected to arrive in New York about Jan. 15.

MR. J. B. CAHOON, the secretary of the National Electric Light Association, has recently returned to New York City from a long trip out through the Pacific Coast on expert work. He reports the affairs of the Association in a most flourishing condition, with accessions of membership from all over the country.

MR. JOHN M. MACK has resigned from the board of directors of the Philadelphia Electric Company, the resignation to take effect Jan. 1. Rumor connects Mr. Mack's resignation with the recent striking out by councils committee of the clause in the Keystone ordinance allowing the company to use their conduits.

MR. Y. NOGAMI, the engineer of the Tokio Electric Light Company, which concern operates the largest lighting plant—4,200-hp.—in that part of the world, sailed for Europe Saturday after a visit of some three months' duration on this side, during which time he inspected several of the large power plants throughout the country.

MR. CARL SCHWARTZ, formerly of Siemens & Halske, in Germany, has joined the engineering staff of the Chicago Edison Company, at Chicago, where his services are valuable because of his intimate knowledge of European electric lighting practice. Mr. Schwartz has already made many friends also in New York City.

MR. W. JAC MARLAND, general agent of the Brooklyn N. Y. Edison Company was very agreeably surprised at Christmas time by receiving from the members of his staff a handsome and beautifully finished clock, as a mark of their appreciation of his manly qualities and the good feeling toward him of all working under him. Mr. Marland is making a great success of his work in Brooklyn, developing the patronage given the company.

MR. S. L. BARRIETT, of the Cincinnati Electric Motor Company, has been visiting New York during the Christmas holidays. He has many friends in the city who have watched with interest his development of motor production further west. Mr. Barriett has long been known in the motor field, and is now building from his own designs motors from ½ up to 10 hp.

MR. MANNING K. EYRE has been elected president of the Buckeye Electric Company, of Cleveland, Ohio, to which position he advanced from that of general sales manager of the same company. Mr. Eyre has been identified with the incandescent lamp industry for the past ten years, having started in the Edison Lamp Works, of which, several years later, he became manager.

MR. H. H. SUPLEE, editor of the *Engineering Magazine*, has an interesting résumé of the quarter's progress in "Applied Science" in the January-March *Forum*. He notes especially how the standardization of methods of manufacture and the discouragement of the demand for special articles have contributed to make the work of modern engineering of a much more wholesale character than formerly.

MR. ANDREW CARNEGIE has notified the Provost of Greenock, Scotland, that he is prepared to give $50,000 to erect a memorial to James Watt, the inventor, who was born in that city on Jan. 19, 1736, in recognition of his engineering achievements; or he will head a movement in America to raise a large fund which, in conjunction with sums raised in Great Britain, will provide for a more extensive scheme of commemoration.

MR. PHILIP DAWSON.—In our issue of Nov. 1 we gave an account of the interesting plans for the big power plant and transmission of the Midland Power Co., England. We learn that Mr. Philip Dawson and his associates in the firm of Kincaid, Waller, Manville & Dawson, of London, were the engineers who designed the complete installation, supervised the construction, and are responsible for the sucessful completion of the plant.

SIR HIRAM MAXIM will leave England for America, where he expects to remain about two years. Sir Hiram explained to a newspaper representative that he had a twofold object in making a long stay in America. In the first place he hopes to cure a troublesome throat complaint, and, secondly, he intends to carry out an important series of experiments with a view to building a flying machine somewhere along the coast of Connecticut. He has already done some important work in this field.

MR. RAMON VALDES, of 44 Broad Street, New York, has returned from a trip to Porto Rico, where he recently went in the interest of the Rio Plata Electric Company, which proposes to build a dam and power house in the Rio Plata, located in the mountains about 17 miles distant from the city of San Juan, and which also contemplates the conversion of the existing narrow gauge steam road running between Catano and Bayemon, a distance of about four and one-third miles, into a broad gauge electric traction system. George W. C. Drexel is president of the company.

MR. G. WESTINGHOUSE.—An interesting cable dispatch from London, of Dec. 27, says: George Westinghouse is here now taking things easy at his hotel for the holidays after two months of hard work. There is no busier man in London than this great engineer. At 7 o'clock in the morning he is out to his city office—three hours before the leisurely English capitalists think of starting to work—and often before that hour he is speeding to Manchester to see to his enormous establishment there, which is quite as large and important as his Pittsburg house. Mr. Westinghouse takes no recreation in London. He hardly ever goes to the theatre, and no one has ever seen him at a race meeting. His work is his life. Every railway train in the United Kingdom is fitted now with his air brake. He will return to Pittsburg early in February.

STROMBERG-CARLSON BANQUET.—On the evening of Dec. 12, the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, Ill., and Rochester, N. Y., gave a banquet at the Great Northern Hotel, Chicago, at which the following men were present: Alfred Stromberg, T. R. Finucane, C. W. Stiger, A. J. Rousseau, H. G. Webster, A. Hulbrich, Eugene L. Brown, F. L. Martin, William Bowen, F. L. Middleton, R. B. Tyler, E. C. Lewis, H. B. Hewitt, H. D. Eddy, L. R. Krum, C. E. Knickerbocker, A. S. Munsell, G. A. Muir, Paul D. Meyers, G. H. Pierce, B. B. Willis, H. L. DuPont, G. L. Burlingame, C. H. Hague. The banquet was given largely to enable the men to meet each other, also to explain to the salesmen the use of a new book of "Standard Switchboard Specifications," which the company has recently gotten out. This has been pronounced by many prominent telephone men, who have seen the book, as one of the most complete treatises on telephone switchboards that they have ever seen. It will, no doubt, help to standardize all the apparatus manufactured by the independent companies, as well as to maintain their own standards. Following the banquet and preceding the explanation of the above book, Mr. Bowen, the company's Iowa representative, in behalf of the salesmen, presented Messrs. C. W. Stiger and F. L. Middleton each with a scarf pin with diamond setting. Following the presentation, Messrs. Stiger and Middleton responded in a fitting manner, thanking the gentlemen for the token of their appreciation, also for the efficient service rendered. Following the above, general remarks were made by Messrs. Finucane, Stromberg, Middleton, Bowen, Brown, Rousseau, Stiger, Martin, Tyler, Meyers, Lewis, Smith, Munsell and Pierce. At the close of the banquet a flashlight picture was taken of the members present.

EDUCATIONAL.

UNIVERSITY OF ILLINOIS.—There has recently been received the last shipment of the new generator set for the power plant of the University of Illinois. This combined engine and generator set consists of a 200-hp. compound Westinghouse engine and a 150-kw. Westinghouse generator, with revolving field. This new equipment has been made necessary by the recent increase in the number of buildings at the University.

THE MANSFIELD TECHNICAL SOCIETY, of Mansfield, Ohio, has been organized among the officers and employees of the Ohio Brass Company, of that city. The object of the society is the promotion of technical knowledge among its members. The regular meetings of the society are held on every third Tuesday, at which time papers pertaining to various branches of technical work are read and discussed. A reading and reference library has been established in connection with the society, and a number of technical papers, trade journals, etc., are kept on file for the use of the members. Any contributions in the way of the scientific or trade papers will be thankfully received.

Trade Notes.

NEW AUTOMOBILE FACTORY.—A $1,000,000 automobile factory will be built at Atlanta, Ga., to be known as the De Loach Varispeed Company. A. A. De Loach and others are interested. A charter has been applied for.

THE D. M. STEWARD MFG. CO., of Chattanooga, Tenn., manufacturers of Lavite, the well-known insulation, will remove its New York offices Jan. 1st, from 107 Chambers St., to 8 Jay St.

THE TELEPHONE DEPARTMENT of the Electric Appliance Company, Chicago, has been improving the celebrated Noxem receiver until it feels warranted in claiming that it is a perfect receiver. It follows this statement with the one that it has never put a telephone specialty upon the market which has met with the wonderful success that has been accorded to the Noxem receiver.

STERLING VARNISH COMPANY, of Pittsburg, Pa., reports that its European address is Brougham Street, Blackfriars Road, Salford, Manchester, England, where all communications as to its foreign business should be addressed hereafter.

BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, has just issued for 1903 another charming series of illuminated portrait calendars, the portraits being those of well-known scientists and engineers. We are glad to note in the series the portrait of the company's chief engineer, Mr. B. A. Behrend, of whom an illustrated biography appeared in these columns, July 6, 1901.

MESSRS. H. B. COHO & CO., contracting engineers, 114 Liberty Street, New York, have issued a neat booklet telling briefly what they have done, what they are doing and what they can do. Illustrations show various buildings, institutions, etc., equipped by this firm, and they show a varied class of equipment. The firm's work embraces steam, hydraulic and electrical engineering, and it has been engaged in these lines for the past ten years.

THE OSBURN FLEXIBLE CONDUIT COMPANY has found the demand for Flexduct so much greater than it had anticipated that it has been obliged to increase its facilities for manufacturing it. It has just completed a new factory in Hoboken, N. J., adjoining the old one, which gives it about one-third greater capacity than before. Mr. Corrigan, the vice-president and general manager of the company, reports that the sales have been increasing tremendously and that Flexduct is now in use all over the country, besides which considerable quantities have been shipped to South Africa and the various European countries.

THE AMERICAN MINIATURE & DECORATIVE LAMP COMPANY, of New York City, will move Feb. 1 from 436-438 Broome Street to new quarters at the corner of Hudson, Spring and Vandam Streets. The new location affords much larger quarters than the old one, the space being about five times greater than that which is now occupied. The company has had a wonderful record since it started, the present removal being the fourth which it has made in the past four years, each time to larger quarters; while it is the second increase made in one year alone. The company manufactures a very fine line of miniature lamps of all shapes and for all purposes.

THE ELBLIGHT COMPANY OF PITTSBURG, Pittsburg, Pa., has recently issued a pamphlet descriptive of the Elblight system of electric lighting. As is well known, this system comprises a form of cable for decorative lighting and boards for sign and similar work. A lamp becomes lighted, no matter where it is placed along the cable or on the board. The simple operation of sticking it into place is all that is necessary. This system of lighting has been a conspicuous feature at many important gatherings, some of which decorations have been illustrated in ELECTRICAL WORLD AND ENGINEER during the past year. The pamphlet is illustrated with views of ball-rooms, banquet halls, exteriors, etc., decorated and illuminated by means of this system. There is no limit to its application.

COUCH & SEELEY COMPANY, Boston, Mass., announces that on Dec. 15 an arrangement was concluded whereby the Haines & Noyes Company, 153 South Jefferson Street, Chicago, Ill., become the Western Department of the former company. Commencing Jan. 1, Mr. N. H. Holland, formerly in the employ of the Holtzer-Cabot Electric Company, and more lately consulting engineer for the Automatic Telephone Meter Company and the Holmes-Mayberry Company, will become associated with the Couch & Seeley Company. Mr. Holland's technical knowledge and experience in telephone matters cannot fail to make him a valuable assistant in the executive department of this company. The Couch & Seeley Company is much gratified at the large increase in the volume of business being handled. It is making a full line of exchange apparatus, including both central energy and magneto call equipment, a complete line of interior inter-communicating apparatus, and a line of telephones especially adapted to street railway and police service.

THE CHLORIDE STORAGE BATTERY IN EDISON STATIONS.—The Electric Storage Battery Company, of Philadelphia, has just completed the largest year's business in its history and a notably large amount of the orders closed are for installations for Edison stations. The New York Edison Company has just contracted for eight new batteries of its standard unit size, each having a capacity of 8,000 ampere-hours. With the thirteen installations already in service this makes twenty-one chloride batteries, having a total capacity of 176,000 ampere-hours operated by the New York Edison Company. This is the largest amount of storage battery operated by any one company in the world. The Chicago Edison Company has also recently added three new batteries to its system and have increased the capacity of its other batteries, making ten installations with an aggregate capacity of 108,000 ampere-hours. The Brooklyn Edison Company recently added two new batteries to the six already in service, each consisting of 8,000 ampere-hour capacity, making a total battery capacity for this company of 51,000 ampere-hours.

SHOW CASE LIGHTING is a subject that appeals to every merchant who desires the interior displays of his goods to accord with the impression his customers receive from well-lighted windows and other advertising. With the realization of the need for this form of lighting comes the natural questions as to methods for producing best results. I. P. Frink, manufacturer of reflectors, 551 Pearl Street, New York, has been especially successful in this line of work, as the numerous large contracts will testify. Among these might be mentioned: Simpson, Crawford Co., R. H. Macy & Co., John Wanamaker, Lord & Taylor, New York City; Gimbel Bros. and N. Snellenburg & Co., Philadelphia; Panton & White, Silberstein & Bondy, Duluth; Hahne & Co., Newark, N. J.; Abraham & Straus, Brooklyn. It is but natural these stores should adopt Frink reflectors for their case lighting, as they had all shared in the success of "The Great Window Light," and those with art galleries used the same system for the artificial lighting thereof. Many merchants who have been convinced of their need of improved lighting for floor and wall cases have put the matter off until the holiday rush was over. This month affords a convenient season for installing fixtures, and goods brilliantly lighted will attract a trade to whom suggestion is necessary. Electrical engineers and contractors would do well to recommend these devices, as the Frink people are always willing to suggest the right reflector for results desired, and to quote prices on application.

DOUBLEDAY-HILL ELECTRIC COMPANY'S NEW BUILDING.—After Jan. 1st, the Doubleday-Hill Electric Company, of Pittsburg, will occupy its spacious new building, 919 Liberty Avenue, Pittsburg. Its large and rapidly increasing business has made more commodious quarters imperative, and some idea of the facilities now at its disposal can be gained from the fact that the new building measures 23x116 and is eight stories in height, besides the basement. This is said to be the tallest building in the world devoted exclusively to electrical supplies. The salesroom and sales offices are located on the first floor where every up-to-date convenience for the display of goods and transaction of business is offered to customers. Immediately in the rear is the receiving and shipping room. The second floor is devoted largely to the general offices of the company, including the auditing and purchasing departments, lockers for the employees, etc. A large quantity of overhead material will also be stored in this floor. The sides of the third floor are lined with bins extending from floor to ceiling, as well as a double row of bins down the center. These contain broken packages of porcelain, incandescent lamps, switches, etc. The assembling room for orders is conveniently located close at hand. The fourth floor affords facilities for storing rubber covered and weather proof wire in quantities, also bins for glassware and shades. Lamps of all kinds in unbroken packages fill up the fifth floor. Prominent among these, of course, are the A.-B. arc lamps and Nernst lamps. Large supplies of Packard and Peerless incandescents are always on hand. The sixth and seventh floors contain original packages of sockets, switches, receptacles, tubes, etc., and conduit and moulding. Battery supplies and fans (including "The Emerson") are also kept here. The entire eighth story is given over to the repair and rewinding department. The amount of work entrusted to this department has steadily increased since its establishment and the new facilities placed at its disposal in the way of improved machinery and conveniences promise well for the future. In the basement is located a generating plant for supplying the building with light and power. This consists of a 25-hp double cylinder gas engine connected to a 12½-kw generator. Cross arms, pine brackets and galvanized wire are stored here also. All goods are received and shipped at the rear of the building—a large freight elevator affording communication between the different floors.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 23, 1902

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

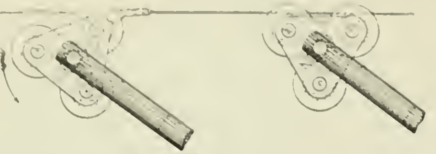
716,36 . TROLLEY; W. L. Baker, Painesville, O. App. filed Sept. 29, 1902. The trolley wheel is confined in the fork between springs in a manner to permit it to tilt laterally.

716,365. ELECTRICAL COOKING RANGE AND BROILER; M. Bayno, Cedarhurst, N. Y. App. filed Dec. 31, 1901. The heating resistances are of special character and arranged vertically in two planes, so that a broiler can be inserted between them in a position to apply the heat to both sides of the material being cooked simultaneously.

716,366. ELECTRICAL COOKING APPARATUS; M. Bayno, Cedarhurst, N. Y. App. filed Feb. 19, 1902. A modification of the preceding invention.

716,372. INDUCTION ALTERNATE CURRENT METER; Otto Titus Blathy, Budapest, Austria Hungary. App. filed March 20, 1902. An electric meter of the induction type, with a rotating disk between an upper and lower magnetic core; the upper core is V-shaped and carries the voltage coils; the lower and opposing core is E shaped and carries the current coil on the central stem, the other two stems being opposite the legs of the V.

716,376. TROLLEY POLE, T. C. Buder, St. Louis, Mo. App. filed Dec. 18, 1901. Three trolley wheels are mounted in a triangular frame pivoted in the harp. If one wheel strikes an obstruction on the wire the frame swings to bring another into position upon the wire and thus avoid derailing the trolley.



716,376.—Trolley Pole.

716,398. FUSE; W. L. R. Emmet, Schenectady, N. Y. App. filed Aug. 24, 1898. The fuse is mounted under tension in a chamber of such construction that the arc is ruptured before the ends of the fuse are entirely withdrawn from the chamber.

716,406. ELECTRICAL SWITCH; A. H. Gibbings, Liverpool, Eng. App. filed Dec. 3, 1901. Details.

716,411. ELECTRIC TRAM AND RAILWAY; R. Hacking, Nottingham, Eng. App. filed Dec. 13, 1901. Details of a system whereby current is successively applied to the sections of a supply conductor by the passage of the vehicle.

716,429. COMPENSATING SYSTEM; J. F. Kelly, Pittsfield, Mass. App. filed August 1, 1901. (See Current News and Notes.)

716,445. MEANS FOR REGULATING AND PROTECTING ELECTRIC MOTORS; R. Lundell, New York, N. Y. App. filed Sept. 20, 1902. Means for automatically adjusting the field strength of the motor at the time the armature circuits are changed from series to parallel or from parallel to series, and for preventing an undue rush of current at the time such changes are made.

716,460. MULTIPLE SWITCHBOARD; W. E. McCormick, Chicago, Ill. App. filed Aug. 26, 1901. (See page 33.)

716,475. EXTINGUISHING ELECTRIC ARCS; R. H. Read, Schenectady, N. Y. App. filed April 3, 1901. (See Current News and Notes.)

716,477. TROLLEY GUARD; P. M. Reed, Paterson, N. J. App. filed Oct. 24, 1902. A split pulley is mounted above the main wheel and runs above the wire; its parts are carried on two outwardly-opening spring arms which have sufficient tension to keep the trolley in place, but will open when required to remove the trolley.

716,487. SOCKET FOR INCANDESCENT LAMPS; A. P. Seymour, Syracuse, N. Y. App. filed Feb. 4, 1902. Details.

716,506. ELECTRIC SWITCH; G. H. Whittingham, New York, N. Y. App. filed Jan. 21, 1902. A switch whereby when the connection with the main circuit is broken at one side of the switch for stopping or reversing the motor, the armature and field will remain closed and will not be opened except when the motor circuit contact blades are about to enter the main terminals on the opposite side of the switch; this gives the armature time to slow down before the armature and field circuit are broken, thereby avoiding arcing.

716,540. SWITCHING APPARATUS FOR ALTERNATING CURRENT; E. M. Hewlett, Schenectady, N. Y. App. filed Nov. 21, 1900. The combination of an alternating current circuit, of a high potential circuit breaker therefor, an electric control circuit for the circuit breaker, devices responsive to overload in the system governing said control circuit, and a relay also governing said circuit, having one member responsive to line current and the other to line potential.

716,559. DEPOSITION OF METALS ON EARTHENWARE ARTICLES; G. W. Laybourn, Stoke-upon-Trent, Eng. App. filed June 17, 1902. Consists in steeping the article in water, applying to it an electrical conducting medium and then depositing the metal on the article by electrolysis.

716,562. RAILWAY SIGNALING SYSTEM; W. Locke, Troy, N. Y. App. filed Feb. 26, 1902. An arrangement of track circuits and apparatus in a block signalling system.

716,578. ELECTRIC LAMP SOCKET; C. D. Platt, Bridgeport, Conn. App. filed Aug. 20, 1901. A pull-socket having a rotary ratchet and circuit controller.

716,583. CURRENT INTERRUPTER; William Scheidel, Chicago, Ill. App. filed Aug. 29, 1902. An electrolytic current interrupter of the Wehnelt form with improvements designed to prevent frothing of the electrolyte and permitting ready adjustment.

716,584. CURRENT INTERRUPTER, Carl Oscar Schneider, Chicago, Ill. App. filed June 14, 1902. An electrolytic interrupter of the Wehnelt type with means for maintaining a uniform area of exposure of the anode surface, and varying the same at will.

716,641. JUNCTION BOX, C. G. M. Miller, Newton, Mass. App. filed March 2, 1901. The knock-out diaphragms are formed by making opposing depressions in the wall of the box.

716,649. CIRCUIT BREAKER, E. A. Stevens, Chicago, Ill. App. filed July 19, 1901. Details.

716,653. BALANCED-CIRCUIT INDUCTION COIL; J. P. Alexander, Jackson, Tenn. App. filed March 21, 1898. (See Current News and Notes.)

716,654. CABLE HANGER; P. H. Auxer, Cleveland, O. App. filed May 28, 1902. Details.

716,656. ELECTRIC BATTERY COMPOUND; G. Bastedo, Brooklyn, N. Y. App. filed May 28, 1902. Dilute sulphuric acid, 15 pounds; nitric acid, 50 drams, and bisulphate of mercury, 1 ounce.

716,663. PROCESS OF PREPARING STORAGE BATTERY PLATES; R. C. Browne, and F. Balch, Salem, Mass. App. filed April 21, 1902. The raw plates are steeped in a solution made by adding potassium nitrate to heated sulphuric acid and cooler water added to the latter.

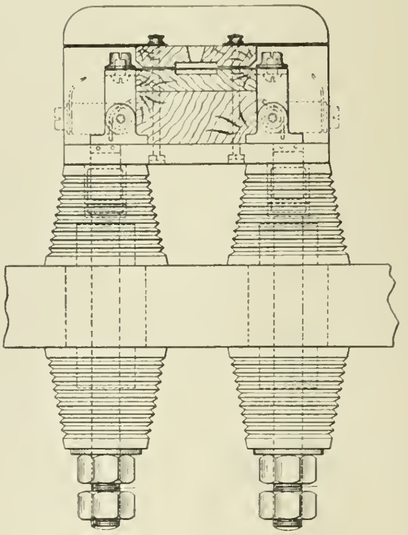
716,762. ELECTRIC BATTERY; G. Rosset, Paris, France. App. filed Feb. 20, 1901. Cupric acid is used as the depolarizing agent.

716,771. MULTIPLEX TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 25, 1901. The invention involves various features of construction affording synchronous movements to all parts along the line and an automatic correcting device in each station.

716,779. TELEPHONE TRANSMITTER CIRCUIT; A. B. Stetson, Malden, Mass. App. filed June 6, 1902. (See page 33.)

716,789. MANUFACTURING CHLORATES; Richard Threlfall, Birmingham, England. App. filed May 2, 1902. The electrolyte is subjected to unequal electrolytic action at the anode and main cathode, the action of the anode being greater; the excess of current is diverted to a subsidiary vessel producing therein an alkaline solution and at the same time a corresponding amount of chlorine in the main electrolyte.

716,801. ELECTRIC BELL; F. W. Wood, Newport News, Va. App. filed Sept. 2, 1902. The hammer actuating mechanism is inclosed in a watertight casing.



716,398.—Fuse.

716,802. TELEPHONE SYSTEM; W. C. Wright, Amarillo, Tex. App. filed Jan. 29, 1902. (See page 33.)

716,804. APPARATUS FOR PRODUCING CAUSTIC SODA BY ELECTROLYSIS; Edward A. Allen, Rumford Falls, Me., and Hugh K. Moore, Lynn, Mass. App. filed Dec. 27, 1898. The main features are in the use of a vertical diaphragm of non-conducting material, on the outside of which is the cathode, consisting of a mattress made up of a plurality of layers of wire cloth or a bed of steel-wool forming a comparatively thick sponge; and an anode consisting of a plurality of gas carbons cast in a lead supporting plate.

716,833. METHOD OF BREAKING ELECTRIC CURRENTS; W. L. R. Emmet, Schenectady, N. Y. App. filed Aug. 24, 1898. (See Current News and Notes.)

716,844. BATTERY INSTALLATION; S. Lake, Bridgeport, Conn. App. filed May 4, 1902. The battery carried by a submarine boat is placed in a sealed compartment which is fitted with means for discharging gases generated by the batteries outside of the boat and for maintaining a predetermined atmospheric pressure within the compartment without the introduction of external air.

716,848. MODE OF EXTINGUISHING ELECTRIC ARCS; R. H. Read, Schenectady, N. Y. App. filed April 3, 1901. (See Current News and Notes.)

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CONTENTS.

Editorial 61
American Appointment for Prof. J. J. Thomson 64
December Meeting of the A. I. E. E. in Chicago 64
Commercial Pacific Cable at Honolulu 64
Electrical Supply from Water Power at Portland, Me. By Alton D. Adams. 65
Present Status of Electric Automobilism. By Hayden Eames 68
Three-Phase Measurements. By Leslie L. Perry 69
Hints on the Care of Electrical Equipment. By W. E. Witter 71
Joliet-Chicago Transmission Started 72
Washington Meeting of the American Association for the Advancement of Science and of the Affiliated Societies. By N. Monroe Hopkins 73
Arnold Report on the Chicago Transportation Problem 75
Experience with a Third-Rail Road in the Open Country. By Charles Esselstyn 77
The Requirements of Machine Tool Operation with Special Reference to Motor Drive. By Charles Day 78
A Year's Output of Bell Telephone Instruments 81
Mr. Marconi and his Critics 81
Underground Electric Road for Boston 81
New Telephone Patents 82
Current News and Notes 83

LETTER TO THE EDITORS:

Mean Spherical Candle-power. By A. J. Wurts 84
Digest of Current Electrical Literature 85
New Books 88
Electro-Pneumatic Control on the Brooklyn Elevated Railway 89
Lamp Adjuster 90

NEWS OF THE WEEK:

Financial Intelligence 91
Commercial Intelligence 92
General News 94
Trade Notes 96
Record of Electrical Patents 98

SOUTH SEA CABLES.

Congratulations have been deservedly won by, and are heartily due to, the management of the Commercial Pacific Cable Company, on the completion of the first section of their system, reaching Honolulu. Next comes Manila in July, and soon thereafter China. We can only regret that Mr. Mackay is not alive to share with his son, Mr. George G. Ward, and other leaders in the enterprise, this successful fruition of part of their plans, which mean so much in the furtherance of American enterprise and commerce in the Far East. Whatever public memorial his family may hereafter elect to raise to his memory, Mr. Mackay has certainly created for himself a great monument in his Atlantic and Pacific cable systems, linked by land lines, and touching the Empire of Germany, in Europe, on the one hand, and the Celestial Kingdom on the other. Given the possession of great wealth, few men have been able to employ it so advantageously as did he for the benefit of the race and especially for the peaceful development of American enterprise. Such a great work could not be carried out except with the aid of loyal, enthusiastic and intelligent advisers, and to these we beg to tender our sincere and cordial felicitations. They have done wisely and well, and we trust that all their bold, well-conceived plans will soon be carried out to the letter. No South Sea "bubbles" are these, but golden links with the Asian shores, where lies so great a part of our national destiny.

THE WASHINGTON CONVENTION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The convention last week, in Washington, of the A. A. A. S. was, on the basis of attendance, very successful. The numerical strength of the gathering was in the neighborhood of 1,400, and the communications presented aggregated more than 500. This necessitated the subdivision of the papers into definite groups; so that, at any one time, there were generally half a dozen different communications being presented to the various sections. Under such conditions the Baconian limitation of a body being capable of situation in only one place at any one time is severely felt. Under this condition there is a crying necessity for some system whereby publicity in print may be given to papers, but we regret to say that no provision whatever had been made to this end. Some hope of an improvement over past conditions in this respect was awakened by the conduct of the Pittsburg meeting, but the secretariat at Washington relapsed into its normal state of inefficiency, with the consequence that most of the papers presented might almost as well never have been rewritten. Until the American Association for the Advancement of Science organizes a permanent secretariat under a management similar to that of our professional societies, it will continue to remain a neglible factor in scientific advancement, and to occupy its present position of deplorable inferiority with respect to similar bodies abroad.

The presidential address by Professor Newcomb before the Astronomical and Astrophysical Society of America contained much matter of interest to the physicist. Among the topics discussed was the mystery of the apparent emanation of nebulous matter from the recently-born star, Nova Persei, that became visible to the inhabitants of our world between February 19 and 21, 1901, or less than two years ago. It was shown that the distance of this star from the earth was probably very great, probably many times as great as the nearest fixed star, with its four and a half years of light-speed interval. But the rate of development of nebular emission from Nova Persei during the two years since its appearance has been quite appreciable in dimension as seen through telescopes. At the nearest possible distance of the Nova, this represents an enormous velocity of emanation or propagation. It had been suggested that the visible expansion of the Nova might be some function of luminosity, spreading out in all directions from the star with the velocity of light, or 186,000 miles per second (300,000 kilometers per second). This enormous velocity, however, was shown to be too small to account for the dimensions of the nebulous emanation at successive periods of its observed development. Moreover, the outline of the nebula was not sharply spherical, as the light speed theory would entail. The emission extended somewhat raggedly in different directions. Consequently, it would seem that agencies are at work in the visible universe acting with velocities that may be many times greater than that of light.

In Physics, one of the most important papers was on the pressure of radiation, by Profs. E. F. Nichols and G. F. Hull. It has been known since the days of Maxwell that light should exert a pressure in the direction of its propagation, so that a beam of light may be said to try and push its way into the thing on which it falls. When we say that a ray of light *strikes* an object there is a certain amount of appositeness in the expression. The push of either luminous or non-luminous radiation is equal in baries to the volumetric radiation energy in ergs per cubic centimetre. A number of experimenters have searched for this radiation pressure. Crookes tried to measure the pressure exerted by a beam of light upon a vane suspended in an exhausted receiver. But the thermo-dynamic action of the residual gas in the chamber completely masked the effect sought. He tried to make a radiobarometer and discovered the radiometer instead. For years, the push of radiant energy has been obscured by the radiometer action of vacuum tubes, and the experimental determination has been rendered very difficult by the interference of residual gas-action on the suspended vane submitted to the radiant beam. Nevertheless, there has been a general belief that the effect existed, and its existence did not even depend upon the truth of the electromagnetic theory of light. That theory analyzed and accounted for the push; but any reasonable mechanical theory of wave propagation necessitates the admission of radiant push.

In the case of the experiments described before the section, a pair of spectacle vanes were suspended by a quartz fibre in a jar provided with windows in such a manner that the deflection of the vanes and twist of the fibre could be measured at any time, while a beam of arc light was allowed to fall on one vane. The deflection was measured both as a function of time and as a function of gas-pressure in the jar. It was found that the gas-action was at some pressures with the beam of light and at other pressures against it; so that at two particular pressures or degrees of vacuum the resultant gas-action was nil. By selecting the more convenient of these two pressures of no gas effect (16 mm. of mercury or about 1-50th atmosphere) and working at this exhaustion, the true radiant push could be observed. As a still further precaution, since the gas push increases with time, while the radiant push commences at full strength, the measurements were made ballistically, by allowing the beam to strike the vane for only six seconds at a time and measuring the resulting throw of the suspended system. In this ingenious way the observed radiant push was found to be within about one per cent. of the calculated push. The magnitude of the push is, of course, quite small, being only a few microbaries in fairly strong arc light. One of the applications of this principle of radiant push was exhibited experimentally by the authors of the paper in the form of a miniature comet's tail. It has been shown at various times in the past that since the surface area of a mass of matter increases as the matter becomes more finely divided, there must be a certain limiting size of material particles at which the radiant push of the sun on their surface is greater than the gravitational pull on their mass. Below this size, material particles would move away from, or be seemingly repelled by, the sun. Consequently, since comets carry their tails behind their backs when advancing toward the sun, and before their faces when receding from him, it has been supposed that this repulsion of the sun for the tails was due to radiant push on the extremely tenuous caudal matter.

A sort of hour glass vacuum tube was exhibited which contained some carbon sponge dust of particles only one or two microns in diameter, the chambers having been very carefully exhausted to as a high a vacuum as possible. When the dust was allowed to fall from the upper to the lower chamber in a powerful arc-light beam, the larger particles were seen to fall vertically; while the finer ones fell out of plumb, and away from the light. The angle of deviation was stated to be about that to be expected on the radiant push hypothesis.

THE WIRELESS TELEGRAPH SITUATION.

The recent work of Marconi has raised his transatlantic experiments to the dignity of a serious demonstration. That their character has been conclusive to a degree not shared by the experiments of a year ago is to be attributed to material improvements in the receiving apparatus and more especially to the more adequate energy utilized in the transmission. The cruise of the *Carlo Alberto* last summer gave full warrant for the reasonable expectation of readable messages across the Atlantic whenever the work was attempted with adequate sending and receiving apparatus. In a few days another attempt to increase the working radius of action will be made from the Marconi station at Wellfleet, Mass., with every expectation of success. Transatlantic wireless telegraphy must now be regarded as an accomplished fact, and must be reckoned with seriously as such. Its possibilities and limitations have yet to be discovered. We earnestly hope in this connection that the inquisitive Mr. Maskelyne, who industriously kept tab on the cruise of the *Carlo Alberto,* has not deserted his post. His record, although disputed with some acerbity, did go far toward convincing doubting minds of the tremendous possibilities of the art. It was distinctly more satisfactory than any report coming wholly from interested parties could be and it furnished, moreover, information regarding the difficulties to be surmounted which the Marconi Company could not reasonably be expected to be made public. It furnished, too, a datum line from which to measure present and future improvements, a thing of itself most useful and desirable.

For instance, it now appears that the speed of transmission of messages is reasonably high, and can doubtless be pushed higher. It was not to be expected that in the experimental sending to the *Carlo Alberto* speed would be pushed to the limit or anywhere near it. The point to be demonstrated was distance, and for the time being speed was a non-essential. A profoundly interesting part of the record then obtained was the apparent advantage of sending at night, but whatever may have been the cause of this, the difficulty seems now to have been in great measure overcome, since the recent work is reported to have been done in full daylight. On the other hand, this raises the question whether the previous difficulty in daylight sending may not have to be charged to the secondary, perhaps meteorological, conditions rather than to the intrinsic effect of sunlight suggested by Marconi. There are numberless questions of this kind that must arise in practical working and which can only be settled by considerable experience. The relation of wireless telegraphy to the world's cable systems seems to be an indeterminate quantity as yet, but as Marconi has pointed out, the wireless plant has so immense an advantage in the matter of fixed charges that it will constitute itself a very wholesome competitor, even if it should prove to be more erratic in its working. And competition, modern American practice to the contrary notwithstanding, is a good thing. But really it seems to us that transatlantic wireless telegraphy is less important than the easier and less sensational task of keeping in constant touch with vessels even a few hundred miles from the coast. This is now in theory a commonplace affair, but it is far from being worked to its full value. We should much like a record, not of the messages thus sent, but of those which have failed to get through. It seems more than likely that in this case lack of power is at the bottom of the difficulty, just as it has been with the attempts at using portable wireless telegraph sets for military purposes. This important use of the system seems to have made singularly little headway, and so far as we have learned, has, save experimentally, scored a long series of abject failures.

In any event the big work now fairly under way raises more strenuously than ever the question of possible interference, its remedies and regulation. Syntonic working seems as yet to have made little appreciable progress; and what is going to happen if, for instance, Mr. Tesla cuts loose with his big plant on Long Island in a determined attempt to open communication with Manila? There is certainly no reasonable excuse for interfering with his right as a good American citizen to use the air, about the only common property left us, for experiments of obvious and practical importance. Yet if he chanced to open fire on the ether at the time when Marconi was launching expressions of cordial regard at the distinguished Ahkund of Swat, trouble would very probably ensue. The question is not at all to be taken lightly, for it deals with very probable conditions. It seems to us that the Kaiser's call for international discussion and regulation of the whole question was most pertinent. Unless something of the kind is undertaken there is certain to be vexatious interference and venomous litigation, and we can imagine no cause more likely to require two or three generations for its settlement than an action arising from an etheric collision with a full line of expert testimony on each side. The French Spoilation Claims would be a police court case compared with it. If, as now seems likely, the world is to be dotted with wireless stations employing divers systems and all working in a common medium, there must be something more direct and effective than ordinary legal methods applied to its regulation, and a full international discussion would go far toward clearing the air—not to say the ether. One thing at all events is assured, that Marconi has scored a most notable success even now, and what he may do later is hardly to be predicted. He is certainly doing honor to the noble heritage which has come down to him from a long list of illustrious Italian men of science, and his country and the world may well be proud of his achievements.

SOME LIMITATIONS OF WATER POWER.

The tremendous growth of power transmission in the last few years has compelled public admiration, and, in addition, has tended to blind the public to some of the difficulties in the water power situation. Most of the power transmission thus far undertaken has been commercially successful, but this has been due rather to the inability of hazardous schemes to get upon their feet, than to the inherent cheapness of water power. A half century ago, when fuel was costly on account of lack of transportation and engines required double the amount of steam required in present practice, the development of water power saw its palmiest days. Investments were made on propositions that to-day could not raise $15 on the street, and some that promised well stand to-day burdened by a weight of fixed charges that would stagger any new enterprise. It is a fact well known to practical engineers that many, perhaps most, of the older water-power developments of New England actually represent an investment that if honestly charged against them would not permit them to sell power in competition with a steam plant. There may be behind them a record of profit and loss accounts and reorganizations that enable the present owners to show a profit, but the whole proposition is intrinsically uncommercial. On the other hand, the claims made by steam engineers, especially those based on mill practice, must be received with great caution as a basis of comparison. Absurd claims are often made in behalf of both steam and water, and a brief analysis of the present situation may be not without value.

To begin with, water power presents the unusual feature of nearly fixed cost irrespective of output, so far, at least, as the generation of electricity goes. It seldom pays to develop a stream partially, and when the property is secured and the hydraulic development made, the cost of running is about the same for all loads extending over the same number of hours per day. Hence water power is cheap, other things being equal, when it can be fully utilized all the time, and dear when the load factor is poor. If a water power is bought, or water is rented on the basis usual in the hide-bound old plants built for running mills, the price is simply ruinous, so far as electric generation is concerned. And unless the power is, humanly speaking, absolutely continuous, its value for electrical purposes is greatly reduced, since the plant then has to carry the burden of a complete steam reserve. We could mention a number of electrical plants using water power in which the cost per horse power is demonstrably higher than it would be with a good modern steam plant—not one of the mill plants estimated on paper or operated wholly in the bookkeeping department—but such plants as one actually finds in electrical service. More than this, we have seen plants go to an expense for storage and auxiliary plants to enable a water power to be fully utilized that ensured a net yearly loss over a straight steam plant. And this is the case with coal at normal prices for points not near the mines, so that a portion of it would be doubly true for districts where cheap coal or cheap fuel oil can be obtained. The moral is that in going ahead with a water power proposition one should exercise the greatest caution in making sure of the exact conditions of flow and the economies of the fuel situation present and future.

The reverse of the bill is the great uncertainty as to the real cost of steam power, not the cost figured in the designing engineer's notebook or from the ledger in the first year of operation, but from the grim total that piles up as the average of a decade. We constantly hear of plants in which the cost per kilowatt-hour is almost any small fraction of a cent, but we know well the items that have been dropped out of sight, and it is dollars to pennies that within twenty years the whole plant will be reorganized and the cost charged up to improvements and covered by an increase in capitalization. A sinking fund is almost an unknown quantity in the finances of electric plants, and while it is true that a sinking fund cannot easily be applied to the meeting of material obligations that mature, not at any fixed time, but as the art changes, the case demands for that reason a far larger allowance for the changes that inevitably come. Moreover, it looks at present as if in the future cheap fuel was to be classed as an "iridescent dream." With the coal supply demonstrably in the hands of a virtual, if not a formal, trust, and the fuel oil, save in a few isolated producing districts, absolutely in the hands of a close monopoly that does not scruple to keep its prices on the heels of coal, it will be far safer to look forward to $5 steam coal than to exhaustless culm piles to be had for the asking. This is the menace that makes reckoning on steam power a trifle uncertain. Every rise in the price of fuel gives water power an advantage, and a good fall well utilized cannot be brought to the verge of ruin at the will of a group of coal barons on strikers. Many a small electric plant is hard pushed this winter, and more than one will go to the wall, but the chap who is running on water can afford to sit by and grin. Intrinsically, water power has some serious elements of uncertainty, but once acquired it is a permanent asset through cheap coal and dear

American Appointment for Prof. J. J. Thomson.

Every American interested in physical science will be interested to learn that another great English scientist has decided to accept an invitation from the United States. Prof. Joseph John Thomson, D. Sc., F. R. S., 1880, for the last eighteen years Cavendish Professor of Experimental Physics at Cambridge University, England, was appointed this week by the Trustees of Columbia University head of the Department of Physics, to succeed the late Ogden Nicholas Rood.

Prof. Thomson was born at Manchester in 1856, and attended Owens College and Trinity College, Cambridge. At Cambridge he was Second Wrangler and Second Smith's Prizeman in 1880, Fellow of Trinity College in 1881, lecturer in 1883, and President of the Cambridge Philosophical Society in 1894. In 1896 he was elected President of Section A of the British Association and is a member of the Athenæum and Saville clubs. His recent work in the investigation of atoms and molecules, and their relation to electrical charges, is fresh in the mind of the public. Prof. Thomson not long ago accepted an invitation to give a series of lectures at Yale, as noted in these pages.

The Trustees voted to designate the physical laboratories for research work by the name of the Phoenix Physical Laboratories, in memory of Stephen Whitney Phoenix, of the class of '59, who left a large sum to the University several years ago for physical research.

December Meeting of the A. I. E. E. in Chicago.

The Chicago members of the American Institute of Electrical Engineers met in Chicago on Tuesday evening, December 30, to discuss the subject of "Braking and Traction Brakes." The paper by R. A. Parke on "Railroad Car Braking," was read by T. P. Gaylord in abstract. The paper by J. D. Keiley on "Some Brake Tests and Deductions Therefrom," was read in abstract by B. J. Arnold. Mr. Gaylord, at the close of his reading, called attention to the necessity for larger motor equipments for electric brakes, where the motors were used as generators, and said that complaints from electric brakes were likely to be due to having a too small motor equipment designed only to be used for accelerating and propelling the car.

B. J. Arnold, at the close of his reading, spoke ot the tests which he made about a year ago on comparative steam and electric traction, in which a negative acceleration or braking at the rate of three miles per hour per second was obtained in a few instances.

J. R. Cravath called attention to the fact that it is only very recently that interurban roads have felt the necessity of increasing the rate of braking common in ordinary service stops. Recently he had known at least one high-speed interurban road upon which the regular schedules would be so fast as to call for a rate of braking almost equal to an emergency stop. The question had come up how to accomplish, with an ordinary straight air brake, what a Westinghouse automatic high-speed brake does in applying the brakes with high brake-shoe pressure at first and gradually reducing this pressure to compensate for the increase in brake-shoe friction at the lower speeds. In one case he believed it was proposed to accomplish this by teaching the motormen to apply the brakes with high pressure at first and gradually decrease this pressure as the car lowered its speed. This would call for considerable skill on the part of the motorman, but much judgment is required by him anyway, with a modern interurban straight air brake apparatus, because the storage reservoir pressure is usually much greater than could be let into the brake cylinder without sliding the wheels. Care is thereofore required in every application of the brakes.

An informal discussion followed, which was taken part in by a number of members, on the recently exploited apparatus for increasing the coefficient of friction between the wheels and rails by means of magnetism, thereby increasing the possible rate of braking on a slippery track.

E. B. Clarke described briefly the braking precautions on an ore-carrying machine in the Illinois Steel Company's plant, of which he is electrical engineer. This machine had air, electric and hand brakes. There had been some trouble with broken axles that he had suspected was due to the use of the electric brake and inquired whether trouble from this source had been experienced in railway work. None of the members seemed to have heard of any unusual trouble of this kind on roads employing the electric brake.

The question of the rapidity of action of the Westinghouse quick-acting automatic air brakes on long trains came up. R. H. Pierce spoke of some apparatus which he knew of a number of years ago, for applying the air brakes under all the cars of the train simultaneously, by means of electricity. B. J. Arnold told of tests which he witnessed in 1887 on the quick-acting automatic air brake on long trains, and showed that the application of the brakes on the rear cars of a long train was more nearly simultaneous with the movement of the engineer's valve than if the rate of brake application had been transmitted through the train with the velocity of sound. While electrical apparatus for working the valves under each car was instantaneous, it was evidently not enough better than air to justify the complications it would involve.

Commercial Pacific Cable at Honolulu.

After a gallant fight with wind and wave, the cable steamer *Silvertown* succeeded in landing the shore end of the Commercial Pacific Cable at Honolulu as the old year ended and the new year began, and connection through to San Francisco was made, January 1, at 8.43 p. m., Honolulu time. The next step, that of connecting Manila, is already being taken. A great many messages of celebration were exchanged, notably the following:

Honolulu, January 1, 1903.

The President, Washington:

The people of the Territory of Hawaii send their greetings to you and express their gratification at the inauguration of telegraph communication with the mainland. We all believe that the removal of the disadvantage of isolation will prove a strong factor in the upbuilding of a patriotic and progressive American Commonwealth in these islands. (Signed) Henry E. Cooper,
Secretary of Hawaii.

The President's response was as follows:

White House, Washington, January 2, 1903.

Henry E. Cooper, Secretary of Hawaii, Honolulu, Hawaii:

The President sends through you to Gov. Dole and the people of Hawaii his hearty congratulations upon the opening of the cable. He believes that it will tend to knit the people of Hawaii more closely than ever to their fellow-citizens of the mainland and will be for the great advantage of all our people. (Signed)
George Cortelyou, Secretary to the President.

Honolulu, January 1, 1903.

Mr. Clarence H. Mackay, President, New York.

We send this token of our high appreciation of the completion of the great enterprise undertaken by your company of laying a telegraphic cable from the coast of California to these islands. Mingled with our joy there is a feeling of deep regret that John W. Mackay did not live to see the completion of his project, and we assure you that his name will ever be cherished in fond remembrance by our people. (Signed) Henry E. Cooper,
Secretary of Hawaii.

Honolulu, January 1, 1903.

Geo. G. Ward, Vice-President and General Manager, New York.

To your untiring efforts Hawaii is indebted for an early consummation of the enterprise that means untold advantages to all her interests, and we tender our hearty New Year greetings and trust that the final completion of the entire project will be to your full satisfaction. Henry E. Cooper,
Secretary of Hawaii.

Messrs. Clarence Mackay, President George G. Ward, Vice-President and General Manager, and the other officials of the Commercial Pacific Cable Company are naturally greatly pleased at the completion of the company's cable between San Francisco and Hawaii. They state that by July 4 they expect the cable will have been completed to Manila. Mr. Ward said: "The Commercial Pacific Cable Company's cable to Hawaii was connected through to San Francisco at 8.43 p. m., January 1 (Honolulu time). The cable opens for public business on Monday morning, January 5. The widespread interest and enthusiasm created by bringing the Hawaiian Islands into electric touch with the Pacific Coast is evidenced by congratulatory cablegrams received to-day. It is a particular satisfaction to us to have the cable completed on the first day of the new year, because it fulfils our promise to Congress. Rapid progress is being made in the manufacture of the sections to be laid between Honolulu and Manila, and over 3,500 miles of this cable have already been manufactured, and I fully expect messages will be exchanged with Manila by July 4 next. The laying of the remaining sections will commence from Manila the first week in May next."

Electrical Supply From Water Power at Portland, Me.

By ALTON D. ADAMS.

SEBAGO LAKE, 270 feet above mean low tide, 50 square miles in area and with a drainage basin of 470 square miles, furnishes the energy for a great part of the electric light and power distributed in Portland, Me., seventeen miles away. The only outlet of this lake is the Presumpscot River, 21.6 miles in length, which empties into Casco Bay, about four miles north of Portland. This short stream, with its total fall of 270 feet, or 12.5 feet per mile on an average, offers a succession of water powers. At one of these powers known as Great Falls, in North Gorham, the generating station of the Portland Lighting & Power Company is located, distant thirteen miles from the sub-station in Portland. Sebago Lake forms an ideal storage reservoir because of its great area compared with that of its drainage basin. As the figures for these areas show, the lake has one square mile of surface for each nine square miles of the territory which it drains, so that a moderate rise in the lake level will provide storage for a large percentage of the water annually flowing into it. During more than a decade records have been kept of the total discharge of water from Sebago Lake, and the annual average has been found to represent a rainfall of 21 inches over its 470 square miles of drainage area. It follows that this entire annual run-off would raise the lake level only 15.75 feet if all of it were stored. As a matter of fact, the average annual variation during a period of more than ten years has been 5.75 feet between the extremes of lake levels. From records extending back to 1887 it appears that the average annual discharge of water from the lake has amounted to 800 cubic feet per second. These facts give to water powers on the Presumpscot River a degree of reliability and constancy second to no others in New England. The storage capacity of Sebago Lake is made available for all the water powers on the Presumpscot River by a stone dam at the head of the latter which raises the elevation of the lake surface during the wet seasons.

The water privilege of the Portland Lighting & Power Company on the Presumpscot includes the entire flow of the river over two falls about 3,000 feet apart. At Great Falls, the larger of the two, the river drops 37 feet, and at Whitney Falls, further down stream, the descent is 18 feet. At present only the upper and greater fall is fully developed and in use, but the application of the lower fall to electrical supply in Portland is probably a matter of the near future. Behind the dam at the fall now in use is a pond about one mile long, 1,000 feet wide and 15 feet deep, that serves to store or release water as required by the daily fluctuations of load. At the lower falls the Portland company has secured the river frontage on both sides for a distance of about one mile, so that a storage pond may be created there when the power is developed. At Great Falls, the location of the present generating station, the dam, 450 feet long, 22 feet high, and 24 feet wide at the bottom, is built on a solid ledge. This ledge thus provides 15 feet of the total 37 foot fall. For about 360 feet of its length the dam is of the crib type, filled with stone, and for the remaining 90 feet the construction is coursed masonry. This masonry portion of the dam acts as a forebay wall from which four steel penstocks pass to the generating station, the rear wall of which is 40 feet distant. East penstock is eight feet in diameter, constructed of ⅜-inch plate, and enters the forebay wall ten feet below the surface of the water in the pond. In this way water is drawn from the bottom of the pond, the surface is left quiet, so that it freezes over with the first cold weather, and all trouble with anchor ice is avoided. Though the equipment of this plant is just being completed, one generator has been in operation during two winters and has never been shut down a minute on account of anchor ice. The power station is built on solid ledge, one story, with brick walls, interior posts and crane beam of structural steel; cement floor, and plank roof covered with tar and gravel. On the ground the station measures 54 by 57 feet and 18 feet from floor to roof, with an extension in the rear 15 by 28 feet. Close to the rear of the station is a brick building 10 by 12 feet on the ground, with cement floor and corrugated iron roof, which is used in part for the lightning arresters connected with the transmission lines and in part as a wash room, also to store oil and waste. No fuel is burned in any part of this plant, all heating being done with electricity, even to the hot water in the wash room. Two cranes, one on each side of the station, sweep the entire area of the main room. The station is lighted entirely by incandescent lamps at the roof. Close to the station on two of its outer sides tail races have been cut through solid rock, and these tail races unite at a point between the station and the place where the water joins the river. Each of the two tail races receives the discharge from two pairs of water wheels.

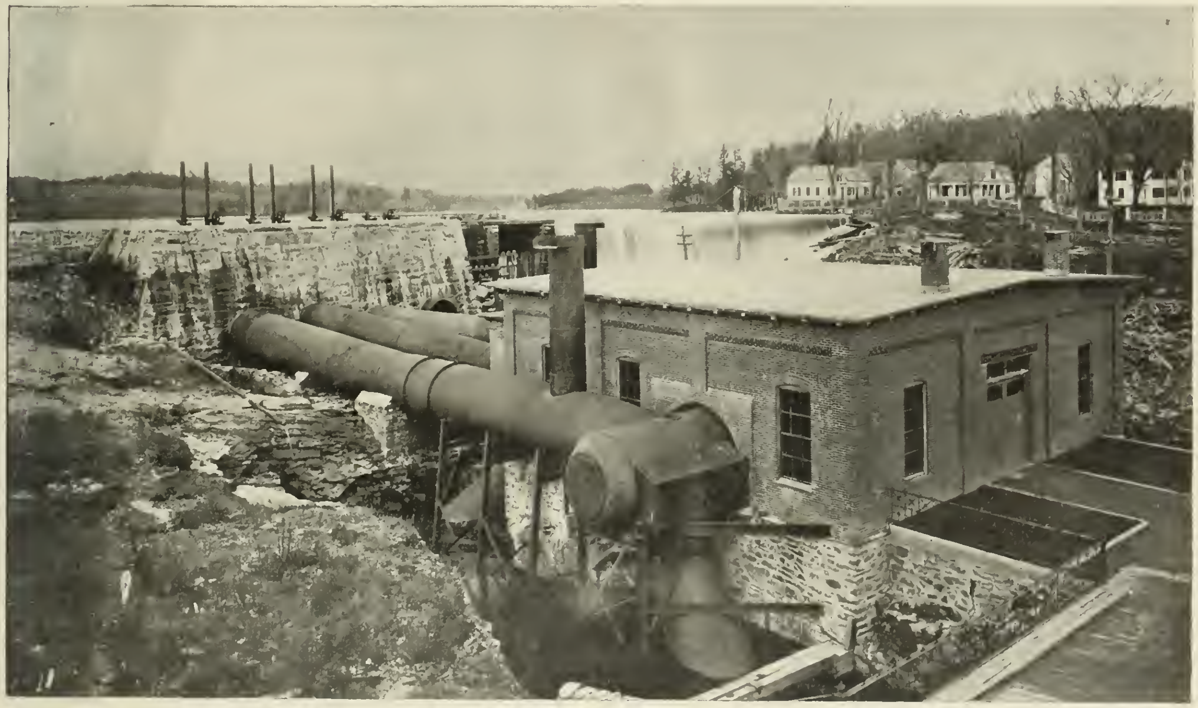
FIG. 1.—GENERAL VIEW OF WATER POWER PLANT AT GREAT FALLS, ME.

The penstocks above mentioned are provided with overflow pipes in order to avoid heavy strains when the flow of water through any wheel is shut off quickly. Each of the four penstocks already named is provided with a gate in the forebay wall and delivers water to a pair of Victor turbines. A heavy steel rack extends in front of all the gates. Each turbine case contains a pair of wheels, and is partly inside and partly outside the station wall, so that the draft tubes are entirely outside of the station. As two wheel cases enter the station from the rear and two from the sides, the line of two wheel shafts is at right angles to the lines of the other two. This plan was adopted to enable the operator to follow indications at the switchboard more promptly.

Each turbine wheel is 33 inches in diameter, of the central discharge type, and operates at 225 r. p. m. under the head of about 37 feet. Each pair of wheels is rated at 880 horse power and is direct connected to a 500 kw. generator, which latter can thus be overloaded about 24 per cent., if its efficiency is 94 per cent. The four 500 kw. generators are of the revolving magnet type, three-phase, 60-cycle, and operate at about 10,000 volts. Belted to each generator shaft is an exciter of sufficient capacity for two generators. All of the electrical machinery is the product of the General Electric Company. The speed of the connected water wheels and generators is regulated by four Lombard governors belted to the generator shaft in each case. The main cylinder of the governor is 6 by 24 inches, and the energy 11,300 foot-pounds, which may be developed in two seconds, if required.

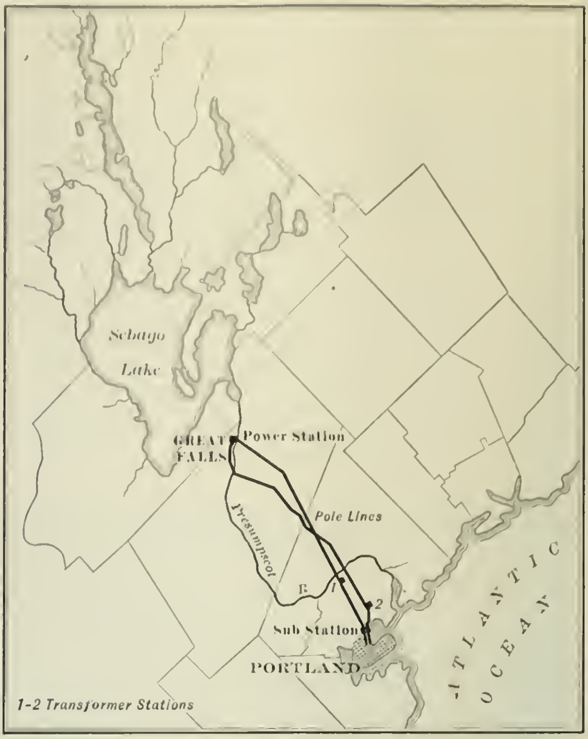

FIG. 3.—MAP OF ROUTE OF TRANSMISSION LINES.

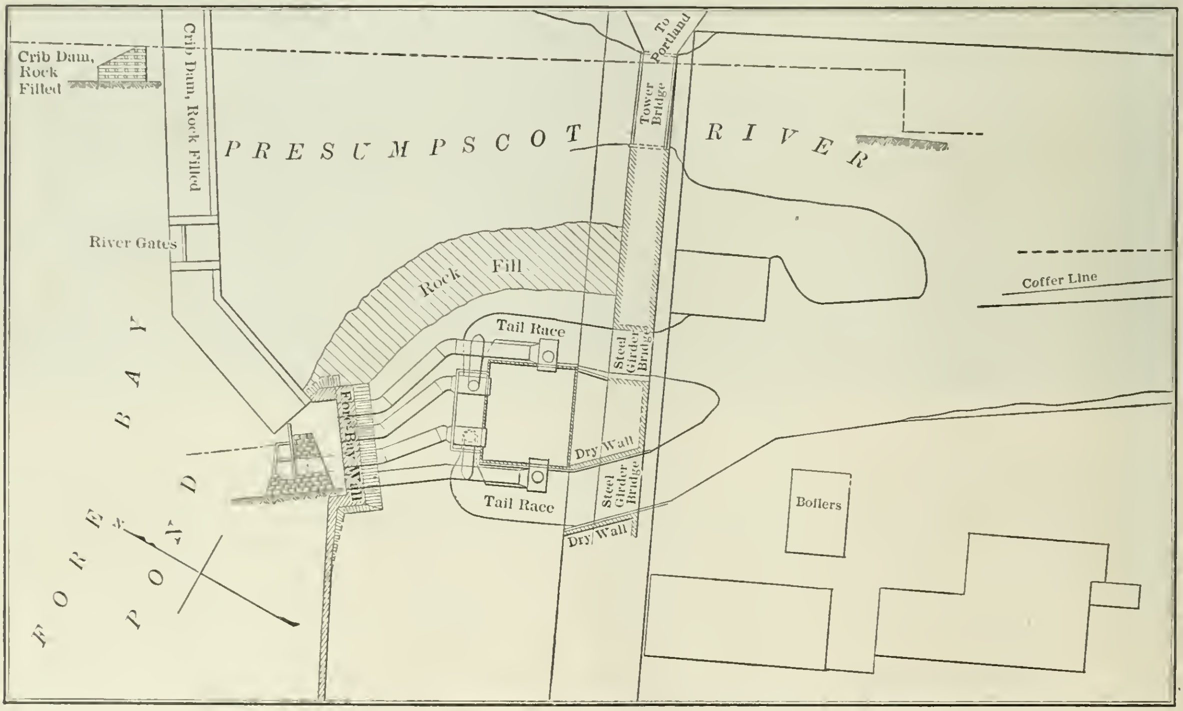

FIG. 2.—PLAN OF PLANT AND DETAILS OF DAM CONSTRUCTION.

At the rear end of the station a marble switchboard is fitted with oil switches and indicating instruments for each generator. Four transmission lines of three wires each are also to connect with this board, one to carry the current of each generator. The fourth pair of turbine wheels and fourth generator is being installed at this time, so that the photograph taken some time ago shows one vacant foundation, and only three lines entering the switchboard. The transmission lines pass from the switchboard to the rear wall of the station and through this wall to the transformer house previously named. Connections between the generators, exciters and switchboard are all affected by cables laid in conduits beneath the concrete floor of the station. A series of hand holes with iron covers, as shown in the photograph, gives ready access to all of these connecting cables. After connection to series of lightning arresters the transmission wires pass out over two lines of poles on their way to Portland. These two pole lines by different routes extend from the generating plant to the sub-station in Portland, a distance of 13 miles.

As may have been noted, this transmission system is divided into four entirely independent sets of apparatus, each extending from a gate in the forebay wall of the dam to the sub-station at Portland. These four sets of transmission apparatus are usually operated inde-

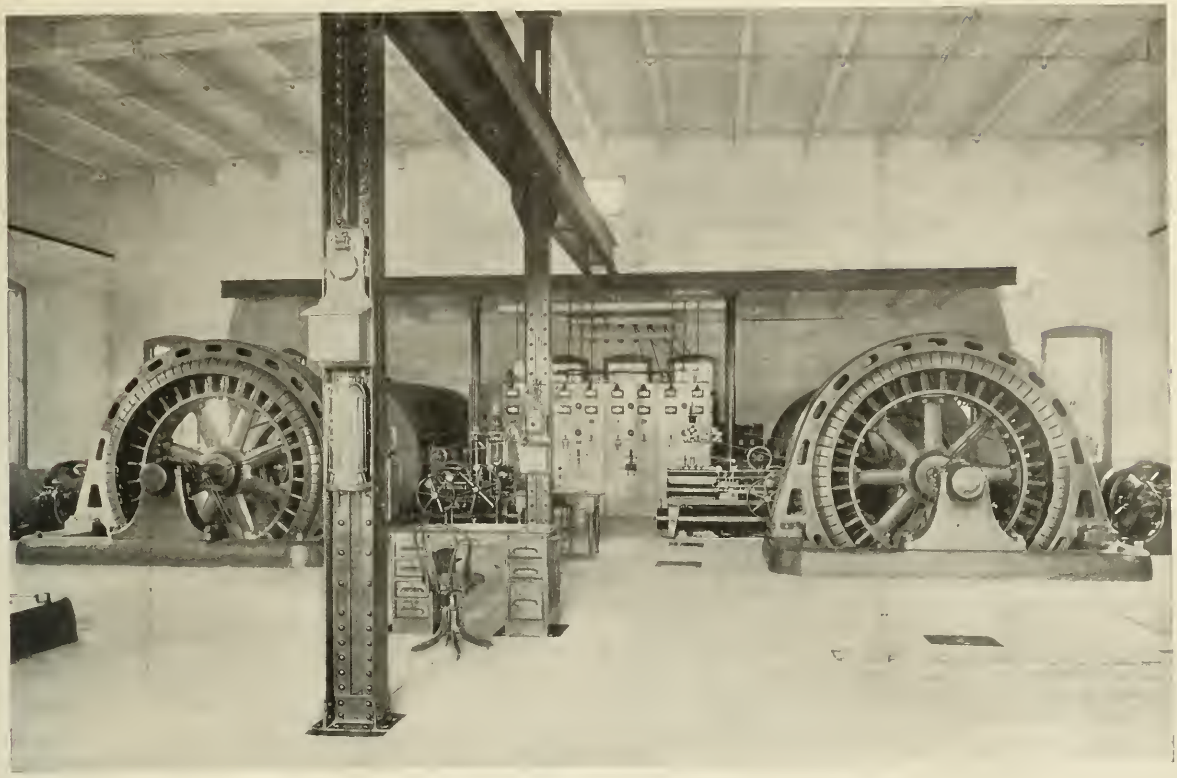

Fig. 4.—General View of Interior of Power Plant.

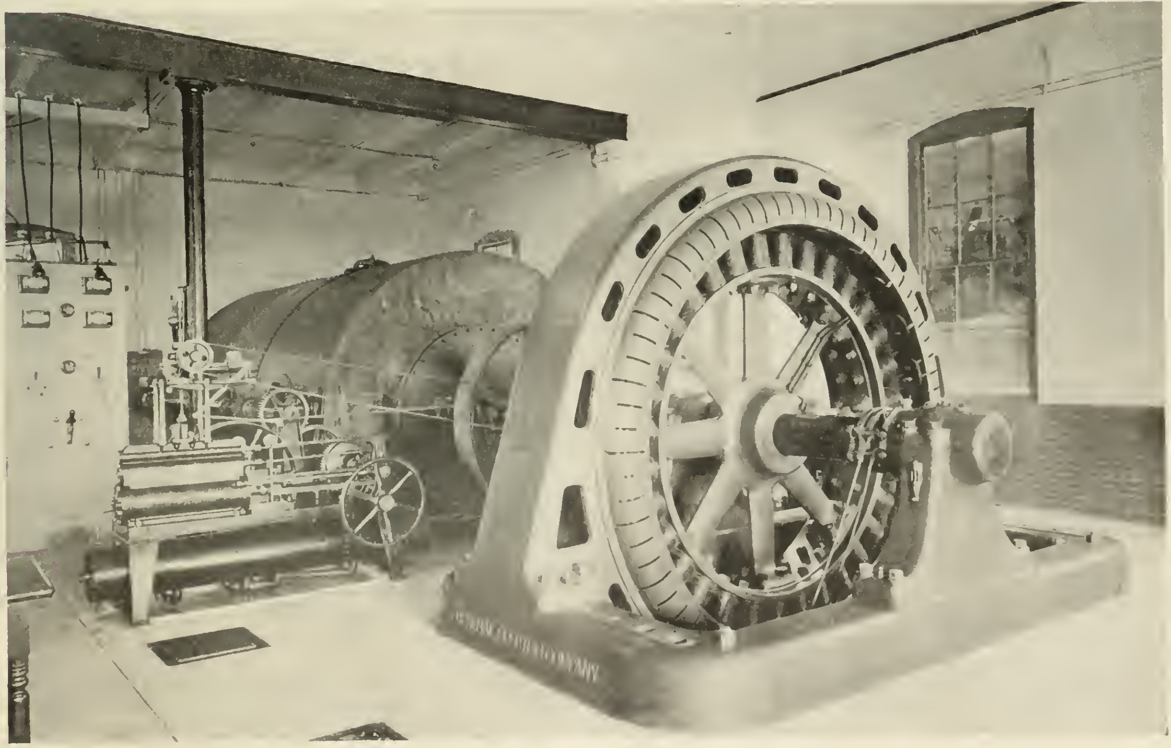

Fig. 5.—Water Wheels Direct-Connected to 500-Kw., 60-Cycle, 3-Phase, 10,000-Volt Generator.

pendently of each other, one generator and circuit being devoted exclusively to motors, another generator and circuit to a certain part of the lighting load, and so on. The object of this arrangement is to avoid fluctuations due to changes in some parts of the load and particularly to avoid the effect of changing motor loads on lamps. Each of the four 10,000 volt transmission circuits leaving the generating station consists of three No. 2 bare wires of solid soft drawn copper. Each of these wires is supported by Locke No. 10 glass insulators mounted on regular 1.5 inch locust pins. On one pole line the three wires of a circuit are arranged flat on a single cross arm, and on the other pole line two wires of each circuit are on one side of a lower crossarm and the third wire of each circuit is on an upper crossarm. Wires on the same crossarm are 18 inches apart and the upper crossarm is 24 inches above the lower. The wires are not transposed but maintain the same relative positions over the entire line. Neither pins, crossarms nor poles have been treated with any insulating or preservative compound. One pole line between the generating plant and the sub-station is located along a highway, and the other pole line partly on a private right of way and partly along another highway. The standard pole for these lines is of chestnut, 30 feet long, and with a 7-inch top. Poles of different lengths have been much used, however, where the lines go up and down hill in order to avoid sharp changes in the elevation of the circuits. This practice greatly reduces the strains on wire, insulators, pins and poles in a hilly country, and materially improves the appearance of the line. On straight runs these poles are set 110 feet apart, on curves 55 feet apart, and all sharp angles are made with two poles set 6 or 8 feet apart. Poles at sharp angles all carry double crossarms so that the two poles give each wire four points of support. At a point where the transmission lines cross the Presumpscot River with a span of about 200 feet, two poles with double arms are used on each bank, so that the strain of each wire is taken by four pins and insulators. Guy wires of 7-16 inch galvanized and stranded iron cable, or else wooden struts, are used to support all corner poles. These guy wires are attached to poles directly beneath their lower crossarms and are said to give no trouble. On one of the pole lines a private telephone circuit connects the generating station at Great Falls with the sub-station at Portland.

The 10,000-volt transmission lines do not reach the city, but enter transformer houses outside of its limits. On one line the transformer house is about one mile and on the other line about four miles from the sub-station. At each transformer house the 10,000-volt pressure is reduced to 2,500 volts and the separate circuits pass on to the sub-station at this voltage. One of these transformer houses contains three oil-insulated transformers of the Wagner make and rated at 150-kw. each. At the other transformer house there are six transformers of 200-kw. each, made by the General Electric Company, three of these transformers being cooled with air and three with oil. The fourth set of transformers for the fourth transmission circuit is not yet in position.

About one mile from the business center of Portland is the substation to which the 2,500-volt transmission lines from the two transformer houses come. The transmission circuits are connected through General Electric *C R* regulators to separate sets of bus bars at the sub-station, and from these bus bars the distribution circuits for power service, street lamps and for commercial lighting go out at about 2,500 volts, three-phase. One set of circuits is devoted exclusively to street lighting, another to motive power, and a third to commercial lamps. Motors of less than one horse-power capacity are in some cases connected to the commercial lighting circuits. The sub-station contains one 250-kw. three-phase, 60-cycle generator connected by rope drive with a 250-horse power engine of Armington & Sims make. This generating set is used occasionally on Sundays when work is being done on the transmission lines, but is not intended to provide for lack of water power, its capacity being too small for any such contingency. Moreover, the water power has thus far proved ample for the loads at all times of year. Besides this generating set the sub-station contains a 200-horse power 2,500-volt three-phase, 60-cycle induction motor of General Electric make, connected at each end of its shaft to a Brush arc dynamo of 8,000 volts and 6.6 amperes capacity. These two arc dynamos are devoted to the operation of enclosed arc street lamps. One constant current transformer in the sub-station is devoted to the operation of series incandescent street lamps. At other points in the city four constant current transformers of 6.6 amperes and 4,000 volts each are devoted to street lighting, being fed by the 2,500 volt circuits.

The circuits of the Portland Lighting & Power Company now supply 36 motors with an aggregate capacity of 835 horse power, the largest of these motors being rated at 300 horse power. All these motors are of the induction type, three-phase, 60-cycle, and are supplied through transformers from the 2,500 volt lines. Most of these motors were made by the General Electric Company.

It may be noted that the average size of these motors is unusually large for an electric supply system, being 23 horse power, or if the one 300 horse power motor is omitted, the average capacity is 15 horse power. This comparatively large average capacity for motors and also their large total capacity indicates that the low power rates made by the Portland Company are forcing motors into many factories and buildings where steam engines would ordinarily be employed. The street lighting circuits of this system supply 302 enclosed arc street lamps. The commercial circuits supply 50 enclosed arcs and about 20,000 incandescent lamps of 16 candle power for interior use. Most of this load has been secured since construction was begun on the new station at Great Falls in the Spring of 1899. It is interesting to note that the power factor of this system is raised by operating the 200 horse power motor at the sub-station without load during hours when street lamps are not wanted.

The construction of the foregoing system has been engineered and its successful business policy carried out by Mr. E. H. Mather, its treasurer and manager, who has kindly furnished the materials for this sketch.

Present Status of Electric Automobilism.

By HAYDEN EAMES.

WE often see the statement made in the public prints that much engineering development will still be required before the automobile can be regarded as a commercial success, the implication being that the available automobile of to-day is not adequate to the economical performance of the commercial service to which it is proposed to apply it. Even in conspicuously accurate financial papers we see such statements as "There are many problems of construction and mechanical device to be solved."

ELECTRIC EXPRESS DELIVERY WAGON.

Nothing could be more erroneous. The electric automobile express wagon and delivery wagon are to-day in a position to very much more than compete with present methods of transportation, considering first investment, expense and depreciation. The principal obstacle to the rapid introduction of the automobile lies in the misconception of the public as to what it can do and what part it may be expected to play generally in contributing to its convenience.

These are not predictions. It is happily no longer necessary to state in the future tense the economical advantage of electric express and delivery service over that performed by horses, and the data is now so ample and so variously corroborative that to those informed its force is not impaired by the adverse results of the blundering experiments that have been made from time to time in the application of electrical automobiles to merchandise delivery. It is worthy of note that in the majority of cases the value of these experiments has been almost wholly destroyed either by the obtrusion of the advertising element as opposed to the utilitarian or by the readiness to sacrifice the conclusive nature of the experiment to a desire to make it at the least possible first cost.

HORSES.

Investment.		Annual Expense.		
3 wagons at $175	$525	Interest at 6%		$69.90
4 horses at $160	640	*Wagons:*		
		Deprec. at 10%	$52.50	
Total rolling stock	$1,165	Repairs at $35	105.00	
				157.50
		Horses:		
		Deprec. at 20%	$128.00	
		Feed, care, shoeing, & stable exp. at $28.75 per mo., $345; per annum	1,380.00	
		Blankets, stable fixtures, harness at $3 per mo., $36; per annum	144.00	
				1,652.00
		Men:		
		3 at $45 per mo		1,590.00
				$3,469.40
Annual saving Electric over Horse Wagon				$1,470.90

The enclosed comparative statement of the actual performance of a delivery wagon like that shown in the photograph herewith is a fair example of the nature of the data now available. Every item on this sheet is derived from actual performance with this wagon, except the figure for battery renewals, which is placed at $50 higher than one could have contracted for the care of such a battery six months ago. The terms of renewal offered by battery manufacturers continually improve and this figure, to be up to date, should be considerably reduced. As a matter of fact, the corresponding actual figure in this particular case, on the original terms as to renewal, amounted to $189 in ten months, and this included a complete renewal of positive plates. This performance is not as good as that of many other batteries that have come under my notice in service even more severe.

In making comparisons of the various kinds of power and in considering the question of electric delivery wagons generally, it seems to be generally assumed that as in the case of most apparatus, the cost of battery renewals will continue in a continually increasing scale until the time comes when the battery will be entirely destroyed in some mysterious and unspecified way and has to be written off to depreciation, due allowance being made for it in advance from time to time in figuring estimates. It only takes a moment's reflection to recognize how absolutely inaccurate such a statement is. The actual depreciation of jars and separators seems to be represented by nothing but the breakages in handling and cleaning, and each renewal of elements and parts thereof, if properly made, restores the battery almost to its original utility, and this occurs at *each* renewal. It is quite possible, even with the most ordinary care on the part of men of the education and class which it is economical to employ for this service, to have a battery, like the motors, "wear out" the rest of the structure, the only charge to the battery account being for current, cleaning, ordinary care and renewals. This item offers the principal advantage of the storage battery driven vehicle over the prime mover vehicle for express and delivery service in cities. We have yet to hear the most sanguine advocate of the prime mover vehicle fix a life of more than seven years (more frequently five) for the life of the prime mover and its attendant mechanism when used under the relatively speedy and severe conditions of urban delivery, at the end of which time repairs could no longer be economically undertaken.

This depreciation in a "prime mover" vehicle, at least, at the speeds required for the particular service referred to, must be accompanied by a further depreciation account for rubber tires, without which the depreciation of the mechanism itself must necessarily be enhanced. On the other hand, the experience of the last fourteen months has demonstrated conclusively that with proper designs of wheels and treads no form of rubber tire is necessary to the economical performance of the storage battery driven express wagon. The same experience has entirely disposed of the well-founded early impressions as to the difficulty of obtaining satisfactory traction with iron tires.

The economy of the electric automobile having been established over all other available methods of urban merchandise delivery, the burning question is how those interested can obtain in a reasonable time the tremendous number of vehicles which will be required in this country alone to supplant the horse in the transportation of merchandise? The simplicity possible in the electric vehicle makes available the only ready solution to this question. The inherited empirical knowledge of centuries has put the horse wagon and carriage manufacturer in a position to successfully cope with the unmeasurable and uncomputable inequalities of road service, and has enabled him to develop the most economical construction and methods of manufacture to meet these conditions. Any motive power, therefore, of which the horse carriage and wagon manufacturer can avail himself without serious departure from the general methods of construction and manufacture which he has so thoroughly developed, immediately makes available to those engaged in express and delivery service the same sources of supply for the power wagons as formerly were available for the horse wagons for which they will be substituted. It is very fortunate that the same form of power—the electric—meets this condition and is at the same time the most economical for the purpose to which it is to be applied. The importance of this can hardly be overestimated, not only from the point of view just recited, but also in its effect in preserving the value of those ready-made investments which otherwise will be greatly impaired by the general substitution of the automobile for the horse in merchandise transportation.

ELECTRIC.

Investment.		Annual Expense.		
Total rolling stock	$1,925	Interest at 6%		$115.50
1¼ batteries at $500	625	*Batteries:*		
Wagon without battery	1,300	Electric current, care & renewals per annum		400.00
Motors	300	*Wagon:*		
Wagon & remainder of equipment	1,000	Depreciation of motors 5%		15.00
		Depreciation of remainder of wagon at 10%		100.00
		Mechanical repairs at $9 per mo.		108.00
		Men:		
		1 at $60 per mo	720	
		1 at $45 per mo	540	
				1,260.00
				$1,998.50

The above statements must not be construed as in disparagement of the economy of application of automobiles propelled by prime movers to those particular fields to which the electric vehicle is not adapted. To what extent future improvement in prime mover vehicles will extend their domain into that of the electric vehicle it is, of course, impossible to say, but the fact remains that the last two or three years' experience with the electric automobile, makes it possible to positively assert that it is to-day the most economical and convenient means for the wholesale transportation of merchandise and retail transportation of people in cities.

Three-Phase Measurements.

By Leslie L. Perry.

I HAVE read with much interest the article on "Three-phase Measurements," by Mr. A. S. McAllister in your issue of December 13, but beg to differ from him when he states that "in interconnected polyphase circuits carrying unbalanced loads the power factor will have practically as many different values as there are terms by which it can be determined." I give below a method which I have never seen in print, by which the power factor of any three-phase circuit, no matter how unbalanced are the currents and voltages, can be calculated from the measurements of the three voltages, the three-line currents and the total watts of the circuit. The method shows that the term "power factor," even in unbalanced circuits, has a very definite meaning.

To illustrate the method, I take Mr. McAllister's example:

Line Voltages.	Line Currents.	Total Watts.
$ab = 100$	$A = 26.45$	6,000
$ac = 100$	$B = 36.05$	
$bc = 100$	$C = 43.60$	

Forgetting for the time being that we know the watts let us find the relations of currents and voltages as follows: Construct a Y diagram of currents as in Fig. 1, by making triangle *C′ B O* where *B O = current B, C′ B = current A, C′ O = current C.* Then carry *C′ O* to *C*, making *C O = C* and *A O = A*. The Y will then give the currents in their correct phase relations, as their resultant must be zero. The voltages can now be made into a delta, as in Fig. 2.

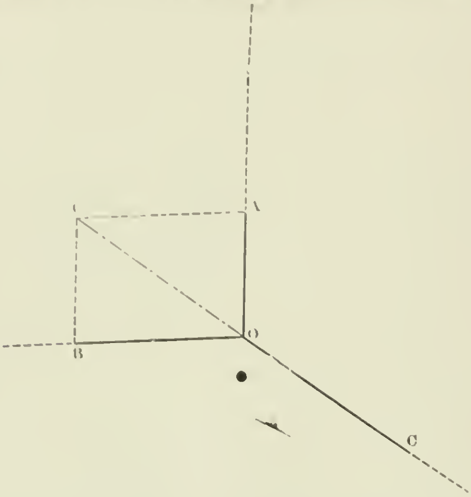

FIG. 1.—Y-DIAGRAM.

The next step is to superimpose the delta of voltages upon the Y of currents, or more correctly, perhaps, upon the counter e.m.fs of the Y, which in non-inductive circuits are in phase with the currents. By drawing the delta on one piece of paper and the Y on another, a little manipulation will give the correct arrangement, where the vertices of the delta fall upon the legs of the Y, as shown in Fig. 3. Then following out diagrammatically the action occurring in two wattmeters connected to indicate the watts of the circuit, project current *A O* on voltage *ab* as at $a_2\ o_1$, current *C O* on voltage *cb*, as at $c_2.\ o_3$, and we obtain as the watts,

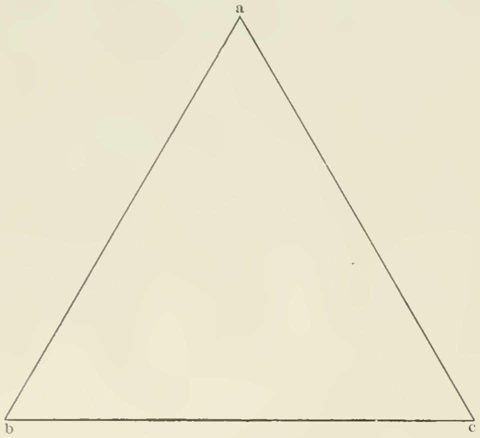

FIG. 2.—DELTA DIAGRAM.

$$a_2\ o_1 \times ab = 20 \times 100 = 2{,}000$$
$$+\ c_2\ o_3 \times cb = 40 \times 100 = 4{,}000$$
$$\text{Total watts} = 6{,}000$$

Similarly we can get for the other possible wattmeter connections,

$$a_3\ o_2 \times ac = 25 \times 100 = 2{,}500$$
$$b_3\ o_3 \times bc = 35 \times 100 = 3{,}500$$
$$\text{Total watts} = 6{,}000$$

and

$$b_1\ o_1 \times ba = 25 \times 100 = 2{,}500$$
$$c_1\ o_1 \times ca = 35 \times 100 = 3{,}500$$
$$\text{Total watts} = 6{,}000$$

This construction has been independent of the watts. Recalling now that the watts tested 6,000, we see that our assumption of non-inductive conditions was correct.

But now suppose with the same currents and voltages the watts measured 5,400, giving with the watts calculated by my method a power factor of 90 per cent., apparently, and a lag angle of 25° 51′. Then it is evident that the delta of voltages must be turned 25° 51′ ahead of the Y of currents, giving Fig. 4. Projecting the currents on their corresponding voltages as we did before, we obtain from Fig. 4:

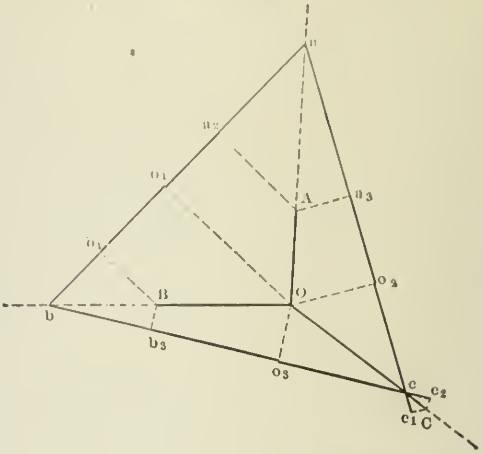

FIG. 3.—CURRENT AND VOLTAGE DIAGRAM.

$$a_2\ o_1 \times ab = 33.8 \times 100 = 3{,}380$$
$$c_2\ o_3 \times cb = 20.2 \times 100 = 2{,}020$$
$$\text{Total watts} = 5{,}400$$
$$a_3\ o_2 \times ac = 10.4 \times 100 = 1{,}040$$
$$b_3\ o_3 \times bc = 43.6 \times 100 = 4{,}360$$
$$\text{Total watts} = 5{,}400$$
$$b_1\ o_1 \times ba = 26.3 \times 100 = 2{,}630$$
$$c_1\ o_3 \times ca = 27.7 \times 100 = 2{,}770$$
$$\text{Total watts} = 5{,}400$$

This checks with the measured watts and proves the correctness of the construction.

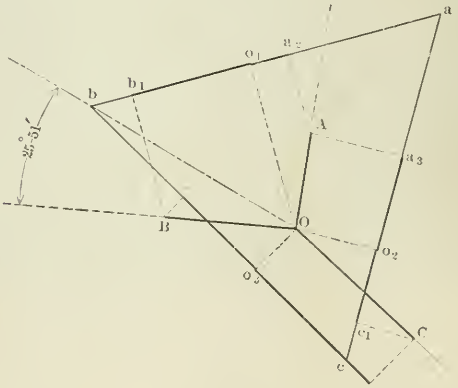

FIG. 4.—CURRENT AND VOLTAGE DIAGRAM.

In case, even, we assume zero power factor, that is zero watts, the volts and amperes being the same, we will find the method correct, for now the delta of voltages must be turned 90° ahead of the Y of currents, as in Fig. 5. It will then be found that in each pair of products one has become negative and equal numerically to the other, giving a wattage of zero; thus

$$a_2\,o_1 \times ab = 17.3 \times 100 = 1{,}730$$
$$c_2\,o_3 \times cb = 17.3 \times 100 = 1{,}730$$
$$\text{Total watts} = 0$$
$$a_3\,o_3 \times ac = 8.7 \times 100 = 870$$
$$b_3\,o_3 \times bc = 8.7 \times 100 = 870$$
$$\text{Total watts} = 0$$
$$b_1\,o_1 \times ba = 26.0 \times 100 = 2{,}600$$
$$c_1\,o_2 \times ca = 26.0 \times 100 = 2{,}600$$
$$\text{Total watts} = 0$$

From the above I would define the lag angle of an unbalanced

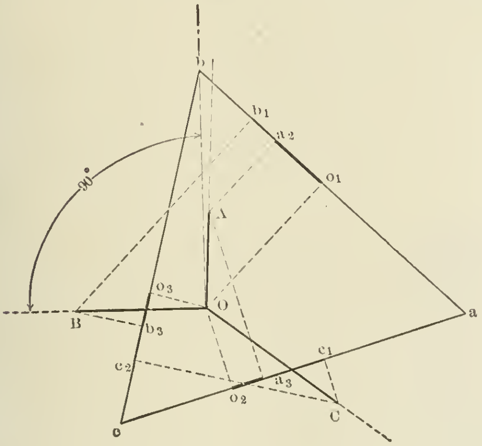

FIG. 5.—CURRENT AND VOLTAGE DIAGRAM.

three-phase circuit as the angle between the delta of voltages and Y of currents, and the power factor as the ratio of the actual to the apparent watts.

Hints on the Care of Electrical Equipment.

By W. E. Witter.

In the lighting and power plant of a large factory, peculiar conditions often arise, with no solution of the trouble for awhile, occasionally requiring a great deal of study and examination, into the conditions as they were at the time of trouble, and what led up to it. If such information could readily be obtained, the solution of the problems would locate the fault at once; but it is seldom one can obtain such facts, and with only a slight clue, he must ferret it all out like a Sherlock Holmes. Some of these problems are as follows:

It was necessary to learn the cause of the burning out of a rotor of an induction motor, the motor having been repaired and put in place. In looking over the wiring, it was discovered there were two branches of the 110-volt lighting circuit arriving at the motor from two different sources, each two-wire circuit having a cut-out, and thence to a two-phase single-throw knife switch, thence to each phase of the 1-hp induction motor. Current was applied, but the rotor did not revolve. If either phase were open, the same condition would result. In the accompanying diagram, it will be observed that connecting a 110-volt lamp across 1—3 or 2—4 at the switch will indicate whether a fuse is blown, or if the circuit is open elsewhere.

It was found that both circuits were receiving current from the same phase, and by changing a double-throw switch, at the switchboard to another phase, the trouble was made right. To make similar tests on 440-volt power circuits for induction motors, connect four lamps in series and test across the blades of the switch at the motor or at the "auto." Sometimes the trouble is on the autostarter, when one of the blades is rough because of an arc, and does not allow the switch to enter far enough for all the blades to make contact, which would prevent the motor from starting. A fact which had puzzled the former electrician was that in testing from the rotor conductors to the core, the magneto rang. This he at first mistakenly took to mean a grounded armature, but is as it should be.

Next to be decided was the cause of a certain large induction motor stopping every once in awhile. Some said it was due to overload, others thought there was something wrong with the motor, and advised taking it apart to locate the trouble; but none of them were versed in the diseases of induction motors.

True, if the motor were heavily overloaded, it might stop; but as long as the voltage was kept normal, it would take four times the normal load to stop the motor, and in this case it was almost impossible to give it such a load. Besides, the motor was not overheated, being less than 20 degs. Centigrade above the surrounding air. It was rated at 114 amperes per phase, full load; but there were no meters at hand, so it was impossible to find out in that way what it was doing. The belt was just tight enough to prevent slipping, and its bearings were only reasonably warm. The aggregate load on the composite generator was at such times very much in excess of its capacity.

Therefore, while others were fixing their attention on the motor, the electrician was busy elsewhere, watching the instruments in the engine room, the men in charge being otherwise engaged. The electrician arrived just in time to discover that the generator voltage was far below normal. The engine had slacked up under its load, with the result that the voltage went down, and the motor had too much load to run on with so greatly decreased voltage. An attendant opened the motor switch just in time to save a complete tie-up on that feeder, which supplied other motors.

Elevators driven by induction motors next claimed attention. There came a report that a motor was burnt out and its elevator disabled. The even temporary loss of an elevator which is in constant use for getting out goods for shipment means considerable in a great establishment. The first decision, before the electrician came, had been to "take out the armature" and get it repaired. A hasty glance at the elevator controller revealed two burnt out coils, with the tape completely off the outside layers, and smoke still rising when the electrician arrivd. He cleared away the burnt stuff, filed and sand-papered the controller contacts, used a very little lubricant on the latter, tried the controller with the switch open, to see if it went "all on" and "all off." The coils had burnt out because the controller stuck and was running on the resistance. The dashpot was cleaned out and refilled with clean glycerine and water, and then the controller worked all right on and off. The operator was advised to handle the apparatus as carefully as possible, and not put on heavy loads until the coils had cooled down. The result was, the elevator was kept in operation until quitting time, after which the coils were replaced with new ones. The workmen learned a point in connection with this repair job that they hadn't known before.

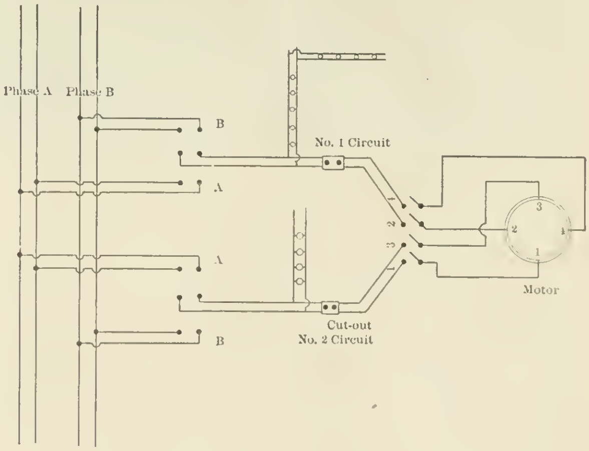

DIAGRAM OF CIRCUITS.

When the new coils were put in one of the workmen was surprised to find that the motor still did not operate right, and that the coils he had inserted got so hot on starting that they would have burnt out in a short time had current been applied longer. He had put it in "wrong side to," reversing the current in the new coil, which gave a buck and stopped the controller at that point. He "couldn't see what difference that made", but when the coil was changed, all was O. K. once more. These coils consisted of bare German silver ribbon, insulated between layers with thin mica. On one occasion two men worked continuously for twenty-four hours to take apart and put together an elevator motor, only to find that the armature was all right, and their work unnecessary. The peculiar mechanical construction, whereby the motor and elevator were coupled together in an almost inaccessible flange union, was what required so long a time for taking apart and replacing. The needless see sawing of an elevator by a new man will always give more or less trouble. An operator should be given all the information possible, to avoid the shut downs that will frequently occur with a new man, especially with a variable-speed elevator, induction motor, direct connected.

A direct-current lighting generator, compound-wound, which without warning suddenly determined it would produce no more light, puzzled the electrician sorely. He tried a two-ampere fuse across the leads of the brushes after the brushes were adjusted and the shunt field circuit closed. Not enough current was generated to melt this fuse; hence he decided that the armature was either short-circuited or open-circuited, but after a little more coaxing, the generator built up and ran all right the next night until nearly morning, when it stopped once more. Poor contacts in rheostat were looked for, and shunt connections examined. The motor was taken where it could be tested with current. By means of a water rheostat it was run as a motor for some time, proving that the armature was all right. The trouble was found to be due to a poor splice, consisting merely of wires twisted together and taped over. Some one had attempted to run the machine forward to take up the slack in the belt, putting a strain on the wire; and had probably used this method to cover up his tracks.

The next thing to be looked into was poor light in one or more of the buildings. It was found that one feeder was carrying just twice what it was rated at. A two-phase system was in use, induction motors being used to operate different floors, and the lights were tapped from both phases. The phases were practically balanced until the lighting load came on, when, in spite of attempts to keep it so, one transformer would get hot from overload. An extra transformer was installed, putting two in parallel on one phase, which necessarily required considerable changing of circuits to maintain a balanced load.

It is essential that the entire wiring of any building be done in the very best way possible. In a large plant some work will be slighted and slid over, in spite of inspection; but it should be followed up closely. The National Code can be very conveniently twisted by uninformed persons to suit different classes of work, and a man may even reason himself into thinking it will do even if it is not all right. Nevertheless, the company usually pays heavily for careless work.

Vapor-tight globes should be used where there are dangerous gases, and no switches allowed where the arc is liable to cause an explosion. In the plant herein referred to, it was found necessary to replace many lamps with vapor-tight globes, and to leave out fuses in various places, where link fuse cut-outs were in use. Enclosed fuses were used in dangerous locations, where link fuses were used before. In damp cellars, where brass sockets disintegrated because of dampness and gases, they were replaced by water-proof sockets. Extension cords were found under water tanks, where water trickled over them. Incandescent circuit wires were strung over belts, which would flap up and tear them loose; and instead of boring holes through the joists and inserting porcelain tubes for the wires, they had been connected in the same careless way, necessitating a periodical repair bill. Where gas was used for soldering purposes, lamp sockets were found tied to the gas pipes, and cords were hitched over in another direction, with a long piece of wire solder for a tie.

It kept one man busy in this department for awhile replacing fuses, on account of these conditions, and putting wires in order. A ground on the system was invariably found here. One four-story building, constructed entirely of ironwork, and in which oils were stored, had a main extending up to the fourth floor, with taps on each floor, with fourteen to seventeen lights on each circuit, with but a five-ampere single-pole switch controlling each floor circuit. The wires were strung mostly on knobs. A boy reached for a lamp one day, and couldn't get away from it. His cries drew the attention of the men, who had to run to the engine room, 600 feet away, to have that circuit opened. The single pole switch was wrong in the first place, as there were more than six lamps on the circuit. Each should have been 10-ampere double-pole.

Wires crossed iron pipes in all directions without protection. One cannot be too careful in such work. A change was made where a 440-volt power line ran along the side of a room which was constantly flooded. The wires were covered with wood guards, and a doorway made to get at the fuses. A constant stream of water ran down over these, and the asbestos covering on the inside of the door was saturated and ready to drop off. A few feet away, the wires extended up to the next floor, and practically no water reached this place. The cut-outs were removed to this riser, and no further trouble experienced there. No man cares to replace fuses where no switch is at hand, even on a 400-volt circuit, if he must stand in water during the operation.

Careful and intelligent inspection will bring to light many possible improvements in almost any large plant. Some plants in which the system is large enough and the processes are more or less fraught with danger, employ a daily inspector. Included in his duties is the inspection of all wires. Pipe-men and carpenters often raise havoc with wires of all sorts which are in their path of work. One threw a lamp cord over a revolving shaft; and a ground on a wire was traced to a lamp dropped into an oil drip pan, up among shafts and gears.

Leave out knots in the cords, and should a lamp socket break off and hang down on the flexible wire on a side wall bracket, fix it at once. Do not let the wires on a portable desk lamp become so badly worn that it will short-circuit itself. Shades that perch rakishly on one side, like the hat of Happy Hooligan, should be straightened out and fastened so it cannot occur again. Lamp switches that light only after a dozen turns, or perhaps not at all, and loose fuse terminals in cut-out blocks which cause a fuse to get hot and blow when most needed, should be promptly corrected.

These may seem small affairs; but when the small leakages of a great factory multiply the result is very considerable. Look after the "stitches in time"; keep up the little repairs, and in the majority of cases, the large ones will take care of themselves. Moreover, careless work is not business-like, and should in any case be avoided.

Joliet-Chicago Transmission Started.

The 31,000-volt transmission from Joliet to Chicago, to supply power for operating the Bridgeport pumping station of the Illinois-Michigan canal, was put in operation last week. This is the first high-tension transmission line to enter Chicago. The power comes from the plant of the Economy Electric Light & Power Company, at Joliet, which is a water power plant operating mainly with water derived from the flow of the Chicago drainage canal. Thus Chicago sends waste water to Joliet and has it returned in the shape of electrical energy. The transmission distance is about 30 miles. The three lines are No. 2 solid copper carried on glass insulators, all three on one crossarm. The pole line follows the line of the canal. The Bridgeport pumping station formerly was operated by steam and played an important part in the sewage disposal of Chicago, as it pumped the Chicago River into the Illinois-Michigan canal, keeping the flow of the river away from the lake and causing the greater part of the sewage to flow away by the Illinois-Michigan canal. The pumping was done by a row of marine type engines coupled to centrifugal pumps located in the dam between the river and the canal. Since the completion of Chicago's great sanitary canal the necessity for so much pumping at the Bridgeport pumping station has disappeared, but the Illinois-Michigan Canal Commission must still keep this latter canal supplied with water, and to enable this to be done more cheaply than formerly, a contract was made for the power transmitted from Joliet. The load is an ideal one for a water power plant, for it is as constant as the water power itself.

There are installed two 300-hp 60-cycle 2,200-volt 3-phase induction motors of the internal starting resistance type. One of these is located in each end of the power house, which is located on the dam. The motors are belted to a line shaft running the length of the power house and from this shaft a number of centrifugal pumps in the dam are belted. The shaft is divided into sections by clutches, thus making a very flexible arrangement.

Washington Meeting of the American Association for the Advancement of Science and of the Affiliated Societies.

BY N. MONROE HOPKINS.

THE fifty-second meeting of the American Association for the Advancement of Science and the Affiliated Societies, held in the various buildings of the Columbian University, Washington under the presidency of Dr. Ira Remsen, proved without question the most successful in the history of the organization, and brought together the largest number of scientific men of note that have ever met in this country.

This is the initial meeting of the American Association during the holiday season in conjunction with all the affiliated societies, and the credit for this accomplishment is due to a special committee of the Association, of which Dr. Charles S. Minot, of Harvard University, is the chairman. This committee secured from all the leading colleges and universities throughout the United States their consent either to lengthen the holiday vacation or to arrange so that all professors may have the necessary leave of absence to attend.

From December 29 to January 3 had been named as convocation week and the experiment of meeting in midwinter as one great unit has proven so very successful that it will undoubtedly continue as the regular meeting scheme of the Association and the affiliated societies hereafter. The attendance of the Association alone at this winter meeting numbered 975, as against the 475 of the Pittsburg meeting last year, and with the registration of the affiliated societies added, the number reached 1,337, as compared with the 635, which was the sumtotal of the American Association and affiliated societies at Pittsburg. In adding the number registering in the affiliated societies care has been taken not to include those who are members of both the Association and of the affiliated societies.

There have been 375 new members elected since the Pittsburg meeting and 50 members were elected Fellows at this Washington meeting. Five hundred and forty-three papers were presented at this meeting, showing an increase of 183 over the meeting last summer.

It is of interest to note that the American Association has increased its membership by about 1,500 in the last eighteen months, the growth resulting from the united expansion of its ten sections in a remarkably well balanced manner, until to-day there are over 3,700 Fellows and members. The Association has 51 published volumes and is without doubt the largest scientific body in America.

COLUMBIAN UNIVERSITY, WASHINGTON, D. C., "HEADQUARTERS," A. A. A. S. MEETING.

The present convention was called to order on Monday morning, December 29, by the retiring president, Professor Asaph Hall, U. S. N., who introduced the president-elect, Dr. Ira Remsen. Addresses of welcome were made by Dr. Charles W. Needham, President of the Columbian University, on behalf of the educational institutions of Washington; Charles D. Walcott, on behalf of the Washington Academy of Sciences; Hon. B. F. Macfarland, on behalf of the District of Columbia, and the Hon. David J. Hill, on behalf of the National Government.

The addresses were responded to by President Remsen, which response was followed by announcements from the general, permanent and local secretaries, including statements as to the honors of meeting and adjournment of the general session. Then followed registration and organization of the sections and societies in their respective halls, provided for by Professor Charles E. Munroe, Chairman of the Committee on Meeting Places and Equipment.

Upon organization, which consumed the remainder of the forenoon, a luncheon was given to all the visiting scientists by the local committee. Monday evening the retiring address was delivered by Professor Hall. Among the social features of the convention may be mentioned the various dinners and smokers given by the numerous societies, in addition to the general luncheon noted. There were few visits to places of interest at this meeting, most of the time being given up to papers and business, even on New Year's Day the sections meeting as usual. Among the visits made, however, may be mentioned the reception by the President of the United States on Saturday morning, and a visit to the plant of the Columbia Liquid Air Company, where the machinery was seen in operation and liquid air exhibited and experimented with.

The place of meeting for next year and the officers for this meeting were chosen on Friday evening as follows. Meeting place, St. Louis. President, Dr. Carroll D. Wright, of the Department of Labor, Washington, D. C. Vice-Presidents—Section A, Mathematics and Astronomy, O. H. Tittman, Superintendent United States Coast and Geodetic Survey; Section B. Mathematics and Astronomy, Edwin H. Hall, of Cambridge, Mass.; Section C, Chemistry, W. D. Bancroft, of Ithaca, N. Y.; Section D, Mechanical Science and Engineering, C. M. Woodward, of St. Louis; Section E, Geology and Geography; I. C. Russell, Ann Arbor, Mich.; Section F, Zoology, E. L. Mark, Cambridge, Mass.; Section G, Botany, T. H. Macbride, Iowa City, Ia.; Section H, Anthropology, M. H. Saville, of Museum of Natural History, New York; Section I, Social and Economic Science, S. E. Baldwin, Supreme Court of Errors, New Haven, Conn.; Section K, Physiology and Experimental Medicine, Prof. H. P. Bowdich, Jamaica Plain, Mass. Permanent secretary, Dr. L. O. Howard, Washington, D. C.; general secretary, C. W. Stiles, Washington, D. C.; secretary of the council, C. S. Howe, Cleveland, Ohio.

In view of the meeting place being Washington this year, and the election of Carroll D. Wright, of Washington, to the presidency for next year, it may be of interest to note the number of past presidents who have been elected from Washington. They are: Simon Newcomb, S. P. Langley, T. C. Mendenhall, William Harkness, Theodore Gill, and G. K. Gilbert, and with the election of Dr. Wright at this last meeting, the list makes a most favorable showing for Washington as a scientific center.

Among the affiliated societies which met with the American Association during convocation week may be mentioned the following: American Anthropological Association, American Chemical Society, American Folk-Lore Society, American Morphological Society, American Philosophical Society, American Physical Society, American Physiological Society, American Psychological Association, American Society of Naturalists, Association of American Anatomists, Astronomical and Astrophysical Society of America, Botanical Society of America, Botanists of the Central and Western States, Geological Society of America, National Geographic Society, Naturalists of the Central States, Society of American Bacteriologists, Society for Plant Morphology and Physiology, Society for the Promotion of Agricultural Science, Zoologists of the Central and Western States, American Alpine Club, National Association of State Universities, American Microscopical Society, Society of Economic Entomologists.

Among the papers presented at the Washington meeting may be listed the following of interest from the physical or electrical engineering standpoint

"A Systematic Method of Calculating the Dimensions of Dynamo-electric Machines," by Carl Kinsley, University of Chicago. The paper deals with dimensions so arranged that a set of three simultaneous equations gives the relations existing between the diameter of the armature, its length, and the number of conductors on the winding. These equations are primarily made to depend upon considerations which will determine the satisfactory operation of the dynamo. The first equation is made to depend on the electromotive force desired. The second equation considers the rise in temperature allowable. The third equation determines the efficiency of the machine. The intermediate assumption, such as the area covered by the pole pieces, affect the ultimate dimensions, but all unite in giving the essential features desired, namely, the electromotive force, rise of temperature and efficiency.

"Exhibit of a New Mechanical-Metallurgical Product in Copper," by C. A. Waldo, Professor in Purdue University, Lafayette, Ind. The paper is descriptive of a hollow copper ball of uniform thickness and predetermined weight and strength, made by an entirely original process.

"The Construction of a Sensitive Galvanometer," by C. G. Abbott, Smithsonian Institution, Washington, D. C. This paper will be published in the Proceedings of the Smithsonian Institution, and describes what is probably the most sensitive galvanometer ever constructed. The instrument has sixteen coils, and a resistance of 1.6 ohms. Its constant is 5×10^{-11} ampere, and is capable of indicating a current as small as 1×10^{-12} ampere. This paper was given with an introduction by S. P. Langley, Secretary of the Smithsonian Institution.

"The Condition Governing the Coherence of Metals When There is an Electrical Discharge Between Them," by Carl Kinsley, University of Chicago. The paper describes an apparatus for studying coherence effects between surfaces whose distance apart could be measured to a .04 of a wave length of light. Prof. Kinsley also read a paper on "The Determination of the Frequency of Alternating Currents by the Automatic Adjustment of the Circuit to Resonance."

"Experiments Concerning Very Brief Electrical Contacts," was the title of a paper by Herschel C. Parker, Columbia University, New York, which gave an account of experiments concerning very brief electrical contacts by means of a gravity contact key.

"Derivation of Equation of Decaying Sound in a Room and a Definition of Open Window Equivalent of Absorbing Power of a Room," by W. S. Franklin, Lehigh University, consisting of a mathematical discussion on acoustic properties of rooms and halls in which the interesting point is brought out that theory agrees with experiment. Deals fully with absorption of sound by walls and objects in a room.

A paper "On the Velocity of Light as Affected by Motion Through the Ether," by Edward W. Morley, Western Reserve University, and Dayton C. Miller, Case School of Applied Science, referred to experiments which will involve a year or more for their performance. The paper describes some new points in the theory, and it reported that the experimental work so far carried out gives promise of important discoveries.

A paper "On the Distribution of Pressure Around Spheres Moving With Constant Velocity," by S. R. Cook, Case School of Applied Science, is a mathematical discussion, and although very valuable, not of general interest.

In a paper entitled "Damped Ballistic Galvanometer," Prof. O. M. Stewart, of the University of Wisconsin, showed that, contrary to the usual supposition, the damped ballistic galvanometer gives deflections proportional to the quantities of electricity discharged through it.

A paper "On the Electrical Conductivity of Solutions in Amyl Amine," by Louis Kalenberg, University of Wisconsin, contains a description of a form of cell for investigating conductivity of solutions when the solvent is expensive or difficult to obtain in large quantities. It gives the results of solutions in amyl amine, a solvent whose dielectric constant is of the order of chloroform.

"On the Thermal Conductivity of Glass," a paper by H. W. Springsteen, Case School of Applied Science, describes measurements made on different samples of glass, the determinations being obtained through the agency of a thermo-electric couple.

Mr. Charles K. Wead, United States Patent Office, read a paper "On Some Relations Between Science and the Patent System," in which he called attention to certain unique opportunities for research afforded to the public by the Patent Office and by its publications

"Why the E.M.F. of the Daniell Cell Changes When the Densities of the Solutions Change," was the title of a paper by Prof. Henry S. Carhart, University of Michigan, in which it was shown that the thermal change is abundantly large to explain the changes mentioned in the title. Prof. Carhart also read a paper on "The Absolute Measurement of the E.M.F. of the Cadmiun Cell," in which Prof. Karl E. Guthe, University of Michigan, collaborated. The paper described the preparation of the materials for use in the cadmium cell and an electro-dynamometer for making accurate measurements.

"The Coefficient of Expansion of Some Alloys of Nickel and Cast Iron," by Theo. M. Focke, Cleveland, Ohio, was the subject of a paper describing experiments which show that an alloy of 36 per cent. of commercial nickel and 64 per cent. of common cast iron make an alloy whose coefficient of expansion is about one-third of that of iron. This material has been used in making engineering instruments.

Prof. R. H. Thurston, Cornell University, in a paper entitled "Sulphur Di-Oxide and the Binary Vapor Engines," described the condensation of steam by sulphur-dioxide, and the utilization of the expansion of the sulphur-dioxide gas in a separate cylinder, thereby increasing the efficiency of the engine.

A paper by Prof. E. Rutherford, of McGill University, described the phenomena of "The Magnetic and Electric Deviation of the Easily Absorbed Rays from Radium."

A paper on "A Lecture Room Method of Analyzing Irregular Electric Currents," by Prof. W. J. Humphreys, University of Virginia, described an arrangement of a small gas chamber built upon an ordinary telephone receiver, with a pipe leading thereto. The vibrations of the diaphram affected a jet of gas which was lighted at the small opening provided. A revolving mirror apparatus completed the equipment.

Four papers dealing with radioactivity were as follows: "A Penetrating Radiation from the Earth's Surface," by E. Rutherford and H. L. Cook, McGill University. "Induced Radioactivity Excited at the Foot of Water Falls," by J. C. McLennan, Toronto University. "Note on the Possible Cause of Radioactivity," by Carl Barus, Brown University. "Radioactivity of Freshly Fallen Snow," by S. J. Allen, McGill University.

Among other papers read were the following: "Certain Data Bearing on the Occurrence of Lightning," and "The Electrical Charges of Water Nuclie," by C. Barus, Brown University. "The Critical Current Density and Drop of Potential at the Cathode in Vacuum Tubes," by C. A. Skineer, University of Nebraska.

"On the Double Refraction of Dielectrics in a Magnetic Field in a Direction at Right Angles to the Lines of Force," by L. T. Brace, University of Nebraska.

Indicting Brooklyn Trolleys.

The December Grand Jury in Brooklyn has presented a report to Judge Aspinwall on the conditions existing on the Brooklyn Rapid Transit lines. The presentment recites that the Grand Jury found poor light in the cars and insufficient heat. It also found that there were not enough cars run during the non-rush hours. The Grand Jury recommends that the Aldermen pass an ordinance compelling the company to properly light and heat its cars and to run more cars during the non-rush hours. On account of what it regards as the neglect of the public, it recommends that the Attorney-General be instructed to bring proceedings to annul the charter of the subsidiary lines of the Brooklyn Rapid Transit. It also recommends that the city of New York take over these lines and operate them. The Grand Jury says that it has examined officers of the company and found them unwilling to do what they could do to improve conditions. The presentment calls attention to the tendency towards an increase in immorality and pickpocketing as a result of the crowded conditions on the surface and elevated roads.

Arnold Report on the Chicago Transportation Problem.

The report of Mr. B. J. Arnold, to which we referred last week, comprises an octavo volume of 310 pages, accompanied by fifteen sheets of curves and a case containing fourteen maps. The report is divided into six parts and appendix, and is prefaced by a summary of conclusions and recommendations, which are printed below.

A general discussion of street railway systems and the conditions governing them forms Part I of the report. Part II discusses the inadequacy of present terminals and service and contains recommendations for improvement under divisional ownership. The discussion includes a consideration of the present terminals in the business center, the uses made of the same and their inadequacy; reasons for the inadequate service being furnished at the present time and reasons for dead trackage in the downtown district; how electric terminals were granted in the business center; reasons why cable operation as a system and operation of cars in trains should be abandoned; conclusions as to what should be done to better conditions under the present system of divisional operation by separate managements; discussion of the relative merits of overhead and underground conduit types of electrical construction; recommendations for an arrangement of loop terminals to take the place of the present terminals, and recommendations as to the disposition of the present terminals, with estimates of the capacity required of terminals; recommendation of a system of routing to eliminate largely the use of transfers; reasons for the desirability of double-truck cars; teaming conditions and their influence on car traffic; speed of cars, with reasons for not further limiting the speed; report on the system of transfers in use, and recommendations for the building of additional tracks to better serve the public.

Part III treats of the growth of population and development of the transportation business, with a discussion of probable future increase and an analysis of capitalization and financial results obtained in past operations. Twenty-eight charts of curves are included, based upon population statistics of Chicago and several of the metropolitan cities of the world. The heads of this section are as follows:

Population by divisions in tables and graphically for ten years from 1892 to 1901, giving percentages of increase and decrease, track mileage and population per mile of track, revenue passengers carried by divisions, rides per capita per annum, passengers carried per mile of track, gross passenger receipts per year, per mile of track per year, and per car mile operated per year; tentative conclusions regarding future population of Chicago and probably future earnings of railway companies; statement of operations for last fiscal year and analysis of existing capitalization.

Part IV is on through routes, universal transfers and the one-city-one-fare question. It treats of the relative merits of operating cars over through routes as compared with downtown terminals, discusses the subject of universal transfers and the question: Could a unified company afford to conduct the transportation business of Chicago on a one-fare basis?

Part V consists of the discussion of a new, reorganized and unified street railway system for Chicago and recommends a general plan of surface transportation under a unification of control of the Chicago City Railway Company, the Chicago Union Traction Company, the Chicago Consolidated Traction Company and the Chicago General Railway Company, utilizing subway and surface terminals in the business district and routing cars through all divisions; a general plan is given of subways required for such operation, with an outline of the use of transfers, and a schedule of routes recommended, showing length of routes, time, number of cars and headway of cars; also a schedule of streets on which tracks should be built in the creation of such a system, showing distance and type of track construction; estimates are submitted of the cost to produce the system ready for the operation of cars, and an estimate of the earnings to be derived from the operation of such a system, based on the past performances of the present companies.

Part VI comprises various technical problems, valuations and estimates, and is divided in six chapters, as follows: Chapter I, subways. Chapter II, underground electric conduit system. Chapter III, electrolysis. Chapter IV, Union Elevated Railroad loop. Chapter V, track rails and track construction, with illustrations. Chapter VI, unit-price estimates. Chapter VII, valuation estimates. Chapter VIII, valuation of lines under expiring grants. Chapter IX, cost estimates.

The appendix gives tabulated information concerning present routes, length of round trip, time, and maximum number of cars operated by the Chicago Union Traction Company and the Chicago Street Railway Company; recommendations as to routes in the business district for the operation of cars under divisional ownership with joint use of tracks, reference being made to an accompanying map; recommendations for the operation of cars under a unification of management of the Chicago Street Railway and the Chicago Union Traction Company; schedules showing points at which transfers are issued and received by the Chicago Street Railway and the Chicago Union Traction Company; list of streets on which tracks are laid, with the distances in feet of street and single track; recommendations as to the streets on which to construct tracks, showing mileage and giving amount to be constructed in subways and amount of underground conduit type.

The engraved plates at the end of the book give cross sections of proposed subways, double-track subway stations, underground conduit railway construction and further population curves.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

I. THE ONE-CITY-ONE-FARE IDEA.

Chicago, with respect to transportation as well as other things, should be regarded as one city, not three. Divisional lines ought to be obliterated, as far as possible. A street car passenger should be carried over the most direct route between any two points within the city limits for a single fare. Complete unification of ownership and management is the best plan for realizing the one-city-one-fare idea. The same end can be accomplished, however, but in a less satisfactory manner, under divisional ownership, by a plan of through routing of cars, joint use of tracks and interchangeable transfers. To a still less satisfactory degree the same end can be accomplished by the interchange of transfers between companies without joint use of tracks.

II. THE THROUGH-ROUTE PRINCIPLE.

Routes through the business district ought to be substituted for downtown terminals, wherever possible. Outside the business district, too, the best results would follow from connecting together the detached lines now found on several streets and operating cars over such lines from end to end on the through route principle.

III. SUBWAYS.

A system of subways should be, and eventually must be, built to accommodate the street car traffic of Chicago and relieve the street surface congestion in the business district. Galleries should be provided in connection with such subways for the accommodation of present and future underground utilities. Two subway plants are outlined in the report. One plan, referred to as Subway Plan No. 1, shown on map No. 11, calls for three north and south subways, from Fourteenth Street on the south to Indiana Street on the north, and two subways entering the business district from the West Side, utilizing the present Van Buren and Washington Street tunnels and looping back of Clark Street. This is a system of high level subways throughout, with no dips. Its estimated cost is $16,000,000. The other subway plan, known as Plan No. 2, shown on map No. 5, calls for practically the same north and south high level subways in combination with three or more low level subways from the West Side, passing under the north and south subways and reaching Michigan Avenue, and should future developments warrant, under Lake Front Park as far as it may be extended. The low level subways would require the use of elevators. The estimated cost of subways built according to this plan is $20,000,000. Plan No. 2 is recommended as best for the city from an engineering and transportation point of view, but in case this plan is deemed inadvisable for business or other reasons, a system of single-decked high level subways, as outlined in Plan No. 1, can be constructed, which will to a large extent accomplish the results. No subways should be built in such a manner as to preclude the operation of cars through them on the through route principle. Under either of the plans as outlined, the whole system of subways need not necessarily be constructed at once. One or more of the subways could be built at a time and utilized separately, but with a view to their ultimately forming a part of a comprehensive system. The subway plans as submitted do not necessarily call for the removal of all tracks from the street surface in the business district, and Subway Plan No. 1 necessitates some surface loops. Under either plan there could be a street surface system connecting the depots and designed to accommodate short haul traffic in the business district. Under Plan No. 2 there could also be a low level subway system for connecting all depots, and by using it in connection with this subway all tracks could be kept off from the surface of the streets in the business district for some years to come.

IV. THE PRESENT RIVER TUNNELS.

It is inadvisable to attempt to lower the present river tunnels and at the same time retain them for surface railway use, for the reason that lowering the tunnels to a sufficient depth to accommodate future river traffic would involve extending the tunnel approaches at least a block further into the business district. In the interest of navigation, therefore, the tops of the tunnels ought to be promptly removed, leaving the lower parts of one or perhaps two of the tunnels for utilization later as parts of a future subway system.

V PLAN FOR A UNIFIED COMBINED SURFACE AND SUBWAY STREET RAILWAY SYSTEM.

A plan is presented for a new, reorganized and unified combined surface and subway street railway system, comprising the lines of the City Railway Company, the Union Traction Company, the Chicago General Railway Company and the Chicago Consolidated Traction Company within the city limits, and new lines necessary properly to connect the now disconnected parts of the system. The total single track mileage of this system as outlined would be about 745 miles, and its estimated cost, if constructed new, with everything first class throughout, but exclusive of subways, would be $70,000,000. Adding $20,000,000, the cost of the subways constructed according to Plan No. 2, would make the total cost of the new system complete $90,000,000. With Subway Plan No. 1, instead of Subway Plan No. 2, the total cost of the new unified system would be $85,800,000.

VI. PLANS FOR IMMEDIATE IMPROVEMENT OF TERMINALS AND SERVICE.

Plans are presented for the rerouting of surface terminals in the business district, (1) under the present divisional ownership and operation, (2) under the joint use of tracks in the business district under divisional ownership, and (3) under unified ownership and management. Immediate improvement of Chicago's local transportation facilities may be effected by substituting electric for cable power and routing cars according to any of the plans outlined, all cars from the West and North sides to enter the business district over bridges until such time as subways shall be constructed.

VII. ELECTRIC UNDERGROUND CONDUIT SYSTEM.

The operation of cars in Chicago by the electric underground conduit system is practicable and feasible. Overhead trolley construction should be prohibited within the area bounded by Twelfth Street on the south and the river on the north and west. Outside of the district named the objections to the overhead trolley are esthetic in nature, and it is for the city authorities to say—after a balancing of financial against esthetic considerations—how much, if, any, underground conduit construction should be required. The cost per mile of single track (track alone, including feeders), of electric conduit road construction would average $81,300 for a system covering the entire city, including feeder wire, but exclusive of the cost of power, rolling stock and paving of right of way. All conduit construction, however, within the business district would cost about $100,000 per mile, due to the numerous curves, large amount of special work required, and the extra cost of labor, due to the congestion within the district in which the work must be prosecuted. To either of the above figures should be added the cost of paving, as follows: Brick, $12,650; asphalt, $12,880; dressed granite, $18,400. Overhead trolley road construction would cost $20,836 per mile of single track, using the same weight of rail. It would cost nearly as much to convert the Chicago cable roads into electric conduit roads as to build new electric conduit roads.

VIII. GROOVED RAILS.

A grooved girder type of rail, of special design, is recommended for well-paved streets upon which cars operate often enough to properly clear the groove of dirt and ice. On outlying streets and on poorly paved and poorly maintained streets the girder type of rail should be maintained as best for team traffic, and the railway companies.

IX. ELECTROLYSIS.

The destruction of underground utilities from electrolysis is now well in hand by the city, and if the present ordinance governing the subject is enforced no serious difficulties may be anticipated from this source, and when the underground conduit system is adopted there should be no further injury from electrolysis in the area served by the conduit system, because this system uses a complete metallic circuit.

X. THE FINANCIAL ASPECT OF THE ONE-CITY-ONE-FARE PLAN.

A unified company could afford to conduct the transportation business of Chicago on the basis of a single fare for a continuous ride anywhere within the city limits. The present divisional companies by the interchange of transfers, could afford to do the same thing, provided they were properly protected against the fraudulent use of transfers, but it would be at a somewhat greater cost to themselves, and with greater inconvenience to passengers. than would be the case under unified management.

XI. GROWTH OF POPULATION AND TRAFFIC IN THE PAST AND ESTIMATES AS TO THE FUTURE INCREASE OF STREET CAR TRAFFIC.

The population of Chicago has increased since its incorporation in 1837 to 1902 at the rate of 8.6 per cent. per year compounded, and is now increasing at the rate of 7.7 per cent. per year. For the nine years from 1892 to 1901, inclusive, the number of revenue passengers carried by the Chicago surface and elevated lines combined has increased at the rate of 5 per cent. per annum compounded. The increase for the surface lines during the same period has been at the rate of 1.5 per cent. per year compounded. The increase for the combined surface and elevated lines from 1894 to 1901, inclusive, a period of seven years, has been at the rate of 6.3 per cent. per year compounded. The increase for the surface lines alone during the same period has been at the rate of 3.9 per cent. per year compounded, and the increase for the elevated lines alone has been for the same period at the rate of 2.6 per cent. per year compounded. The population of Chicago has increased more rapidly than that of any other city in the world, but it is improbable that this rate of increase should continue indefinitely. Figures and curves are presented showing the past growth of Chicago as compared with other cities, also the future results if present rates of increase should be maintained, but as this is improbable curves are shown representing the increase in population and gross receipts that may reasonably be expected for the combined surface and elevated railways during the next fifty years.

XII. ESTIMATED COST OF REPRODUCTION AND PRESENT VALUE OF EXISTING PLANTS.

The cost to reproduce the following properties complete, with new construction and equipment throughout, would be: Chicago City Railway Company, about $17,200,000; Chicago Union Traction Company (not including the Consolidated Traction Company), about $22,200,000. The actual present value of the physical properties for railway purposes of the following companies, taking into consideration the obsolete equipment and construction which must be discarded, but not taking into account any franchise rights or earning capacity of the properties, is estimated as follows: Chicago City Railway Company, about $12,000,000; Chicago Union Traction Company (not including Consolidated Traction Company), about $15,000,000.

XIII. NEED FOR REGULATION OF TEAM TRAFFIC.

At the present time team traffic interferes with street cars to an unwarrantable extent. A reasonable regulation of team traffic is essential to the improvement of street car service.

XIV. THE UNION ELEVATED LOOP PROBLEM.

The junction points are the ultimate limiting factor of the capacity of the Union Elevated Loop. At the present time, however, the platform stations are the limiting factor. The first and simplest way to increase the capacity of the loop is to lengthen the station platforms so that two trains can load and unload to a station at the same time. When the capacity of the junction points is reached, added facilities can be provided by building stub-end terminals just outside the loop. The terminal capacity of the loop could be increased by dividing the present loop into four smaller loops, but presumably there would be public objection to such a plant, because it would involve encumbering more downtown streets with elevated structures, and it is, therefore, not recommended. The ideal solution of the elevated loop problem would be to utilize the loop structure as sections of through routes between the different sections of the city.

Experience With a Third-Rail Road in the Open Country.

By Charles Esselstyn.

When the Albany & Hudson Railway and Power Company completed its third-rail line, 36 miles long, between the cities of Albany and Hudson, and extending through a dozen villages and the city of Rensselaer, there were many who prophesied that for summer outings the road would prove a pleasant novelty and a picnic success, but that with winter weather the inevitable snows and sleets and landslides, as the track runs through a score of deep cuts and over a dozen newly built embankments, it would meet its Waterloo. Many of these Cassandras anticipated open cars and cooling breezes, and failed to realize that a railroad was being born, and not a city trolley system. They had hoped to climb into the back seat for a smoke, or to enjoy a chat with a friend, forgetting that their cigars would be blown from their mouths and their hats from their heads, when the power was on and the shoes were in place. They did not know that open cars had no right on a road where from 40 to 60 miles an hour was frequently the speed. When the opening day did come, when the big cars, to all appearances like the railroad coach, began a regular schedule, the city folk of Albany and Hudson, and the country folk of the adjoining counties of Albany and Columbia, began to appreciate that this 36-mile third-rail system was no toy, to be used merely for a picnic or an evening ride, but a real live railroad, built for business and calculated to make business. Instead of trolleys running at the pleasure of the motorman, they found a railroad time table which the descendants of the Dutch settlers gradually learned could be depended upon. Admiration followed amazement, and the road took its place as a real something to be used as a means of transit, and not as a target. But the Cassandras were not through. "Wait until the snow comes," they said, with the same confidence that the original had displayed in foretelling the troubles of Troy.

The third rail cars soon acquired a reputation for regularity, and to-day the company claims to run nearer to its schedule, with a smaller percentage of late trains, than any railroad, steam or electric, in this or any other country. And then the snows did come, and they have been coming ever since, but the interference with the schedule has been slight. A huge rotary plough and an ordinary one furnished the company's equipment to meet the white stuff which often lies a foot and a half deep on the levels and drifts to any depth in the cuts and on the open. The rotary has never been out of the car barns. At the first sign of storm the ordinary plough is prepared for work and after a few thin inches have fallen, it is started on its journey up and down the track. On December 13, when the railroads in the vicinity of Albany were blocked and the New York Central trains were six hours late, the Albany & Hudson kept its schedule to the minute, and all of that Sunday it was the only dependable means of communication between Hudson and Albany.

"But wait for the *sleet*," said the Cassandras, "then you will see the system go out of business." Sleet and rain which freezes as it falls was what the management feared. Thousands of dollars had been spent, it is said, in experimental investigations for the discovery of some successful plan with which to fight this common enemy. At last the management, despairing of the advice of experts, prepared a cast-iron block with blades, which was attached to the car just ahead of the front shoe; this was manipulated by air pressure, which received its power from the same air that controlled the brokes. It could be worked by a mere grip of the hand, pressed hard upon the rail, or elevated. The knives were set on the bias to the slightly raised third rail and were followed by a stiff brush. The first rain that fell and froze took the company unawares and there was a brief two-hour delay all along the line. From that day to this, that record has never been repeated or approached. Although there are some slight delays under abnormal circumstances, they arise from the fact that but two cars in the company's service are as yet equipped with the knives, and upon these two falls the duty of keeping the third rail free from ice. In the winter the service is only hourly, so that before the car second to the one with the scraper gets fairly on the line it sometimes happens that the rain has again taken hard hold of the cold third rail. If every car was equipped with this device or if the service was on a shorter headway, there would be no question of the thorough efficacy of the invention in use on this road, and the delays of a few minutes which now arise would be entirely done away with. The car with the blades makes its time, the car following does, but the car an hour after these sometimes finds the rail with a fresh coating of this cold varnish which cannot be shoveled or brushed off, and only succumbs to the knife. Dr. Lorenz's methods would fall short in this crisis, which needs something lethal.

The practical working of the road under adverse conditions has driven the prophets of evil to the pawnbroker. They realize that the third-rail system between Albany and Hudson differs materially from those run by "hot air" on the products of a wood pulp mill. With the rest of the country people, they are learning that it is quite safe to set one's watch by a third-rail train, and that even on days when the rain is freezing and the steam trains are falling behind time, there will not be much detention on the electric system, where the untutored farmer's sons control the power and collect the fares, and the station agents and managers have not even the stimulus of the bustle of a big city to urge them to the mark.

A block system, it may be incidentally noted, has recently been installed, which, while not electric, works satisfactorily and seems guaranteed to prevent rear end collisions. By it no train can leave a station until the station master has been notified of its predecessor's arrival at the next station and in case of the absence of the station master the conductor must call up the train despatcher at Rensselaer by telephone, with which each station is equipped, and receive his permission to proceed. The road will be double tracked next spring from Electric Park, which is midway between Albany and Hudson, to Albany, thus enabling it to increase its summer service, which was tested to its capacity last season.

Besides the passenger traffic, the management has to take care of a large freight business that includes carrying farmers' products to market and the outputs of a score of mills, which sustain the thriving villages along the railroad's route. The installation of the third-rail system revolutionized this trade, gave an increased value to the farm lands, and an invitation to manufacturers that is being rapidly accepted. How they managed before is now the wonder of those dependent upon it, and while mishaps have come, as they must to all enterprises going into a new field, the Albany & Hudson Company is doing a mighty work in building up and making stable the country through which it passes. It is working out its own salvation in summer and in winter, in sunshine and when the sleet freezes, in a manner calculated to give it a prominent and lucrative field to live on and thrive in.

Trolley Mileage in Connecticut.

The annual report of the Connecticut Railroad Commissioners shows that during the last seven years trolley mileage in Connecticut has grown from 317 to 517 miles. The capital stock was $8,604,240 in 1895 and $23,571,248 in 1902. The earnings were then $2,232,051, while now they are $3,937,771.

The Requirements of Machine Tool Operation With Special Reference to the Motor Drive.*

By Charles Day.

In opening the subject Mr. Day dwelt on the fact that machine tool operation by motor drive in any case involved not only intelligent analysis but also a broad view of the subject that the relative importance of the various factors be evident. It is easy to become so interested in a given detail—the motor drive as an example—that its true position in the general scheme is entirely lost sight of.

As example of such an analysis, Mr. Day considered a plant composed of foundry, machine shop and office, manufacturing complete machines from the crude material, and the chart of Fig. 1 was presented as enabling the relative data to be quickly grasped, the chart showing the distribution of cost of the finished product of the plant in question.

It would be easy to analyze still further the fixed charges, labor and material shown above. The former can be divided into insurance, depreciation, repairs, power, etc. Labor may be subdivided into productive and non-productive, and material into proportion of steel, cast iron, brass, etc. The more subtle factors, such as sanitary conditions and light, must also be constantly borne in mind. Of all these factors only the equipment and means which may be necessary to enable the workman to use it to its full capacity will be considered. We will start in the pattern shop or forge department, and see that everything is done to facilitate future handling and machining. A lug on a heavy casting to make it easy to catch hold with the crane, or in some cases additional metal to remove, to prevent the possibility of working too close to the chilled scale, will frequently effect more saving than is possible by other means.

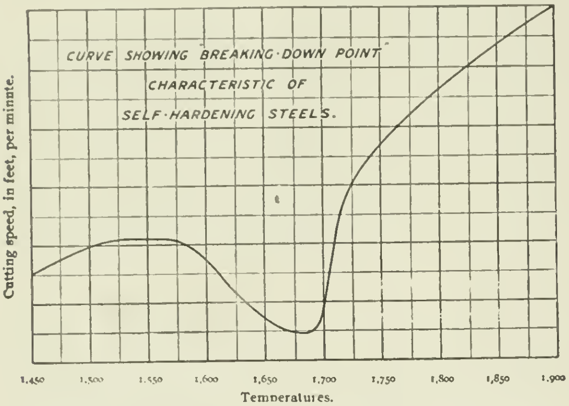

FIG. 1.—CURVE SHOWING PRINCIPLE OF TAYLOR-WHITE PROCESS OF TREATING TOOL STEEL.

The remarks that follow will relate to shops doing a general class of work, as it is much easier to arrive at a high standard where parts are duplicated in large numbers. In the latter case we can profit by experience, while in the former we must anticipate each move. In one instance machines are designed for a given duty, while in the second they must be adapted to a certain class of work, and as a result seldom handle any job to the best advantage.

Referring again to the example under consideration, we will suppose the castings have been received in the shop and the method of machining determined upon. A certain amount of metal has to be removed and a definite finish is required, our object being to accomplish this result in the least possible time, or, rather, at the least expense. Instead of taking any given example the course of reasoning will be outlined which must be applied before we can intelligently answer this question.

The tool steel is the keynote to the situation, and a complete knowledge of its characteristics and possibilities forms the starting point for all further work. Carbon steel will give a finer finish on steel than the air-hardening variety, and for form cutters is still largely used. Where heavy roughing cuts are possible, air-hardening steel has unquestionably replaced it; and, in fact, the recent developments in the processes of hardening have been the direct means of revolutionizing old methods of machine tool design and so-called shop practice.

We must ever bear in mind that "best shop practice" should mean "arriving at the desired result at the least cost," and can be used in a relative sense only. If drilling with a feed of 1-16 of an inch per revolution gives the desired finish in much less time, it is certainly good practice, and if under these conditions we find a sharp point on the drill is not essential, so much the better.

The influence of the Taylor-White process has been so revolutionary in character that it may be dwelt upon for a few moments. The underlying principle of this discovery is clearly shown on the accompanying curve, Fig. 2, which is plotted from values of cutting speeds and temperatures. It will be seen that this curve rises from the zero point until 1,550 degrees are reached, when the cutting values suddenly fall off. The most interesting and valuable fact that these values again increase if the hardening temperature is carried beyond the "breaking down point," was the result of work just referred to, which established the superiority of steel treated in this way over Sheffield Mushet.

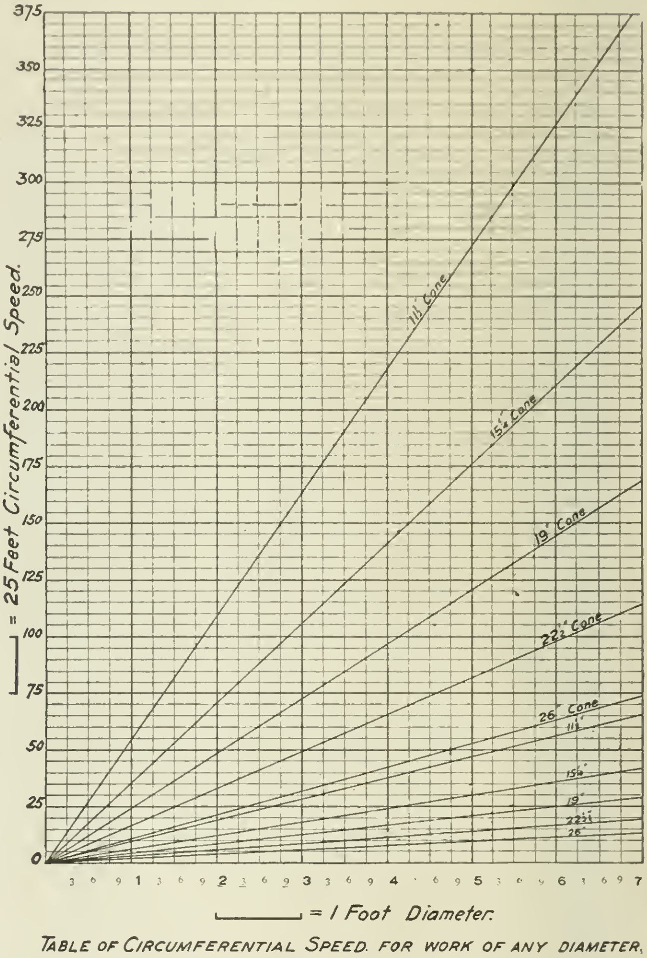

FIG. 2.—CHART USED FOR DETERMINING CUTTING SPEEDS.

An exact knowledge of the cutting speeds of which these tools will permit when machining different materials, and the power to pull various cuts under all conditions, are absolutely essential if we wish to properly design machine tools, or use them to their full capabilities in actual service. The value of this information is now being realized by several of the machine tool builders, and the results are already being felt in the shop in the form of much more efficient machine tools.

In driving machine tools the requirements to be met are the following: A machine having been designed for a given duty, its maximum and minimum speeds are limited by the character of the work it will do; the number of speeds is determined by the character of the metal machined, and the uniformity of the tool steel and the power required is fixed by the most severe conditions it must meet.

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* Abstract of a paper presented before the December meeting of the New York Electrical Society.

For the average machine tool we do not think present conditions demand a closer speed regulation than 10 per cent., as no good means has yet been reached for determining the character of the metal, and in the average shop little is understood about the relations existing between feed, speed and depth of cut for various materials.

There are two sides to the question, viz.: the refinement of speed required by the various elements with which we are dealing and the possibility of using this refinement to its full efficiency in actual practice. The first set of requirements may demand a speed regulation of 10 per cent., while the second would indicate that it is extremely difficult to use it to advantage in actual practice with present facilities.

For certain classes of work slide rules based upon the empirical formulæ referred to above seem to us to be the only solution to the problem. By means of these most ingenious rules it becomes possible to instruct the workmen how to do the work to insure maximum efficiency, the feeds, speeds and cuts all being dictated indirectly by the positions of the various handles and gears controlling these factors. These slide rules must be in the hands of a force of men who are perfectly conversant with machine shop work and able to lay out the course any particular piece should pursue in going through the shop. The cutting speed for steel is determined by the tensile strength and elongation, while for cast iron the problem is still more complex. The hardness is not only affected by the chemical composition, but the method of cooling and size of the casting, so that we seldom find two castings that will permit of machining at the same speed.

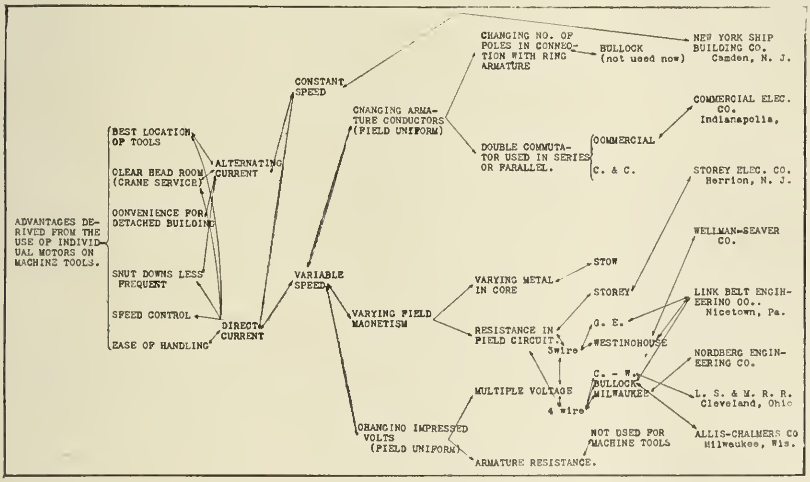
ADVANTAGES DERIVED FROM THE USE OF INDIVIDUAL MOTORS ON MACHINE TOOLS.
BEST LOCATION OF TOOLS
CLEAR HEAD ROOM (CRANE SERVICE)
CONVENIENCE FOR DETACHED BUILDING
SHUT DOWNS LESS FREQUENT
SPEED CONTROL
EASE OF HANDLING
ALTERNATING CURRENT
DIRECT CURRENT
CONSTANT SPEED
VARIABLE SPEED
CHANGING ARMATURE CONDUCTORS (FIELD UNIFORM)
CHANGING NO. OF POLES IN CONNECTION WITH RING ARMATURE
BULLOCK (not used now)
NEW YORK SHIP BUILDING CO. Camden, N. J.
DOUBLE COMMUTATOR USED IN SERIES OR PARALLEL.
COMMERCIAL
C. & C.
COMMERCIAL ELEC. CO. Indianapolis,
STOREY ELEC. CO. Herrion, N. J.
WELLMAN-SEAVER CO.
VARYING FIELD MAGNETISM
VARYING METAL IN CORE
STOW
STOREY
RESISTANCE IN FIELD CIRCUIT.
3wire
G. E.
WESTINGHOUSE
C. - W.
BULLOCK
MILWAUKEE
LINK BELT ENGINEERING CO.. Nicetown, Pa.
NORDBERG ENGINEERING CO.
L. S. & M. R. R. Cleveland, Ohio
ALLIS-CHALMERS CO Milwaukee, Wis.
MULTIPLE VOLTAGE
4 wire
CHANGING IMPRESSED VOLTS (FIELD UNIFORM)
ARMATURE RESISTANCE.
NOT USED FOR MACHINE TOOLS

Fig. 3.—Principal Advantages and Various Methods That May Be Adopted for Driving Machine Tools.

It is possible, however, by careful observation and experiment, to ascertain approximately for a given shop the cutting speeds of which various jobs will permit, so it is absolutely essential to have some good means of determining it. It is impossible to judge the speed by eye, even where a man works on the same tool continuously; nor will the character of the chip when cutting cast iron indicate the proper speed.

As a means of remedying this difficulty charts such as that of Fig. 2 enable the men to ascertain the cutting speed from a knowledge of the diameter of the work and location of belt and gears. Great difficulty is found, however, in making the men sufficiently familiar with these charts to use them to advantage. The antagonism when introducing new methods or machines, so often evidenced by the men, is largely eliminated when the innovation is so extremely simple that its use can be grasped by the men at once. A much better scheme than the charts is the use of tables designating the spindle speed for each point of the controller or position of the belt, as feeds are frequently enumerated on lathes, etc.

When slide rules are not used a "speed tally" on each machine would be the only proper way of enabling the workman to know the speed at all times. No skill is required in its use or time lost in making the reading. A tachometer suitable for this work would be a desirable addition.

The most characteristic and valuable features of the electrical systems are the elimination of complication and physical effort in handling the machines and the direct advantage resulting from this cause, may be very far-reaching. The inefficiency of the belt and step cones, as a means of machine tool driving, even when installed in such a way as to permit of good crane service, is too well understood to demand much consideration here. The motor is an equally poor investment if, after its introduction, the shop is run along the same old lines, and for this reason an understanding of its possibilities is most essential. This applies to the motor on individual tools, and, although the remarks are general in character, it is understood that its use is not advised on every machine.

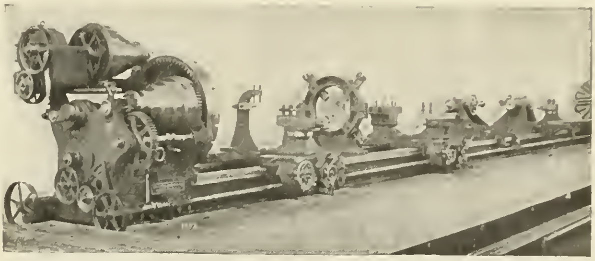

Fig. 4.—Lathe Driven by Induction Motor.

The accompanying chart, Fig. 3, shows at a glance the different methods on the market for motor-driving machines. The constant-speed motor, particularly of the alternating type, is so simple in character we naturally turn to it as a possible solution to the problem. It lacks, however, the two great essentials, ease of handling and speed regulation, and all attempts to supply these shortcomings by mechanical means have so far proved unsatisfactory.

The induction motor is a source of power, just as the line shaft, and the principal advantages resulting from its use are clear overhead room, independent location and possibly a saving in power. These features are all embodied on the lathe shown in Fig. 4, but the inefficiency of the outfit from other causes makes this application out of the question. The motor is handled from the head stock, and as a result the ease of handling is far inferior to the old belt and shifting pole. The heavy double belt of such short centres must be tightened to such an extent that much time is lost in shifting, and in many instances it would not pay to do so.

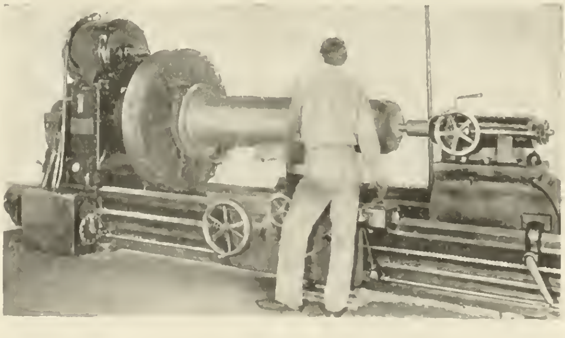

Fig. 5.—Lathe Driven by Variable Speed Motor (Four-Wire System).

When the operator is working at a distance from the head stock on a job where the tool is liable to dig in and cause trouble, it becomes necessary to have a helper at the switch to shut down the motor upon signal from the machinist, the inefficiency of such an arrangement being self evident. In comparison with this lathe another illustration (Fig. 5) is given, showing the operator varying the speed. The control is always under the hand of the machinist, 42 speeds ahead and six reverse being possible in a range of 6 to —. The controller is shown attached to the bed under the head stock, and the 4 pole fused switch of specially heavy design is bolted to the head casting. The motor is a standard type, and can be replaced on short notice in case of accident.

The variable speed counter shaft would seem to be a natural solution, but Mr. Day says that, speaking generally, all such devices that depend upon power transmission through frictions, are unsatisfactory for general adoption in the shop, and in most cases the method of handling is not comparable with the multi-voltage systems. A variable-speed countershaft that is to meet with the success anticipated by some engineers must be handled from a master control, and in fact do everything that is possible with the highly perfected electrical systems that are now being installed.

As the ease of handling and close speed regulation cannot be efficiently obtained with the constant speed motor, attention will now be given to the variable-speed type.

Fig. 6 shows the schemes of voltages adopted by the principal manufacturers of multiple-voltage apparatus, one sketch showing a three-wire system and the other two four-wire systems, the voltages being arranged in geometrical and arithmetical progression respectively.

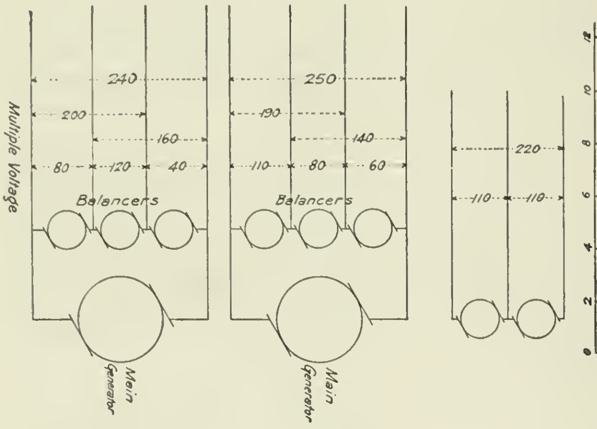

FIG. 6.—SCHEME OF VOLTAGES ADOPTED BY MANUFACTURERS OF THREE AND FOUR-WIRE SYSTEMS.

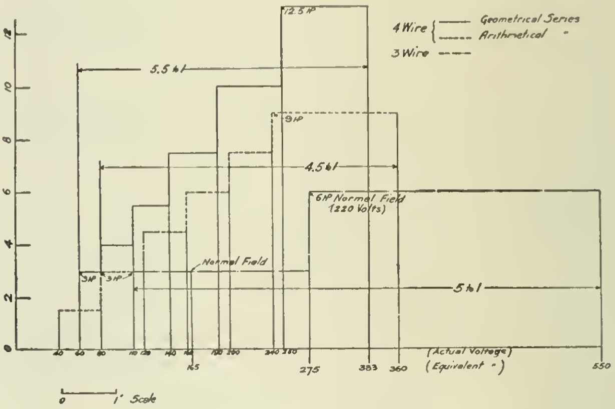

FIG. 7.—HORSE-POWER CURVES OF THREE AND FOUR-WIRE SYSTEMS.

In the first instance but two voltages are used, while in the latter cases, six are possible. Intermediate speeds are obtained by inserting resistance in the field, 100 per cent. variation being necessary in the three-wire systems, as compared with 30 per cent. in the four-wire. In either case the horse power that the motor can develop satisfactorily is directly proportional to the voltage.

A comparison of the underlying principles of these systems is clearly shown by the accompanying curves, Fig. 7. It is interesting to note the relative sizes of motors required to obtain a given range, but in this connection we must not form a hasty conclusion, as the cost for a given horse power depends upon the system adopted. That is, with the three-wire scheme there may be a variation in speed of 150 per cent. by field weakening alone, a special field winding being necessary. The satisfactory operation of these systems can only be ascertained after experience with the apparatus in the shop, so we can readily see how many considerations must be looked into before a final decision as to their relative merits can be reached. In a desirable system, standard motors should be utilized, the controller operated by a single handle, and the entire range of speeds passed over while the work continues.

The range of motor speeds is a most important factor, as the first cost of the motor, the cost of the installation and the efficiency of the outfit are all dependent upon it. It is impossible to lay down any fixed rules to base our discussion on, as each machine is a different problem, and must be treated as such. For general machine shop work we have found that a range of 4 to 1 to 6 to 1 adapts itself to all conditions fairly well, but in every case where old tools are being equipped we must be satisfied with a compromise.

We must study present conditions and in each case see how much they will be bettered by the use of a motor. Crane service alone may be ample reason for its adoption, or, again, where the intelligence of the men or facilities offered, make it possible to run each tool to its limit. We must ever remember that the belt drive, as applied to most machines, does not permit of running to the tool limit on the average job, while the motor, if properly installed, offers the opportunity. It can do nothing more.

If we cannot accurately figure beforehand what economy will result from the use of the motor, it may at least be of interest to investigate the records of shops who have made such installations. We must, however, be very careful not to draw too hasty conclusions as to the merits of the apparatus from such investigations, as the equipment is utterly useless without the management and organization behind it.

In the shops of the Link-Belt Engineering Company, an accurate record, extending over five years, gives the pound cost of machining, and the reduction in this figure during this period gives a more accurate gauge of the economy effected than any other method. These figures were compiled by a disinterested party, and after taking into account every detail which might in any way introduce an error, and allowing the men a decrease of 10 per cent. in time, with the same wages per week, a clear saving of 30 per cent. on the entire labor bill was shown.

The problem is such an involved one that it would be decidedly wrong to attribute this sum to any direct cause, it being the result of better management, equipment and understanding of its possibilities. It is needless to say that this saving is vastly in excess of the interest and depreciation of the entire expenditures necessary to bring about the result.

The successful engineer must ever keep foremost in his memory the utility of the apparatus he is designing, the importance of the management and organization, and the great value of anything which simplifies these underlying factors of all manufacturing establishments. To quote the convictions of one of the greatest managers, who said, in substance: If you swept from him trade, factories and finances, but left him his organization of captains, that minimum cost could be secured throughout every detail of mining, shipping, refining and manufacturing, so that instead of doing part excellently and some badly, in a few years his cost advantage would restore his trade, plant and facilities. So certain was he others would do both well and ill, not well throughout.

New German Cable Ship.

The new German cable steamship *Vulcan* was launched at Stettin, Germany, on December 30. The following dispatch was received by Max Guillaume, the chairman of the company, from the Kaiser on the occasion of the launching: "I hope the new German Atlantic cable will contribute to further strengthen the good relations between Germany and the United States."

A Year's Output of Bell Telephone Instruments.

It is stated from Boston that the net output of the American Telephone & Telegraph Company for the year ended December 20, 1902, was the largest in the history of the Bell telephone system and amounted to 624,714 instruments. The net output last year was larger than the total number of instruments outstanding in 1894. The rate of growth was, however, less than in two former years, 1901 and 1899, being 25 per cent. last year, against 29 per cent. in 1901 and 40 per cent. in 1899. We note also for the month of December a net decrease of 7,070 instruments in the output.

The company's record of total instruments outstanding for the past ten years ended December 20 follows:

	Total outstanding.	Increase.	% Increase.
1893	566,491	13,771	2.4
1894	582,506	16,015	2.8
1895	674,976	92,470	15.8
1896	772,627	97,651	14.4
1897	919,121	146,494	18.9
1898	1,124,846	205,725	22.3
1899	1,580,101	455,255	40.4
1900	1,952,412	372,311	23.5
1901	2,525,606	573,194	29.3
1902	3,150,320	624,714	24.7

In the five years ended December 20, 1897, the number of instruments outstanding increased 66 per cent. In the five years ended December 20, 1902, the number increased no less than 242 per cent. The remarkable growth in the last five years has been owing to the marvelous business activity of the country and the popular favor into which the telephone has recently come. The high-water mark of rapidity of growth was reached in 1899, although the net output of instruments was larger in the past year. The lower rate of increase in 1902 indicates possibly the effect of independent competition, and that the phenomenal growth of the past few years will be succeeded by a period of slower but still steady growth, as in 1892-97. The slowdown may, however, be offset by the cheapening of the cost of service, by which means the company hopes still further to extend the use of the telephone. In New York City, for example, the Bell system is growing at a tremendous rate.

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Mr. Marconi and His Critics.

Note was made in the newspapers last week of the criticisms offered on Mr. Marconi's recent work and its commercial status; particularly the remarks of Sir W. H. Preece. In a public reply to these comments, Major Flood Page, of London, director of the Marconi Wireless Telegraph Company, of London, and of kindred interests, says: "Sir William is reported to have said that there was nothing conclusive given a year ago by Marconi to show that the signals across the Atlantic, made by the wireless system, were not due to atmospheric conditions. There was nothing conclusive about those signals, except the word of Marconi, which, though not good enough for Sir William, was sufficient for Mr. Edison, Prof. Bell, and Prof. Pupin. It should have been sufficient for Sir William Preece, who knows Mr. Marconi well, and who also knows that Mr. Marconi has never had to withdraw a single statement that he ever made to the public.

"As for Sir William's statement that the cable companies are not disturbed with reference to the wireless possibilities, I will say that only a short time ago in America, in talking with one of the best-known men in England, connected with the cables, this man said to me: 'Yes, you Marconi people are playing "Old Harry" with our cable companies, and have reduced the shares most appreciably. I will say, though, that when they fall a few points lower I shall put all the money I can scrape together into cable stock, as I believe it will be worth the reduced price to which they are rapidly falling.' This man is as well known to Sir William Preece as he is to me, and instead of being one of the 'old women' shareholders, to which Sir William refers, he is a competent electrician who has assisted and is still assisting the cable companies to the best of his abilities.

"As for the reliability of the Marconi messages, I will say that only a few days ago Mr. Marconi sent a long message to his Majesty King Victor Emmanuel of Italy. The message was entirely in Italian, was received at Poldhu by operators, none of whom were familiar with that language, and was delivered to the King, absolutely correct and without a mistake in it. On receipt of the message the King sent an answer signed by his own hand, which was received at Cape Breton by Marconi. What more conclusive proof of the reliability of the Marconi system could any one wish?

"Sir William also says that it is possible to tap every message. Supposing, for the sake of argument, that it is possible to tap every message; have not telegraphic codes been established, and as an officer in the British Navy told me not very long ago, it is quite possible, were it necessary, to change the code every day. Even if at present it is easy to tap the messages of the man of whom Sir William is so evidently jealous, there can be no doubt that the genius of Marconi, which has already overcome so many difficulties successfully, will be able to solve a problem which is not near so difficult as Sir William Preece asserts.

"It is true, of course, that the cables, with their fifty years' experience, can send a message more quickly than can the Marconi system, but they cannot send them more accurately. Mr. Marconi, in his recent address before the Royal Institute of England, said that with his magnetic detector he could transmit thirty words a minute. While this will not bear comparison with the speed attainable by the cables, it will nevertheless compare quite favorably with the speed of the cables fifty years ago, which I believe was about one word a minute. We are not foolish enough to imagine that we shall be able to compete for some time to come in either speed or in the amount of our business with the well-established and wealthy cable companies. We do believe, though, that there is room for us as well as them, and that we shall be able in a time, measured by months, to have in operation a successful Marconi wireless telegraphic service across the Atlantic Ocean."

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Underground Electric Road for Boston.

The fact has not attracted general attention that the citizens of Boston have accepted the act formulated to provide for a new underground elecric railway system. This act requires that a contract for the use of the tunnel and subway should be made by and between the Boston Transit Commission and the Boston Elevated Railway Company. Such a contract was signed September 25, and many of its items are interesting. The term is twenty-five years from the beginning of the use of the tunnel, and the annual rental is to be 4½ per cent. of the net cost of the tunnel and subway respectively, including all expenditures incurred in acquisition and construction—damages, expenses, salaries of the commission, and interest at 3¼ per cent. per annum on the debt incurred in construction prior to the beginning of use. Such net cost shall also include amounts expended for preliminary investigations and for alterations in the existing subway and approaches thereto necessary to readapt it to the use of surface cars. Deductions shall be made from the cost for the proceeds from sales of property and for a fair valuation of lands and structures no longer needed for the purposes of transportation.

The act empowers the Boston Transit Commission, which has had charge of the construction of the earlier subways and the East Boston tunnel, to build a system of tunnels and subways so designed as to be adapted for the accommodation of two tracks especially for use by elevated cars or trains and two tracks for surface cars, with the necessary approaches, stations and other appurtenances, including connections with the East Boston tunnel and the existing subway. The new tunnel and the new subway may be built entirely separate or may be connected, as may be decided by the commission to be most economical and convenient for traffic. The exact locations have not been determined but are limited to a territory averaging about 1,200 feet in width easterly from the existing subway, excepting that north of Scollay Square the zone of location extends to the westward of the existing subway a similar distance, as well as to the eastward.

The act requires that the construction of the tunnel shall be begun immediately and of the subway at such time after the expiration of one year from the completion of the tunnel as the Commission and the Boston Elevated Railway Company may agree upon, but it is intended to push the construction of the subway also.

Borings have been made to determine the character of the subsoil under Washington Arch and other streets where the subway may run, and a field party has been put at work to survey and test the foundations of the buildings in the district which may be affected by the construction of the new subway and tunnel. Each of these new underground thoroughfares will have double tracks, and it is reported as cheap to build them separately as to construct a double-deck subway. The matter of cost will, however, be subordinated to public convenience. Contracts will probably be let as soon as the preliminary work is finished, and construction work actively pushed in the early spring of 1903. Although the commission has an additional year in which to begin the construction of the subway for surface cars, it will probably be started at about the same time as that for elevated trains.

Upon the completion of the new subway there will be three underground rapid transit trunk lines traversing Boston's business district from north to south.

◆

New Telephone Patents.

Of the patents of the issue of December 23 of interest to the telephone field two did not come to hand until too late for consideration in connection with the other telephone patents of that issue. These cover respectively a new type of sneak current protector and an improvement in cable hangers.

The new protector is the invention of E. A. Stevens and consists of a thermal or heat coil wound upon a metallic spool, to the upper surface of which there is attached by a suitable low fusing alloy a metallic spring. The circuit to be protected is carried through the heat coil, soldered connection and spring in the ordinary manner. When an excessive current flows and the alloy is melted, the spring flies away from the spool, thereby opening the circuit. The chief merit in the invention is its adaptability to almost any of the present designs of fuse holders, as is well shown in Fig. 1, which shows two of the many styles of mounting.

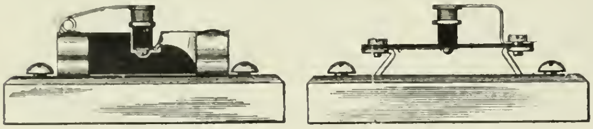


FIG. 1.—STEVENS CIRCUIT-BREAKER.

The improved cable hanger or cable clip is of the flexible zinc band type, various modifications of which type have followed each other in rapid succession of late. This latest design is the invention of Frederic P. Auxer, of Cleveland, O., and resembles in general appearance the well-known "Boston Cable Clip." The hook and link, however, are herein so designed that they form a tightening and locking device so that when the hanger is once in position the zinc band fits the cable very snugly, being locked so that it cannot loosen. The object of this is to overcome the unruly tendency that clips of this general type show to becoming displaced along the cable and gradually working into groups.

Coming now to the Patent Office issue of December 30, there are found six telephone patents, of which the Kellogg Switchboard & Supply Company, of Chicago, are the assignees of no less than four. These embrace two special designs of telephone receiver, both the inventions of Mr. K. B. Miller, and a new distributing board protector and its spring holder. These latter are the inventions respectively of William A. Taylor and William Kaisling. For convenience the two receivers will be considered together and as will also the two arrester parts.

Fig. 2 shows sectional views of both of Mr. Miller's receivers. In the receiver shown in the upper part of the figure a heavy diaphragm, perforated at its center, is formed across the rear end of the containing shell, and upon this diaphragm the terminal lugs of the receiver are mounted, the terminal wires of the receiver coils, heavily insulated, being carried out to them through the central aperture. Beyond the diaphragm a rounded cap, removably fastened to the receiver shell through the agency of screw threads, is arranged. This cap also has a central aperture, but in this case to admit the receiver cord. By this arrangement and design of the parts, there are no exposed metallic connections to give a shock to the telephone user or to be readily disturbed by him. Another special feature of this receiver is the enlargement of the receiver cord, plainly shown inside the cap, which enlargement serves to transmit all undue stress to the body of the cord, rather than to the electrical connections.

Almost the only claimed difference between this and the second receiver is that in the latter, instead of the terminal diaphragm being a portion of the receiver shell it is mounted integrally with the receiver magnets, the supporting cord fastening being now transferred to this diaphragm. The specified result of this is that in case of undue strain coming upon the receiver cord, such as when the receiver is dropped and the fall is stopped by the receiver cord, there is no tendency to break the hard rubber shell, all parts of it being removed from the line of stress.

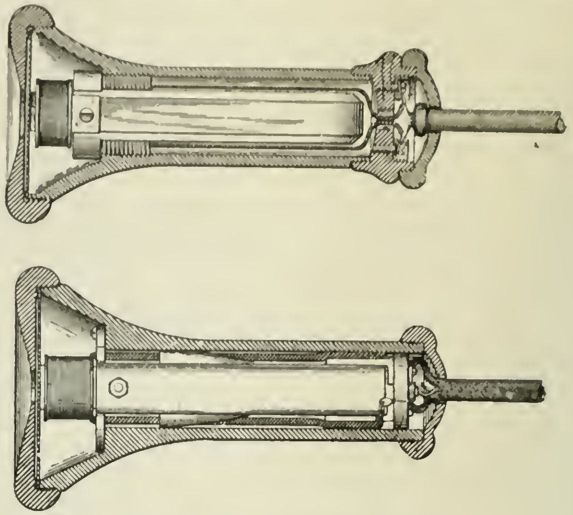


FIG. 2.—MILLER TELEPHONE RECEIVER.

The new distributing frame protector is well shown in Fig. 3, in which we have a plan view of an arrester bar and a sectional view of one of Mr. Taylor's thermal devices. In this latter device, instead of the coil of fine wire customary for such apparatus, there is provided a small cylinder of graphite or some similar refractory substance of high specific resistance. Both ends of this cylinder are copper-plated, and upon each is soldered by means of fusible alloy a small metallic cap. These metallic caps are adapted to engage the arrester springs, b^1 and c^2, as shown, these springs forming part of a group of eight springs, sufficient for one pair of complete protectors. Of these eight springs the two marked *a* are connected to the switchboard, while those marked *b c* are connected to the cable or outside wires. The springs *a* and *b* assume normally the position shown on the upper side of the arrester strip, but when the thermal device is inserted, they are pulled into the position shown below the strip. Thus the insertion of a thermal device puts this latter under a tensional stress and holds the point b^3 of the spring *b* away from the ground plate and the spring *h*. Now when an excessive current passes toward the switchboard, the graphite cylinder becomes heated, due to its high resistance, with the result that the fusible alloy melts and one of the caps is pulled from the cylinder. This opens the circuit toward the switchboard and grounds the wire from the outside, so that the excessive current may do no further damage. It also incidentally grounds the spring *h* and thereby operates an alarm to give notice of the open subscriber's line. Of course, the regular carbon block open space cutout is also provided for these protectors, *c c* being carbons, with the usual mica separator indicated between them. A very good feature of this device is the series of two con-

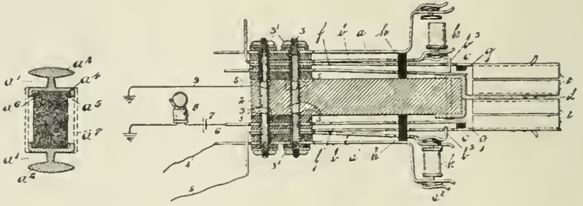


FIG. 3.—KAISLING PROTECTIVE APPARATUS.

tacts held together by fusible alloy, one of these at each end of the graphite. In case one contact sticks in any manner the other is in a position to operate. By this means the liability of a failure is materially reduced.

A fifth telephone patent of the issue under consideration is that granted to T. C. Knowles, and relates to the provision of a pivoted receiver arm for telephone sets, so arranged that while normally it hangs down in an out-of-the-way position, it may be raised to a nearly horizontal position, when it will hold the receiver in such relation to the transmitter that the telephone user must come close to the transmitter mouthpiece. The receiver arm is arranged in addition to control the hook switch mechanism, and as it is locked in position by a spring after using the instrument, one must remember to release the receiver. The device is really just the equivalent of the so-called hand microphone, except that it is self supporting and that the receiver is much more likely to be, so to speak, "left off the hook."

"Automatic Electric Exchange System" is the title under which Mr. W. R. Binkley patents certain improvements to the Strowger or similar automatic systems, whereby selective ringing party lines may be connected to such an exchange. The key to this invention lies in the fact that instead of special station designations, consecutive numbers are assigned to the various stations of the party lines. For example, the stations of two party lines would be designated by numbers, such as 1,255 and 1,256, or 6,820 and 6,821. Similarly, for four party lines, four numbers would be assigned, thus, 1,255, 1,256, 1,257 and 1,258, or 6,820, 6,821, 6,823 and 6,824. This method of designating is made use of by carrying the conductors of the line through points, first in one bank of contacts and then in the other, instead of as at present, where one bank of contacts is used exclusively for one side of the line. This may be better understood by reference to Fig. 4, wherein 1 and 2 are the two banks of contacts of a line selector, and *a b c d a' d'*, etc., are the contacts of a four-party line with stations S^1, S^4. Contacts *a* and *b* are connected in each case to the opposite side of the line from *c* and *d* of the same bank of contacts. Now if station *S*, shown in the upper part of the figure, has operated his selectors in a manner to leave the wipers *1* and *2* upon the contacts *a* and *a*, and if he then pushes his key, *12*, to signal, current will flow from the grounded battery *38* through the upper retardation coil *R* and thence through a readily traceable circuit involving the coil of the relay *E* through the line selector and the various preliminary selectors *B C D* to the ground *14*. This causes relay *E* to operate, performing thereby the usual functions of a ringing key and connecting the terminal marked + to the line wire L^1.

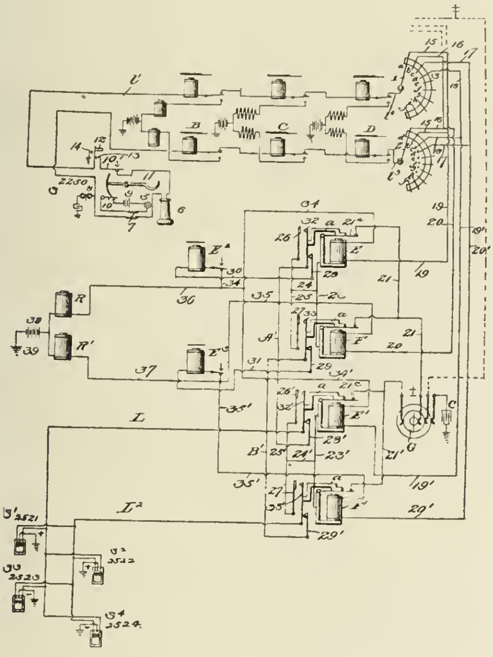


FIG. 4.—BINKLEY EXCHANGE SYSTEM.

This is designed by the inventor to ring the station S^1 only, but as the circuits are arranged by him it will ring both S' and S^3, for he has inserted a condenser *c* at the ringing generator ground, completely losing sight of the fact that a discontinuous pulsating current becomes alternating upon passing through a condenser. The principle of the invention is not, however, affected. If the wipers had been advanced to *b* b^1, and we will suppose the bell at S^1 only responded, relay *F* would have been brought into position to ring S^2, etc.

It is not quite apparent from the circuit drawing, but as a matter of fact the relays *E*, E^1, *F*, F^1, are so disposed in the circuits that they produce no effect upon the normal selective actions of the system. They do, however, introduce a decidedly objectionable feature in that for all calls toward a party line the windings of two of them are in the talking circuit.

CURRENT NEWS AND NOTES.

KING EDWARD'S TRAIN.—The new royal saloon train for King Edward and Queen Alexandria not only has electric lights in fixtures, electric fans and electric heating and cooking apparatus, it is said, but portable electric lamps adjustable to plugs and electric cigar lighters. All it now needs is electric propulsion.

ELEVATORS IN ITALY.—U. S. Consul R. Pearson, writing from Genoa, says: "American elevators, if once introduced here and elsewhere on the Continent, would quickly and surely supplant the cumbrous, uncertain and inefficient, machines turned out by the factories in Milan and in various parts of France. The houses in this city average seven stories in height. Elevators are greatly needed; the few that are installed were purchased in Milan, and the contrivances are almost comically defective. They take passengers upstairs at a snail's pace and cannot bring them down at all."

CRITICISM ON TROLLEY CARS.—In a letter addressed to the Merchants' Association of New York Dr. George A. Soper, sanitary expert, speaking of the modern electric car of the type used in New York says: "It seems to have been built with the idea that the public would not crowd at all or would be willing to crowd like cattle. The small proportion of space devoted to seats as compared to that devoted to standing room, the broad platform, the central location of the electric lights, and the want of an adequate ventilating system, are all evidences that the cars are not well adapted to carrying the number of people who ride upon them." All of which sounds true, but the great trouble is to remedy the general conditions that necessitated the creation of such cars.

POETRY IN LIGHT.—Discussing stage effects, Mr. David Belasco, the famous playwright, says: "All the miracles that electricity has wrought, all that it may yet achieve, will be seized upon by the dramatist. Let him have only soul and imagination; electrical science will step in and paint his pictures for him. Sunsets, drifting clouds, sandstorms, flowing rivers—these, and more, have been reproduced to the life. If so much can be done with electricity in its comparatively undeveloped state, who shall say to what ends this marvelous force may not be carried in its uses on the stage? Painted scenery, as we know it to-day, may become a thing of the past. The whole stage picture may be a light picture, and the scenic artist may yet be required to do with lights all that to-day he does with brushes and paints."

PRANDIAL ELECTRIC REPTILES.—As though modern nerves had not already enough to jar them, it is stated that a woman with a mania for the curious is planning a "reptile" dinner with which to dazzle her guests. In the center of the table she has planned to have a miniature lake on which will float water lilies and their pretty green pads. About the lake and scattered all over the table will be a profusion of sinuous reptiles, with an occasional frog and brilliant beetle to enhance the effect. These odd creatures will be gorgeous in hue and big as to eye, for it is in the grotesque bulging eyes that the electric lights will be placed to glisten upon all beholders. In the bodies of the snakes other lights will be concealed to illumine their whole scaly lengths. Combinations of colored lights and seemingly live crawling things will produce a startling effect. It has been suggested that the snakes and things may be too realistic to please her masculine guests. For them it will be literally a case of "seeing things at night."

NORTHWESTERN ELECTRICAL ASSOCIATION.—The regular winter convention of the Northwestern Electrical Association will be held in Milwaukee, beginning Wednesday, January 21, 1903. Secretary Thomas R. Mercein, 85 Michigan Street, Milwaukee, announces that an interesting programme is in preparation, but that all the details have not been completed as yet.

BUILDING A ROAD BY NIGHT.—The plan of building a railroad by electric light is a novelty that will be introduced by the Santa Fe Company when it begins construction of its cut off to connect its Pecos Valley line with its main line in New Mexico, within two months. Six hundred men will be put to work in Abo Pass canyon and a large electric light plant will be installed at its mouth, so that men can work at night as well as day.

ELECTRICAL INSTALLATION AT INDIAN DURBAR.—On several occasions, in describing the preparations for the great Indian Durbar, recently held at Delhi, the correspondent of the New York *Sun* has made special reference of the electrical features. In a recent dispatch he pointed out that the electrical installation was the largest ever known, for a temporary affair. The overhead wires weighed some 60 tons and there were 50 miles of underground cable.

"THE DAILY MIDOCEAN" may be the name of a daily newspaper soon to be issued on one of the Cunarders, giving daily news of all kinds received by Marconi system. It is said that the Cunard offices here have been besieged by editorial candidates. A somewhat similar scheme was unfolded in these columns a few months ago, as to anchoring a steamer off the Scilly Islands, to send and receive news, telegrams, etc., with other passing steamers, by Marconi messages.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Miss Harriet Billings, assistant secretary of the Association, writes us: "I take great pleasure in advising you that this Association begins the New Year with a total active membership of 445, an increase of 264 since the Cincinnati meeting. I feel sure that a great deal of this growth is due to the kind manner in which the Association has been supported by the electrical press and I wish to thank you for courtesies extended during the year."

NERNST LAMP GLOWER.—A defect of a solid Nernst lamp glower is its tendency to break down under currents of considerable volume, by reason of the central portion of the glower becoming fused by the current. In a patent issued December 30 to Henry Noel Potter, a glower is described which is designed to obviate this defect. The glower is in the form of a hollow tube, with the terminal wires twisted about the ends and covered with a pasty material similar in composition to that of the glower proper.

DIGEST OF TELEPHONE PATENTS.—A digest of all United States telephone patents issued to December, 1901, compiled by Mr. Jas. T. Allen, will soon be published. The work will be issued in three volumes and comprise several thousand pages of drawings, briefs and letter press. It will also include all of the reissues, designs and trade-marks granted during the same period, as well as a complete list of all the references cited, and the interferences and decisions incident to the course of the applications through the Patent Office.

TELEPHONY IN PARIS has always been pretty bad. A league of telephone subscribers has been formed in Paris, under the presidency of M. Tissot, the distinguished French chemist, for the purpose of forcing the Ministers of Posts and Telegraphs to improve the service. Several lawyers and barristers have joined the league, their intention being to enter an action against the Government whenever the neglect is flagrant or causes grave damage. M. Bérard has already promised to increase the number of female telephonists, and to make other beneficial reforms.

AUTOMOBILISTS IN FRANCE.—Mme. Reville, who recently received a prison sentence in France for fast automobiling and lost on her appeal to a higher court, has appealed to the President of the Republic for pardon. M. Ballif, president of the Touring Club de France, has made a protest to the Minister of the Interior against the undignified treatment of chauffeurs sent to prison for various alleged crimes. The Minister has ordered that the practices objected to be discontinued. His action is noted with sympathetic interest by automobilists in America.

PORTRAIT OF AMPERE.—A. Hermann, 6 Rue de la Sorbonne, Paris, has published at six francs a portrait of Ampere, printed on heavy Holland paper, 13 x 16 inches. The engraving is reproduced from an original which portrays faithfully the homely but strong features of the great savant, in this respect differing widely from the usual portrait found in print. We can vouch for the authenticity of this portrait, having some years ago received a copy of the same original from a Member of the Académie des Sciences, who had submitted it to several friends of Ampere still living, and by them it was pronounced an excellent likeness.

METRIC SYSTEM IN FRANCE.—A special cable dispatch from Paris says: The action of the American Chamber of Commerce in Paris in recommending the adoption of the metric system has led to an agitation among the Anglo-Saxon business men in favor of the change. It is believed here that England is only waiting on the United States Government to signify an intention of adopting the metric system to join in the movement. The only opposition encountered is among those engineers or manufacturers whose establishments are run on conservative principles and whom the introducing of the metric system would compel to overhaul their measures and machines, entailing considerable labor and expense.

COMPOUNDING ALTERNATORS.—Two patents issued December 30 to E. W. Rice, Jr., describe an interesting method for compounding alternators, based upon the employment at the generating station of a circuit which reproduces there the conditions existing at the receiving end of the line, as in the case of the Mershon indicating system. In the main line are two transformers, the primary of one being shunted by an inductance and resistance in series having the same relation to each other as the inductances and resistances in the transmission line; if capacity is to be compensated for a condenser would also be included in this circuit. The secondaries of the two transformers are in series and the resultant voltage, which corresponds to that at the receiving end of the line, may be impressed on a rotary converter, when the direct current side will supply a current to an auxiliary winding on the field of the generator; or the current from the miniature circuit may be rectified and fed direct to the auxiliary winding. The latter winding is connected in opposition to the main winding and its effect will be to decrease the field strength when the e.m.f. at the receiving end of the line rises, and vice versa.

ELECTRICITY IN SIAM.—U. S. Consul Hamilton King, of Bangkok, Siam, reports to the State Department that the electrical development of the city of Bangkok during the last ten years has been wonderful. The Siam Electricity Company, Limited, has a capital of £150,000 ($729,975), plus 200,000 ticals ($100,000 Mexican, or $46,000 in United States currency). It has 17,000 lamps of 16-cp, a tramway track of eleven miles in operation, and 40 cars in use, and others under construction; it is supplying electric power for various industries throughout the city, and is considering a line of automobiles to be run in connection with its tram line. The manager is now in America on business for his company. A request for another concession on the other side of the river is being pushed, and there are 26 private plants in the various mills, forts and dock companies, and in the navy yard of the city. The United States controls the market in this line now, and, with intelligent management, this trade could be greatly increased. The imports of electrical material direct from the United States in the year ending June 30, 1902, was $28,403, in a total of $52,949, but a large part of imports credited to other countries came from the United States. Consul King states there is a crying need for a large American business house in Siam. At present there is not in the whole of the country one American house competent to consider a Government contract, to push American trade, or to represent American interests.

LETTER TO THE EDITORS

Mean Spherical Candle Power.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the report of the "Pittsburgh Local Section of the American Institute of Electrical Engineers," in your issue of November 22, it would appear that my position with reference to criticism on the mean spherical candle-power method of comparing illuminants has been somewhat misunderstood. It has not been my intention either to abandon the present standard candle power or the use of the photometer, but rather to advocate a new *derived* unit—the effective candle power—a unit which is just as much based on the present standard candle power as is the mean spherical candle-power method of comparing illuminants. For example, to obtain the effective illuminating power of a given illuminant or set of illuminants by means of the two-room proposition described in my paper, it was proposed that the standard room be lighted with standard 16-cp incandescent lamps, and by this statement it was intended to convey the idea that these incandescent lamps should previously have been standardized on the photometer bar in the usual way by comparing with the standard unit candle. In this manner it was my desire to transpose the present standard candle-power unit into terms of effective candle power, and thereby establish not a new unit but a derived and more convenient unit for commercial purposes.

Pittsburg, Pa. A. J. Wurts.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compensating the Phase Difference in Induction Motors.—Osnos; Breslauer.—Two communications referring to the articles abstracted in the Digest November 8 and November 29. Osnos replies to some critical remarks of Bragstadt and La Cour, and states that his arrangements are to be used by the Union Electric Company; experiments with one of his motors and with a Heyland motor showed that there was very little sparking in either case. Breslauer claims that in Osnos's as well as Bragstadt's and La Cour's arrangements it is essentially impossible to avoid sparking at the commutator, and he believes that the Heyland motor is far superior in this respect.—*Elek. Zeit.*, November 27.

REFERENCES.

Operation of Alternators in Parallel.—Benischke; Rosenberg.—Two communications in which they continue their controversial discussion concerning some special features in the causes of surging.—*Elek. Zeit.*, October 23, November 20.

Commutation.—Arnold; Freund; Rothert.—Three communications referring to Rothert's article on the theory of commutation, recently noticed in the Digest. Arnold claims that some suppositions, made by Rothert, do not agree with the facts. Rothert in his reply does not deny this, but believes that his theory is an approximate representation of the facts.—*Elek. Zeit.*, October 30, November 13, 20.

Operation of Alternators in Parallel.—Georges.—A theoretical article in which he gives some critical notes on the theories of Rosenberg and Benischke.—*Elek. Zeit.*, December 4.

Lights and Lighting.

Osmium Lamp.—H.—An anonymous (apparently editorial) article giving the results of some tests of osmium lamps. The form of the globe of the osmium lamp is the same as that of the ordinary carbon incandescent lamp, while the light is whiter, but not as white as that of the Nernst lamp. The osmium lamp is always to be hung up perpendicularly, so as to point downward, and some caution is required in the use of the lamp, but not as much as with the Nernst lamp. Nine osmium lamps of 37 volts and 25 cp were used in the test, three in series at 110 volts. The tests took place for 300 hours, but the lamps were still in good condition after this time; the company states the life to be 500 hours. During the tests the lamps were burning for ten hours, and then disconnected for one hour, and so on. The different lamps gave about the same results; in one of them the candle-power decreased from 23 to 17.5, the current consumption in watts per candle increased from 1.53 to 1.97, while the average value of all tests for the 300 hours is 1.65 watts per candle. A comparative table is then given of the behavior of the ordinary carbon filament incandescent lamp, the Nernst lamp and the osmium lamp. The watts per candle are 3.20, 2.05 and 1.65 respectively. The first cost is 9, 50, 125 cents respectively; if the price per kw-hour is 16 cents, the average total cost of a candle-hour is 0.0005, 0.00035 and 0.00045 cents respectively. This shows that the osmium lamp is economically superior to the ordinary carbon filament incandescent lamp, while it is still inferior to the Nernst lamp; but concerning the latter point it is said that the Nernst lamp must be handled with greater care than the osmium lamp.—*Elek. Anz.*, December 18.

Power.

REFERENCES.

Indian Power Plant.—A long illustrated description of the Cauvery Falls power plant in India, which will furnish power to the mines of the Kolar gold fields, as was noticed before in the Digest.—*Eng. & Mining Jour.*, December 27.

Elevators.—An illustrated article on elevators without shaft, but with counterpoise and electric windlass; elevators with shaft, and with compensators actuated electrically; and hydro-electric elevators.—*Sc. Am. Sup.*, December 27.

Electric Power in Iron Plants.—Perkins.—An illustrated description of electrically operated charging machines, hoists, hauling and conveying apparatus in iron and steel plants.—*Sc. Am. Sup.*, December 20.

Traction.

Electrolysis of Gas and Waterpipes.—A note based on the report of a German gas journal stating that the committee appointed by the German Association of Gas and Water Engineers to inquire into the question of electrolysis of gas and water pipes, has failed to bring about any definite result. It had been hoped that, with the co-operation of the Verband Deutcher Elektrotechniker, some protective measures would have been drawn up and adopted; but when the suggestion made by the representatives of the gas industries were submitted, the electrical engineers would not accept them, and the deliberations have thus far not been productive of any beneficial results. The gas committee has, therefore, come to the conclusion that it will work independently of the electrical committee, at any rate for the present, and in the meantime will make inquiries of various gas and water authorities in large towns as to the extent of the damage which has been done by stray electric currents. They then propose to carry out experiments based on the information received, which they hope will guide them in drawing up certain rules for protection.—*Lond. Elec.*, December 19.

REFERENCE.

Electrolysis from Stray Currents.—Moerk.—A long communication in which he repeats his former proposal to prevent the dangerous results of electrolysis due to stray return currents from tramway systems, by reversing the direction of the current of the trolley system at periodical time intervals. He gives diagrams and describes arrangements by which this can be done easily and without danger.—*Elek. Zeit.*, December 4.

Installations. Systems and Appliances.

Central Station Statistics of Germany.—The annual very complete statistical tables showing the development and conditions of the central stations of Germany to April 1, 1902. Isolated plants and pure tramway plants are excluded. The information concerning the capital invested in the plants is incomplete, as only 475 of the total 870 have sent in reports on this subject; these 475 plants with an aggregate machine capacity of 197,061 kw, have cost about $77,800,000, i. e., about $395 per kw; in last year's statistics this average cost has $407 per kw; if a mean of $401 is assumed, the capital invested in the total plants of 358,000 kw aggregate capacity, is about $143,000,000. Sixty-six new plants have been opened, and the total number of central stations on April 1, 1902, was 870. Of these 709 are direct-current stations, 684 (or nearly all) being provided with storage batteries, their machine capacity being 150,500 kw and the combined machine and storage battery capacity being 208,800 kw. Twenty-five direct-current stations, with a machine capacity of 6,200 kw, have no storage batteries. Single and two-phase alternating-current systems are used in 45 stations of 30,500 kw capacity.

Three phase currents are in use in 52 stations of 76,000 kw capacity. Combined three phase and direct current systems are in use in 50 stations of 87,000 kw machine capacity and 107,000 kw combined-machine and storage battery capacity. Combined single phase and direct-current systems are in use in 12 stations of 7,500 kw machine capacity and 8,000 kw combined machine and storage battery capacity. The total capacity of the storage batteries installed in direct-current stations is 27 per cent. of the total capacity of the direct-current stations; 58.6 per cent. of all stations use steam power and the machine capacity of these stations is 79 per cent. of the total machine capacity of all stations; 6 per cent. of the total number of plants (with a capacity of 1⅓ per cent. of the total capacity) use gas engines. The number of water power plants is 9.65 per cent. of the total number, the capacity being 6.75 per cent. of the total capacity; 353 stations have a capacity below 100 kw; 360 have a capacity between 101 and 500 kw, 66 to 1,000 kw, 33 to 2,000 kw, 30 to 5,000 kw; 17 more than 5,000 kw. The largest station is Berlin, Moabit, 9,000 kw, and with sub-stations 26,612 kw; the next one Berlin, Oberspree, 13,000 kw, and with sub-stations 25,425 kw; the next one Rheinfelden, 12,360 kw. All these are combined three-phase and direct-current systems. The next station in size is Berlin, Spandauer St., 10,785 kw, using direct current. The total capacity of the 47 plants which have a capacity above 2,000 kw, is one quarter more than all the other 833 stations together. At consumers' terminals these were connected with 50-watt incandescent lamps, an equivalent of 796,298 lamps (against 779,312 in 1901), of 10-amp arc lamps 20,613 (against 14,208 in 1901), and of motors 50,645 hp (against 35,645 hp in 1901). The enormous increase in the use of motors is due to their increased application in small shops in cities and partly also in agricultural districts.—*Elek. Zeit.*, December 18.

WIRES, WIRING AND CONDUITS.

Calculation of Networks.—MONATH.—An illustrated discussion of a new method of calculating the current distribution in networks, based upon Kennelly's theory of the equivalence of triangles and three-pointed stars in conducting networks (ELECTRICAL WORLD & ENGINEER, v. 34, p. 413, 1899) and later developed more in detail by Herzog and Feldmann. The method is explained and then illustrated by special curves. The author thinks that this method is well suited for the calculation of networks containing comparatively many branching points, and very few feeding points. But in other cases he thinks that the Coldri-Seydel method is preferable on account of its brevity and because it is systematic.—*Zeit. f. Elek.*, November 2, 9, 16.

REFERENCES.

Fuses.—HUNDHAUSEN.—A very long communication, illustrated by many diagrams, on the best construction of fuses.—*Elek. Zeit.*, December 4.

Wiring.—An article, illustrated by dynamos, on several problems in wiring.—*Lond. Elec. Times*, December 11.

ELECTRO-PHYSICS AND MAGNETISM

Electrical Discharge from Hot Carbon.—CHILD.—An account of the results obtained in his continued researches on this subject. When a carbon pencil is heated, the positive discharge occurs first; this is true whether the carbon is heated in air at normal pressures, in a vacuum, or in hydrogen; if in air, it requires only a slight increase in temperature to produce the negative discharge; at higher temperature the negative discharge is the greater; both positive and negative pass through maxima as the temperature is raised. Within an enclosed tube the discharge is very much smaller than in open air. In a vacuum the negative discharge becomes many times greater than the positive at higher temperatures; the rates of discharge do not here pass through maxima. In hydrogen at higher temperatures the positive and negative discharges have nearly the same value; the discharge is here much higher than in air; both discharges pass through maxima. In general, the discharge from hot carbon behaves in a similar way to that from hot platinum; the velocity of the ions is diminished because of the presence of particles driven off from the carbon. The smaller velocity of the negative ions in the electric arc is quite probably due to the loading of the negative ions with these particles.—*Phys. Rev.*, December.

Ionization of Salt Vapor.—MOREAU.—An account of some experiments made to elucidate the mechanism of flame conduction. He introduced two small platinum condensers into a flame, gave a high charge to the lower one, and observed the conduction across to the upper one. He found that this conduction was independent of the charge of the lower one, and hence concludes that the flame contains no free ions, since these would be absorbed by the lower condenser. In another experiment he mounts a salted flame between and in contact with two unsalted flames, in one of which an electrode is fixed. A movable electrode plunges into the other flames, and as soon as it touches the salted flame the conductivity goes up abruptly, to a great extent if the electrode is negative, and to a small extent if it is positive. This unipolar conductivity is analogous to that of a mass of hydrogen surrounding a carbon filament. The author believes that the presence of a metallic conductor is essential for ionizing a vapor.—*Comptes Rendus*, November 24; illustrated in Lond. *Elec.*, December 19.

Crystallization from an Electrolyte.—HEYL.—An account of an experimental investigation. Having failed to find any effect produced by electrostatic stress upon crystals formed under its influence, he investigated the effect produced upon crystals formed from an electrolyte carrying a current. The results are likewise entirely negative. Two substances were used: copper sulphate in an aqueous solution and mercuric iodide in concentrated hot hydrochloric acid. The passage of the current produces no effect comparable with that produced by the heating of the solution.—*Phys. Rev.*, December.

REFERENCES.

Ionization of Air in Caves.—EBERT AND EWERS.—An account of experiments in which they repeat and continue similar experiments of Elster and Geitel. They find that underground air is not like "activated" air, but rather resembles radium and thorium compounds, which, while neutral themselves, are capable of ionizing gases by means of the free ions they emit.—*Phys. Zeit.*, December 1; abstracted in Lond. *Elec.*, December 12.

Change of Length and Thermo-electric Power by Magnetization.—RHOADS.—An article describing experiments showing that there exists a relation between the changes of length and the changes of thermo-electric power caused by magnetization.—*Phys. Rev.*, December.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Alkali Industry.—J. B. C. KERSHAW.—The conclusion of his illustrated article. He discusses the electrolytic alkali industry in the United States, and makes brief remarks on some American companies, but gives nothing new, nor is his review complete. Some general remarks on the financial conditions of the electrolytic alkali industry and the rivalry of the older Le Blanc process are added. The fall in the selling value of bleaching powder, while it will seriously curtail the profits of the Le Blanc works, will not cause actual loss in the manufacture, and continued competition from this quarter must be expected by the electrolytic alkali companies. The author reaches the conclusion that the total cost of 1 ton 72 per cent. caustic soda and 2.1 tons 35.0 per cent. bleaching powder by the best electrolytic processes is about $70, while the present selling price in 1903 will be $86.25. The prospects of the electrolytic alkali works are, therefore, not so hopeless as their rivals are disposed to believe.—Lond. *Elec.*, December 12.

Electrotype Reproductions of Phonograms.—AZOULAY.—A description of two methods by which any number of duplicates may be made from a single original phonogram (meaning the wax cylinder of a phonograph), which, however, is destroyed in the process. A mould is taken of the original cylinder by electro-deposition of copper on the original, and the mould, which must be 2 mm or 3 mm thick, is subsequently nickeled. This mould forms the basis of both the processes. In the first process the mould is mounted on a mandril in the shape of a truncated cone, and wax is poured in and allowed to cool very gradually, the mandril being withdrawn at the proper moment. In the other process a hollow cylinder of wax, somewhat shorter and narrower than the interior of the mould, is placed inside the latter, and heated and pressed against it from within by means of a rubber bag inflated to some eight atmospheres, or by hydraulic pressure. "After cooling, the wax detaches itself in both cases from the copper mould, and the latter is ready for another reproduction."—*Comptes Rendus*, November 17; abstracted in Lond. *Elec.*, December 5.

Making Ozone for the Sterilization of Water.—A description of two German plants installed by Siemens & Halske, in Wiesbaden and Paderborn, and of a plant in Holland using another system; a description by van't Hoff of the latter has already been abstracted in the Digest. In the two German plants the Siemens & Halske ozonizer is used, which consists of two concentric metallic tubes separated by a glass tube; cooling water flows through the inner tube and the silent discharge occurs in the air space between the glass and the outer metallic tube. At Wiesbaden the ozonizers are 48 in number, and are arranged in two sets of 24 each, the ozonizers which are of the tube type, have one pole earthed on account of the water used for cooling purposes. The tubes are contained in closed cast-iron boxes divided into three compartments, the upper one of which contains the high-potential current connections and the air inlets to the tubes; the middle compartment contains the glass ozonizing tubes with the metallic envelopes, and the lower compartment acts as a reservoir for the ozonized air. These cast-iron boxes are provided with glass windows in the tops, fronts and bottoms, so that it is possible to observe the color and character of the electric discharge, and in this way observe the proper operation of the ozonizers. The high-potential conductors are carefully protected from all possibility of contact. Alternating current at 8,000 volts is used. In an editorial discussion of these installations it is pointed out that the problem of the purification of water by ozone is an economic one and the important data are the cost per cubic meter of water. The average cost in the three installations is 7.46 cents per 1,000 cubic feet. It is said that until this cost is reduced, it is doubtful whether the process can come into general use.—Lond. *Elec.*, December 5.

Aluminum Anode.—Taylor and Inglis.—An abstract of a (Brit.) Phys. Soc'y paper in which they first call attention to the fact that aluminum is very slowly acted upon by dilute sulphuric acid even at moderately high temperatures; but with dilute hydrochloric acid or when a little hydrochloric acid or some soluble chloride be added to dilute sulphuric acid, the action is violent. This peculiar phenomenon is thought to be connected with the other well-known fact that when an aluminum electrode is used as anode in a solution of a sulphate or of sulphuric acid, there is a very great resistance which does not exist when the aluminum plate is cathode or when other acids are substituted for sulphuric acid; and this is generally supposed to be due to an insulating film. The authors endeavor to explain both phenomena as being due to the same cause, and conclude that the origin is that the film of aluminum hydroxide on the anode is permeable to certain ions, but impermeable to others. They made experiments on the rate of diffusion of various ions through a film of aluminum hydroxide, and found that several salts of potassium diffused rapidly through such a film, but the sulphate passed through very slowly.—Lond. *Elec.*, November 28.

Conductivity of Electrolytes.—Kunz.—An account of experiments with concentrated solutions of sulphuric acid, caustic soda and calcium chloride which have very low freezing points. With a 45 to 70 per cent. solution of sulphuric acid, temperatures below 70° could be attained and measured by means of a constantan iron couple. His measurements show that the conductivities of all of these do not converge to zero at 39°, as Kohlrausch supposed, but more likely at absolute zero, thus representing the reverse of the case of the pure metals, whose resistivities converge to zero at the same point.—*Comptes Rendus*, November 10; abstracted in Lond. *Elec.*, November 28.

REFERENCES.

Limits of Electrolytic Conductivity.—Bonsfield and Lowry.—A paper in which they show that electrolytic conductivity has a lower and an upper limit quite apart from that due to freezing or boiling. At the lower limit the viscosity of the solvent stops the motion of the ions, and at the upper limit the solvent loses its ionizing power. —*Proc. Roy. Soc.*, October 17; abstracted in Lond. *Elec.*, November 28.

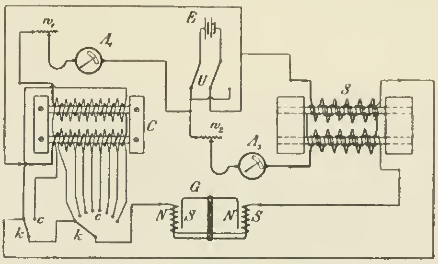
High-Temperature Electro-Chemistry.—Hutton and Petavel.—The first part of a (Brit.) Inst. Elec. Eng. paper in which he describes the electro-chemical laboratory of Owens College and also gives some notes on actual electro-chemical processes.—Lond. *Elec.*, December 12.

Electrolytic Rectifier.—Guthe.—His paper in full on the theory of the electrolytic rectifier, an abstract of which was recently noticed in the Digest.—*Phys. Rev.*, December.

Electric Manufacture of Steel.—Reyval.—An illustrated description of the Harmet process.—*L'Eclairage Elec.*, November 15.

Units, Measurements and Instruments.

Compensation Magnetometer.—Corsepius.—An illustrated description of an instrument for testing the magnetic properties of iron. Two small iron rods are connected together by end pieces, so that a closed magnetic circuit is formed. Around each rod a primary coil is wound with a secondary above it; contact knobs enable one to disconnect any portion of this secondary. The arrangement of the whole test is seen from the adjoining diagram. Direct current from the source of current *E* flows through the magnetizing coil of the sample of iron introduced in *S*; another direct current flows through the primary coil of *C*, which apparatus was described above. By means of the switch *U* both currents are simultaneously reversed, and the current is measured in the circuit formed by the oppositely connected secondary windings of the sample iron, *S*, and the auxiliary apparatus, *C*, *G* being a measuring instrument of special construction. By adjusting the levers, *k* of *C*, this current is made zero. *G* is a needle galvanometer, the movable part of which consists of two U-formed magnetic rods, the one embracing the other from the outside in the opposite direction, so that the opposite poles of both rods are near each other. The ends of the one rod are surrounded each by a thin coil; the astatic system is bifilarly suspended and has a needle; great sensibility and mechanical compactness are claimed for the instrument.—*Elek. Zeit.*, November 13.



COMPENSATION MAGNETOMETER.

High Carbon Resistances.—Longden.—A long article describing some methods of making high resistances of carbon. For instance, he mixes 10 grammes of pipe clay and 2 grammes of flake graphite with 10 cc of a 20 per cent. solution of ordinary granulated sugar; the moist clay is then pressed into cylindrical sticks about 5 mm in diameter; these are thoroughly dried in an oven at 150° and then carbonized by keeping them at a red heat 8 hours in a covered crucible, packed with graphite. The graphite used in this method may also be omitted so that the resulting sticks contain no carbon except that which is furnished by the sugar. The resistance of the carbon sticks made by the first method was from 1,000 to 5,000 ohms per cm, while that of those made by the second method was several megohms per cm. One of the objections to these resistances is the rapid increase of resistance with time. A more serious objection proved to be the unreliable character of the junctions between the carbon sticks and their terminal wires. He succeeded, however, in electroplating copper terminals to the clay carbon sticks; this is easily done by passing the current from the anode through the solution to a fine copper wire twisted several times around the end of the carbon stick; the copper is at first deposited only upon the copper wire, but in a short time it begins to creep out over the surface of the clay carbon stick and forms a perfect coating, the contact between the copper and the carbon being fully satisfactory. A more satisfactory form of carbon resistance consists of a film of smoke deposited upon a strip of glass; camphor smoke appears to give more nearly uniform results than candle smoke or smoke from a gas jet. A film 5 cm long by 1.5 cm wide may have any resistance from about 50,000 ohms to about 100 megohms. In order to get good contacts between the carbon and the terminal wires, he uses the following method. The ends of the glass strip are first coated with metallic silver, chemically deposited, and then the resistance material is deposited in a uniform layer over the entire surface of glass and silver. The silver tips may be thick enough to stand electrolytic depositions of copper at the extreme ends, or they may even be made so thick that fine copper wires may be soldered directly to the silver. On account of the extreme delicacy of a film of smoke upon glass, it is necessary to protect this film; a simple bath in alcohol vapor is sufficient to harden a smoke film to such an extent that it may be further protected by flowing upon its surface a coat of shellac varnish, India rubber varnish, or melted paraffin. The resistance of such silver-tipped smoke films is considerably more constant than that of the clay carbon sticks with copper plated terminal, mentioned before.—*Phys. Rev.*, December.

Theory of the Wehnelt Interrupter.—Klupathy.—A note on a paper presented to the Hungarian Academy of Sciences. The interruptions in the Wehnelt interrupter are caused by the development of steam in the acid which then acts as an insulator. Simon had explained the steam production as being due to Joulean heat. The present author shows that this explanation is not sufficient and that the Peltier effect plays an important part. A platinum electrode in sulphuric acid is heated as anode and cooled as cathode by the Peltier effect. As a rule the thin wire is made the anode of a Wehnelt interrupter, so that Joulean heat and Peltier effect here act together, producing a high temperature and causing a strong generation of steam. If the wire is made the cathode, it will be cooled by the Peltier effect, though it will receive its share of the Joulean heat. There will furthermore be a liberation of hydrogen at the cathode, and a voltaic arc will play between the cool wire and the warm, well conducting acid, provided the current intensity be high; as a result the wire cathode will be liable to fuse. If the currents are not very strong, the wire cathode will not make a very good Wehnelt interrupter. Klupathy further observed that the frequency of the interruptions of a wire anode which was not pointed, was increased when the electrode was especially heated by a branch current. As regards condensers and self-induction, he finds that when the condenser is joined in parallel to the interrupter, the frequency will rise if the anode wire is thin and the self-induction small, but will diminish if the wire is thick and the self-induction considerable. In his opinion, the process could then be explained in the following way: The heat produced in the wire electrode, both Joulean and Peltier, evaporates the acid in its immediate neighborhood; the steam generated insulates the electrode, and interrupts the current momentarily; the extra current then strikes through the steam, the spark re-establishes the circuit, and the phenomenon repeats itself.—Lond. *Eng'ing*, December 5.

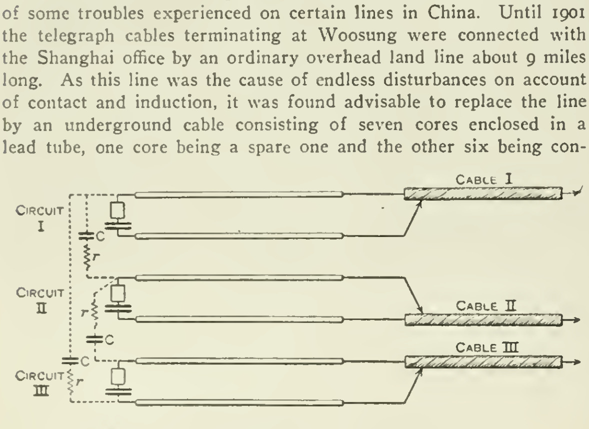
REFERENCES.

Testing Laboratory.—Uppenborn.—A well-illustrated description of the electric testing laboratory of the municipal electric central station of Munich, for testing and replacing meters, making photometric measurements of lamps, testing insulation materials and general testing purposes.—*Elek. Zeit.*, November 27.

Electromagnetic Brake.—An illustrated description of the eddy current brake, devised by Pasqualini for testing motors, etc.—*Elek. Anz.*, November 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Disturbances on Underground Cables.—Schoenan.—An account of some troubles experienced on certain lines in China. Until 1901 the telegraph cables terminating at Woosung were connected with the Shanghai office by an ordinary overhead land line about 9 miles long. As this line was the cause of endless disturbances on account of contact and induction, it was found advisable to replace the line by an underground cable consisting of seven cores enclosed in a lead tube, one core being a spare one and the other six being connected in pairs to three seagoing cables at Woosung. Return earth to Woosung being used on all three circuits, it was not considered necessary to cover the cores with brass tape or a similar metallic coating in order to prevent induction. It was, however, soon discovered that a very considerable interference, partly due to induction and partly to interference between the earths at Woosung, took place between the circuits. A remedy was found by introducing an "induction balance" as illustrated in the adjoining diagram, in which r are resistances and C condensers; in this particular case the condensers, C, had a capacity of about 0·1 microfarad, the resistances r were about 100,000 ohms, and the resistance of the seven cores about 220 ohms each. He thinks that a similar "induction balance" would be of use, not only on underground cables where metallic circuit is not used—it may even perhaps in some cases be used as a substitute for a metallic return—but also on long overhead lines, where induction is felt.—Lond. *Elec.*, December 19.



INDUCTION BALANCE FOR UNDERGROUND CABLES.

MISCELLANEOUS.

Training of Electrical Engineers.—Feldmann.—A long abstract of a lecture discussing the principles upon which the education of an electrical engineer should be based. He believes that the foundation should be a broad one; specialization should not begin too early. The student should be well equipped in mathematics; he thinks that the difficulties of the practical introduction of the three-phase system in England were mainly due to the lack of mathematical training of English engineers; he thinks that while in France mathematical education is highly developed, the geometrical methods are neglected in favor of purely analytical methods. A good knowledge of physics and chemistry is required and the study of foreign languages is strongly recommended. "For the (German) electrical engineer the knowledge of the English, American or French technical literature becomes more and more a necessity; that of the French literature on account of the theoretical investigations, that of the English and especially American literature on account of the daring and magnificent enterprises." The practical training should be in the first part of the time the same as that of mechanical engineers. He refers to the proposal to require a year of practical work, before a student can get his degree; this is necessary to show the student what a drawing must look like, in order to be understood by the workingman; it shows him the different steps of the manufacture of a certain machine or apparatus; for this purpose training in a small factory is better than in the plant of a large factory. The student should also be taught the principles of business and commerce.—*Elek. Zeit.*, December 4.

REFERENCE.

Biographical.—A biographical sketch, with portrait, of T. A. Edison.—*Sc. Am.*, December 27.

New Books.

Transactions of the American Electrochemical Society. Volumes I and II. Being the Proceedings of the Inaugural Meeting at Philadelphia in April, and of the Second Meeting, at Niagara Falls, in September, 1902. Philadelphia: Published by the American Electrochemical. Vol. I, 249 pages; Vol. II, 274 pages. Price, each volume, $3.00.

These volumes are splendid evidences of great activity in the formation of a society, in the first year of life enrolling 433 members, of whom 355 were charter members. The membership extends to Russia in the East and to Honolulu and Australia in the West.

The papers printed in these transactions are, in general, excellent in character. The discussions as printed do not, however, appear to have been very animated, although there are a few papers that are well discussed. The papers vary from dissertations of purely theoretical electro-chemical phenomena to descriptions of practical processes. The mingling of practical and theoretical topics causes the *Transactions* to have a wide range of value.

Among the most valuable theoretical papers are those discussing the nascent state, and the phenomena of concentration cells. Several of the practical papers discuss continuous furnaces, and an excellent paper by Mr. Hugh Rodman gives a resumé of the present state of the storage battery art. These *Transactions* will be eagerly read by the student and worker in electro-chemistry.

Motor Cars. By Rhys Jenkins, M. E. New York: James Pott & Co. 370 pages, 100 illustrations. Price, $5.

That the subject of automobiles must create a very large literature of its own becomes increasingly evident. The bicycle once did this also, but there are very few new bicycle books nowadays. We do not believe that the bicycle era has definitely closed, but it seems probable that the literary opportunities of the machine, technically considered, are pretty well exhausted. Unless we err greatly, the contrary is the case with the automobile. That machine affects so many fundamental interests in society and industry, and is susceptible of so many feasible variations in type, design and application, we can readily entertain the opinion that in time it will be as prolific a theme as the steam engine or the dynamo.

Just now the literature of automobilism is passing through the historical and rudimentary stage, when every author feels almost constrained by a sense of duty to sum up what has been attempted, and like the Offenbachian burgomaster begins his address with, "The Year One——"; while in treating the subject at its present point he is equally compelled by a desire to be fair and comprehensive to include many forms that are mere freaks and are as sure to disappear as the bad roads, now giving them such swift dispatch and such slow advance. After all it is as well that these historical records should be compiled while the materials and the pioneers are accessible. It is likewise not amiss that even the oddities and crudities of the earlier years should be set down and noted, extinct monsters in a museum of mechanical antiquities.

Mr. Jenkins has performed admirably in this portly and handsome volume the task which he set himself, and has crammed into pages that are a pleasure to the eye as well as a constant source of instruction, an amazing amount of data. As we have intimated, he bows profoundly to the historical fetich and rather than sin by omission is overkind to some machines the world would willingly let sink into oblivion. Another point of fair criticism is that he is curiously uninformed as to the latest work in electric automobiles, still very strongly in the running; and also has a lot to learn about what is doing in America, what men like Riker, Sperry, Maxim, Baker, Condict and others have attempted and achieved. But we can heartily commend the book to American readers for what it contains as to the subject in general and as to a great deal of recent European development in particular. The book, of British origin, is, moreover, an encouraging sign that England is wider awake on this important subject, and that a country which has been active in filling the world with locomotives, plows and lathes is to do something in meeting the twentieth century demand for autos.

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Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

Interstate Independent Telephone Association, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

Kentucky Independent Telephone Association, Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, January 21, 1903.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

Electric-Pneumatic Control on the Brooklyn Elevated Railway.

As intimated in these columns last week, the Brooklyn Elevated Railway Company has given an order to the Westinghouse Electric & Manufacturing Company for 210 multiple train-control equipments for the operation of electric trains. A few years ago the management of this road decided to discard steam locomotives and to operate all trains electrically. Before making such a wholesale change, however, it was deemed prudent to test exhaustively the different methods of handling electric trains. If the steam locomotives were to be replaced by simple electric locomotives, many of the advantages of electric traction would be sacrificed. In order to reduce the dead-weight hauled and to obtain a higher tractive effort when starting, it is better to place the driving motors on the trucks of several of the passenger cars of a train and thus take advantage of the weight of the cars than to put the motors on a locomotive, which must be artificially loaded down to give it the necessary adhesion. Other reasons for choosing a system employing a number of motor cars per train rather than a single locomotive were that, since the service is fluctuating, during a part of the day the large motors of the locomotive would be operated at a light load and consequently low efficiency. Moreover, the trains could not be broken up into single units, as is possible when a number of the cars carry their own motor equipments. This reasoning is familiar to our readers and need not here be expanded.

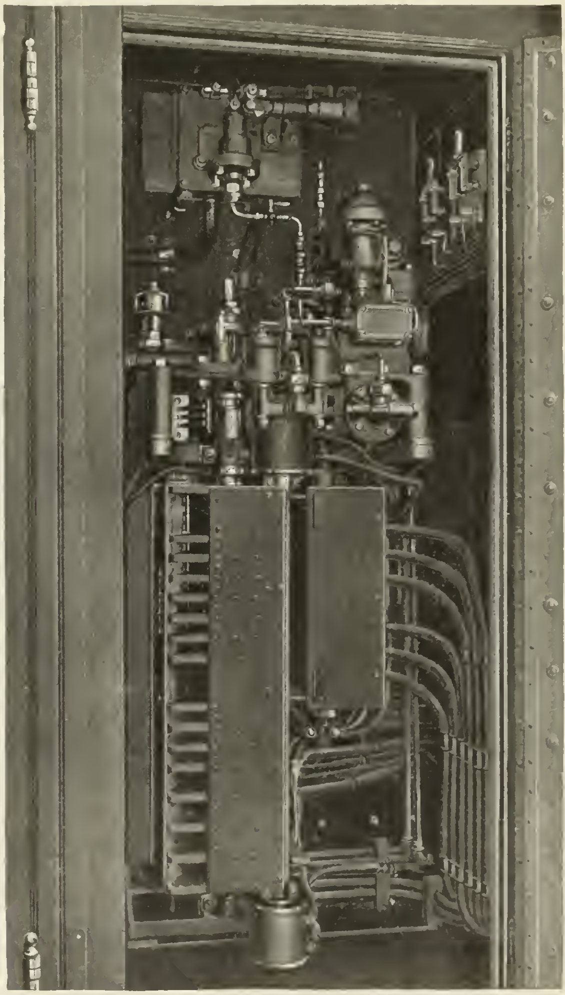


FIG. 1.—VIEW OF CONTROLLER COMPARTMENT, OPEN.

The Brooklyn Elevated Company, therefore, went to the leading electrical manufacturers who had developed systems for controlling a number of motor cars in a train, and asked them each to equip a number of model trains for testing purposes. These trains were placed on the Brooklyn road a few years ago and have since operated in the regular daily traffic. Careful records were kept of the number of miles run by each train, the number of accidents met with, the cost and time required for repairs, the comparative convenience in operation, and all other matters that might influence the decision. The result of this investigation has been the placing of the order mentioned above. All steam locomotives now in use will be in a short time replaced. In addition to the order for 210 cars, the company has already purchased about 150 equipments which have been in satisfactory operation for nearly a year.

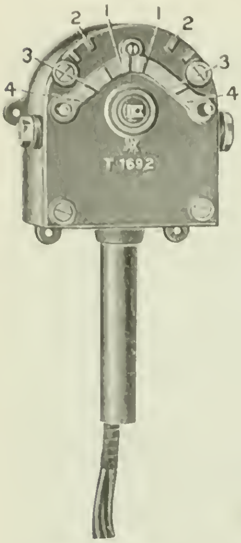


FIG. 2.—MOTORMAN'S CONTROLLER.

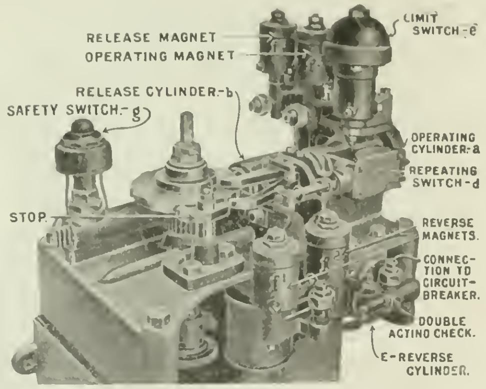


FIG. 3.—TOP OF CAR CONTROLLER.

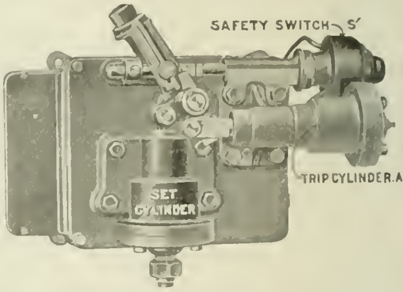


FIG. 4.—CIRCUIT BREAKER.

The Westinghouse multiple train control system has been developed by Mr. George Westinghouse. It involves the use of compressed air for moving the current controlling apparatus, electro-magnetic valves governing the admission of air to the controlling cylinders and low-voltage electric circuits running from car to car for controlling the action of the magnet valves. The connections for the low-voltage circuits are the only ones which have to be established between the cars of the train, no air connections being required outside of the ordinary brake hose. A complete equipment for each motor car consists of two or four electric motors, a controller very similar to those used on ordinary street cars, and one or two motormen's controlling switches, from any one of which all the car controllers on the train may be operated. The car controller consists essentially of two drums which revolve in bearings, and stationary contact fingers which make contact with points upon the revolving drums. The large, or main, drum opens the main circuit and makes the motor and resistance combinations; the small drum reverses the motors. A multiple control switch is placed at one or both ends of each motor car and by means of the one at the front of the leading car the motorman controls the action of the controllers on all of the motor cars in the train. The system uses the standard type of controller and standard types of valves and magnets, the latter having been used for years in the operation of the Westinghouse electro-pneumatic system of switches and signals upon the largest railways of the world. It is the only system in which the control circuit is isolated from the main power circuit. The control circuit is, therefore, not affected by a momentary interruption of current due to ice and sleet on the rails, or other causes. With the low-voltage current, grounds and short circuits at the connectors between the cars during stormy weather or fires resulting from high voltage circuits through the train are, it is said, entirely eliminated. The current for the motors is simply collected from the third rail, led through the local car-controlling apparatus to the motors, and then back to the service rails, and does not pass from car to car. The controlling apparatus is so located that the motorman may have convenient access to all parts from the platform.

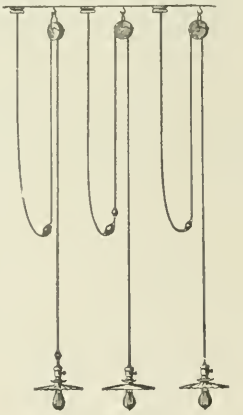
The motor circuits on any car are automatically opened in case of excess current, and they can all be simultaneously closed at the will of the motorman. All controllers are automatically turned off by the application of the automatic air brakes, which is an important point since in case of a train breaking in two the brakes are automatically applied and at the same time the power is shut off. Under old conditions, it has often been found impossible to shut off the power from some of the cars, while in this electro-pneumatic system there are a number of ways in which that may be accomplished, greatly reducing the possibility of accident. Both controllers and circuit breakers are opened by a snapping in two of the train, this action being independent of and in addition to the effects obtained by the application of the air brake. The controllers may be operated by hand, thus permitting the train to run to a terminal station in case of any derangement of the controlling apparatus. The operation of both brakes and controllers is effected by a single air-hose connection between the cars, the air compressor which furnishes air for the brakes also furnishing air used to operate the controllers.

The Brooklyn Elevated will equip all its new cars with four motors each. The 150 cars now in use equipped with the Westinghouse system have each two motors. The trains on the road are made up of five or six cars, two or three of which are usually motor cars. When these trains reach the suburbs they are broken up into smaller units of one or two cars, each of course containing a motor car, and the smaller trains branch off on different divisions.

In the great transportation problems which are being solved in New York City, the Westinghouse Company has borne a prominent part. It has furnished the power equipment of the Brooklyn Elevated, also the power equipment of the Manhattan Elevated, including eight of the largest generators ever built. It has contracted to furnish the power equipment of the Rapid Transit Subway, the power house of which will contain six units similar to those furnished to the Manhattan people, while the Brooklyn Elevated contract indicates a further advance in dealing with the train control situation.

Lamp Adjuster.

Skelly & Company, Electric Building, Cleveland, are introducing a new type of lamp adjuster for incandescent lamps, known as the "Acme" adjuster. By means of a balance weight the lamp may be placed at any height and remain there until moved. The counterbalance is applicable for any weight of lamp or shade. For window display illumination the device is especially adaptable, allowing for the changing of design as often as desired without trouble or expense. It is also useful in shops and offices, avoiding the necessity of a multiplicity of lamps because of the wide range over which one lamp can be used without entanglement of wires.



LAMP ADJUSTER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 6 per cent. for 60 to 90 days. There was activity in stock speculation with general advances. Manipulation by large interests was apparent, but public interest has increased and sales to secure profits are quickly absorbed. Among the features were Amalgamated Copper and the traction group. The former advanced from 59½ to 66, on the belief in brighter prospects for that and other copper stocks. On reiterated reports of a combination of traction interests in Greater New York, Manhattan and Brooklyn Rapid Transit, together with Metropolitan, made a decided advance. Manhattan closed at 149, thus making a net gain of 2¾; Metropolitan gained 1⅛, closing at 141, and Brooklyn Rapid Transit, receding, closed at 66½, a net loss of 1⅝ points. The electrics made substantial gains, General Electric closing at 184½, being a net gain of 6⅝, the trading being rather limited. Westinghouse com. closed at 212, being a net gain of 17½, and preferred at 215, a net gain of 13 points. Western Union made a gain of ⅜ point, closing at 88⅜. American Dist. Tel. closed at 40¼, a net gain of 2¾. Following are the closing quotations of January 6:

NEW YORK.

	Dec. 30.	Jan. 6		Dec. 30.	Jan. 6
American Tel. & Cable......	86	85	General Electric.	177½	189⅜
American Tel. & Tel........	164	163	Hudson River Tel...........	..	..
American Dist. Tel....	37½	38	Metropolitan St. Ry..........	140⅛	142⅛
Brooklyn Rapid Transit ..	67¾	69⅞	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	169½	..	N. Y. & N. J. Tel............	161	..
Electric Boat	22	30	N. Y. E. V. T. Co..	9½	11
Electric Boat pfd......	35	42	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	3	3	Western Union Tel...... ...	88¼	90
Electric Vehicle...	3½	5	Westinghouse com....	202	218
Electric Vehicle pfd........	9	11	Westinghouse pfd..........	202	222

BOSTON.

	Dec. 30.	Jan. 6		Dec. 30.	Jan. 6
American Tel. & Tel	164¼	163½	Western Tel. & Tel. pfd....	99	99½
Cumberland Telephone....	124⅞	127	Mexican Telephone.........	2	2
Edison Elec. Illum...	262½	..	New England Telephone ...	138	138
General Electric.............	..	.	Westinghouse	99	107
Western Tel. & Tel	..	24	Westinghouse pfd..... ...	99	107

PHILADELPHIA

	Dec. 30.	Jan. 6		Dec. 30.	Jan. 6
American Railways	51½	52½	Phila. Traction	97⅝	98¼
Elec. Storage Battery.. ...	*84	80	Phila. Electric	8⅛	8¾
Elec. Storage Battery pfd..	..	..	Pa. Electric Vehicle.........	..	..
Elec. Co. of America.	9½	10	Pa. Electric Vehicle pfd. ..	..	..

CHICAGO.

	Dec. 30.	Jan. 6		Dec. 30.	Jan. 6
Central Union Tel.	..	..	National Carbon pfd........	97	97
Chicago Edison.........	175	..	Northwest Elev. com........	.	..
Chicago City Ry....	205	208	Union Traction	14¼	15¼
Chicago Tel. Co	..	..	Union Traction pfd.......	45	45
National Carbon	26	26			

* Asked.

LARGE TROLLEY EARNINGS.—Since January 1st last the Detroit United Railway Company has each month reported gross and net earnings larger than those of the corresponding months a year ago, and at the end of eleven months has an increase in gross earnings to its credit of $409,477, of which $260,270 is absorbed by increased operating expenses, leaving $149,206 as net increase. Fixed charges for the period are $68,344 larger than for the corresponding period a year ago and the surplus shows an increase of $68,344. The surplus after charges for eleven months is $664,395, which is equivalent to 5.3 per cent. on the $12,500,000 outstanding. Twin City Rapid Transit's business in November contributed an increase in gross earnings of $40,951, bringing the gross gain of the year to date to $401,246. In the eleven months expenses were increased $177,369, leaving a gain in net earnings of $223,877. The surplus after fixed charges and the eleven months' proportion of preferred dividend which have been deducted is $958,466, or over 5¾ per cent. on the common stock. An increase of $17,960 in gross earnings is shown by the statement of the Montreal Street Railway for November. In two months of the current fiscal year gross earnings have increased $33,304 and net earnings $14,957, while surplus is $12,240 larger than for the same period a year ago. In the year ended September 30th last the company earned almost exactly 10 per cent. on its stock and the increase in surplus indicates that just about 10¼ per cent. is now being earned.

GENERAL ELECTRIC.—Reports from Boston state that earnings of the General Electric Company for the fiscal year ending January 31 will, it is understood, show about $10,500,000 net. It is now rumored in Boston also that while it is quite likely that the General Electric Company will take over the Stanley Electric Company, any such absorption will not include the Electric Storage Battery Company, as the General Electric Company directors are unanimously opposed to taking over this company at any price. The Whitney-Ryan-Roebling interests control both the Stanley Electric and the Electric Storage Battery companies. They have had under consideration a consolidation of these two companies, it has been reported, for some time, and have been willing to dispose of them to the General Electric Company. Negotiations to this end have been going on for some time, but the Whitney-Ryan interest, while seeking to include the Storage Battery Company in the purchase, have not met the views of the General Electric Company as to an equitable price for the Stanley Company by itself. It is understood that the upset price fixed by the General Electric Company is about $2,500,000, or $125 per share for the $2,000,000 capital stock of the Stanley Company, and indications are that the trade will shortly be closed. The Stanley Company is said, however, to have more money invested in it than the sum just named. It is doing a very large business.

BELL TELEPHONE FINANCES.—Note is made elsewhere of the proposed increase of the capital stock of the New York Telephone Company from $30,000,000 to $50,000,000. The increase of capital stock of the subsidiary companies of the American Telephone & Telegraph Company from time to time has aroused interest as to the money requirements for the year 1903. The Cumberland Telephone Company, which operates throughout Tennessee, Kentucky and other Southern States, is asking authority of stockholders for an increase in its capital stock from $10,000,000 to $20,000,000, and as the American company owns 52 per cent. of the capital stock of that company, it will be called upon to furnish $5,200,000 of the increase, although the new stock may not all be issued in one year. It is estimated that the Bell telephone companies alone will require $25,000,000 in 1903 for extensions throughout the United States and Canada. This sum will put in about 200,000 new subscribers and build the necessary long-distance lines. Of the $25,000,000 the minority stockholders of the subsidiary companies will furnish $10,000,000 and the parent company $15,000,000. Most of the capital furnished by the subsidiary companies will be through stock issues, although there may be small bond issues. The American Telephone & Telegraph Company is expected to benefit its stockholders about midsummer by issuing new stock at par to provide for its needs. The stock is now selling easily around 160.

NEW YORK TRACTION FINANCE.—The statement is made that the Rothschilds have invested $10,000,000 in the Interborough Company, organized to provide rapid transit for New York. This is a larger sum from any other one interested in the company has put up. In mentioning this fact, the *Wall Street Journal* says: "If it were not for capital outside of New York hardly any of the improvement in transit facilities in New York would have been so far possible. It will be remembered that the Metropolitan Street Railway system itself is developed by Philadelphia capital. The opening up of Greater New York by the Pennsylvania Railroad is by outside capital. It may be said that the Manhattan Company alone has had most of its money contributed by local people, but it may also be said that the Manhattan Company, whether from this cause or not, has, nevertheless, had more trouble in pushing improvements and making headway against the powers that be in this city than all the other companies put together."

THE PHILADELPHIA COMPANY owning several electric lighting properties, etc., has had a very successful year, as shown by the increase of $1,437,028 in gross earnings for the eleven months ended November 30th, and that it has been very generous in the operating expenses is indicated by an increase of $1,038,078 in that item for the same period. The company's income other than that derived from direct operation increased $1,036,394, of which $969,253 is contributed by the increase in dividends received on stocks of sub-companies owned. This increase in income from sub-companies is, however, largely offset by an increase of $670,257 in interest on funded debt and an increase of $108,988 in preferred dividend requirements, leaving surplus $17,689 larger than last year. But the amount of this surplus belonging to the minority stockholders in properties of the Philadelphia Company is $461,791 less than last year, so the final surplus is $379,478 larger than last year.

CHICAGO TROLLEY CONSOLIDATION.—With regard to the rumors already noted in these pages respecting a consolidation of all the Chicago street railways, it is now stated that such a plan, to include the elevated roads, is being consummated. It is said that the capitalization of the new combine will be placed at $270,000,000 and that Lyman Gage is to be president and have associated with him Marshall Field, C. T. Yerkes, Gen. G. M. Dodge and Thos. F Ryan. The recent employment of John N Jewett to look into the franchise of the Chicago General Railway Company with a view to its utilization to get around the expiring franchises of some of the street railways is thought to have been a preliminary move in the direction of a general consolidation of all lines and a systematic transfer arrangement between the surface and "L" roads.

CUMBERLAND TELEPHONE.—At the regular meeting of the board of directors of the Cumberland Telephone and Telegraph Company, at Nashville, a resolution was passed calling a special meeting of the stockholders to vote on the proposition of increasing the capital stock of the company from $10,000,000 to $20,000,000. The stockholders have since held the necessary meeting. Stockholders of record January 10 will be entitled to the new stock in the proportion of one new share for every four shares then held. The right to subscribe will expire February 2. Payments for stock are to be made, 25 per cent. February 2, 25 per cent. July 1, 25 per cent. October 1, and 25 per cent. January 2, 1904. The funds derived are to be used to retire a part of the present floating indebtedness and to care for the increased business during 1903.

OHIO STREET RAILWAYS.—The State Railway Commissioner's report for 1902 shows that 28,499,313 passengers were carried, the average distance being 25.54 miles. Total earnings from passenger service, $101,001,341, being an increase over the previous year of 12.6 per cent. The total mileage, including all tracks, is 14,264.05. The common stock proportion for Ohio is $210,335,071; preferred, $100,370,125. The operating expenses showed an increase of 9.04 per cent. Taxes paid by the companies were $2,799,341.17, or an increase of $156,940. Money spent on permanent improvements, $1,063,183, an increase of $449,791. The surplus on hand at the end of the first six months was $9,331,631.63, an increase of over $1,000,000. Salaries of employes show an increase of 12.19 per cent. Tons of freight transported were 132,113,976, an increase of 12.31 per cent.

GERMAN ELECTRICAL FINANCE.—A cable dispatch from Berlin of December 28 says: Prior to the holidays, trading on the Bourse was very light, and values were maintained, but yesterday the trading was uncommonly strong, with an increased volume of business. All departments shared in the upward movement. Electrical shares profited by the alliance of the Allgemeine Electrical Company and the Union Electrical Company. It is said now that the Siemens & Halske Electrical Company, of Berlin, and the Schuckert Electrical Company, of Nuremberg, will make a price arrangement with the new consolidation.

DALLAS ELECTRIC MERGER.—At Dallas, Tex., on December 22, the City Council ended the two months' fight over the street railway merger ordinance by sustaining the mayor's veto. This, for the time being at least, it has been alleged, blocks the plans of the Boston syndicate to consolidate all the Dallas lines into the "Metropolitan Street Railway Company," and float $4,500,000 worth of bonds on the property. Other reports state, however, that the merger plans will be pushed ahead all the same.

NEW YORK TELEPHONE CAPITAL.—The New York Telephone Company, of New York City, has filed with the Secretary of State a certificate of increase of its capital stock from $30,000,000 to $50,000,000. The certificate is signed by Frederick P. Fish, president of the company; Robert C. Clowry, Charles F. Cutter and others. The company's business is increasing at an enormous rate, and it announced recently having attained over 100,000 subscribers.

FINANCING EVERETT-MOORE PROPERTIES.—It is stated that at a conference of Ohio financiers it was decided to form a company to lease several of the properties associated with the Everett-Moore syndicate. The capital of the company will be $2,500,000 and the roads to be included are the Detroit United, the Toledo Railways & Light and the Lake Shore Electric. Dividends will be guaranteed to the stockholders in the two former concerns.

COMMONWEALTH ELECTRIC.—The Commonwealth Electric Company, of Chicago, has voted to increase its capital from five to ten millions. The company is building a very large plant, costing six millions. It will be remembered that this company is virtually an extension of the Chicago Edison Company, which through it controls business in outlying territory.

INDEPENDENT UNION TELEPHONE.—The Independent Union Telephone Company has voted to increase its capital stock from $200,000 to $1,000,000, to connect its system in western New York with properties in the eastern and southern part of the State. Samuel B. Rawson, of Elyria, O., has been re-elected president.

KEYSTONE ATTACHMENTS.—Two attachments, aggregating $74,193, have been granted against the Keystone Telephone Company, Philadelphia, for the National Conduit & Cable Company.

INDIANAPOLIS TROLLEYS.—The stockholders of the Indianapolis Street Railway Company have ratified the lease of the company's lines to the Indianapolis Traction & Terminal Company. The capitalization of the Terminal Company will be increased from $500,000 to $5,000,000. Hugh McGowan was re-elected president.

UNDERGROUND ROAD IN CHICAGO.—It is reported from Chicago that New York and Chicago capitalists have combined to build an underground and a new elevated railway in Chicago at the estimated cost of $51,000,000. The Interborough Rapid Transit Company, of New York, is said to be at the head of the traction plan.

MACON RAILWAY AND LIGHT MORTGAGE.—The Macon Railway & Light Company, of Macon, Ga., has executed a mortgage for $1,000,000 on all its properties to the North American Trust Company, New York, as trustee. This perfects the consolidation of all the street railway and lighting companies of Macon, Ga.

HUDSON RIVER TELEPHONE.—The Hudson River Telephone Company will offer 3,868 shares of new stock at par to stockholders of record, January 10, in the proportion of one new share for every 10 shares then held, the right to subscribe to expire January 31. Payment for new stock is to be made January 31.

BERKSHIRE TROLLEY BONDS.—N. W. Harris & Co. are offering to investors $500,000 first mortgage 5 per cent. gold bonds of the Berkshire Street Railway Company, operating in Pittsfield, Lee, Lenox, Stockbridge, Great Barrington, Cheshire, Adams and North Adams, Mass.

EVERETT - MOORE TELEPHONE.—It is announced from Cleveland, O., that a plan proposed for putting the Everett-Moore telephone properties on a solid financial footing is to organize the United States Telephone Company, of New Jersey, with $10,000,000 capital.

CAMBRIDGE (MASS.) LIGHTING.—The Gas & Electric Light commissioners of Massachusetts have authorized the Cambridge Electric Light Company to issue 1,000 shares of new stock at $140 per share for the enlargement and extension of its plant.

DIVIDENDS.—Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent., and an extra dividend of 1 per cent., both payable January 15 to stockholders of record January 5.

Commercial Intelligence.

THE WEEK IN TRADE.—The holidays and stocktaking have limited trade somewhat, but satisfaction and confidence are maintained. Wholesale distribution has, according to *Bradstreet's*, been down to a minimum, while retail buying, though satisfactory, feels reaction from previous activity. Perhaps the most notable features are the strength of prices of staples as the year begins and the hopefulness as to the outlook for next spring and summer's trade. The only unfavorable feature noted is the continued shortage of anthracite coal in the East. Reports of increased trade in 1902 over 1901 continue to come from nearly all northern, eastern, western and Pacific Coast points. The outlook for 1903 on the Pacific Coast is almost uniformly favorable and even at the South favorable reports predominate. There is little new in the iron trade. An excellent outlook for a large business and steady prices is noted at Pittsburg. Merchant furnaces are sold ahead from six to eight months, but independent iron men say that high raw materials and low-priced finished products leave them little or no margin for profit. Nearly all lines of trade show gains for 1902 over 1901 at New York, the majority ranging from 5 to 10 per cent. Industry, generally, is active, the demand for labor being large for the season. Wages advances taking effect January 1 were numerous. Railroad men have been special gainers, while the profit-sharing plan inaugurated by the leading iron and steel interest is a notable contribution to the stability of this trade. Prices in copper have been advanced, but there was a very light demand for the metal. Quotations are: Lake, 11.87½ @ 12c.; electrolytic, 11.75 @ 11.87½c.; casting stock, 11.62½ @ 11.75c. *Bradstreet's* notes that 1902 has been a record breaker in the matter of business failures, only 9,971 of these being recorded, with liabilities of $105,693,000 and assets 48 per cent. of this = 5.5 per cent. fewer failures than in 1901, and 19 per cent. less liabilities, the latter being the smallest for twenty years.

STEEL FOR MEXICAN PLANT.—Milliken Brothers, of 11 Broadway, New York, got the contract for the structural steel for the central power plant of the Mexican Gas & Electric Light Company, of the City of Mexico, which is also to be equipped with American machinery.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended December 27: Argentine Republic—76 pkgs. material, $1,894. Antwerp—1 pkg. machinery, $60; 19 pkgs. material, $1,111. Berlin—4 pkgs. material, $303; 1 pkg. material, $114. Bergen—1 pkg. machinery, $76. Bremen—1 pkg. material, $150; 1 pkg. machinery, $75. British Possessions in Africa—21 pkgs. machinery, $1,195; 275 pkgs. material, $11,869. British Guiana—35 pkgs. material, $1,373. British East Indies—1 pkg. material, $35; 5 pkgs. machinery, $175. British West Indies—20 pkgs. material, $248; 3 pkgs. machinery, $145. China—11 pkgs. material, $227. Cuba—6 pkgs. machinery, $416; 80 pkgs. material, $1,916; 2 pkgs. machinery, $175. Chili—32 pkgs. material, $2,477. Central America—39 pkgs. material, $507; 9 pkgs. machinery, $603. Danish West Indies—2 pkgs. material, $13. Ecuador—9 pkgs. material, $263. French West Indies—1 pkg. material, $25. Geneva—12 pkgs. material, $132. Genoa—14 pkgs. machinery, $500. Hamburg—1 pkg. machinery, $52; 7 pkgs. material, $444. Hong Kong—14 pkgs. material, $190. Helsingfors—3 pkgs. machinery, $95. Hayti—1 pkg. material, $11. Havre—3 pkgs. material, $675; 78 pkgs. machinery, $6,000. Japan—15 pkgs. machinery, $1,717; 21 pkgs. material, $1,173. Liverpool—325 pkgs. machinery, $21,760; 31 pkgs. material, $1,933. London—100 pkgs. machinery, $5,631; 148 pkgs. material, $6,011. Mexico—297 pkgs. material, $4,027; 7 pkgs. machinery, $320. Manchester—2 pkgs. machinery, $60. Marseilles—7 pkgs. material, $350. Newcastle—1 pkg. material, $106. Nova Scotia—24 pkgs. material, $192. Naples—1 pkg. material, $25. Philippines—60 pkgs. material, $433. Reval—4 pkgs. machinery, $947. Rotterdam—1 pkg. material, $32. San Domingo—6 pkgs. material, $42. Sheffield—12 pkgs. machinery, $456. Sunderland—1 pkg. material, $19. Southampton—5 pkgs. machinery, $626; 6 pkgs. material, $154. U. S. Colombia—6 pkgs. material, $1,385. Venezuela—91 pkgs. material, $401. Wigan—1 pkg. material, $94. Following are the exports of electrical materials and machinery from the port of New York for the week ended January 3: Antwerp—8 pkgs. machinery, $720; 18 pkgs. material, $2,451. Argentine Republic—7 pkgs. material, 0893. British West Indies—71 pkgs. material, $475. Bristol—1 pkg. machinery, $76. British Australia—240 pkgs. machinery, $14,424; 30 pkgs. material, $866. Brazil—47 pkgs. material, $2,209. Berlin—2 pkgs. material, $97. British East Indies—11 pkgs. machinery, $525; 3 pkgs. material, $267. Cuba—17 pkgs. material, $386. Central America—7 pkgs. material, $629. Genoa—2 pkgs. material, $85. Glasgow, 20 pkgs. material, $1,299; 2 pkgs. machinery, $81. Halifax—1 pkg. material, $25. Havre—92 pkgs. machinery, $4,000. Hamburg—3 pkgs. machinery, $250; 121 pkgs. material, $3,550. Liverpool—139 pkgs. machinery, $5,448; 25 pkgs. material, $1,417. London—269 pkgs. machinery, $14,127; 238 pkgs. material, $17,315. Mexico—49 pkgs. material, $1,479. Preston—5 pkgs. material, $92. Peru—43 pkgs. material, $2,086. Stettin—12 pkgs. material, $1,032. Southampton—5 pkgs. material, $82; 1 pkg. machinery, $50. U. S. Colombia—3 pkgs. machinery, $42. Vienna—1 pkg. material, $31. Wigan—1 pkg. material, $100.

ELECTRIC TRACTION FOR MARITZBURG.—Nearly $400,000 is to be expended in the construction of a trolley system in the city of Maritzburg, South Africa. As a first instalment, six and one-half miles of track, part of it double but the major portion single, is to be built. Ninety-pound girder rails will be used in the urban division. In the suburbs a 75-pound rail is to be employed. The initial number of cars will be six. Special designs will be necessary, because the municipal authorities have decided to make a new departure in regard to the seating of Europeans, natives and coolies. In Cape Town, Port Elizabeth and East London there are no restrictions on the use of the street cars by the colored population. In Maritzburg it is proposed that the color line shall be as strictly drawn as it is "Down South." The municipality is not disposed, however, to exclude the natives from the cars, it being the intention to adopt a compromise which is expected to initiate a new usage in street railway economy in South African cities. The cars are to have seats for five natives at each end. The natives will sit behind the motorman in a compartment partitioned off from the rest of the car. The Maritzburg cars are to be 30 feet long. Instead of the trolley the sliding bow is to be used. For the purpose of furnishing energy to operate the road, 400 hp of equipment will be added to the existing plant now used for lighting and power. Skidmore Ashby is the electrical engineer of the municipality.

UNITED TELPHERAGE COMPANY.—Mr. H. McL. Harding, President of the United Telpherage Company, 20 Broad Street, reports a very prosperous year in 1902 for this vigorous and most promising young industry. It has barely been in operation a year, but has already some 40 telpherage plants in operation all over the country, in which the telphers haul aerial loads ranging from a few pounds of freight up to six or seven tons, of all classes of material, including cotton goods, hogsheads, ashes, metal parts, coal, limestone, bags of cement, bottles, etc., etc. A considerable inquiry for this entirely new class of American apparatus has grown up abroad, and not only have foreign plants been sold, but arrangements have been made with very influential concerns to represent it actively in various countries. It already is becoming evident that largely thanks to Mr. Harding's efforts and those of his associates, a new industry has been started of great magnitude; one, indeed, which they expect to compare at no distant date with the trolley art of passenger transportation.

LIGHTING EQUIPMENT FOR SAN LUIS POTOSI.—The Potosina Electric Company, of San Luis Potosi, Mexico, which has succeeded the old San Luis Potosi Electric Light Company, has just awarded contracts through the electrical engineering and contracting firm of Sanderson & Porter, New York, for three 100-kw Westinghouse generators for direct connection to horizontal tandem single crank gas engines of 170 hp capacity each, to be built by the Westinghouse Machine Company, Pittsburg, and the order for which was given to Westinghouse, Church, Kerr & Company. The engines will be operated on Loomis-Pettibone producer gas. The Mexican plant is laid out with a view to the installation of two additional units of 220-kw capacity each. Former General Manager Waddill, of the old company, is president of the new concern, which is composed exclusively of American capitalists, and has the concession for furnishing light to the important city of San Luis Potosi. H. A. Corbitt is the engineer.

MORE YANKEE EQUIPMENT FOR AFRICA.—Bids are now being invited by the New York offices of the British firm of Macartney, McElroy & Co. for the supply of considerable equipment intended for the new Lourenzo Marquez electric traction system, Portuguese East Africa, the contract, valued at over $500,000, for the construction and equipment of which road was recently awarded to the firm. In the first instance it is proposed to build 15 miles of line. The trolley wire is No. 00. The cars will be open, single-deck ones, somewhat similar to the open cars operated on the Metropolitan road during the summer. They will have a capacity for about fifty passengers. Single trucks will be utilized. The motors will be either two 30-hp or two 25-hp for each car. The power house equipment is to comprise two 200-kw generators, which are intended to be direct-connected to high-speed engines.

THE STURGEON FALLS PULP COMPANY, of Ontario, Can., is building a large paper mill which will be operated by alternating-current induction motors throughout. The Westinghouse motors are to be used to drive the variable-speed shaft of the paper machines, and two 75-hp motors will drive the constant-speed line-shaft of the same machines. Another 75-hp motor will operate other machinery in the mill. A 15-hp induction motor will be direct-connected to a triplex pump, one of 10 hp will drive the wet machines, a 20-hp motor will drive the agitators for the clay-mixing tanks, and a 30-hp motor will drive the conveyors. The order to the Westinghouse Electric and Manufacturing Company also includes a 560-kw revolving field alternator, designed to be direct-connected to a water wheel, with the exciter, switchboard and instruments to accompany the generator. The engineer and designer of the Sturgeon Falls plant is Mr. George F. Hardy.

OMAHA TROLLEY EXTENSIONS.—The Seligman banking house of New York, which recently purchased control of the Omaha street car lines, has announced the construction of 200 miles of suburban electric lines in Eastern Nebraska and Western Iowa. Incorporation papers were filed in Omaha recently under the name of the Omaha & Council Bluffs Street Railway Company, capital $15,000,000. The company also announces a ninety-nine-year lease of the Council Bluffs & Omaha Bridge & Motor Company, operating the Council Bluffs street car lines, and a bridge over the Missouri River between Omaha and Council Bluffs. The suburban lines will be in six directions from Omaha in Nebraska and in one direction in Iowa, but others are to be constructed in the latter State after those planned are completed. The company will also erect a $750,000 power plant in Omaha.

RICHMOND (VA.) TROLLEY DEAL.—Announcement is made that Frank J. Gould has obtained control of the Virginia Passenger & Power Company, which operates a traction system in Richmond, Va. The company has 122 miles of track in Richmond, Manchester and Petersburg, including an electric line twenty-two miles long between Manchester and Petersburg. The deal was consummated through the Merchants' Trust Company, of New York City, which is to be the fiscal agent and depositary of the company's funds. This company was organized last year under a special perpetual charter, combining six local companies in and around Richmond. The stock consists of $4,000,000 outstanding preferred, and $10,000,000 common. There are $6,000,000 of 5 per cent. mortgage bonds, and $7,000,000 underlying bonds, $2,000,000 of an issue of $15,000,000 remaining in the treasury. The balance, after interest payments from earnings for the quarter to November 1, was $95,000.

COPPER COATED CARS.—It is stated by the Metal Plated Car & Lumber Company, which was awarded the contract for sheathing 500 coaches with copper plate by the Interborough Rapid Transit Company, that it will require about 80 tons of copper to complete the work. The copper to be used on these cars was purchased about two months ago in anticipation of closing the contract from the Ansonia Copper Company. It is likely that the Rapid Transit Company will have at least 1,000 cars by the time the road is ready to be operated. In case the remaining 500 cars are to be finished in the same way, it would, of course, take 80 tons more to finish the work, making 160 tons consumed on the outside of Rapid Transit cars.

THE BROWNING MANUFACTURING COMPANY, Milwaukee, Wis., announce that it has established agents throughout the country to handle its motors. In the East it will be represented by the D'Olier Engineering Company, of New York, Philadelphia and Baltimore; the Western Electrical Supply Company, St. Louis, will represent it in the Southwest, and the Goudey-McLean Company, New York, will represent its foreign department. The selling arrangement which formerly existed with the Milwaukee Electric Company has been discontinued. The Browning motors have become widely known throughout the country and are in excellent demand.

ANOTHER JAPANESE ELECTRIC TRACTION PROJECT.—The construction of an electric traction system is contemplated in Osaka, the commercial capital of Japan, and a city of some 500,000 inhabitants. The Osaka Electric Light Company, which operates the second largest lighting plant in Japan (Tokio has the largest one), is said to be primarily interested in the project. The lighting plant is equipped with generators built by the General Electric Company. It is proposed to furnish power in the first instance to operate a 300-kw motor-generator. Twenty-four cars will be used as initial equipment. Each car will be fitted with two 25-hp motors.

BALL ENGINE ORDERS.—The Savoy Hotel, Kansas City, Mo., is installing an electric plant, consisting of 125-hp engine direct-connected to 75-kw General Electric generator; the Ball Engine Company, Erie, Pa., furnished the engine. The Glauber Brass Manufacturing Company, Cleveland, O., is installing an electric plant; the Ball Engine Company furnished a 175-hp engine. The Monument Pottery Company, Trenton, N. J., has recently installed an electric power plant consisting of 125 and 50 hp engines, direct-connected to Western Electric Company generators; the Ball Engine Company furnished the engines.

HUDSON RIVER POWER.—It is stated that the Hudson River Water Power Company and the Hudson River Electric Company, jointly, have made a 15-year contract with the electric light company at Albany to supply it with 8,000 hp, and with the electric light company of Troy to supply it with 6,000 hp at a price which will net about $60 per hp per year. This 14,000 hp is to be used for electric lighting. The Hudson River companies are also to deliver to the Albany and Troy companies, for power purpose, 3,000 and 5,000 hp respectively at a price which will net the Hudson River companies $96 per hp per annum.

NEW GERMAN WORK.—The Schlesischen, Kohlen & Kokswerke, in Fellhammer (Schlesien) Germany, contemplate installing a new electric power station, the total cost of which is to be 1,750,000 marks. In the following cities in Germany the municipalities have just passed upon the erection of electric power plants: Habelschwerdt, Reg. Bez. Breslau; Kostritz (Reuss J. L.); Rheinberg (Rheinpreussen); Steinheim (Westfalen). For further information address the Stadtverwaltung of the different cities. In Swinemunde the municipality is contemplating the building of an electric street railway.

FIRE ALARM CONTRACT.—The New York Central Railroad Company has made a contract with the Gamewell Fire Alarm Telegraph Company for the installation of fire alarm systems for the piers, buildings and premises of the company at Sixtieth Street, New York City, and at Weehawken, N. J. It is a pity that something cannot be done to renew the antiquated and obsolete fire alarm boxes of the New York City Fire Department. Commissioner Greene, of the Police Department, has made public a proposal to adopt an extensive police patrol signal system.

BROOKLYN UNDERGROUND CONTRACTS.—Mr. G. M. Gest, the conduit contractor, has been awarded additional contracts for placing underground the remainder of the overhead system of the Brooklyn Heights Railroad Company, Brooklyn, N. Y., which is being done on account of the recent order of Commissioner Robert G. Monroe. This will practically complete the removal of the overhead system of that company within the prescribed area, and work will be finished early in the spring. These contracts amount to nearly $40,000.

BIG OFFER FOR MEXICO CITY TRACTION SYSTEM.—The Mexico Electric Tramways Limited, of London, which is practically controlled by the Anglo-African house of Wernher, Beit & Company, is said to have refused an offer of no less than $18,000,000 for its properties and concessions. The authorized capital of the concern is $10,000,000, but the stock issued amounts to only $5,000,000. The road operates over 600 American cars. These figures represent Mexican money.

BOILERS FOR JAPANESE PLANT.—The Hakata Electric Company, of Hakata, Island of Kiushi, Japan, particulars of whose new American electrical equipment were given in our last issue, will have installed in its plant two 250-hp Cahall horizontal boilers, manufactured by the Aultman & Taylor Manufacturing Company, of Mansfield, O. These boilers will displace the Japanese ones now in use. The contract was secured through Bagnall & Hilles, Yokohama.

LIGHTING CONCESSION FOR RANGOON.—The municipality of Rangoon is expected to invite applications shortly for the granting of a concession to light electrically that Burmese city. The franchise is to be offered for a period of 42 years, after which time the local authorities will reserve the privilege of purchasing the property. Provision will also be made for the construction of an electric traction system.

STEEL FOR YOUNGSTOWN, O., PLANT.—The American Bridge Company, of New York, 100 Broadway, has secured the contract for the new engine house which the Youngstown-Sharon Railway & Light Company, 46 Wall Street, is having built at Youngstown, O. The company's plant is being enlarged from 2,400 hp to 4,500 hp. Sanderson & Porter, Bank of Commerce Building, New York, are the consulting experts.

MOTORS IN BROOKLYN.—In its Bulletin for December, 1902, the Edison Electric Illuminating Company gives the following interesting exhibit of the growth in horse power of motors connected to its circuits: 1891, 156 hp; 1892, 403 hp; 1893, 1,042 hp; 1894, 1,424 hp; 1895, 1,884 hp; 1896, 2,532 hp; 1897, 3,146 hp; 1898, 3,759 hp; 1899, 4,425 hp; 1900, 5,809 hp; 1901, 7,864 hp; 1902, 12,734 hp; Dec. 1, 1902, 14,052 hp.

COAL FROM ENGLAND.—The Philadelphia Rapid Transit Company has closed a contract for 20,000 tons of Welsh and Northumberland coal, because of inability to secure prompt delivery of Pennsylvania anthracite and has chartered several steamers to bring it over. This is rather amusing, not to say startling, when one remembers that Philadelphia is largely a creation of the Pennsylvania coal fields.

ADDITIONAL EQUIPMENT FOR POWER PLANT.—The Worcester and Connecticut Eastern Railway Company, of Danielson, Conn., has contracted for the supply of an additional Westinghouse generator of 400-kw capacity. The company's plant is operated by water power. The generator will be belted to a turbine built by the Holyoke (Mass.) Machine Company.

S. D. WARREN & COMPANY have recently bought three induction motors, two of 100 hp and one of 150 hp, from the Westinghouse Electric and Manufacturing Company, to be installed in their paper mill at Cumberland Mills, Me. The two 100-hp motors will be used for driving blowers furnishing mechanical draft, and the 150-hp motor will drive papermaking machinery of various kinds.

EQUIPMENT FOR MANILA PRINTING PLANT.—The National Electrical Supply Company, of Washington, D. C., is letting considerable contracts for various equipments to be installed in the United States Bureau of Public Printing, Manila. The Crane Company, of Chicago, has been allotted a substantial order for its specialties.

PUMPS FOR JAPAN.—The Nagaoka Kogio Kaisha, Japan, has ordered through Takata & Company two oil-pressure pumps, to be built by the International Pump Company. One will be a 10-in. x 2½-in. x 10-in. Worthington. The other will be a 12-in. x 3-in. x 12-in., of Snow build. Both pumps are to be horizontal duplex.

WESTINGHOUSE EQUIPMENT FOR BATAVIA, N. Y.—The electrical engineering and contracting firm of Sanderson & Porter, New York, has let contracts on behalf of the Consolidated Gas & Electric Company, of Batavia, N. Y., for three 150-kw Westinghouse generators for direct connection to 260-hp Westinghouse gas engines.

G. E. MOTORS IN JAPAN.—The General Electric Company will furnish the motors for the sixteen trains to be operated on the new Kobu high-speed electric road, which will run in the vicinity of Tokio, Japan. Each train will be composed of three cars. The motors will aggregate 200 hp per train.

GERMAN PROPOSALS WANTED.—The firm of Louis Walter & Co., manufacturers of electric light and power supplies, in Cologne, Germany, wish proposals for motor-driven machinery and apparatus for all kinds of industrial machinery, also the latest devices for light and power generation purposes.

General News.

THE TELEPHONE.

LOS ANGELES, CALIF.—The United States Long Distance Telephone Company, organized some time ago in Washington, D. C., with a capital stock of $200,000,000, proposes to cover Southern California with its wires, and as an initial step in the enterprise has made application for a blanket franchise from the Board of Supervisors to do business throughout Los Angeles County. As an evidence of its good faith the company offers to obligate itself in the franchise asked for to expend $40,000 in four years.

ALAMOSA, COL.—The Colorado Telephone Company is preparing for extensive improvements in the San Luis valley the coming year. The company has over 100 telephones working in Alamosa, besides as many more in the smaller towns of the valley. The company purchased all the telephone lines in the southern part of the valley and is trying to buy the lines in the northern part. The company has plans to extend its lines from Alamosa to Creede, Pagosa Springs and Durango, also south into the Red River country in New Mexico.

AMERICUS, GA.—The Bell Telephone Company has been enjoined by farmers from running its long distance lines across farms between here and Savannah. The Bell Company will soon have lines running in every direction from Americus.

KLONDIKE, ILL.—The Montmorenci Telephone Company will build ten more miles of line as soon as the weather will permit.

LAKE PARK, IA.—The Midland Telephone Company will build a telephone exchange at this place.

ELDRIDGE, IA.—The Eldridge Mutual Telephone Company, capital $10,000, has been incorporated. Mr. Jas. H. Wise is president.

CAMBRIDGE, IA.—The Cambridge Independent Telephone Company has incorporated, with a capital stock of $10,000, by Frank Thompson and others.

DELPHI, IND.—The Yoeman Co-operative Telephone Company has applied for a franchise at this place.

CORYDON, IND.—The Eureka Telephone Company is extending its system in this section and is building lines in Boone, Heth, Washington, Posey and Taylor townships. A new exchange is to be established at Corydon.

EVANSVILLE, IND.—City Attorney Funkhouser says the litigation between the city and the Cumberland Telephone Company will in no way interfere or delay the work of installing a municipal telephone system in this city. He and Mayor Covert have just returned from Chicago and say they succeeded beyond expectation in interesting supply men.

BLUFFTON, IND.—The United Telephone Company, of Indiana, has decided to issue bonds to the amount of $500,000 and of this amount to use $100,000 to take up indebtedness of the plant. Four hundred thousand dollars will be used for extensions and repairs. The company has plants at Marion, Huntington, Hartford City, Montpelier and Bluffton. The company held its annual meeting at Bluffton on Dec. 23, when the plans of operations were discussed and agreed upon. Hon. Hugh Dougherty is president of the company.

INDIANAPOLIS, IND.—The New Telephone Company, of this city, claims to have broken the record, on Christmas eve, in the number of messages handled in the main exchange. During the day there were put through 83,794 calls. During the hour between 4 and 5 o'clock P. M. there were put through 8,266 calls. This work was done by 38 operators and was an average of 217 calls an operator. During that busy hour the operator having the highest number made 433 connections, an average of 7.2 per minute.

FT. WAYNE, IND.—The Gas Belt Construction Company, composed of Ft. Wayne telephone capitalists has been in existence for less than a year, but the stockholders received a 10 per cent. dividend as a Christmas present. The company will turn over the Muncie and Alexandria independent telephone exchanges on New Years' Day to their local owners. Another contract has been taken for the construction of an exchange at Eaton and for stringing of a new metallic circuit on the toll lines connecting the principal cities of the gas belt. The profits of the toll lines in some cases have reached 50 per cent.

INDIANAPOLIS, IND.—The Central Union Telephone Company has placed a new switchboard in the private telephone exchange of the Indianapolis *News*. The switchboard is for use only at branch exchanges where there are five or more trunks and twenty or more stations connected with same. This is a great improvement in private exchange switchboards over those formerly in use and much more simple. Figures are always interesting and often suprising. For instance, a comparison with directories just issued by the two telephone companies doing business in this city, the Central Union shows about 7,200 subscribers and the New Company 6,000 subscribers, making a sum total of 13,200 for both companies. A careful investigation reveals that only about 13 per cent. subscribe to both services or only 1,716 subscribers of the total number have both, leaving 11,484 who have no communication with each other.

AUBURN, KY.—Farmers of Stowers and Auburn have organized a telephone company and will build lines connecting both towns with an exchange at Auburn.

BOWLING GREEN, KY.—The Bowling Green Telephone Company has placed a contract with the Stromberg-Carlson Company for its switchboard and telephones. The exchange will be completed as soon as possible.

NEW ORLEANS, LA.—About 3,500 miles of telephone wire have been strung on the Illinois Central Railroad leaving only 200 miles yet to be built.

LITCHFIELD, MICH.—The Common Council has granted a franchise to a local company to establish a telephone exchange in the village.

BAY CITY, MICH.—Articles of incorporation of the Northeastern Telephone and Telegraph Company, of Bay City, have been filed. The capital stock is $100,000, all subscribed, of which $30,000 is paid in. The board of directors consists of George E. Dutton, Saginaw; James F. Land, Detroit; Wm. W. Jones, Toledo; O'Brien O'Donnell, Toledo; Thomas F. Hancock, Detroit.

GRAND RAPIDS, MICH.—President C. F. Root, of the Citizens' Telephone Company, announces that a contract has been placed with the Automatic Electric Company, of Chicago, whereby an automatic system will be installed and placed in operation by July 1, 1903. The improvements will cost about $150,000. The new board will have a capacity of 12,000 lines.

KANSAS CITY, MO.—The Kansas City Home Telephone Company, of Kansas City, has increased its capital stock from $50,000 to $3,000,000.

HENDERSONVILLE, N. C.—The Asheville, N. C., Telephone Company is rebuilding the plant at Hendersonville. A new switchboard is being installed by the Stromberg-Carlson Company.

FAYETTEVILLE, N. C.—The American Long Distance Telephone Company, which is to build a line between Petersburg, Va., and Cheraw, S. C., has been granted a franchise to install a long distance station here.

FARGO, N. D.—The Twin City Telephone Company has applied for a franchise in this city.

EAST ORANGE, N. J. The New York and New Jersey Telephone Company has awarded the contract for an office building in this city to cost $58,600.

MOUNT VERNON, N. Y.—John D. Rockefeller and Miss Helen Miller Gould remembered the telephone and telegraph operators at Irvington and Tarrytown on New Year's Day by sending them each a ten-dollar gold piece.

CLEVELAND, OHIO.—The Cleveland Telephone Company (Bell) is preparing to erect a modern branch exchange at Lakewood.

CINCINNATI, OHIO.—The City & Suburban Telephone Association paid its employees an extra months' salary as a Christmas present. During the past year the local business of the company has increased nearly 40 per cent.

NEWARK, OHIO.—The Central Union Telephone Company is installing one way party lines on a six months' trial at $1. The plan is being followed in other towns in the State where it is desirous of building up the system.

RELIEF, OHIO.—The Muskingum Valley Telephone Company has been incorporated with $5,000 capital stock by Amos Lawrence, W. M. Fisher, E. B. Vincent, T. W. Milner and W. W. Mason, all of Relief. It will build a system centering in that town.

TOLEDO, OHIO.—The Wheeling & Lake Erie Railroad is trying the experiment of installing telephones in its cabooses. Connection will be made with the telephone wires by means of an extension pole and it is believed the movements of trains will be greatly facilitated.

TOLEDO, OHIO.—The Toledo city authorities claim the United States Telephone Company is preparing to run its lines into the city without a franchise, in order to connect with the Toledo Home Telephone Company, and they have stationed police officers on the outskirts of the city to prevent the stringing of wires.

LORAIN, OHIO.—The Black River Telephone Company made a fine showing during the past year. It now has 900 telephones in operation, an increase of 200 during the year. It has orders for 300 more which will be installed as soon as the new Sterling board now under construction is completed. The new board has a capacity of 4,000 telephones.

CLEVELAND, OHIO.—It is understood on very good authority that the Cuyahoga Telephone Company is planning to increase its rates without asking the consent of the city. The officials of the company as well as prominent attorneys are of the opinion that the city has no right to dictate the prices a telephone company shall charge and that the contract between the city and company is void so far as this point is concerned. It is proposed to increase the residence rate from $36 to $44 and the business rate from $48 to $60. It is also proposed to furnish four-party line service in residences at $18. It is believed that if these charges can be made, the business will increase materially and the property placed in good financial condition.

CLEVELAND, OHIO.—It is reported in financial circles that Henry A. Everett will personally purchase from the Federal Telephone Company a controlling interest in the United States Telephone Company and will devote his attention toward making this the greatest independent system in the country. It is also stated that Maxime Reber, at present general manager of the company, will become president. Despite the fact the United States Telephone Company has spent very little in improvements during the past year, the earnings are showing a good increase and on the October earnings as a basis it is paying all fixed charges and earning 3 per cent. on the outstanding stock. With contemplated improvements, the property will be placed on a fine earning basis.

STOUT, OKLA.—The Stout Rural Telephone Company, capital $10,000, has been incorporated by W. B., S. M. and George Aurier, and others.

TRENTON, S. C.—A corps of surveyors is near here to locate a long distance telephone line to Augusta. The line may be extended to Columbia, S. C.

WALHALLA, S. C.—The Oconee Telephone Company has been granted a charter with a capital stock of $10,000. The officers are W. J. Stribling president and treasurer, and W. R. Dongle, secretary.

CHATTANOOGA, TENN.—The committee on granting a franchise to Mrs. Annie McElroy Brett will report favorably upon granting a telephone franchise for 21 years, Mrs. Brett agreeing that the franchise shall become void if $300,000 is not spent within one year, the work to be started within six months, and 2,000 subscribers to be secured.

RICHMOND, VA.—The Richmond Telephone Company has begun putting its wires underground; $250,000 will be expended in the work.

BETHANY, W. VA.—The West Penn Telephone Company, which had an exchange here, will discontinue the service as there are not enough subscribers.

GREEN BAY, WIS.—The Valley and Telegraph Company, of Green Bay, has been incorporated, capital stock $200,000. Incorporators: William Joannes, J. S. Van Nortwick and Jules Parmentier.

ELECTRIC LIGHT AND POWER.

CLAREMONT, CAL.—Articles of incorporation have been filed by the Citizens' Light and Water Company, of Claremont; capital stock, $75,000. Directors: L. T. Gillet, G. A. Gates, C. C. Johnson, E. C. Norton and L. N. Smith, all of Claremont.

HARTFORD, CONN.—The Hartford Electric Light Company will build a five-story building adjacent to its present plant on Pearl Street.

VALDOSTA, GA.—The Valdosta Electric Light plant is to pass into the ownership of the Westinghouse interests. It is stated that $125,000 will be invested by the new owners.

MILLEDGEVILLE, GA.—The fine water power at Furman's Shoals on the Oconee River will probably be developed soon. Litigations have checked the development, but the question of ownership has been settled recently and the company's plans will be announced in the near future.

BRUNSWICK, GA.—The plant of the Brunswick Light and Water Company has passed into the hands of the Mutual Light and Water Company. The former concern has been in the hands of a receiver, Maj. W. S. Greene. Albert Fendig will be manager of the Mutual Company. He has been elected president of the concern. Major Greene has also been named as receiver for the Columbus Light and Water Company, of Columbus, Ga.

CLINTON, ME.—The Clinton Electric Light & Power Company, of Clinton, has been incorporated with a capital of $10,000. President, F. L. Hesse; treasurer, Manby Morrison, both of Clinton, Me.

LANSING, MICH.—The Lapeer Light & Power Company, of Lapeer, has been incorporated with $30,000 capital stock.

CORRY, MICH.—The Corry Electric Lighting Company has notified its patrons that on account of being unable to secure coal, it will be compelled to abandon its incandescent service in order to keep the city lights burning.

KALAMAZOO, MICH.—The large new dam of the Kalamazoo Valley Electrical Company at Plainwell was put into service on Dec. 23 in the presence of a large assemblage. The dam has a capacity of 1,600-hp and the six turbine wheels furnish electrical power for the lines of the Michigan Traction Company in Kalamazoo, the Interurban line between here and Battle Creek and many manufacturing plants in this section of Michigan.

ASHEVILLE, N. C.—The W. T. Weaver Power Company proposes to furnish the city with electric power from a plant now being built on the French Broad River where a minimum of 3,000-hp is available. It is expected to have the plant in operation by July 1, 1903.

BUFFALO, N. Y.—The city hall trustees have asked for an appropriation of $45,000 for the installation of an electric light plant.

SARATOGA, N. Y.—The Hudson River Water Power Company's stockholders have voted to increase the capital stock from $2,000,000 to $5,000,000.

MIDDLETOWN, N. Y.—The National Consolidated Company, which plans to supply gas and electric light and power to Middletown, Goshen, Port Jervis, Huguenot, Cuddebackville, Otisville, Monticello, Fallsburg, Liberty and Jeffersonville, in Orange and Sullivan Counties has been incorporated with a capital of $50,000. The directors are C. M. Priggen and G. R. Larwill, of Brooklyn, and Henry Floy, of New York.

PROSPECT, OHIO.—The Prospect Electric Light Company is installing new equipment.

PERRYSBURG, OHIO.—The Witzler Electric Light Company has been incorporated with $10,000 capital stock by C. F. Chapman, Frank W. Laughling, Wm. B. Duck, George C. Weller and Raymond Hartshorn. The company will build a lighting plant at Perrysburg.

GEORGETOWN, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway has submitted a proposition to furnish current to the village for electric lighting and an engineer is to be employed to furnish estimates on the cost of erecting poles, installing wire and arc lamps. If the figure is right the proposition will be accepted.

HARRISON, OHIO.—The citizens of Harrison are considering a proposition to purchase the lighting plant owned by J. A. Graft of that place. The town is directly on the State line, the portion known as West Harrison being in Indiana. The citizens of the Indiana town have declined to pay the rates demanded by Mr. Graft.

PITTSBURG, PA.—The Manufacturers' Light & Heat Company has increased its capital stock from $5,000,000 to $10,000,000.

PITTSBURG, PA.—In the Folsom district, Wetzel County, W. Va., the South Penn. Oil Company is erecting an electric power plant for operating its pumping and drilling wells. The plant, when completed, will cost about $200,000 and if it proves a success will be enlarged to several times its initial capacity.

LEWISBURG, TENN.—The town has voted $5,000 electric light bonds for building an electric light plant.

LYNNVILLE, TENN.—The citizens of Lynnville are considering the proposition to build an electric light plant.

CHATTANOOGA, TENN.—The board of public works will ask that $115,000 be included in the proposed bond issue for municipal lighting. There is some opposition to the present lighting service.

CHATTANOOGA, TENN.—The Chattanooga Light and Power Company has begun a large addition to its plant which together with new machinery purchased represents an investment of about $200,000.

KAUFMAN, TEX.—The Kaufman Electric Light Company, of Kaufman, capital stock $25,000, has been incorporated by M. A. Joy, G. E. Nolle, Terrell, and W. S. Catlin, Kaufman.

RACINE, WIS.—W. J. Hayes & Sons, Cleveland bankers, have submitted a proposition for the purchase of the Racine municipal electric lighting plant and water works. The matter is under consideration.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has put in operation a second electric railway to Ensley. The capacity of the power plant is also being doubled.

MACON, GA.—The Macon Railway and Light Company has executed a mortgage for $1,000,000 to the North American Trust Company, of New York, as trustees, on all of its properties. This will perfect the consolidation of the street railways. The bonds run for 50 years and are 5 per cent. gold coupons.

NEW ALBANY, IND.—The council has granted a new franchise to the New Albany Street Railway Company, giving it the right to carry freight, baggage, express and mail.

LOGANSPORT, IND.—The Wabash Traction Company has completed its line between Wabash and this city and trial trips have been made. Charles W. Blakeslee, of New Haven, Conn., is the principal owner.

TERRE HAUTE, IND.—The Indianapolis & Plainfield Traction Company is about to complete arrangements for the extension of its line to the west, the plan being to reach Indianapolis by connecting with the Terre Haute & Knightstown Railway.

AURORA, IND.—The Indiana Southern Electric Railway Company has been incorporated and will build a line from this city to Rising Sun. August Herman, the Cincinnati capitalist, is interested in financing the road and is one of the directors. The original capital is $10,000.

TERRE HAUTE, IND.—An electric line is to be constructed between this city and Clinton. The plans have been made and the project financed by the Stone & Webster Company, of Boston. Gardner E. Wells has charge of the construction and is preparing to build the line at once.

LAPORTE, IND.—A company has been formed and articles of incorporation are ready to file which will promote the building of an electric railway to connect Laporte with Logansport, and which further contemplates building a branch line from Bass Lake via Lake Maxinkuckee, to Rochester.

INDIANAPOLIS, IND.—The Indianapolis, Lebanon & Frankfort Traction Company has filed a notice changing its title to the Indianapolis & Northwestern Traction Company and increasing its capital stock from $25,000 to $2,500,000. The line will extend to Lebanon and is being constructed to Frankfort and Lafayette.

WABASH, IND.—The survey of the Wabash and Rochester trolley line, under the direction of P. A. Tuttle, president of the company, has been completed. The line is 35 miles long. Work is to begin as soon as the weather permits and the line is to be completed and in operation by September. T. W. Latham, of Cleveland, Ohio, is secretary of the company.

FT. WAYNE, IND.—General Manager Nelson, of the Ft. Wayne & Southwestern Traction Company, announces that his people have succeeded in financing the Ft. Wayne & Southern Railway from Huntington to Warren, with two branches from Warren, one to Montpelier and the other to Marion. With the completion of this line and branches, the system will have about sixty miles of track.

SOUTH McALESTER, I. T.—Articles of incorporation have been filed by the Purcell and Lexington Street Railway. The authorized capitalization is $100,000. The articles state that the object is to build and operate an electric street railway between Purcell, I. T., and Lexington, Okla. William T. James, Thomas C. Woods and J. F. Sharp are the incorporators.

DETROIT, MICH.—The Detroit United Railway paid its regular quarterly dividend of 1 per cent. on Jan. 3.

CITY OF MEXICO, MEX.—The electric street railway company in the City of Mexico is considering the project of building an electric road to the town of Texcoco, a distance of about eighteen miles.

ALBANY, N. Y.—A certificate of consolidation of the Fonda, Johnstown & Gloversville Railroad Company, the Amsterdam Street Railroad Company and the Cayadutta Electric Railroad Company, under the title of the Fonda, Johnstown & Gloversville Railroad Company, has been filed. The capital is $1,950,000, and the officers and directors are: J. L. Hees, Fonda, president; Gustave Levor, Gloversville, first vice-president; J. C. Ferris, Johnstown, second vice-president; G. M. Place, Gloversville, secretary and treasurer.

CELINA, OHIO.—J. W. Loree, representing Muncie and Portland people, has applied for a railway franchise in this town.

MARION, OHIO.—The Columbus, Delaware & Marion Railway Company will be extended from Marion to Bucyrus, by way of Caledonia. The company is installing a large direct-connected unit in its station at Stratford. It will more than double the capacity of the plant.

CAMBRIDGE, OHIO.—The Consolidated Street Railway Company, of Cambridge, has been granted a franchise to extend its line through Byesville.

GREENVILLE, OHIO.—The Greenville, Bradford & Covington Electric Railway Company has been incorporated to build a line from Greenville to Covington, by way of Bradford.

SANDUSKY, OHIO.—Negotiations are pending for the merging of interests of the Sandusky, Clyde, Tiffin & Southern Railway with those of the new Sandusky Southwestern Traction Company.

CINCINNATI, OHIO.—The Board of Public Service has adopted a resolution requiring the Cincinnati Traction Company to relay tracks and operate cars on the old cable line on Sycamore Street.

MARIETTA, OHIO.—There is talk of extending the Parkersburg & Marietta line northward following the Ohio side of the river as far as Fly and then crossing to Sistersville, W. Va. This would connect with the line being built from Middlebourne to Sistersville.

ZANESVILLE, OHIO.—The Appleyard syndicate has acquired control of the Bellaire, Zanesville and Cincinnati Railroad and will standardize its gauge and change it to an electric interurban line. The Ohio River and Western Railway Company will be the new name of the corporation.

GRANVILLE, OHIO.—The Newark & Granville Street Railway has secured a new 25-year franchise in Granville. The road is owned by the Columbus, Buckeye Lake & Newark Traction Company.

DELAWARE, OHIO.—W. G. Hale, representing Chicago capitalists, has applied for a franchise to cross county highways between Marion and Forest by way of Marseilles. Private right of way is being purchased.

GALLIPOLIS, OHIO.—A company has been organized to connect Chambersburg with Raccoon Island, in the Ohio River. Ernest Riggs is secretary of the company. An effort will be made to secure entrance to Gallipolis.

NEWARK, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company is surveying a new route for its extension from Newark to Zanesville. The company had difficulty in securing right of way over the route originally laid out.

GALION, OHIO.—The Ohio Central Traction Company will shortly install a new generator which will be direct-connected to a DeLaval steam turbine. The additional unit will give the company a total of 10,000-hp. at its Galion station.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has completed plans and closed some of the contracts for its new power station. The building will be of brick, 130 x 72 feet, and it will have a capacity of 4,000 horse power.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is placing gongs on the rear platforms of a number of its cars. The gong is operated by the motorman and warns passengers stepping from the car that another car is approaching from the opposite direction.

DAYTON, OHIO.—Dayton is to have another interurban line to be known as the Dayton & Camden Railway. The proposed route is over the Dayton Pike to Bowerstown, Germantown, Mudlick, Winchester and Camden. J. Borris and Peter Grubbs, of Dayton, are the promotors.

KENTON, OHIO.—The Appleyard syndicate which is building the Urbana, Bellefontaine & Northern Railway has applied for a franchise through Kenton. The syndicate announces that the line will be extended northward to connect with Toledo, affording a new Cincinnati-Toledo line.

HAMILTON, OHIO.—The Cincinnati, Dayton & Toledo Traction Company has voluntarily increased the wages of motormen and conductors. The advance takes the form of a sliding scale, with a minimum of 16 cents and a maximum of 19 cents for city lines, and 19 to 23 cents per hour on interurban cars.

CLEVELAND, OHIO.—The Washington, Baltimore & Annapolis Railway, which has its headquarters in this city, has purchased a site at Annapolis for car house and machine shop, and another at East Hyattsville, Md., for its main power house. The road is being built and equipped by the Cleveland Construction Company.

BARBERTON, OHIO.—Ladies of this town have instituted a unique crusade. They complain that laborers from the numerous potteries are so covered with dust that it soils dresses to sit near them, and they have requested the Northern Traction Company to provide brushes on the platforms and oblige the men to brush their clothes before entering the car.

SPRINGFIELD, OHIO.—The syndicate headed by Ex-Gov. Asa Bushnell has formed a construction company to be known as the Champion Construction Company. which will build the various lines promoted by the syndicate. The first roads to be built will be from Springfield to Washington, C. H., and from Springfield, Troy, Sidney and Piqua. Grading on these lines will start at once.

COLUMBUS, OHIO.—The Cincinnati, Dayton & Ft. Wayne Railway Company, of Dayton, has been incorporated with $1,000,000 by S. F. George, C. W. Gebbart, B. B. Levy, J. E. Welliver and G. F. Giel. The company proposes to construct a line from Cincinnati to Ft. Wayne with a branch line to Toledo. The company was originally incorporated under the laws of South Dakota and it has secured considerable right of way.

CLEVELAND, OHIO.—The Lake Shore Traction Company has been incorporated by Cleveland people who propose to build a line from Buffalo to Dunkirk, N. Y. The company will have a capital stock of $2,000,000, with a bond issue of the same amount. At a meeting held in Buffalo the following officers were elected; J. W. Holcomb, Cleveland, president; Fred Green, Fredonia, N. Y., treasurer; Clarence Bushnell, Buffalo, secretary. The above, with Luther Allen and Jay Latimer, Cleveland, are directors.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Railway Company has been incorporated, with $10,000 capital stock, by H. R. Klauser, P. McRory, L. E. Flory, H. S. Landis and D. H. James. It is proposed to build a line along the lake shore from Toledo through Millbury, Elmore, Oakharbor and Port Clinton to Lakeside. Officers have been elected as follows: P. McCrory, president; L. E. Flory, vice-presidentt; D. H. James, secretary, and H. R. Klauser, treasurer. The above, with A. E. Klauser, P. Landis, are directors.

AKRON, OHIO.—It is stated that at the annual meeting of the Northern Ohio Traction Company a proposition will be proposed for the repurchase of the Canton-Akron Railway. This road was purchased by the company about a year ago after a large sum had been spent in right of way and grading. At the time of the Everett-Moore trouble the Canton-Akron road was taken over by the Tucker-Anthony syndicate, of Boston. That there are close relations between the two companies is evidenced by the fact that an arrangement has been effected whereby round trip tickets are now sold clear through from Massillon and Canton to Cleveland.

CLEVELAND, OHIO.—The officials of the "Union Traction Company," which some months ago fitted up palatial offices in the Williamson Building, this city, are missing and a lot of creditors are anxious to learn their whereabouts. The company advertised freely for clerks, stenographers, bookkeepers, conductors, motormen, etc., and when replies were received the applicants were told they would have to buy stock in the company. Motormen and conductors were promised 23½ cents an hour and were to be given employment "after cars began to run between Saginaw and Flint, Michigan." For the past month there has been no one in the offices. Recently a furniture company, which furnished the offices, attached the furniture, but the agent of the building declined to permit the constable to use the freight elevator, as the building had an account against the traction company for office rent. The constable carried his point by hiring several laborers and carrying the goods down twelve flights of stairs.

LAWTON, OKLA.—The Lawton & Craterville Electric Railway Company, capital stock $500,000, has been incorporated by L. W. Brewer, C. F. Smith, J. E. Williams, A. L. Quint, J. R. Lewis, J L. Wiggins, G. A. Horton, P. T. Benbow, W. M. Turner, M. M. Holmes, J. S. West, J. W. Martin and F. M. Robinson.

OTTAWA, ONT.—It is stated that a charter will be asked for an electric railway, in New Ontario, to run between Lac Seul and the Mikado mine, and to develop and transmit electric power. The road will pass through Keewatin, Norman and Rat Portage. A feature of the project new to electric railway promotion is that the promoters say they will place a stated number of settlers in the country opened up.

OTTAWA, ONT.—Toronto and Pittsburg, Pa., capitalists propose building a belt electric line through the most interesting part of the Niagara peninsula. The route is to be from Homer to Niagara-on-the-Lake, thence along the river road to Queenston. Messrs. Frank Broderick and Herbert L. Dunn, of Toronto, Ont., and H. L. Christy, of Pittsburg, Pa., are the gentlemen promoting the scheme. Work is to be commenced next spring and completed by July 1, 1905.

CLARKSVILLE, TENN.—The promoters of the Nashville-Clarksville Electric Railway announce that right of way having been secured, they will begin work on the line in the early spring.

WHEELING, W. VA.—The Wheeling Traction Company is planning to make important improvements to its power equipment and rolling stock.

MORGANTOWN, W. VA.—The Morgantown Electric & Traction Company has awarded contracts for the construction of its system. Contracts for rails were let to the Lorain Steel Company and the Cambria Steel Company while the Westinghouse, Church, Kerr & Company and the Westinghouse Electric & Manufacturing Company have been awarded contracts for the electrical equipment. About four miles of track will be built in the city and 13 cars will be operated at the start. The power station will be equipped with two 200-kw 600-volt engine type railway generators, two 2,200-volt, two-phase alternating-current generators, two 325-hp Westinghouse engines, two 280-hp Westinghouse engines and three 310-hp Sterling water tube boilers. The capital stock of the company is $200,000, and bonds to the amount of $300,000 have been authorized. Officers of the company are I. C. White, president; J. McDermott, vice-president; Frank Cox, secretary; E. M. Grant, treasurer; George H. Switzer, superintendent and electrician, and W. S. Webb, engineer.

NEW INDUSTRIAL COMPANIES.

THE DEL COOBE ELECTRIC COMPANY, of Wilmington, Del., has been incorporated with a capital of $1,500,000.

THE ELECTRIC MINING & MILLING COMPANY has been incorporated at Salt Lake City, Utah, with a capital of $300,000.

THE MOTOR CAR COMPANY OF NEW JERSEY, Newark, N. J., with an authorized capital of $50,000, has been incorporated by Inglis M. Uppercut, Richard T. Newton and C. V. Childs.

THE KIMMEY ELECTRIC LIGHT DISPLAY COMPANY, of Jersey City, with an authorized capital of $1,000,000, has been incorporated by John Kimmey, Ives Horton, Charles A. Stader.

THE AMERICAN ELEVATOR COMPANY, of New York, has been incorporated with a capital of $25,000. Directors: Thomas D. Hewitt, Andrew Woelfee and Sidney L. Josephthal, New York.

THE AMERICAN PUBLIC UTILITIES COMPANY, of Cincinnati, Ohio, has been incorporated to build, own, operate and maintain electric light and gas works and heating apparatus. Capital, $2,000,000.

W. R. OSTRANDER & COMPANY, of New York, has been incorporated, capital $150,000. Directors: J. W. Purdy, Jr., W. H. Roberts, C. P. Lashell and I. A. Terrill, of New York, and H. E. Monk, of Flushing, L. I.

THE DIXON ELECTRICAL COMPANY, LTD., has been organized under the laws of Michigan and will establish a factory in Toledo. L. P. Dixon and O. S. Brumback are interested. The company will do a jobbing business in dynamos, motors and electrical supplies and will also manufacture new and improved lamp sockets, the invention of Mr. Dixon. At present the company is located in the Scott Building, but it will build a new factory next spring.

THE BROSNAN ENGINEERING AND CONSTRUCTION COMPANY, of Worcester County, Md., has been incorporated at Snow Hill, Md., with a capital stock of $500,000. The incorporators are J. M. Brosnan, of New York City; E. Caldwell, Thos. Edwards and Chas. B. Cook, of Baltimore, and Wm. Adams, of New York. The object of the company is to construct and sell electric railways, telegraph, telephone lines, etc.

OBITUARY.

CAPT. OLIVER ELDREDGE, vice-president of the Stockton, Cal., Gas & Electric Company, died in San Francisco on December 16. He was born at Yarmouth, Mass., in 1818, and was for a long time engaged in maritime work. Later he took up mercantile affairs on shore and became interested in gas and electricity.

PERSONAL.

MR EDWARD I. LEEDS, of London, England, manager of the European business of the Brown Hoisting Machinery Company, of Cleveland, Ohio, is now on a short visit to this side in relation to some important contracts pending across the Atlantic.

MR G. MARCONI.—It is stated from Rome, which is a rather roundabout way, that Mr. Marconi, during his recent residence at Bologna, while pursuing his electrical researches, discovered almost accidentally a means of getting pure oxygen from the air at a trifling expense.

MR. R. M. BARWISE, formerly active in the bicycle and automobile field, but latterly connected with electrical interests in Philadelphia, has taken charge of the branch office in that city of the Buckeye Electric Company of Cleveland, with which he has already been associated.

MR. T. A. EDISON interviewed as to problems for 1903 says they are: "Fighting bacteria, getting electricity direct from coal and power from the elements and applying to manufactures the many uses of electricity." He is to have his storage battery ready early this year.

MR. MYRON T. HERRICK, the Cleveland banker, prominent in electric light and electric railway development, is mentioned as a likely presidential candidate, as well as a very probable nominee for Governor of Ohio as a step in that direction. He was a warm personal friend of President McKinley.

MR JOHN BOTTOMLEY, the well known New York lawyer, who is also a nephew of Lord and Lady Kelvin, exchanged Christmas and New Year greetings with them in Scotland by means of the Marconi wireless system, to and from Glace Bay. Mr. Bottomley is now prominently connected with the American Marconi interests.

MR F. R. WEEKS, past president of the National Electric Light Association, and now a member of the firm of Weeks, Kendall & Newkirk, consulting engineers, of Kansas City, Mo., has been visiting the East, renewing old acquaintanceships and calling on old friends. He is greatly interested in the latest developments of the central station art.

MR. F. F. SAPP and Mr. R. Hendrickson, of the North Electric Company, of Cleveland, Ohio, have been visiting the East in the interests of the North telephone system and apparatus. A widespread report has been in circulation that Mr. Sapp, who is an old journalist, though still a young man, was going into the field of telephone journalism, but he states that there is no truth whatever in the rumor.

MR. E. J. PIETZCKER became associated December 1 with the Standard Underground Cable Company, with offices at 322 Rookery Building, Chicago. In a letter issued to the electrical field Mr. Pietzcker speaks of the new copper mill of the Standard Underground Cable Company as being one of the largest and most complete in the world. His former connection with the American Steel & Wire Company has given him a wide acquaintance throughout the electrical field.

MR. L. D. HILLES, of the American electrical firm of Bagnall & Hilles, Yokohama, is now on a long visit to the United States. Mr. Hilles has charge of the Singapore branch of the firm and also directs its interests in the Philippine Islands. He can be found at the offices of the New York Insulated Wire Company, 114 Liberty Street, at which place as already mentioned in these columns Mr. A. L. Bagnall is making his headquarters while in this city. Mr. Bagnall expects to sail for Japan within the next week or ten days, but Mr. Hilles may remain in America for three months or so.

MR. HENRY H. HUMPHREY.—At the annual meeting of the Engineers' Club of St. Louis the annual prize, consisting of $50 in gold and an engraved certificate, was awarded by the executive committee to Henry H. Humphrey, for the best paper presented to the club during the past year. The subject of this paper, which will be printed in the Journal of the Association of Engineering Societies, was "On the Use of Beaumont Oil as Fuel." Mr. Humphrey is the consulting electrical and mechanical engineer of St. Louis, who established more than a local reputation by designing during 1901 a complete power plant of 1,500-hp. for the DeBeers Explosive Works at Cape Town, Africa.

DR. S. S. WHEELER, chairman of the technical committee of the Automobile Club of America, gave the club at its headquarters, on Jan. 6, an admirable talk on his automobile trip last summer all around Europe, when accompanied by Mrs. Wheeler he made a tour from Paris to Salsburg in the Tyrol and thence back through Germany to Holland and Belgium. The lecture was full of humor and good points, and was enthusiastically received by a large audience of club members and friends. It was also profusely illustrated by at least 150 lantern slides from photographs of novel and pretty bits of road, scenery, etc., secured by the doctor himself during this delightful outing.

Trade Notes.

D. M. STEWARD MFG. Co., of Chattanooga, Tenn., which makes lava insulators, etc., has moved its New York offices from 107 Chambers Street to 8 Jay Street.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 183 Lake Street, Chicago, general Western agent of the Eureka flexible conduit, reports a very flattering reception of this conduit in the West. Eureka has been in the West only three months, and the Metropolitan Company has had large and rapidly increasing business in it.

FRANK H. STEWART & CO., of Philadelphia, report not only a good trade in general electrical supplies, but an excellent demand for the well-known Stewart patent adjustable handle for flexible cords. It relieves all strain of the socket connections and rosette and allows handy adjustment at any desired vertical drop. It will grip any size cord.

THE MECHANICAL BOILER CLEANER COMPANY, 413 Western Union Building, Chicago, is in receipt of a very flattering letter of recommendation from the Commonwealth Hygienic Ice Company, in which it states that after putting on cleaners in five of its boilers, it ran the boilers for twelve weeks without opening, and then found them absolutely clean and free from scale. It also speaks highly of the cleaner as a purifier, and recommend it especially for ice companies and brewers.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, of Warren, Ohio, has recently placed on the market a full line of miniature battery lamps, series lamps, multiple lamps and candelabra lamps ranging in candle power from ½ candle-power to 8 candle-power, and in voltage from 2½ volts to 125 volts. The company also in addition to its regular line of standard incandescent lamps, makes as specialties telephone and elevator signal lamps, dental lamps, surgical lamps of all descriptions, and a new type of lens lamp.

GRAPHITE FACINGS.—Graphite is used in foundries as a facing for the surface of a mold for the purpose of preventing adhesion of the metal to the sand of which the mold is composed. The result is a much cleaner and smoother casting. The Joseph Dixon Crucible Company, Jersey City, N. J., in a little pamphlet recently issued, gives some interesting information about the use of graphite for this purpose. The various grades of graphite for facings are referred to and the characteristics of each pointed out.

A CALENDAR DESK PAD with space for daily memoranda has been put out by the Emerson Electric Mfg. Co., 714-718 St. Charles St., St. Louis, Mo., as a 1903 souvenir and reminder. As is well known the Emerson Company is a large manufacturer of alternating current power motors, desk and ceiling fans. Interspersed throughout the calendar are suggestions as to the usefulness of handling Emerson products, and little homilies for the salesman referring to various types of motors for different classes of work among possible customers.

BRAIDED CORDS.—The Samson Cordage Works, 115 Congress Street, Boston, Mass., shows, in a booklet, its full line of braided cords for a great variety of purposes. Its Samson spot trolley cord is well known to the electric railway trade. It has a waterproof finish, as has also the arc light cord, which is another of the Samson Company's products. The company states that experience and tests in running over pulleys show that solid braided cords are much more durable than twisted, cable laid. or hollow braided cords or metal chains or tapes.

CHANGE OF NAME.—The name of the Standard Traction Brake Company of 26 Cortlandt Street, New York City, has, as already intimated, been changed to the Westinghouse Traction Brake Company. This company sells all power brakes for street railway service manufactured by the Westinghouse Air Brake Company, including straight or automatic air-operated brakes with axle-driven or motor-driven compressors, the storage system of air-brakes, and the Westinghouse combined magnetic brake and electric car-heating apparatus.

AS TO CATCH-PHRASES.—A catch-phrase in trade is unquestionably a good feature when maintained until it becomes thoroughly identified with a concern, but the connection of the trade to the name does not always become familiar to everyone. Nearly every one in the electrical trade knows that "Homer of Cleveland" applies to the Homer Commutator Company of Cleveland, but unfortunately the U. S. Postal authorities are not so well up in the idioms of the trade; hence the Cleveland concern requests that patrons who desire to receive prompt attention to their wants address their communications to the "Homer Commutator Company, Mason Street, Cleveland, Ohio."

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 30, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

716,476. SUPPRESSING SPARKING OF COMMUTATORS; R. H. Read, Schenectady, N. Y. App. filed April 8, 1901. Means for suppressing the arc comprising a tubular passage communicating with one point of contact and means for forcing the arc products through said passage. (Issued Dec. 23.)

716,649. CIRCUIT BREAKER; E. A. Stevens, Chicago, Ill. App. filed July 19, 1901. (See page 82.)

716,654. CABLE-HANGER; P. H. Auxer, Cleveland, Ohio. App. filed May 28, 1902. (See page 82.)

716,855. GAS IGNITER; H. Bergner, Frankfort-on-the-Main, Germany. App. filed Aug. 16, 1902. Main and pilot valves are electro-magnetically controlled in relation to the heating of a platinum igniter.

716,868. GROUND DETECTOR FOR ELECTRIC CIRCUITS; F. Conrad, Wilkinsburg, Pa. App. filed July 12, 1901. A movable vane connected to the ground, a number of stationary vanes in inductive relation thereto and condensers the elements of which are respectively short portions of the circuit wires and corresponding lengths of metal supported thereby, the latter being connected to the stationary vane.

716,871. LOCOMOTIVE CAB ELECTRIC RAILWAY SIGNAL; E. B. Cutten, New York, N. Y. App. filed June 22, 1891. A peculiar form of contact wheel arranged to run upon a third rail.

716,889. ELECTRIC LAMP; M. W. Hanks, Pittsburg, Pa. App. filed May 18, 1901. The heater and glower are connected in parallel on a series circuit.

716,953. ELECTRIC ELEVATOR; F. J. Sprague, New York, N. Y. App. filed Oct. 29, 1894. Improvements consist mainly in substituting an improved pilot motor and circuits for controlling the connections and operation of the main motor, whereby the number of wires carried to the car are reduced to four; also other improvements.

716,955. METHOD OF SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. Consists in transmitting signal waves, causing them to effect a zero difference of potential at the terminals of the receiver and causing the received waves to combine to effect a certain difference of potential at said terminals.

716,971. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. App. filed May 7, 1902. Interlocking parts are provided whereby the instrument is prevented from moving when in the casing.

716,974. ELECTRIC LAMP; A. J. Wurts, Pittsburg, Pa. App. filed May 5, 1902. An improvement in Nernst lamps whereby assembling and renewal of parts is facilitated.

716,978. SECTION INSULATOR; J. M. Anderson, Boston, Mass. App. filed Aug. 25, 1902. The device consists of two terminal pieces to be secured to the ends of the wire and an intermediate joining piece.

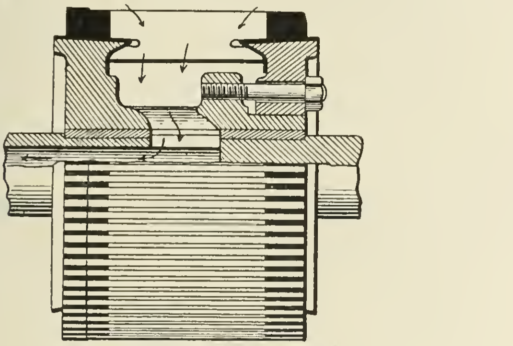
716,988. OVERHEAD ELECTRIC TROLLEY WIRE; J. P. Cribb, Southsea, Eng. App. filed Sept. 8, 1902. A tilting connection which maintains the circuit complete, so long as the wire is horizontal, but in case the latter breaks and falls, the connector opens the circuit to render the broken end dead.

716,995. ELECTRIC RAILWAY; E. W. Farnham, Chicago, Ill. App. filed April 11, 1902. By a movement of a portion of the third rail an oscillatory switch device is thrown to close the circuit to a section of the rail.

716,996. ELECTRIC CLOCK; M. Fischer, Zurich, Switzerland. App. filed Sept. 3, 1901. Details.

717,006. TRANSFORMER; S. E. Johannesen, Edgewood Park, Pa. App. filed Oct. 30, 1902. Passages are provided for the circulation of air between the coils and parts of the core.

717,009. METHOD OF MAKING ELECTRIC CONDUITS; A. M. Lougee, Boston, Mass. Apn. filed May 31, 1902. Layers of different material possessing different degrees of hardness are vulcanized upon the tube.



716,476.—Suppressing Sparking of Commutators.

717,015. AUTOMATIC ELECTROMAGNETIC FLASHER; P. E. Oswald, Chicago, Ill. App. filed Feb. 5, 1902. Details.

717,022. GLOWER FOR ELECTRIC LAMPS; H N. Potter, Berlin, and W. Nernst, Göttingen, Germany. App. filed September 29, 1899. (See Current News and Notes.)

717,035. THERAPEUTIC ELECTRICAL APPARATUS; I. E. Shaffer, Mount Vernon, N. Y. App. filed March 17, 1902. Electrodes are placed in the path of a moving stream while it is being directed upon the part to be treated.

717,046. SOUNDING MECHANISM FOR TELEGRAPH OFFICES; J. C. Stewart, United States Army. App. filed March 18, 1902. Air pressure is released by the operation of valves to strike a heavy blow and thereby create a loud sound.

717,051. CONTROLLER FOR ELECTRIC MOTORS; H. R. Stuart, Wilkinsburg, Pa. App. filed April 2, 1902. Two groups of contacts are spirally arranged on opposite sides of the drum, which is moved by a single handle both to change the direction of rotation of the motor and to vary the speed.

717,065. DISTRIBUTING ELECTRIC CURRENTS; Engelbert Arnold, Ole Sivert Bragstad and Jens Lassen La Cour, of Karlsrube, Germany. App. filed Dec. 31, 1900. Relates to a type of transformer for use with the Arnold system of simultaneous transmission over the same line of alternating currents of different phases or periodicities. The transformer for a single phase and a n-phase circuit has $(n + 1)$ cores. The primary winding is connected in star and the secondary windings for receiving the superposed currents are connected in series.

717,070. CONTACT BOX FOR ELECTRIC RAILWAYS; W. Milt, Johnstown, Pa. App. filed Nov. 30, 1901. Details.

717,071. ELECTRIC SWITCH; M. Milt, Johnstown, Pa. App. filed April 18, 1902. The switch has two open circuit positions and an intermediate closing position, a locking device for holding the switch in one of its open positions and means for retarding or prolonging the movement across its closing position.

717,072. MAGNETOTHERAPEUTIC APPARATUS; J. Burry, Brooklyn, N. Y. App. filed May 8, 1901. A number of solenoids surrounding a common space in which the part to be treated is placed and a switch for throwing the solenoids into circuit.

717,075. RAILROAD SIGNAL AND ALARM; A. E. Caughey, Omaha, Neb. App. filed Dec. 12, 1901. Details.

717,107. SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed May 19, 1900. One of the elements carries a paste containing flourin.

717,108. SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed Aug. 5, 1901. See preceding patent.

717,112. ELECTRICAL SIGNALING SYSTEM; A. C. McKnight, Brooklyn, N. Y. App. filed March 7, 1902. Details.

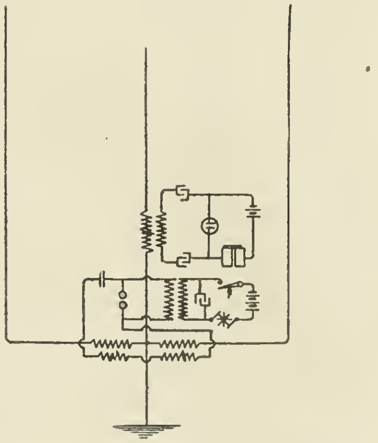
717,123. ELECTRICITY METER; P. Rouget, Paris, France. App. filed Jan. 30, 1902. A series of magnets arranged in separated groups parallel to the flux, whereby none of them can be influenced by the field created by an intense current.

717,137. ELECTRIC SIGNAL GONG; H. C. Thomson, Boston, Mass. App. filed July 29, 1902. The armature carries two hammers adapted to strike two different gongs.

717,152. METHOD OF GENERATING INDEPENDENT ELECTRIC CURRENTS; Engelbert Arnold, Ole Sivert Bragstad and Jens Lassen La Cour, Karlsruhe, Germany. App. filed Jan. 13, 1902. Single phase and polyphase currents are generated in the same armature, the frequency of the former being a multiple of the latter. Details of construction of the generator.

717,188. KEEPER FOR FIRE ALARM BOX KEYS; C. E. Gibson, Indianapolis, Ind. App. filed June 9, 1902. The key to the box is placed in a small fragile case on the outside of the main box.

717,194. ARC LIGHT SWITCHBOARD; E. M. Hewlett, Schenectady, N. Y.; App. filed May 16, 1901. The board is provided with two sets of insulated conductors crossing one another at an angel, one set connecting with the machines and circuits at their ends, and means for cross-connecting the two sets of bars at the points of intersection.



717,513.—Method of Relaying Space Telegraph Signals.

717,201. CUT OUT; J. W. Howell, Newark, N. J. App. filed Feb. 2, 1901. A form of paper contact in which the terminals are flat plates instead of points, as usual.

717,203. INDUCTION COIL OR LIKE INSTRUMENT; O. H. Buebel, Brooklyn, N. Y. App. filed Jan. 21, 1902. Details of the circuit controller mounting.

717,212. PROTECTIVE APPARATUS; W. Kaisling, Chicago, Ill. App. filed Aug. 8, 1901. (See page 82.)

717,218. TELEPHONE-TRANSMITTER; T. C. Knowles, Denver, Colo. App. filed April 1, 1902. (See page 82.)

717,219. TRAIN CONTROL SYSTEM; S. L. G. Knox, Milwaukee, Wis.; App. filed June 5, 1902. Improvements in a master and sub-controller system.

717,227. ELECTRICAL SWITCH; H. Lomax, R. Lomax and J. Tomlinson, Darwen, Eng. App. filed Oct. 18, 1901. Details.

717,233. HOLDER FOR ELECTRIC LAMP CARBONS; P. F. Maines, Philadelphia, Pa. App. filed March 14, 1902. An eccentric clamp for the carbon is arranged in a hole through which the carbon passes.

717,234. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Samuel W. Manger, Schenectady, N. Y. App. filed June 8, 1900. An arrangement of synchronizing circuit which simplifies the wiring and involves the use of but one indicator for any number of machines.

717,262. MULTIRATE METERING; E. Oxley, Lynn, Mass. App. filed July 27, 1899. An independent control wire is run from the station, between which and the supply wires of the system, the meter operating circuits are connected.

717,277. COMPOUNDING ALTERNATORS; E. W. Rice, Schnectady, N. Y. App. filed June 8, 1900. (See Current News and Notes.)

717,285. LIGHTNING ARRESTER; H. R. Sargent, Schenectady, N. Y. App. filed March 27, 1901. Resistance is inserted in series with the air gap as soon as a lightning discharge has passed, so that the line current which tends to follow the discharge is blocked sufficiently to break the arc.

717,291. TROLLEY CONNECTION AND GUARD FOR ELECTRIC CARS; J. G. Sharwell, Newark, N. J. App. filed April 10, 1902. Details.

717,298. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 19, 1899. (See Current News and Notes.)

717,300. CURRENT PROTECTIVE DEVICE; W. A. Taylor, Chicago, Ill. App. filed Aug. 3, 1901. (See page 82.)

717,303. SPEED LIMITING DEVICE FOR SERIES MOTORS; L. A. Turrill, Lynn, Mass. App. filed June 5, 1902. A magnet coil in circuit with the motor releases the rheostat arm when the speed passes a critical point.

717,310. RHEOSTAT OR ELECTRIC HEATER; G. P. Wisdom, New York, N. Y. App. filed Aug. 6, 1901. A resistance consisting of a pile of buckled plates adapted to be forced into more or less uniform contact.

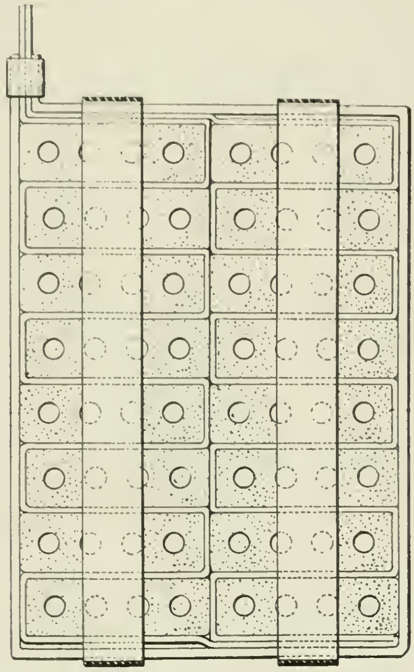
717,312. INSULATOR FOR HIGH POTENTIAL LINES; C. E. Barry, Schenectady, N. Y. App. filed July 30, 1901. An arrangement of cross-heads embedded in insulating material contained in cups.

717,324. SUPPORT FOR HIGH TENSION TROLLEY; A. F. Batchelder, Schenectady, N. Y. App. filed July 24, 1901. The high tension wires are supported by cross wires extending between two insulators.

717,325. APPARATUS FOR AUTOMATICALLY BLOCK SIGNALING ON RAILWAYS; F. B. Behr, Twickenham, Eng. App. filed March 5, 1901. Details.

717,327. AUTOMATIC ELECTRIC EXCHANGE SYSTEM; W. R. Binkley, New Bedford, Mass. App. filed July 14, 1902. (See page 83.)

717,331. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Thomas D. Boyles, Schenectady, N. Y. App. filed July 27, 1900. A switching circuit and switch plugs whereby a single voltmeter may be used in synchronizing without great complexity of wiring.



717,416.—Secondary Battery.

717,351. STORAGE BATTERY; C. H. Clare, Quincy, Mass. App. filed March 1 1902. Means for preventing the detachment of active material.

717,358. FREQUENCY-COMPENSATING MEANS FOR ELECTRIC METERS; A. G. Davis, Schenectady, N. Y. App. filed May 21, 1900. (See Current News and Notes.)

717,359. ROTARY TRANSFORMING APPARATUS; A. G. Davis, Schenectady, N. Y. App. filed May 26, 1900. (See Current News and Notes.)

717,376. ELECTRIC RECORDING INSTRUMENT; W. C. Fish and F. P. Cox, Lynn, Mass. App. filed June 12, 1901. A movable member free to assume without restraint any position within its range and adapted to control a curve drawing pencil.

717,389. THIRD RAIL INSULATOR; E. Gonzenbach, Wheaton, Ill. App. filed Sept. 24, 1902. A standard capped by an insulating ring held in place by a metal ring upon which the rail rests.

717,394. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. The elements of the battery are continuously brushed to free them from precipitates.

717,395. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. See the preceding patent.

717,398. TROLLEY WIRE SUPPORT; E. Hill, Jr., Norwalk, Conn. App. filed April 18, 1902. Two plates clamped together upon the wire and containing cavities for solder.

717,401. TROLLEY STAND; H. Holland, Detroit, Mich. App. filed March 7, 1902. Details.

717,406. RAILWAY ELECTRIC SIGNAL; S. W. Huff, Baltimore, Md. App. filed Dec. 6, 1898. Each signal is provided with an automatic device for setting it to the position which it is normally to assume and with an electrical tripping mechanism set in operation by the train at a given point, provided certain conditions exist on the track to be guarded.

717,414. TROLLEY STAND; W. H. Kilbourn, Greenfield, Mass. App. filed April 1, 1902. A dash pot prevents the rapid upward movement of the arm.

717,416. SECONDARY BATTERY; I. Kitsee, Philadelphia, Pa. App. filed April 10, 1893. A particular construction for the conductor whereby expanding room for the active material is provided.

717,423. TROLLEY STAND; O. F. Lidke, Detroit, Mich. App. filed Dec. 14, 1901. Details.

717,428 and 717,429. TELEPHONE RECEIVER; K. B. Miller, Chicago, Ill. App. filed June 22, 1900. (See page 82.)

717,442. ELECTRIC RADIATOR; J. F. McElroy, Albany, N. Y. App. filed Jan. 16, 1896. A construction of casing for the heater adapting it to be placed against the riser of a seat.

717,443. COMBINED MAGNETIC AND MECHANICAL BRAKE; J. F. McElroy, Albany, N. Y. App. filed July 14, 1899. By turning the brake handle a magnetic brake is first applied and afterwards the mechanical brake, if necessary.

717,451. CURRENT DIRECTOR; J. Reid, Jr., Watervliet, N. Y. App. filed Sept. 15, 1899. Details of a snap switch.

717,464. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 19, 1899. (See Current News and Notes.)

717,467. METHOD OF ELECTRICAL DISTRIBUTION; J. S. Stone, Cambridge, Mass. App. filed Aug. 4, 1902. Consists in causing signals which are to be transmitted to effect the transmission of similar signal by currents of different frequency which shall act upon a properly attuned receiver by which the signals shall be received.

717,468. ELECTRIC CURRENT CONTROLLER FOR INCANDESCENT LAMPS OR MOTORS; H. A. Strauss, New York, N. Y. App. filed Nov. 12, 1902. The lamp socket consists of a cylinder of resistance material into which the lamp is thrust any required distance to vary the current.

717,477. END CELL SWITCH INDICATOR; A. C. Walther, East Orange, N. J. App. filed Feb. 17, 1902. Details.

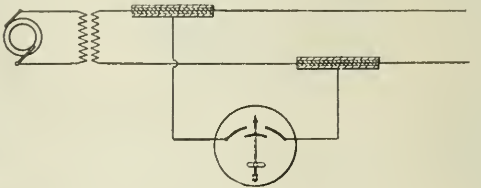
717,488. METHOD OF TRANSFORMING ALTERNATING CURRENTS; J. E. Woodbridge, Schenectady, N. Y. App. filed July 28, 1900. A modification of the Scott two-phase, three-phase system of phase transformation, whereby the current in all of the windings is maintained in phase with the e.m.f of the windings.

717,496. METHOD OF MEASURING THE ENERGY OF THREE-PHASE ALTERNATING CURRENT CIRCUITS; F. Conrad, Wilkinsburg, Pa. App. filed Feb. 14, 1901. Consists in separately measuring the product of the current and voltages of two of the circuits and at the same time measuring the product of the current of the third circuit by the voltages of the said two circuits.

717,497. ELECTRIC ARC LAMP; H. Cuenod, Geneva, Switzerland. App. filed July 10, 1902. Details.

717,507. EXCITING-ALTERNATOR; E. W. Rice, Schenectady, N. Y. App. filed June 8, 1900. (See Current News and Notes.)

717,509. APPARATUS FOR RELAYING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. A relay adapted to be set in motion by the receiver of one system and thereby to operate the transmitter of the other, the said receiver and transmitter conductor being so electrically organized respectively that the receiver will not be operated by signals sent by the transmitter.



716,868.—Ground Detector for Electric Circuits.

717,510. METHOD OF RELAYING SPACE TELEGRAPH SIGNALS: J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. See No. 717,509.

717,511. METHOD OF TUNING VERTICAL WIRE OSCILLATORS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. The tuning is accomplished by distributing the electro-magnetic inertia along the wire and balancing it by a suitable capacity.

717,512. TUNED ELECTRIC OSCILLATOR; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. Apparatus for carrying out preceding method.

717,513. METHOD OF RELAYING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. See No. 717,509.

717,514. APPARATUS FOR RELAYING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. See No. 717,509.

717,515. METHOD OF ELECTRICAL DISTRIBUTION; J. S. Stone, Cambridge, Mass. App. filed Aug. 4, 1902. Method of absorbing the energy of current of one frequency traversing a main line to the exclusion of that of currents of other frequencies on the line, consisting in diverting the energy of the current of the desired frequency by means of a condenser into a local resonance circuit and containing a tuning condenser of small capacity compared to that of the other condenser.

717,518. METHOD OF TRANSFORMING ALTERNATING CURRENTS; J. E. Woodbridge, Schenectady, N. Y. App. filed July 28, 1900. Identical with patent No. 717,488, except in phraseology of claims.

716,867. MEANS FOR MEASURING THE ENERGY OF THREE-PHASE ALTERNATING CURRENTS; F. Conrad, Wilkinsburg, Pa. App. filed Dec. 30, 1902. Two wattmeters are used, the armatures of which may be mounted on the same shaft. The shunt windings are connected to the secondaries of transformers across the line and receive voltages proportional to that of two of the three-phase circuits. The series windings are so connected as to receive currents proportional to the two above circuits, and also to receive jointly current proportional to that of the third circuit.

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CONTENTS.

Editorial 101
Electricity and Fire Insurance 104
The Largest Electric Water Power System in New England 105
Excitation of Asynchronous Generators by Means of Static Condensance. By A. S. McAllister 109
Oerlikon Induction Motor with Four Speed Variations. By Hans Behr.. 111
Old Time Telegraphic History 113
The Armature Reaction of Alternators X. By C. F. Guilbert (*concluded*) 116
Development of Telephony in New York City 118
German Ozone Waterworks. By Dr. Ig. Erlwein 119
High-Tension Switching. By J. N. Kelman 120
Cooper-Hewitt Static Converter 121
The Construction of Aerial Telephone Lines.– I. By Arthur V. Abbott, C. E. 123
New Telephone Patents 124
Changes at Stevens Institute of Technology 125
Current News and Notes 126

Letters to the Editors:

Conditions on the Manhattan Elevated. By L. B. Stillwell 126
Inverted Third Rails. By George T. Hanchett 127
Electricity in the Army. By Chas. G. Chase 127
Digest of Current Electrical Literature 128
New Books 131
Electrically-operated Oil Circuit-breaker for High-tension Circuits 132
Columbia Arc Lamp 133
Electrical Control of Water-wheel Governors 133
Branch Fuse Blocks 134
Combined Soldering Iron and Blow Torch 134
Nail Puller for Electricians 134

Departments:

Financial Intelligence 135
Commercial Intelligence 136
General News 138
Trade Notes 141
Record of Electrical Patents 142

City Telephony.

We hear a good deal lately about the wonderful extension of telephony in the rural districts, but it seems to us that the growth in the cities is even more remarkable. There is unevenness in such development, but New York may well serve to accentuate the point. Eight years ago the local Bell system had under contract about ten thousand stations. In those days the charge for the service was not based on the actual definite use of it, but each subscriber was required to pay a flat rate called a rental, whether he sent two messages a day or fifty. To-day the New York company has no fewer than 105,388 stations under contract in the boroughs of Manhattan and the Bronx, and it secured the enormous increase of 30,338 stations during 1902. It must be obvious to the intelligent student of the art that the flat rate worked as a great hardship against the small user, and made it impossible for the great mass of the people to use the telephone at all except sporadically by means of pay stations. The measured service has been a distinct boon to the community at large, and the policy of its adoption is wholly vindicated.

In these days when to travel in New York City is so frequently unpleasant, the injunction to telephone instead falls on willing ears. especially as the act of telephony taking but a minute or two costs less and is performed in a cosy office while the travel in a crowded car under very uncertain headway yields its long periods of intense discomfort. Of course a very large amount of travel must unfortunately be done, but the wider introduction of the telephone may do as much to mitigate present insufferable conditions as the new subway. If we allow the 100,000 stations an average of ten calls a day, there is a traffic of about one million calls, or as much as the Manhattan elevated system does in the way of fares. If the movement of passengers in New York, all told, is two millions daily, it might be a fair hypothesis to assume, from the above data, that the telephone will be nearer the full measure of its opportunity when it takes care of two million calls daily; and we are confident it will be doing business at that rate very soon. The local management is broad-gauged and is, it may be safely asserted. giving the best telephone service the world has ever seen. That efficiency will continue to be maintained *pari passu* with growth, is all that New Yorkers expect or can ask.

Telegraphic Anec-Dotage.

If anything has been written and rewritten in the domain of electrical history until there is a chance that its readers might become aweary, it is the oft-told narrative of the introduction of the telegraph. In reality it is very hard to discover anything new in that field. An esteemed New York contemporary of ours has for example just been advising the local newspapers of its wonderful literary find of Morse's diary of the early days of the telegraph. out in Mr. Edison's library; and it has proceeded to print copious extracts as great novelties. This is something like going into Trinity Churchyard and copying the inscriptions off the tombstones as "scoop" news items. The fact that Mr. Edison owns the little diary has long been matter of common knowledge. We have ourselves long since had the pleasure of seeing it, and long since were able to identify its contents with some of the most hackneyed incidents in the career of Morse. Anybody who will take the trouble to turn to Prime's standard and familiar biography of the great inventor will there see the same document now quoted with such wonder, set forth, with greater precision and accuracy. The fine prophecy about submarine cables that so awes and charms our unwitting contemporary is given by Prime in both italics and capitals, to emphasize his idea of it, twenty-five years ago, when his book, now in every well read telegrapher's library, was published. Morse's diaries played a busy part in telegraph history and litigation and can only be compared to a squeezed and desiccated orange. We have in our own possession his sketches of circuits of the 1843-45 period that have never seen print, the only reason probably being that they were too technical for such men as Prime to work into their stories. In regard to Morse there is always the grave doubt that any document is the original. We have examined at Poughkeepsie thousands of his letters and scores of his diaries dating back to the earliest days of his youth, and it is curious to note how even an ordinary business letter sent or received was copied and copied again. He had a habit of preserving the preliminary drafts of his own correspondence with painful care, and his diaries are multitudinous. Even his books and copies of legal evidences were annotated profusely.

Elsewhere we note the store of early telegraph records recently deposited at Cornell, a worthy recipient, seeing that that University owed its origin to men and wealth created by the telegraph. But, as our summary shows, there is little that is new and much that is very stale in the files thus preserved. We should not be surprised, however, to see some one else break out soon with a hair-raising story of their startling novelty, in regard to events that are dim, but which people have perhaps momentarily forgotten very much as the hack actor after repeating his lines mechanically for a hundred nights suddenly catches in panic at a cue from the monotonous prompter in the wings.

A NEW CURRENT CONVERTER.

Elsewhere we give you an account of a remarkable practical development resulting from Mr. Peter Cooper Hewitt's investigations of the phenomena of the mercury vapor tube. The first fruits of Mr. Hewitt's studies in this direction was the vapor tube lamp, to which Swinburne in a recent address assigned an efficiency of 3 candles per watt. While the vapor lamp has thus far been handicapped by the quality of its light, the resourcefulness of its inventor as again displayed in his latest work, gives every hope that it will eventually become a vital factor in the art. The idea of other than a mechanical alternating-current rectifier is not a new one, as the considerable literature on "electric valves" attests. Eichberg and Kallir in particular have made an interesting study of the rectifying effect of the alternating-current arc, showing that a direct current is obtained in a circuit shunting such an arc. Hittorf, Righi, Lehman, Wiedemann, Skinner, Capstick and others have investigated the peculiar drop of potential at the vacuum tube anode, and the two latter have pointed out the constancy of this drop for a given gas at a given pressure, regardless of the current passing. Righi has also suggested that the discharge through a vacuum tube is not continuous, and the property of such a tube in suppressing one sign of an interrupted current is well known. Though some of the phenomena involved in Mr. Cooper-Hewitt's invention have thus been investigated, the new current converter appears to be a radical development along lines which no previous student has followed.

The extraordinary feature of the invention is the simplicity and inexpensiveness of the apparatus—a converter having a capacity of 8 kw, for example, weighing but a few pounds, and involving a cost even less than that of the old-time 100-cp incandescent lamp, which it approaches in dimensions. When to this is added a high efficiency, we appear to be brought face to face with an invention likely to have a revolutionary effect on some branches of electrical application. An immediate practical application is in storage battery charging, the fluctuating current here having a decided advantage. There appears to be no reason why the converter may not be connected in parallel and series, in which case its application would be limitless with respect to magnitude of current or voltage. Nor is there any reason to believe that it will prove an exception to the law of reversibility, which law would bring it into complete rivality with the rotary converter. We can also imagine other varied and possibly unsuspected uses for this appliance, which once again attests the manner in which, even when an end of development in some line has been reached, new means and new methods open up to the electrical engineer. It is no breach of confidence, indeed, to state that Mr. Hewitt is already far beyond the point, in many ways, now indicated by this disclosure of his work.

THE NEW YORK PROBLEM OF URBAN TRANSPORTATION.

The present hue and cry of the city authorities after the New York urban transportation companies recalls the bon mot of Janin during a discussion of a bill for the abolition of capital punishment—"Que Messieurs les assassins commencent." No one can deny the gravity of the New York urban transportation problem, but it is due to conditions, which, so far as street traffic enters, can be met only to a slight extent, if at all, by the transportation companies; but which, on the other hand, can be enormously ameliorated by the municipal government through the exercise of powers with which it is now partially and may be fully clothed. President Vreeland recently remarked that if the principal New York street car lines during busy hours were solidly packed with cars their entire length, each passenger requiring transportation could not be provided with a seat. This illustration of the present congestion of street traffic—due not to dereliction on the part of the surface transportation companies, but to conditions incident to great growth of population and geographical contour of the territory to be served—is illuminating as to the practical situation and the futility of seeking a remedy, for the present at least, at the hands of the transportation companies. With this inexorable condition to face, the desideratum is to utilize to the maximum all the existing transportation facilities and thus ameliorate the situation as far as possible; and the vital factor in such an attempt is the municipality.

Were the obstructions to street cars now offered by horse vehicles a necessary concomitant of the joint use of the streets by the two classes, there would be ample grounds for urging that, in interest of the traveling public, the horse vehicle should be required to keep off the several great north and south arteries; and in view of the present acute situation and its increasing gravity, such a regulation applying during the morning and evening hours would undoubtedly meet with warm general public approbation. But a partial remedy and one that would render travel more endurable during all hours could be furnished by the city if it were to exercise fully its inherent powers of regulating traffic. This, however, involves not only a regeneration of spirit with respect to enforcing such ordinances as are already established and the addition of others, but—and this is perhaps the most important point—the taking of drastic measures with the police force in any case. After one has observed the admirable manner in which the London policeman handles street traffic and then notes the hopeless inefficiency in this respect of the average New York policeman, he is apt to revise radically his opinion of "The Finest." One not only misses the evident grasp of the situation by the London policemen, but his New York brother at the crossing seems to perform his work as if the duty were one derogatory to his dignity. And as for the policemen on the beat assisting in expediting traffic, the manner in which teamsters are allowed maliciously to impede traffic by keeping to the track, or by blocking cars while a wagon is being unloaded—which latter frequently occurs where the Sixth and Eighth Avenue lines pass along Fulton Street—shows that he is less an ally of the traveling public than of its enemy.

Events of recent years indicate that the average police captain can scarcely be expected to allow his attention to be distracted from matters of *haute finance* to details which his humblest subordinates appear to view with disdain. A movement in the proper direction, therefore, requires not only action of the municipality in the establishment of necessary regulations, but also in providing for their enforcement. Under present police conditions, and in view of the acute stage of the transportation problem, this should be made the direct charge of an inspector or other police officer of high rank invested with such general authority that he can act vigorously in every case of dereliction. With power to establish the necessary regulations and to provide drastic means for their strict enforcement, the municipality has it within its grasp means to bring about a vast improvement of the present almost intolerable New York passenger transportation conditions. Otherwise electricity might as well be abandoned for a return to horses as being quite speedy enough. The Elevated Road problem is of another character, free from the serious complication of street traffic.

The Electrical Inertia of Matter.

In a paper recently read by Professor Lodge in London before the Institution of Electrical Engineers, the electronic theory of inertia was ably sketched, though the paper made no new contribution to the subject. It was shown that if an insulated sphere be electrified by receiving a quantity of electricity, the sphere will resist being moved with an electromagnetic force proportional to the acceleration; while, if it be once set in uniform motion, the resistance will cease. When, however, the charge is arrested or retarded, the sphere will experience an electromagnetic force tending to resist the stoppage, or tending to make the motion persist. The effect is due to the reaction of the magnetic field set up about the sphere by the movement of electrostatic flux through space. The effect is clearly analogous to what we call the inertia of matter, and the sphere receives, on being charged, an increase in its inertia. The amount of the electromagnetic extra inertia due to the charge is, however, excessively minute, and far beyond our power to detect, although the mechanical inertia of even the smallest pieces of matter that we can handle is readily detected.

If, however, we communicate the same electric charge to a smaller sphere, we increase the electric charge density, the electrostatic flux density, the electric potential, and the electromagnetic inertia. The smaller the sphere to which the electric charge is given, the greater will be the electromagnetic inertia. If we consider an atom of hydrogen as a sphere, and give it, in imagination, the atomic charge, as found in electrolysis, the electromagnetic inertia is still far smaller than the mechanical inertia. But if we communicate the ionic charge to a corpuscle, or chip of an atom, according to modern experimental results, then the electromagnetic inertia of the corpuscle would be as great as its mechanical inertia. If every corpuscle of the atoms of matter carry, as is supposed, an ionic charge as an inherent fundamental property of matter, then the inertia of matter may be adequately accounted for by known laws of electromagnetism. We may, therefore, fairly say that the explanation of mechanical inertia is within reach; but the explanation for gravitation is not yet clear, although various attempts at an explanation based on the electronic theory have been offered with a reasonable chance of success in the course of experimental analysis.

Some Limits in Heavy Electrical Engineering.

Inaugural addresses adorn the interiors of our bookshelves in all directions. Some are light and some are heavy. One might imagine from the title selected, as above, for the particular inaugural address we refer to, by Mr. Swinburne before the British Institution of Electrical Engineers, that it was heavy. On the contrary, it is a very interesting document. Its width of scope and wittily pleasing variety bring to mind the world-discursive nature of a President's message to Congress. Mr. Swinburne is always original, and he stands by his guns as long as the enemy is in range. There is always a zest and a militant ardor in his writings. He is always a crusader. In this case he wields the war-tomahawk with both hands to smite at the current existing use and application of the term "entropy." He complains that the existing usage is all wrong, and that in the entropy temperature diagram of real steam engine operations, the area should be greater than, and not equal to, the mechanical work. This is, of course, a matter of definition in terms, and it would seem best to create a new term for Clausins' entropy, rather than upset generally established terminology and text-book lore.

The view is expressed that a blast-furnace is more valuable than a water-power. The reason given is that the flue gases, or by-products, of the furnace, are better capable of giving cheap power than waterfalls, because of the cost of hydraulic work and the cost of the falls as property. Of course it should be borne in mind that there are not many powerful waterfalls in Great Britain, outside of rainfalls; so that the local prospect may have unconsciously influenced the orator. Very keen and well-aimed blows are also aimed at tide-reservoirs of energy. The indictment is, no doubt, sound that as a rule it is waste of work to impound the tides as workers. Their frequency of one cycle in forty-four thousand seconds is too low. The carbon voltaic cell delivering energy directly from chemical consumption is speedily dismissed as seemingly an impossibility. Fortunately, the poor thing does not yet exist, or it would feel its denunciation keenly.

A very interesting suggestion is offered for a new form of condenser for engineering purposes, namely, an alternating electromagnetic type of condenser in which a coil of wire, included in an alternating-current circuit, is allowed to vibrate mechanically in the annular gap of a radial magnetic field. This imaginary machine is alluded to in association with synchronous motors. But the action of the super-excited synchronous motor, or converter, in so far as it acts as a condenser, is parallel with, or analogous to, that of the electromagnetic condenser suggested. The British standard candle and the standard horse-power justly receive scathing criticism. It is pointed out, however, that the horse has one advantage over the candle; namely that he is not involved with the 4π controversy and that no one tries to rationalize him. A number of important suggestions are made in the direction of the accurate use of units. At present we often see the temperature stated as follows: 20° C. The address prefers 293° A, that is, 293 degrees absolute, or above absolute zero. The idea is good, and liquid air improves it daily; but it suggests an A B C of temperature that will have to be explained away to the casual reader. The efficiency of the Cooper-Hewitt vacuum lamp is set down at about 0.6; that is to say about 60 per cent. of the input is radiated power visible to the eye. This is not only higher than the value generally given, but also, perhaps, the highest artificial luminous efficiency on record. Five candles per watt is taken as perfect, or unit, efficiency. This very suggestive and entertaining discourse after summing up the various barriers that at present limit electrical engineering progress, closes with the invitation to get over such barriers as we can, and to get round the rest.

Electricity and Fire Insurance.

At the 230th meeting of the New York Electrical Society, held at the Lecture Room of the American Institute, on Wednesday evening, January 7th, 1903, the subject for consideration was "Electricity and Fire Insurance." Dr. Samuel Sheldon, president of the society, after some appropriate remarks in opening the meeting, introduced Mr. Joseph Sachs, who spoke on "Electric Fuses in Relation to the Insurance Hazard." Mr. Sachs sketched the development of safety fuses and then proceeded to consider the enclosed fuse in detail. Referring to the matter of fuse rating, he considered fuses should be rated at their maximum fuse load capacity; that is, the maximum number of amperes which will flow continuously through the fuse without injury. The underwriters, however, consider that a fuse shall be rated at eighty per cent. of its maximum continuous current-carrying capacity. Some manufacturers put both ratings on the label and leave it to the user to decide whether he wants to run the device at its maximum current or at eighty per cent. of that maximum. The time interval of overload enters here, for when a fuse is rated at eighty per cent. of its maximum current, there will not be accurate overload operation. The enclosed fuse is particularly adapted to the protection of devices where time interval is a desirable quantity; and in many cases some time limit of operation on overload is desirable. Mr. Sachs brought out the fact that after an enclosed fuse has been blown the external structure of the fuse may be used again.

President Sheldon then introduced Mr. Arthur Williams, who spoke on the subject, "The National Electric Code and High-Tension Circuits." After sketching the history of underwriters' codes, he referred to proposed action concerning high-tension transmission lines passing through hamlets, villages, towns and cities. Heretofore there have been no codified rules governing their installation and use, and until recently such as were suggested practically prohibited them. Such prohibition has been recognized as unnecessary and harmful to the industry, though the desirability for sure control as to where placed and the manner of construction, has been recognized. Hence, the recent action of the insurance and electrical authorities, interested in the National Code, and the considerable, though not as yet final, progress toward an addition to the Code, by which, while the electrical industry will not be retarded on the one hand, the insurance industry will not be subjected to abnormal risk on the other. The risk cannot be of fire, as these transmission lines rarely, if ever, enter premises other than those owned and operated by the electrical companies, but rather of the proximity of property to high-tension wires, causing at least hesitant action on the part of firemen in approaching a burning building, and thereby possibly allowing a fire to gain headway, and causing a larger loss than would have occurred were there no obstacles before the firemen, delaying their movements. The new code will relate chiefly to the method of line construction, the distance which the wires must be carried from buildings and from the conductors of other light, power and signaling systems.

The next speaker was Mr. J. C. Forsyth, who spoke on "The Relation of Electricity to Insurance Rates." There have been, he said, many reports of late (and their number is constantly increasing) to the effect that old equipments are rapidly deteriorating and becoming more and more of a hazard to both buildings and contents. This fact is borne out by statistics which show the record of fires from electrical causes. During the past fifteen months the electrical department of the New York board has secured the expenditure of at least $175,000 in the territory over which it has jurisdiction in re-equipping and overhauling old installations which had become so defective that their continued use was liable to result in serious loss. Equipments have not been condemned simply because they were old, or that out-of-date appliances were found to be in use, but wholly on the grounds of deteriorated condition of insulations and apparatus. The board, moreover, has but scarcely started on this line of work. These conditions together with the fact that changes, alterations and additions are constantly being made which for very obvious reasons are not reported for inspection, raise a feeling of insecurity in the minds of practical insurance men, which unless removed or abated may result in what many of them now think to be the only proper step, viz., the making of a flat increase in rate on all buildings and contents where electricity is used.

The general tendency toward higher potential is also cause of uneasiness, the old two wire, 110-volt system has given away in rapid succession to the three wire 110-220 volt, the two wire 220, and now we have in many sections of the country a 220-440 volt system. In fact, the only limit to the potential which appears to be regarded is the commercial efficiency of the lamp or current-consuming device. With every increase of the potential there is without question an increase of hazard. This hazard may be guarded on new equipments, but changing old installations from one system to another of higher voltage should not be done. New equipments become old in a very few years, and then we will be face to face with the same problem. Without doubt, however, should a flat increase of even ten cents be made when electricity is used for any purpose, the inevitable result would be to practically prohibit installations in thousands of buildings where it is at present in use, and where now considered much more of a luxury than a necessity.

Dr. A. E. Kennelly sent a statement concerning the action of the American Institute of Electrical Engineers on the proposed high-tension underwriters' rules, which was read by President Sheldon. In 1901, he said, the U. N. E. Association promulgated certain proposed new rules affecting the construction of extra high-pressure electric transmission circuits. They considered that these extra high-pressure circuits increased the fire hazard on insured property in the neighborhood, partly by physical obstruction of firemen who could not or would not attempt to cut the wires, and partly by accidental crosses with low-pressure circuits entering buildings. These rules contained a 75-foot distant limit from buildings, and were evidently intended to exclude extra high-pressure wires from settled districts. The proposed rules were so drastic as to elicit protest and expostulations from transmission companies and engineers.

The Board of Directors of the Institute sent printed copies of the underwriters' proposed new high-pressure rules to a considerable number of members of the Institute for comments. A goodly number of vehement objections were returned, and these were turned over to the Institute's Code Committee.

After preliminary meetings the Institute committee met the underwriters' committee at a conference in February, 1902, and a number of tentative joint propositions were drawn up for presentation to the respective governing bodies. The directors of the Institute sent copies of these joint propositions to its members for comment. A number of replies were received during the summer of 1902. General satisfaction was expressed by many replies at the tenor of the propositions; but, in detail, many modifications were suggested.

The entire correspondence was considered by the Institute committee at a meeting in November, 1902. At this meeting the views of the committee were recast. The membership of the committee had also been modified since the preceding year. The recast opinions of the committee were forwarded to the underwriters' committee, with a request for another joint meeting. The joint meeting was held on November 18, 1902.

At the joint conference, a number of joint resolutions were adopted, representing the matters upon which an agreement was reached. The joint recommendations for proposed new rules affecting the construction of extra high-pressure constant-potential circuits was submitted to the respective governing bodies.

The directors of the Institute held a special meeting to consider the proposed new rules as set forth in the joint recommendations. The meeting was held on December 8th, 1902, the day before the annual convention of the U. N. E. Association in New York. In view of the objections raised by certain associations and individuals, and in view of the short space of time in which to secure opinions, the directors decided to ask the U. N. E. A. for a further postponement of action. President Scott attended the convention on December 9th, and presented the request which was acceded to.

The directors of the Institute have recently issued copies of the new joint recommendations to individuals and corporations interested in the matter of an expression of their views. It is expected to hold a committee meeting on the replies in the near future. Since a number of replies have been received expressing satisfaction at the recommendations, it is reasonable to hope that these recommendations will need but little further ratification to meet with general favor.

A discussion by the members of the society, of the topic of the evening followed, in which Messrs. Patterson, Osterberg, Petty, Cook, Eidlitz and Lorrain participated.

The Largest Electric Water Power System in New England.

ELECTRIC supply and traction consume more water power in Manchester, New Hampshire, than in any other city of New England. In these columns there appeared in the issue of May 25, 1901, a full account of the Manchester system as it then existed, and it is the purpose here to record some later developments and special features. At the date just named the water-power plants of the Manchester Traction, Light & Power Company at Kelley's Falls, Gregg's Falls and Hooksett Falls contained one generator of 180, three of 300, one of 450 and one of 1,200 kw capacity, aggregating 2,730 kw, besides some small machines at Garvin's Falls that have since been discarded. Within the past few months a new water-power station has been completed at Garvin's Falls and equipped with two generators of 650 kw each, thus raising the present capacity of the water-driven stations to a total of 4,030 kw. These figures, it is safe to say, surpass the installed capacity of generators in the water-power stations of any other electrical supply or traction system in New England.

At Garvin's Falls, the largest of the water powers included in the Manchester system, the company owns the entire water privilege, only the smaller part of which is utilized by the present development. The new power station at this point is located on the west bank of the Merrimac, about one-fourth mile below the dam. Water reaches this station through a canal which gives a maximum head of about 30 feet above the back water level in the river. The fore-bay wall of this canal forms one side of the wheel room in the station and next to this wheel room comes the room devoted to the generators and switchboard. At the floor level of the wheel room the fore-bay wall is ten feet thick and at the normal level of water in the canal the wall is seven feet thick.

Three wheel cases communicate with the canal water by passing through the fore-bay wall, with their centers 10.5 feet below the canal water level and about 17.5 feet above the tail water level. From each wheel case two draft tubes extend down to a level 30 feet below

FIGS. 1 AND 2.—TWO VIEWS OF THE POWER PLANT AT GARVIN'S FALLS, N. H.

that of the canal water. Between the water side of the fore bay wall and the face of the wall which separates the wheel room from the generator room is a distance of 33.5 feet, and this latter wall is two feet thick. The generator room measures 30 feet by 62 feet inside, the generator shafts being parallel with the shorter dimension. The generator room floor is 15 feet below the level of the canal water and the lower cords of the roof trusses are 27 feet above this floor.

In structure the station is brick on a stone foundation composed in large part of arches, beneath which the tail water passes. The slate roof is lined with wood and supported on steel trusses. On two sides of the generator room the brick walls are each two feet thick, to a distance of 20 feet above the floor, where they decrease to one foot, thus forming shelves on which travels a 15-ton crane over the entire length of the generator room. The outside walls of the station are waterproofed to an elevation eight feet above the floor of the generator room and 2.76 feet above the notable flood water of 1896. As may be noted by the photographs and drawing, the water, after leaving the draft tubes, passes directly beneath the generator room and then into the river.

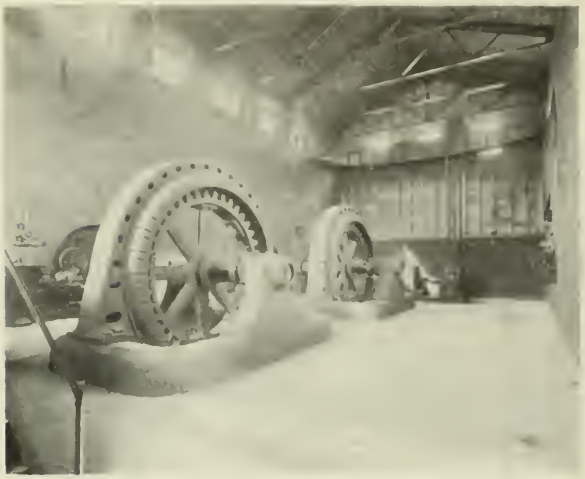


FIG. 3.—GENERATORS, GARVIN'S FALLS STATION.

Of the three wheel cases, two are 12 feet each in diameter and the other has a diameter of five feet. Water is admitted to these wheel cases by gates at the fore-bay wall, which are operated by a 5 hp induction motor located in the gate-house at the top of the wall. Each of the two 12-foot wheel cases contains three Rodney Hunt turbines, 39 inches in diameter, operating at 180 r. p. m and rated at 1,000 h p for the group of three. The 5-foot wheel case contains a pair of 12-inch wheels of the make just named that operate at 600 r. p. m.

Each wheel shaft extends through a water-tight bushing into the generator room, and the shafts of the larger wheels are each direct-connected with the shaft of a 650 kw, 1,200 volt, 60 cycle, three-phase, revolving magnet alternator. The shaft of the 12-inch wheels is direct-connected to that of a 400-ampere, 125-volt dynamo used as an exciter. Another exciter of 50 kw at 125 volts, four pole, is direct-connected to an induction motor rated at 75 horse power, 440 volts and 600 r. p. m. Each of the three sets of water wheels is regulated in speed by a Lombard governor belted to the shaft of the connected dynamo. A 2-hp induction motor at 440 volts drives a rotary pump, used to keep the pits under the generators free from water. All these motors are three-phase, 60-cycle, and, like the generators and exciters, were made by the General Electric Company.

The switchboard at this station consists of six marble panels each two inches thick and 7 feet 5 inches high, exclusive of the mounting frame, the total length of board, including the frame, being 17 feet 4 inches. This frame is of wood treated with chemicals to give it slow-burning properties. Two of the panels are devoted to the exciting dynamos, one panel to the induction motors, one panel to each of the two alternators, and one panel to the transmission lines. Three-phase current at 11,000 volts, generated by the large alternators, is transformed to 440 volts for the several induction motors about the station. On the back of four panels of the board are mounted two sets of bus bars containing three bars each. By means of oil switches the motor transformers may be connected to either set of bus bars, and other oil switches perform a like function for each main generator and for each transmission line.

Energy is drawn from this generating station, as from each of the three other water-power plants, for both lighting and traction purposes. To avoid the effect of fluctuating traction loads on the voltage of the lighting system, the plan involving double sets of bus bars has been carried out in all the water-power stations and at the sub-station. This plan enables any generator or any transmission line in the entire system to be operated exclusively for either lighting or traction work. The practice is to devote one set of bus bars, as the lower, to traction loads in all the plants alike, reserving the other set of bus bars for general electrical supply. As all the stations and offices of the lighting and traction system are connected by private telephone lines, the person in charge of operation can shift any generator or transmission line from one class of work to the other at any time. The switchboard at Garvin's Falls is fully provided with ampere and volt meters, but carries no recording wattmeters, as all the energy records are made at the sub-station.

Two three-phase circuits of three wires each connect the switchboard at Garvin's Falls with the board in the sub-station at Manchester. Before passing out of the generating station each of the six wires of these circuits is connected to an automatic oil circuit-breaker and to a series of four 3,000-volt lightning arresters. The two transmission lines leave the station through circular openings in a slate panel set into the brick wall behind the switchboard, and outside of this panel they are attached to insulators mounted on double cross-arms, which latter are supported by iron brackets extending out from the face of the wall.

Between the Garvin's Falls plant and the sub-station in Manchester, a distance of about 13.5 miles, the two three-phase lines are supported on 744 chestnut poles. These poles are for the most part 35 feet each in length and have tops not less than 7 inches in diameter. Each pole is regularly fitted with two crossarms, one below the other, for the transmission lines, but at all sharp angles double arms are used, giving two points of attachment to each wire per pole. Guy wires are attached 5 feet below the lower crossarms and to stubs set in the ground or to ledges. Guys are stranded with 7 No. 12 wires. Crossarms are each 3¾ inches by 5 inches in section, of white pine, and are painted. Each arm is secured to its pole by two lag screws. Pins used in these crossarms are of oak, 1¾ inches in diameter at the part which enters the arm and are spaced on 18-inch centers. Each pin carries a triple petticoat glass insulator 4¾ inches in height from its lower edge to its top, 5 inches in diameter, and with its lower outside edge 1¼ inches above the top of its crossarm. The transmission wires are tied to the sides of these insulators, and the three wires of each circuit are mounted on one arm per pole. Each of the six wires between Garvin's Falls and the sub-station at Manchester is of bare, solid, soft-drawn copper, No. single o. These lines operate at about 11,000 volts, three-phase.

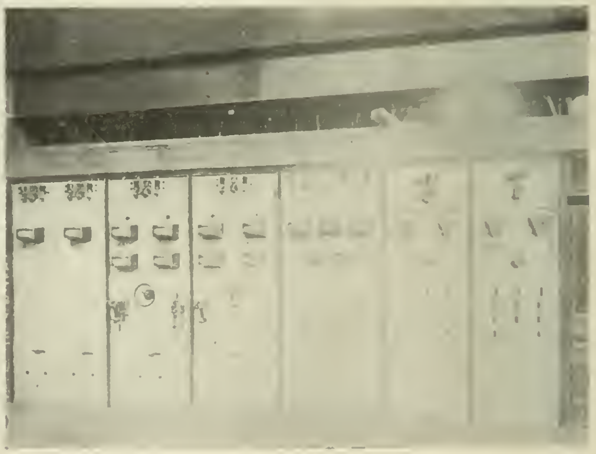


FIG. 4.—SWITCHBOARD, GARVIN'S FALLS STATION.

The sub-station at Manchester, with its equipment, was not completed at the time of the above-named issue of this journal, and some of its special features are now worthy of further notice. The building itself is one-story, brick, with a main floor of concrete supported on steel beams, and these, in turn, by ten brick piers each 16 inches square and by the foundation walls. Beneath the entire main floor is a cemented air-tight basement 6 feet in height. Inside the sub-station at the main floor the dimensions are 41 by 72 feet, and from main floor to the lower chord of roof trusses the distance is 14 feet. The sub-station is lighted by windows on three sides and by two raised skylights in the roof, each of wired glass about 10 by 14 feet, and with two rows of side windows.

Along three sides of the sub-station a series of slate slabs are set into the brick walls between granite sills. Each of these slabs is two feet wide between the upper and lower sill and is 1.5 inches thick. Midway between the granite sills each slab of slate has three circular openings spaced for transmission lines 18 inches apart and for distribution lines 12 inches apart, in a horizontal line, and each opening 5 inches in diameter. These circular openings have their centers about 14.75 feet above the main floor of the sub-station and a somewhat less distance from the ground outside. Outside of and about two feet below the circular openings in the slate slabs long timber crossarms are mounted on iron brackets supported by the brick walls. Along these crossarms pins and insulators are mounted on 18 or 12 inch centers to carry the wires that pass through the openings in the slate. About 18 inches below the center of the circular openings, on the inside of the sub-station wall, a row of insulators is arranged to receive each wire after it passes through its opening. The wires, being held in position by the insulators both inside and outside of the sub-station, do not touch the slate slabs where they pass through.

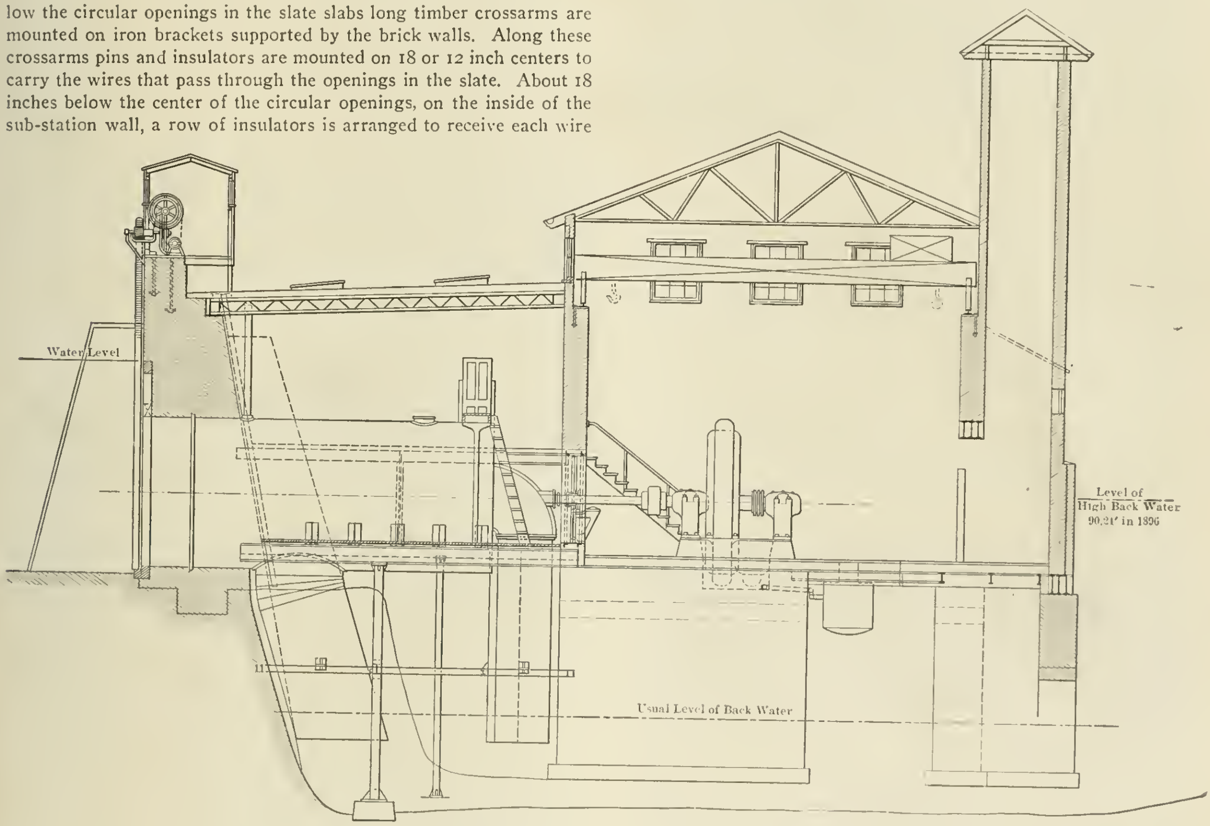


Fig. 5.—Cross Section Elevation, Garvin's Falls Power House.

At one side of the sub-station enter the 2,000-volt, three-phase circuits from the Brook Street steam generating station nearby. Another side of the sub-station is devoted to the 2,000-volt, three-phase circuits that distribute 60-cycle current for commercial lighting and stationary motor service. Through the row of circular openings along the third side of the sub-station come the transmission lines.

In the cement floor of the sub-station there are 27 rectangular openings reaching through to the basement and each 25 by 30 inches. Each of these openings is intended for an air-blast transformer of 200 kw capacity and 21 of these transformers are now in position, giving an aggregate capacity of 4,200 kw. In the basement are located two 10-hp induction motors driving a fan that maintains a sufficient air pressure there to give the required blast through the transformers. This fan draws air through a metal duct which terminates in a hood about 9 feet above the ground on the outside of the sub-station. After cold air from this hood, by way of the basement, has been forced through the transformers, it passes out of the sub-station by way of the windows in the skylights.

Seven transmission circuits containing nineteen wires now enter the Manchester sub-station, as follows: Two three-phase circuits from Garvin's Falls, 13.5 miles away, made up of six No. 1/10 wires. One three-phase circuit from the Hooksett water-power station, ten miles away, made up of three No. 2 wires. Two three-phase circuits from the Gregg's Falls station, six miles away, made up of three No. 4 and three No. 6 wires. Two two-phase circuits from the station at Kelley's Falls, three miles away, made up of four wires. These nineteen wires are all of solid, bare copper. Each of the three-phase circuits operates at 10,000 to 11,000 volts, and the two phase circuits at 6,000 volts. All of these transmission circuits enter the sub-station at the side opposite to that where the switchboard is located. Along the entire length of the wall below the openings where the transmission lines enter five horizontal strips of fireproofed oak are secured at different elevations to serve as supports for the high voltage wires and lightning arresters. Each wire, after passing through a 5-inch opening in a slate slab and to its insulator immediately below is attached to a series of lightning arresters behind which it passes on to one pole of an oil circuit-breaker.

Each wire of a three-phase circuit is connected to a series of four 3,000-volt lightning arresters, and each wire of a two-phase circuit connects with a series of two 3,000-volt arresters. For each three-phase circuit a three-pole hand-operated oil circuit-breaker is mounted just below the lightning arresters, and for the two-phase circuits one four-pole hand-operated oil circuit-breaker is so mounted. The several series of lightning arresters belonging to wires of the same circuit are mounted on center lines 18 inches apart, and between adjacent series an oak barrier 1 inch thick, 12 inches wide and 38 inches long, is placed. After leaving its oil circuit-breaker each circuit passes down the wall, through the cement floor and along the basement ceiling to the point where its group of transformers is located. Each three-phase circuit is connected to a group of three transformers arranged delta fashion and rated at 200 kw each, or 600 kw for the group. Each two-phase circuit is connected with a group of two transformers rated at 200 kw each, or 400 kw for the group. Transformers on the three-phase circuits change the pressure from 11,000 to 2,000 volts, and transformers on the two-phase circuits change their current from 6,000 to 2,000 volts, and from two phase to three phase.

The 2,000 volt, 60 cycle, three phase current from each group of transformers passes by cables along the basement ceiling up through the floor and to a triple pole oil switch at the switchboard. Energy from the transmission lines thus passes down one wall of the sub-station, along the basement ceiling, and up to the switchboard at the opposite wall. This switchboard, which is 40 feet long and carries two sets of three-phase bus bars, was described at some length in the issue of ELECTRICAL WORLD AND ENGINEER above named. It may be again stated here that the equipment with two sets of three-phase bus bars on the sub-station switchboard, together with the double sets of bus bars on the boards at the water-power stations, makes it practicable to apply any generator in either of these stations to general electrical supply or to the traction load.

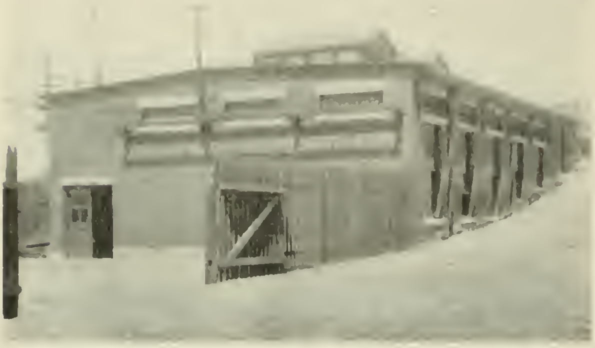


FIG. 6.—MANCHESTER SUB-STATION.

As fully noted in the previous description of the Manchester system, the alternators in the Brook Street station are either driven by engines there and deliver 2,000-volt, 60-cycle, three-phase current to the switchboard in the sub-station, or else one or more of these alternators receives current from this switchboard, operates as a three-phase, synchronous motor and drives the 600-volt street railway generators and the arc dynamos through the main shaft in the Brook Street station. Since the former description of this system was published a 500-kw, 600-volt railway generator has been added to the equipment at the station just named, in such a way that an interesting motor generator has been formed. For this purpose the new 500-kw generator was provided with an extended base at the pulley end and this extension was bolted to the pulley end of the base of the 650-kw 2,000-volt, 60-cycle, three-phase alternator already at the Brook Street station, the joint being babbitted. The shafts of the two generators thus brought into line were coupled and the motor generator was complete. Both of these generators were made by the General Electric Company and their common speed is 360 r. p. m.

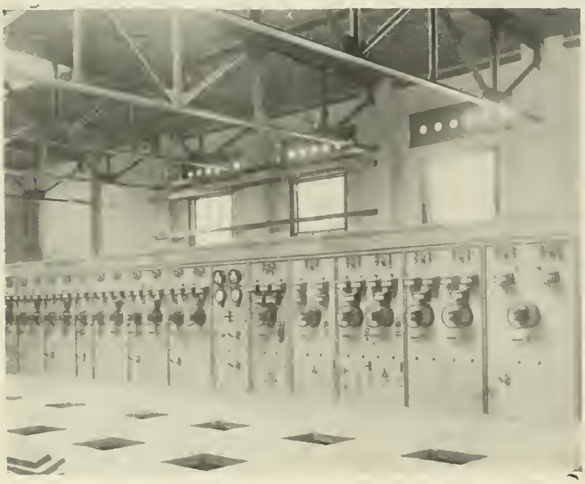


FIG. 7.—SWITCHBOARD IN SUB-STATION, MANCHESTER.

When there is enough water power to carry all or a part of the traction load in addition to the commercial service and street lighting, the 650-kw alternator operates as a motor with current from the sub-station and drives the 500-kw, 600-volt street railway generator. When water power is lacking the motor generator is driven by steam power through a belt connection with the main shaft and either or both of the machines may furnish current. The total floor space taken by this 500-kw motor generator is 25 feet 8¾ inches by 10 feet 8 inches.

A change worthy of note is about to be made in the water power station at Gregg's Falls, where a single generator of 1,200-kw capacity is direct connected to a horizontal shaft carrying three turbine wheels each 27 inches in diameter and all operating at 327 r. p. m. These wheels are mounted in a case at the end of a penstock 10 feet in diameter and a second penstock of equal size enters the station, but is not connected with any wheels. With the three wheels now in use the 1,200-kw generator will deliver only a little more than two-thirds of its rated capacity and it is the intention to extend the idle penstock to a wheel case at the free end of the generator shaft, and in this case to mount two more 27-inch wheels. The shaft of these two wheels will be direct-connected to that of the generator, which latter will then be driven by five direct-connected wheels. By this means the entire capacity of the generator can be obtained at the speed of 327 r. p. m. under not more than 51 feet head of water.

Besides the sub-station at Manchester the system under consideration includes another sub-station equipment in the temporary wooden building at Hooksett. This sub-station at Hooksett is devoted entirely to the supply of direct-current at about 600 volts for the new electric railway line between Concord and Manchester. The Manchester Traction, Light & Power Company does not own or operate this railway, but simply furnishes the power for it under contract. Feeders belonging to the electric railway come to the sub-station and take their power from the switchboard there.

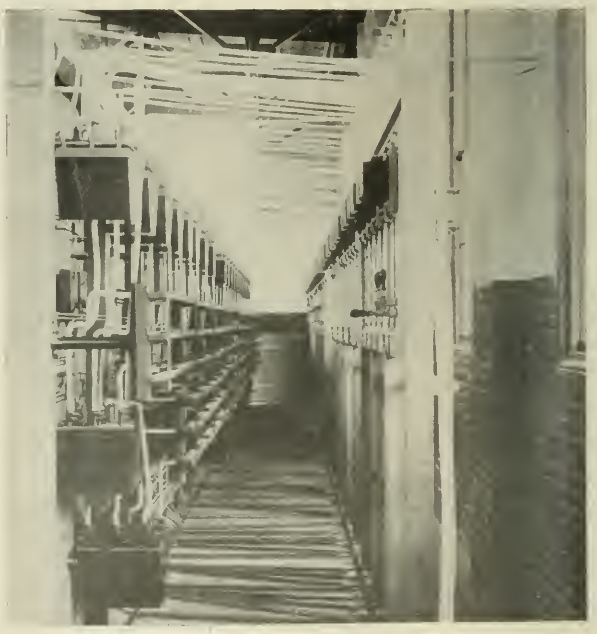


FIG. 8.—BACK OF MAIN SWITCHBOARD, MANCHESTER SUB-STATION.

At this Hooksett sub-station, located ten miles from the sub-station in Manchester, energy is received at about 10,000 volts, 60-cycle, three-phase, and is transformed to about 380 volts, three-phase, for the two rotary converters. Energy for this Hooksett sub-station may be derived from any generating plant of the Manchester system except the Hooksett by way of the Manchester sub-station and the transmission line between Manchester and the water-power plant at Hooksett. Ordinarily, however, the Hooksett sub-station derives its energy from the water-power station close by. A branch from the transmission line between Garvin's Falls and Manchester is carried across the Merrimac River at Hooksett to the sub-station there, so that the transformers and rotary converters there may draw energy directly from the Garvin's Falls station.

The equipment at the Hooksett sub-station includes three transformers of 250-kw each, and two rotary converters, each with a capacity of 300 kw at 600 volts and 600 r. p. m. These converters work at 60 cycles per second and the number of poles in each is therefore twelve. The sub-station also contains a four-panel switchboard of blue marble devoted to the two rotary converters and the railway feeders. This transforming and converting equipment is of Westinghouse make.

From the Brook Street station in Manchester the entire electric railway system of that city is operated with energy from steam or water power, according to the supply of the latter. This railway includes 36 miles of single track, extending in one direction to a distance of nine miles from the sub-station. Included in these tracks are 56, 60 and 70-pound T-rails, and 90-pound girder rails, all laid on ties spaced two feet apart and ballasted with one foot of gravel. Rolling stock includes 84 open and closed cars, each of which is 36 feet 7 inches over all. Each closed car is 25 feet long inside, and each open car has 13 benches. All car motors are of General Electric make and rated at 40 hp each. Cars used only within the city limits have two motors each, one on each truck, and suburban cars have four motors. Included in the equipment are six single-truck snow plows and one rotary plow. This latter has four motors of 40 hp each for traction, and two 40-hp motors that can be worked with series-parallel connections on the fan at either end of the plow.

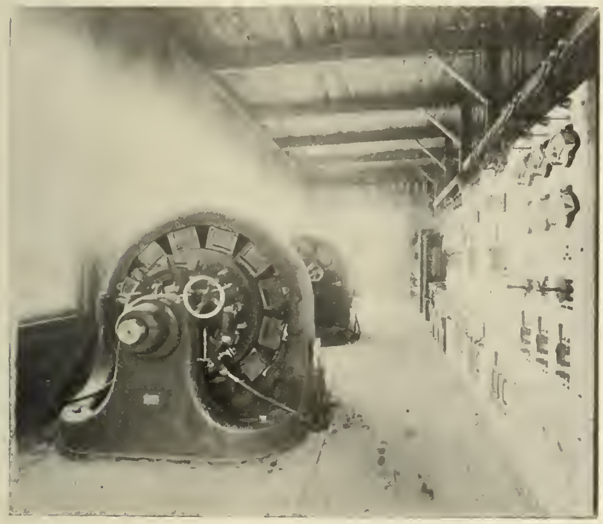


FIG. 9.—ROTARY CONVERTERS, HOOKSETT SUB-STATION.

About 75 stationary motors, with an aggregate capacity of 1,500 horse power, are connected to the distribution lines of the Manchester company. The smaller portion of this power is drawn from the continuous-current generators of 160-kw total capacity for stationary motors, at the Brook Street station. The greater part of this stationary motor service is derived from the 2,000-volt, 60-cycle, three-phase lines that radiate from the sub-station. Among these motors there are in use at the Manchester Mills four of 75 hp each at 2,250 volts; two motors of 200 hp each, and one motor of 30 hp.

All of the motors supplied with the three-phase current are of the induction type and General Electric make, and the usual voltages are 110, 220 and 550. About 40,000 incandescent lamps of 16-cp are connected to the three-phase lines, lamps and motors being supplied from the same mains in many cases. The large motor load at the Manchester Mills has a special feeder from the sub-station. Connected to the 2,000-volt lines are 731 service transformers with an aggregate capacity of 2,679 kw. The secondary voltage of these transformers, where used for incandescent lighting, is 112.

Gas sells in Manchester at $1.25 per 1,000 cubic feet. The large lighting load connected to the electric system at Manchester, as well as the still larger load of stationary motors, seem to be a result, in large measure, of its utilization of water power. The main business section of Manchester occupies a space nearly two miles long on the river bank, between Webster Street on the north and Hayward Street on the south, and extends east from the river about one mile to Wilson Street. Near the river bank and about 0.4 of a mile below Webster Street the sub-station of the electric system is located. Much the greater part of the commercial load of lamps and motors is within a radius of one mile from this sub-station. Under these conditions the sub-station serves as the main center of distribution for the 2,000-volt, three-phase service to lamps and motors, and three-wire circuits extend from this sub-station to every part of the area named. Five of these 2,000-volt circuits, composed of three No. 2/0 wires each, leave the sub-station and branches of smaller wires are connected with these main circuits at frequent intervals. The greatest length of any 2/0 circuit is about two miles. Of the three-wire branches leaving the No. 2/0 mains, one branch is No. 1/0, five are No. 2, two are No. 4, three are No. 6, and there are a large number of smaller branches. In that part of the city where the commercial loads are the heaviest there are several distinct circuits, each running directly back to the sub-station.

Excitation of Asynchronous Generators by Means of Static Condensance.

By A. S. McAllister.

THE fact that an induction motor when driven above synchronism is capable of reversing its usual function as an electromechanical converter, and thus of transforming mechanical into electrical energy, and thereby restoring power to the supply system, has been known almost from the beginning of the existence of the motor itself. This characteristic of the machine has been frequently availed of upon mountain roads, where in descending the primary circuit of the motor is connected directly to the trolley line and the speed of the rotor held practically constant at a few per cent above synchronism, or increased to any desired value by the insertion of resistance in the secondary circuit. Where the system of tandem speed control of two similar motors is used, a braking and energy-restoring effect may be produced, even upon level roads, by placing the motors in tandem connection while they are yet traveling at a speed between one-half and full synchronism, and the rate of retardation may be rendered quite uniform by judicious use of the starting resistance. The same remarks obviously apply when the speed control is obtained by change in the number of magnetic poles of a single motor.

When its rotor is driven above synchronous speed, an induction motor operates as an alternating-current generator, but it possesses a few properties distinctly different from those of the well-known alternator. If the frequency of the supply be constant, then, in order that the machine carry more load, it is necessary that the speed of the rotor be increased. Conversely, if the rotor travel at a constant speed, the frequency will decrease as the load increases. Thus the product of the number of magnetic poles by the rotor speed, in each case, gives a value greater than the number of alternations, the difference being due to the relative motion of the secondary conductors with reference to the primary magnetism, that is to say, to the slip above synchronism.

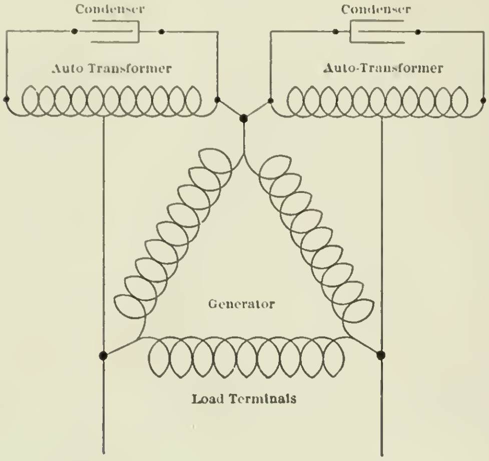
Such an asynchronous generator may be operated in parallel with synchronous alternators, in which case the amount of load which it will assume will depend only upon the relative speed of its prime mover and that of the alternators. It possesses no tendency to hunt, and it may be thrown upon the system without being first brought into exact synchronism. When thus operated its exciting current is obtained from the synchronous alternators while it supplies energy current to the line.

Since at a given frequency the exciting current to produce a constant e. m. f. has a definite fixed value, depending only on the number and distribution of the primary windings and the reluctance of the path of the magnetic flux, the power-factor of operation of the generator varies only with the change in the energy component of current which it supplies to the line and, therefore, for each load on the machine there is a corresponding unalterable power-factor, or briefly, the power-factor of the asynchronous generator is unaffected by that of the load on the system. Any demand for wattless lagging or leading current must be met by a flow of quadrature current from the synchronous alternators.

It is possible to operate a number of asynchronous generators in parallel with a single synchronous alternator, the last machine being used to regulate the e. m. f. supply the wattless currents, and if need be to assist in carrying the load.

In the operation of the equipment as suggested above, it is not necessary that any mechanical power whatever be supplied to the synchronous alternator, except such as is needed to bring it initially to approximate full speed. When the machines are once in operation, the source of mechanical energy may be cut off from the synchronous alternator, and it will continue to be driven as a motor, having a speed synchronous with reference to the alternations of the system, but slightly less than that corresponding to the speed of the asynchronous generators. The e. m. f. of the asynchronous generators is determined by the field excitation of this motor, while the frequency depends upon the speed of the generators and the relative slip due to any load on the system. The motor may conveniently be a rotary converter and thus serve to supply its own field exciting current, and it may be loaded mechanically at the pulley or electrically at the commutator.

The equipment as here described will supply energy to any class of load; the power component of current coming from the generators while the quadrature component is obtained from the synchronous motor. Asynchronous generators may be placed in service without the necessity of first getting them in step with the system, and induction motors may be operated from the system by methods common with such machines. Additional synchronous motors or rotary converters, however, must be generating the proper e. m. f. and be in step before being thrown upon the system.



EXCITER CIRCUITS FOR ASYNCHRONOUS GENERATOR.

It is an interesting fact that static condensance may be substituted for the synchronous motor as a source of exciting current for the asynchronous generator.

The performance of an asynchronous alternator with condenser excitation is strikingly similar in many respects to that of the familiar shunt wound direct-current generator.

Assume, for purpose of illustration, an asynchronous generator which requires an exciting current of I amperes when the terminal e. m. f. is E and speed is such as to give an electrical angular velocity of ω Now, if there be shunted across the terminals a condenser of capacity C, such that $C = \frac{I}{E \omega}$

then, when the source of external excitation is removed, there will be at first a slight drop in current below value of I, which lessened current will cause to be generated an e. m. f. slightly less than E, and there will flow a correspondingly less current in the condenser, and so on. If, however, as the exciting current decreases, the permeability of the cores increases sufficiently, the e. m. f. will not be reduced to zero value, since a considerable decrease in exciting current need not produce a corresponding decrease in the e. m. f. and the condenser will be able to hold the excitation up to practically its normal value.

If at the moment of removing the source of external excitation the condenser under the impressed e. m. f. across its terminals takes more than sufficient current to supply the excitation, there will be at once a rise in the e. m. f. with corresponding increase in current and consequent increase in e. m. f. till the current has increased to such a value that it is just able to send through the reluctance of the magnetic path sufficient lines to generate e. m. f. to sustain that value of current through the condenser. Or, such a generator will excite itself exactly similarly to a direct-current shunt generator.

Its behavior concerning change of speed resembles somewhat that of the shunt machine. Assume that at the chosen angular velocity, ω, the generator excites itself with current I giving e. m. f. E. Now let the speed be increased. The e. m. f. will increase for the same value of field excitation and the increased e. m. f. will cause a corresponding increase in exciting current with accompanying increase in e. m. f., etc., just as with a direct-current shunt generator. The effect, however, is much more pronounced with the alternating-current machine, since at any certain value of e. m. f. more current will be drawn by the condenser at a higher frequency than at one of a lower value, as is seen from the equation, $I = 2\pi C E f$.

Satisfactory performance of a generator thus excited demands that the field cores be operated at a high magnetic density, under which condition the e. m. f. will vary at a rate somewhat greater than the first power of the speed. Under any given condition of service, the e. m. f. may be adjusted by changing the effective condensance in the circuit. This may be accomplished by the insertion of condensance, resistance or reactance in series in the exciting current circuit or by the use of condensance or reactance across the terminals of the generator.

The statements here made have been fully verified by tests upon commercial induction motors with squirrel-cage secondary windings.

The almost inappreciable remnant magnetism in the ring cores of an asynchronous generator may render necessary the introduction of external excitation before the machine will generate. The "priming" may be done with a current of any frequency and of practically any value, and it is possible to employ a static charge in the condenser as a source of initial excitation. Tests have proved that when the speed is above a certain critical value, depending upon the amount of condensance in circuit, the generator will build up instantly to normal e. m. f. without "priming."

The external characteristic of an asynchronous generator with condenser excitation, under non-inductive load, is quite similar to that of a shunt-wound generator with constant value of resistance in the field-current circuit. Since even a non-inductive resistance drop of e. m. f. in the generator windings under load current causes a slight decrease of the current in the exciter circuit under the lessened terminal e. m. f., the best regulation is obtained when the condenser is connected across one set of windings and the load placed across an independent set.

With the familiar synchronous alternator a lagging load current tends to decrease the terminal e. m. f. while a leading current has the opposite effect. An exactly similar state of affairs exists with a self-excited asynchronous generator. In this case, however, the effect is cumulative, since any change in the terminal e. m. f. causes a variation of the current in the condenser exciter and the field magnetism must adjust itself to a correspondingly altered valve. The effect of the wattless currents upon the terminal e. m. f. may be compensated for by the use of series transformers carrying the load current, and so connected as to decrease the e. m. f. at the condenser terminals with leading current, and to increase the e. m. f. with lagging current.

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Telegraphy in Persia.

In a communication from the U. S. Consulate at Teheran, Persia, we are informed that the telegraph administration in Persia is farmed by one family; i. e., they pay the Government, which owns the lines, a rent of about $30,000 a year. From the excess, they pay the expenses of operation, and the ultimate balance is their own profit. The head of the family is the Mukhder-ed-Dowlah. The telephone lines and operation are in the hands of a company-partnership of Belgians and Russians, which goes by the name of the Societé Anonyme de Chemin de Fers et Tramways en Perse. The Belgian address is No. 4 Rue de Quatre Bras, Brussels, and the Russian address is 87 Boulevard Tcherskoi, Moscow.

Oerlikon Induction Motor With Four Speed Variations.

By Hans Behr.

The Oerlikon Company, as is well known, built induction motors as far back as 1893, in which the number of poles could be varied by means of a switch, the binding posts of the latter being connected to the various windings of the induced winding. The switching was quite simple when the ratio of the number of poles was chosen as 1 : 2, and for that reason motors were principally constructed which permitted of this speed ratio. These motors employed a Gramme ring winding, which type, as is well known, is divisable into any desired number of poles. The Gramme ring winding and the scheme of connection are shown in Figs. 1 and 2. A large number of the switches shown in Fig. 1 were built in 1894, the year in which the original drawing was made. According to this method of connection, the motor winding must be divided into 6 groups of coils if it is desired to change from 2 to 4 poles, and into 2 x 6 groups, if it is desired to change from 4 to 8 poles, the system then being considered as being composed of two systems each of 2 and 4 poles grouped behind each other, etc. These six groups of coils are connected by means of three permanent connections, two coils to each phase, so as to form three-phase groups, and three wires lead from each of these groups, nine in all, to the switch. By means of this switch the windings of the two groups of coils, apportioned to one phase, are connected in series if a four-pole field is wanted, and in parallel if a two-pole field is desired; in the latter case any two adjacent coils have a phase difference with respect to magnetomotive force of 60°, and 120 ° for the four-pole field. It must be evident that by means of this switching system the magnetizing current remains about the same, whether the field is a two-pole or a four-pole one; also, that the stray field coefficient of the two-pole winding is about one-half as great as the coefficient of the four-pole winding, and that the capacity of the two-pole motor is almost twice as great as that of the four-pole motor; thus the torque of the two motors remains nearly constant, while the output in relation to the speed becomes greater.

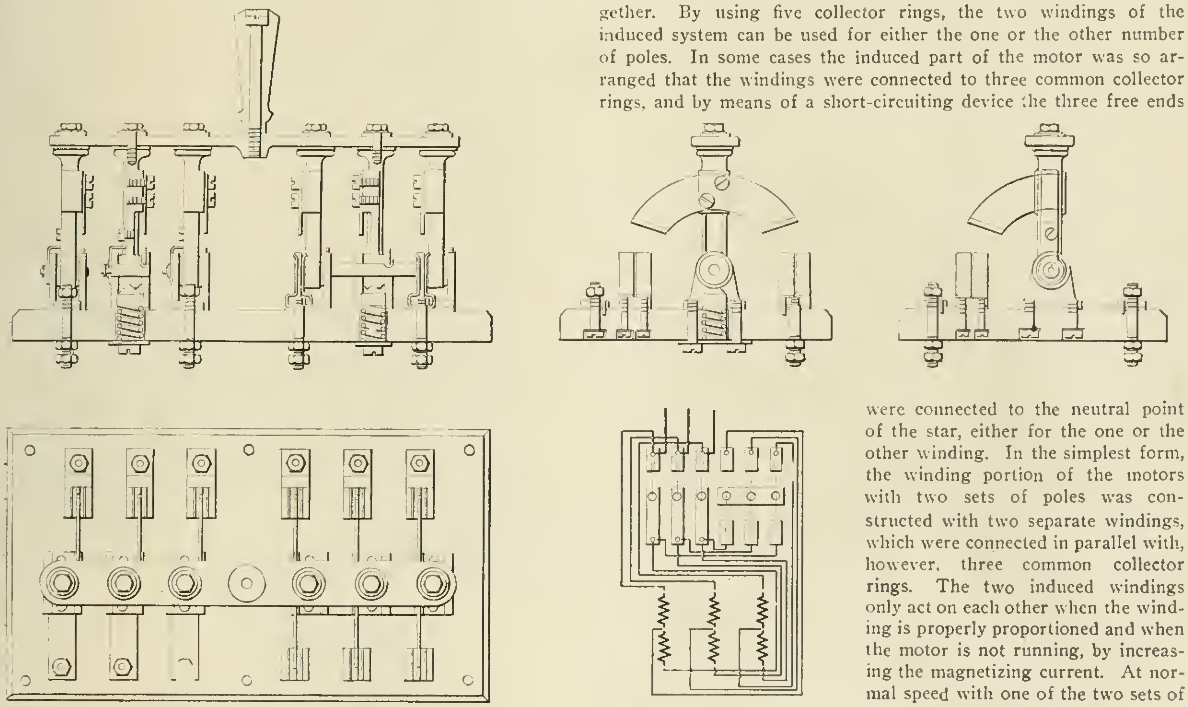


Fig. 1.—Switches and Connections, Induction Motor.

During the past few years, however, the drum winding has been almost universally adopted for induction motors, and the commercial as well as the magnetic and electrical advantages of this winding are well known. The method adopted in 1897 by the Oerlikon Company for varying the poles of motors having a Gramme winding, was changed in the new motors with a drum winding by laying into the same slots of the inducing, and at times even into the induced, system, two coils separated from each other, one being intended for the first number of poles and the other for the second. This method has the advantage that any number of poles may be chosen, and that the proportioning of the windings for the different number of poles may be entirely independent of each other, which is of great value when the output of a motor with a certain number of poles should be entirely different than when it has a different number of poles. Thus, for example, ventilators driven at a small speed require much less torque than when driven at a higher speed; and vice versa, machine tools driven at a small speed usually require greater torque than if they were driven at a high speed. In that case the one winding may be made smaller than the other, which latter may be called the main winding. The disadvantage lies in the fact that it is necessary to construct these motors with special slots in order to have sufficient room for the two coils.

The pole switch has the simple form of the ordinary three-pole switches, one of which cuts in or out the winding of the one set of poles, and the other the winding of the second set of poles. The total motor winding has five binding posts for two different sets of poles, and two ends of the separate windings are connected together. By using five collector rings, the two windings of the induced system can be used for either the one or the other number of poles. In some cases the induced part of the motor was so arranged that the windings were connected to three common collector rings, and by means of a short-circuiting device the three free ends were connected to the neutral point of the star, either for the one or the other winding. In the simplest form, the winding portion of the motors with two sets of poles was constructed with two separate windings, which were connected in parallel with, however, three common collector rings. The two induced windings only act on each other when the winding is properly proportioned and when the motor is not running, by increasing the magnetizing current. At normal speed with one of the two sets of poles, the influence of the parallel connection of the two windings is lost entirely, because the collector rings are short-circuited.

Attempts were made to wind the drums of induction motors similar to the windings of the rings, but these were futile, because with the normal drum winding intended for a definite number of poles the coils have a mean normal advance which embraces a pole division corresponding to this number of poles, and because this system of winding causes an enormous stray field for one-half as great a number of poles with twice the pole division. Such motors in which the common drum winding was altered to meet the pole ratio 1 : 2, as shown in Fig. 1, were very inefficient for a smaller number of poles, and the starting at this ratio was very unsatisfactory when motors with short-circuited armatures were used.

After a long series of experiments, the Oerlikon Company have succeeded in devising a drum winding in which the above-mentioned disadvantages are not present, and the motors show as good economical results as those wound for only one set of poles. This winding is divided into 6 x 7 coils, similar to the old type of ring winding, in which p is the smallest number of pairs of poles which can be formed. These coils are operated by the same switch spoken of above for the pairs of p and 2 p, by connecting two rows of coils for each phase in parallel for p pole pairs and in series for 2 p pole pairs. This method of connection, as shown above, results in motors with constant torque. The number of motor terminals is at least six. It will be seen by reference to the diagram that by simply exchanging the ends of the winding, which all lead to the neutral point, with those connected to the outside circuit, three terminal posts can be abolished. In Fig. 2 the terminals 7, 8 and 9 are permanently short-circuited by each other; for the two-pole connection, then, the three currents enter through 4, 5 and 6, and besides the end 7, 8 and 9, the ends 1, 2 and 3 are also short-circuited. For the four-pole connection the currents enter at 1, 2 and 3 and the terminals 7, 8 and 9 are retained as the junction point.

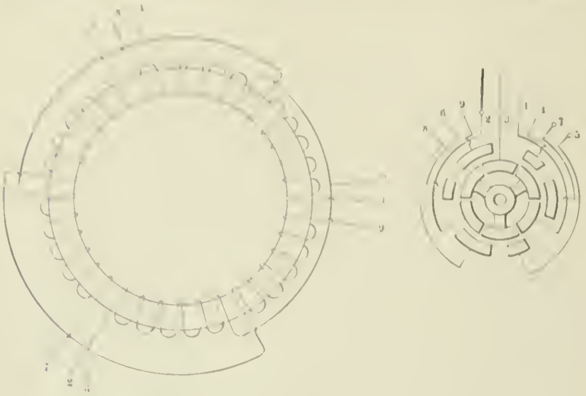
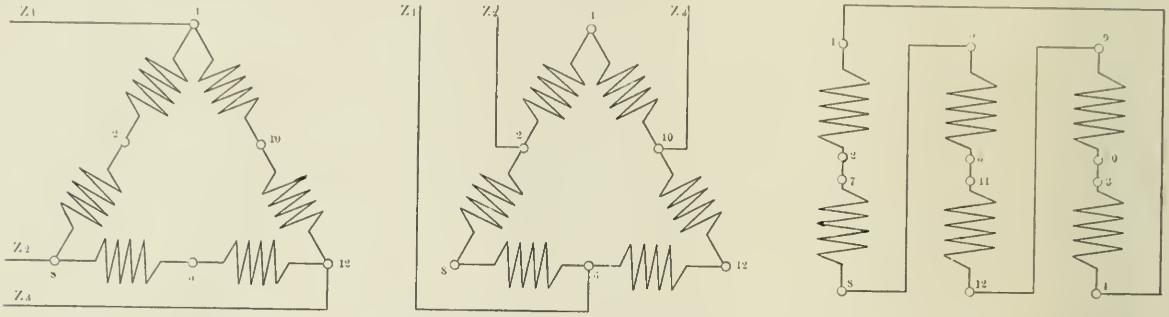


FIG. 2.—GRAMME RING WINDING AND CONNECTIONS.



FIGS. 4, 5 AND 6.—DIAGRAMS OF CONNECTIONS.

A still simpler connection was devised for motors which are to exert less power at high speeds than at low speeds, by employing in place of the star connection of the six coils, the delta connection, in which all six coils are permanently connected in series for two as well as four poles—in fact for any multiple of these numbers—and the currents made to enter at 1, 2 and 3 for the greater number of poles, and at 4, 5 and 6 for the smaller number. In this system, the current at no load is less for the smaller number of poles than for the larger number. This method is shown in Figs. 3, 4, 5 and 6.

By making use of the new Oerlikon method of drum winding, the designer may vary the magnetic and electrical conditions of the motor to suit either the one or the other number of poles, by closing the winding advance of the separate winding elements to suit the pole division of the one or the other number of poles. Several motors for different requirements have been built with the ratios of 2:4, 4:8, 6:12, and these have proven the simplicity of the method.

By using the earlier method of drum winding with two distinct windings, it is very easy to increase the number of speed steps to four, without increasing the number of terminals to an impracticable and unmanageable point. For motors with four speed steps there are 2 x 6 terminals, which is no more than for four single motors. The motor has two distinct windings, each of which can be connected for two sets of poles having a ratio of 1:2. The switch for this purpose is a combination of two ordinary three-pole switches. This small number of terminals and contacts, combined with the single method of winding, which is entirely analogous to continuous-current armature windings, may be called the main features of the new system. The direction of rotation and the direction of the speed steps can be made to suit any particular requirements. The switch, however, is very simple if the speed steps are so arranged that the speed changes from the smallest to the greatest without changing the direction of rotation; and when the motor is stopped, the transition from each greater to the next smaller speed is automatic and almost instantaneous, as the motor which has been changed from a smaller to a larger pole number acts as a generator and sends current into the system, until a speed has been reached which corresponds to a larger number of poles. In general, the stray field coefficient is at least twice as great for double the number of poles, in consequence of which the starting current of the motor with short circuited armature with double the number of poles, reduced to the same magnetizing current, is half as large as it is at a higher speed. This brings out the important advantage, that the motor starting at a small speed requires a reduced starting current compared with that required at greater speeds, so that this method in the case of short-circuited armatures, may be used for reducing the starting current.

The advantages of the pole-switching method are particularly evident in the case of induction motors which have to be frequently stopped and started, as, for example, motors for cranes or railroads, in which the loss of energy at starting plays an important part. It must be clear that with a given power and using starting resistances in the induced circuits, the loss of energy in the starting resistances can be reduced to one-quarter or one-half by increasing the number of poles during the starting period, according to whether the number of poles at starting is four times or double that of the normal number. The economy at starting can, therefore, be made equal to any series-parallel connection of direct-current motors, by employing ordinary types of motors.

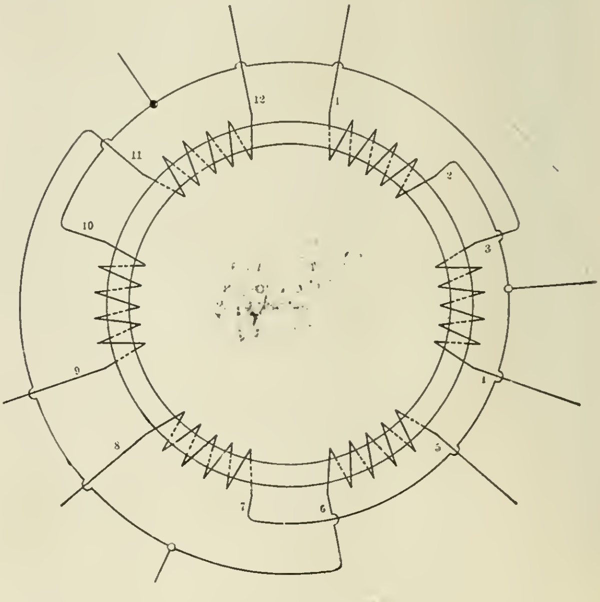


FIG. 3.—DIAGRAM OF CONNECTIONS.

To demonstrate the utility of new types of Oerlikon induction motors, several illustrations with experimental data are herewith presented. In Fig. 7 is shown the first motor of this type, which was built for experimental purposes. The motor is of the ordinary Oerliken type, which at a normal speed of 450 revolutions at 50 periods, has a capacity of 8 hp. The motor weighs about 480 pounds and has an armature diameter of 10 in., the iron having a width of 7 in.; the external diameter is 6 in. and the extreme length of the motor 19 in. The slots of the inducing portion carry the separate windings, one of which is intended for the pole numbers 12 and 6 and the other for 4 and 8. The winding was so chosen that the output of the motor was about 6 hp, at the higher speeds, 1,000 and 1,500, at which it was principally run, so that the stray field and current at no load were particularly small at these speeds. The rotor also contained two separate short-circuited windings, of the well-known Oerlikon bare-wire type.

In the following table are shown the various values of the efficiency at full load and half load, the phase shifting, the maximum torque and the power exerted at starting. For each number of poles the table further gives these values after a three-hours' run, as well as the temperature increase.

The motor is now used for the operation of a lathe, and by using the delta connection can be so arranged that for the greatest pole number the torque is decreased. The values for 6 and 4 poles, using the delta connection, are also given in the table:

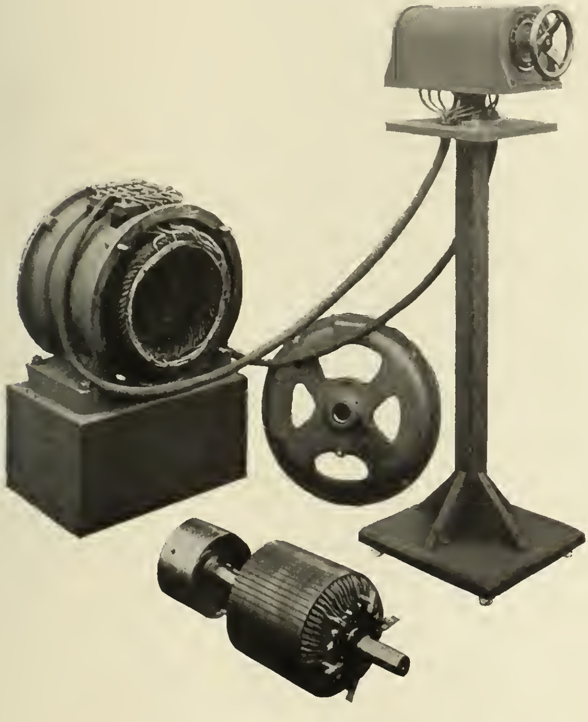


FIG. 7.—ESSENTIAL PARTS ORIGINAL OERLIKON INDUCTION MOTOR.

Speed	1,500	1,000	750	500	350
E.M.F.	130	130	130	130	130
Current at:					
No load	4	2.3	1.8	1.5	1.5
Full "	25	25	25	25	25
Shunt current at:					
No load	0.12	0.21	0.29	0.3	0.8
Full "	0.06	0.12	0.18	0.3	0.6
Output in hp. at:					
Full load	2.9	3.15	3.2	3.3	3.2
Half "	1.4	1.74	1.75	1.75	1.75
Efficiency in % at:					
Full load	66	72	73	74	73
Half "	59	71	74.5	76	74
Temperature rise in armature after 2 hrs. at full load in closed housing in ° C.	50	...	...	...	45

The modification of this scheme of connection for single and two-phase motors may be easily figured out from the foregoing, as the new drum winding is treated the same as a ring winding having the same number of coils.

In comparing the induction motor with pole variation with a direct-current motor with shunt regulation, the most striking difference in the methods of regulation lies in the fact that the induction motor operates with about the same magnetic flux in the air space no matter what the number of poles may be, and at the higher speeds, therefore, will insure greater output and higher efficiency; while the speed of the direct-current motor can only be increased by decreasing the magnetic field, which makes greater output and higher efficiency impossible. In the method of operation an induction motor with two-pole variations would correspond to a direct-current motor with two commutators which may be connected in series or parallel, or a combination of several direct-current motors. These two methods, however, would entail costly and complicated constructions when compared to the shunt regulation and pole variation.

Old Time Telegraphic History.

The following account of a precious telegraphic collection now at Cornell University has been communicated to us for publication. As might be expected in this connection, the old controversy concerning the invention of the telegraph crops out, but it does not appear that any new light is thrown on the subject. It may be well to recall here that in 1895 the *Electrical World,* with a view to placing on record in a complete and systematic manner the evidence pro and con relating to this historic controversy, opened its columns to representatives of the Morse, Vail and Henry families, and also invited contributions to the subject of the invention of the electromagnetic telegraph from several of the principal telegraphic authorities of the world. The result was a series of articles, aggregating sufficient matter to fill an octavo volume. Mr. Stephen Vail maintained the claims made for Alfred Vail, Mr. Edward Lind Morse gave testimony for Samuel F. B. Morse, and Miss Mary A. Henry set forth arguments in favor of Professor Joseph Henry. Other contributors to the discussion were the late Franklin L. Pope, Mr. Francis W. Jones, electrical engineer of the Postal Telegraph Company; Herr Adolph Prasch, engineer of the German State Telegraphs; Mr. J. J. Fahie, of England, historian of the telegraph, and Mr. A. M. Tanner, of Paris, France, well known as an authority with respect to priority of inventions.

The discussion was closed by a rejoinder from each of the principal parties to the controversy. In view of the exceptional competency of the several participants in the discussion, their command of original sources of information and the thorough manner in which every issue was covered, this contribution to the subject may reasonably be considered a finality as a record of evidence and statement and criticism of claims. The following editorial summing up of the discussion is reprinted from the *Electrical World* of December 28, 1895:

"In our issue of last week the series of articles on 'The Invention of the Electromagnetic Telegraph' was brought to a close, thus completing what may be truly considered one of the most valuable contributions yet made to the history of a great subject. What conclusion may be drawn from the discussion depends entirely upon what meaning is given to the word 'invention,' as used by the various writers. To the reader of the series it is needless to say that it has been employed in a number of senses, which necessarily follows from the wide scope of Morse's activity and the many elements contained in the telegraph. The title of the series is in itself somewhat of a misnomer, as the claim for Morse of the broad title of 'The Father of the Telegraph' forms, directly or impliedly, no small part of the discussion. The various matters considered, in fact, include the conception of the idea of the transmission of intelligence by electricity, the invention of the first practical apparatus for the accomplishment of the idea, and the relative credit to be assigned for the various elements entering into that apparatus, aside from its special mechanism.

"Taking up the latter point first, it would seem to have been somewhat needlessly introduced, for if special credit is conceded in one instance it can be claimed in endless succession in others. Claims for participation in the invention of the telegraph based merely upon the inclusion of the electromagnet as one of its parts are not stronger than would be similar claims for the primary battery also employed by Morse. As credit for the battery would have to be apportioned to all who had part in its development, from Volta onward, so would that due on account of the electromagnet have to be divided with Sturgeon, and in the same category would come other elements of the apparatus.

"Secondly, as to the priority of conception of the idea of the transmission of intelligence by electricity, it is scarcely necessary to consider at length the claims made for Morse in this connection. Herr Petsch quotes Wheatstone as saying in 1838, that he had then gathered the names of 62 claimants to the invention of the electromagnetic telegraph. Leaving aside, however, the numerous early speculations on the subject, it is to be noted that Sommering, in 1809, actually constructed an electric telegraph, though an utterly impracticable one; Ampere, in 1820, and Schilling, before 1832, proposed definite forms of electromagnetic telegraphs, though impracticable of execution; in 1831 Henry in America, and a year later, Gauss and Weber in Germany, had in operation electromagnetic sound telegraphs that did not differ in fundamental principle from that in use to-day, though, as devised, impracticable of commercial application. The claims of Morse date from the year of the latter experiments, but it was not until four years later that his ideas took definite shape, which was also the same year in which Cooke took the Schilling telegraph to England in order to develop it. In 1840 the Cooke and Wheatstone telegraph was first operated, and is to-day largely used in Great Britain. The Morse telegraph was first commercially operated in 1844, and is the telegraph of to-day, though in a modified form and with what the inventor perhaps considered its most important feature omitted—the writing mechanism.

"We now come to the most difficult question involved in the discussion—the invention of the apparatus itself. That the main principles of the electromagnetic writing telegraph as completed were the conception of Morse alone, cannot, we believe, be denied, and of the three men who assisted in making it commercially practicable two—Henry and Gale—never claimed to have rendered any inventive assistance, their services having consisted in giving advice with respect to scientific details having no connection with the system considered as an invention. The claims for Alfred Vail are, however, of a different character, relating, as they do, to the invention of the dot-and-dash alphabet, and the design in great part of the operative details of the apparatus as finally commercially perfected.

"As to the claim with respect to the former, it was bitterly repudiated by Morse. Morse's unquestioned prior invention of an ingenious sign code for the same purpose is presumptive evidence in his favor; the alphabet was patented in Morse's name, and in a book written by Vail several sentences occur which, unless a most improbable construction is placed upon their meaning, specifically indicate Morse as the inventor, and with no qualification implying that the writer had any share in the invention. The only independent evidence against this is the testimony of one person, and rests upon his recollection a half century later of what occurred when he was a lad of fifteen. As to the part played by Vail with respect to the mechanical details of the perfected apparatus, the great changes introduced after he became connected with the matter in 1837, together with what is known to have been his skill in mechanism and the acknowledgment by Morse himself of valuable aid received, all indicate that no small measure of the successful execution of the apparatus was due to him. It is possible that if Vail had not been called in, the Morse telegraph might not have been perfected in time to win the honor of having played the leading part in converting the world to telegraphy, and perhaps might even have been perfected independently of Morse.

"Giving to Alfred Vail the largest possible meed of credit does not, however, detract from the honor of Morse as the inventor of the essential features of the system, for were credit for all the details, including the dry stylus, accorded to Vail, Morse would yet occupy a similar position with respect to electromagnetic telegraphy that Bell does to telephony, though, of course, with no such exclusive claims for originality. Even if the credit due to Morse for the invention of the system of telegraphy with which his name is associated were restricted to the minimum fixed by those who oppose the claims made for him, he would yet stand out the greatest figure in the pages of telegraphic history, and, it may be added, though perhaps foreign to the present subject, always remain one of the most inspiring examples of indomitable perseverance in the championship of an idea that America has yet produced."

The library of Cornell University has recently secured by purchase, with income from the Sage endowment fund, an interesting collection of original letters and documents relating to the early history of the telegraph. There are five quarto manuscript volumes and a sixth volume of printed telegraph blanks, forms, announcements, etc., entitled "Old Time Telegraph History," collected by Mr. John Horn, of Montreal. The arrangement is rather unsystematic, but with about 250 portraits and biographical sketches of early discoverers and experimenters in electricity, including Volta, Galvani, Mesmer, Wheatstone, Ampere, Ohm, and letters of Morse, Gale, Vail, French, Rogers, Wood, Cornell, Pell, House, Hughes, and others, the collection possesses much interest and represents the expenditure of considerable time and labor.

Mr. Horn was one of the early telegraph operators but more lucrative opportunities led him to devote his energies to other fields, and he is now enjoying the reward of well directed activities. He made some premature ventures into the field of journalism. In 1880 he mailed two hundred circulars announcing the *Canadian Telegraph Journal*, and received one subscription of $1 for six months, when he concluded that "the time had *not* arrived for regular publication of the proposed organ." He was editor of the *Canadian Electrical News*, published at Montreal in 1884, but that paper lived only six months.

The telegraphers electrical ball was a great event in New York City on January 24, 1868. Mr. Horn was the president. The dances were announced by the original Morse (or Vail) sounder, now in the National Museum at Washington, in a language mysterious to all but telegraph men. On this occasion the electric arc light was first used to illuminate a ballroom. The battery which furnished the current weighed a ton, and several days were required to prepare it for use. Carbon electrodes were used, and also metal electrodes to give colored lights by metallic deflagration.

Prof. S. F. B. Morse was born in 1791 and died April 2, 1872. Whether he was the original inventor of the apparatus which bears his name, and which to-day in the opinion of those who control the telegraphic communication of this country, is the best for practical use, Prof. Morse was the first to establish a commercial line in this country. The story is that the invention was conceived during a voyage home on board the *Sully* in 1832 and resulted from conversations with passengers discussing recent discoveries in electricity.

The first recording apparatus was made in 1835, but the whole plan of a telegraph was not completed until 1837. It was operated over two or three miles of wire at Morristown, and this is the story of it as told in the local newspaper:

"The telegraph consists of four parts. 1st. The battery, a Cruikshank galvanic trough of sixty pairs of plates, seven by eight and a half inches each. 2nd. The portrule, an instrument which regulates the motion of the rule. The rule answers to the *stick* of the printers, and in it the type representing the numbers are passed beneath the lever which closes and breaks the circuit. 3rd. The register, an instrument which receives and records the numbers sent by the portrule from any distant station. 4th. A dictionary containing a complete vocabulary of all the words in the English language regularly numbered. The communication which we saw made through a distance of two miles was the following sentence: 'Railroad cars just arrived, 345 passengers.' These words were put into numbers from the dictionary; the numbers were set up in the telegraphic type in about the same time ordinarily occupied in setting up the same in a printing office." The time of transmission was about half a minute.

On June 24th, 1838, the first private exhibition was made in the Geological Cabinet of New York University, Washington Square. The apparatus at that time was entirely different from that used on the later Morse machine. There was no "Morse Key" and the recorder was a mechanism carrying a pencil point which made v-shaped marks on a moving strip of paper. Only numerals could be sent, as there was no telegraph alphabet of dots and dashes.

On the 24th of February, 1843, the Hon. John P. Kennedy, of Maryland, moved in Congress the consideration of a bill to appropriate $80,000 to be expended under the direction of the Secretary of the Treasury for testing the merits of the telegraph. Hon. Cave Johnson, of Tennessee, moved an amendment that one-half the sum be given to a lecturer on mesmerism then in Washington, for trying experiments on mesmerism under direction of the Secretary of the Treasury. The Hon. J. White, of Ohio, ruled the amendment in order because "it would require a scientific analysis to determine how far the magnetism of mesmerism was analogous to that to be employed in telegraphs." But in February the bill passed the House 89 to 83, and finally in the Senate.

When the first line, between Washington and Baltimore, was completed, Miss Annie G. Ellsworth, the daughter of the Hon. Henry L. Ellsworth, Commissioner of Patents, who communicated to Prof. Morse the news of the passage of his bill, wrote the historic message, "What hath God wrought." This message was sent by Prof. Morse from Washington at 8.45 A. M. on Friday, May 24, 1844.

There is a specimen of the embossed Morse tape preserved in these volumes, part of a message sent by Prof. Morse's own hand from Secretary of the Treasury Bibb to Henry J. Rogers, Assistant Superintendent of United States Telegraph Lines, at Baltimore, April 28, 1846.

The reading of telegraph messages by sound was early attained by operators in this country, although it is but little practised in Europe even now. The Hon. Elijah Paine suggested to Prof. Morse the use of an organ pipe. Prof. Morse replied, July 13th, 1844, that the idea was feasible and stated that he had already used two bells of different tones and adds: "Indeed, I now often read by the sound of the lever without seeing the instrument."

The first public telegraph office in the United States, the Morse line being regarded as experimental, was opened by Messrs. Vail and Reid at Philadelphia in November, 1845. The Magnetic Telegraph Company was the first commercial company, and its line between Philadelphia and Washington was completed in June, 1846. Mr. James D. Reid was the first General Superintendent of Telegraphs.

Telegraph business was apparently not conducted with any greater speed in those days than it is now, for as one glances over the old copies of messages written by Prof. Morse, many of them are embellished with pen sketches of cadaverous heads or skulls. The artist-professor must have possessed grewsome humoristic proclivities, for the design of his prank can only suggest "dead head."

An original letter from Prof. Morse to Cyrus W. Field, delegate to the Telegraphic Convention at Rome, in 1871, contains these words, which seem worthy to be recalled:

"Could there not be passed in the Great International Convention some resolution to the effect that in whatever condition, whether of peace or war between nations, the telegraph should be deemed a sacred thing, to be by common consent effectually protected both on the land and beneath the waters?"

"In the interest of human happiness, of that 'peace on earth' which in announcing the advent of the Saviour, the angels proclaimed with 'good will to men,' I hope that the convention will not adjourn without adopting a resolution asking of the nations their united effective protection to this great agent of civilization."

Prof. Morse's claims to honors and fame as inventor of the electric telegraph have been much disputed, and these volumes contain letters from several of his contemporaries which bear strongly upon this contention. Dr. Charles T. Jackson, of Boston, a man of high attainments in his profession, the discoverer of the anæsthetic use of ether, and a geologist of note, was a passenger on board the *Sully* with Prof. Morse. In a number of letters dating from 1863 to 1872 he steadfastly claims that Prof. Morse got his ideas on that voyage from him. He asserts that Prof. Morse copied in his note book drawings made by himself, and that while he was bringing over an electro-magnet with two batteries and 1,000 yards of insulated wire, Prof. Morse did not know what an electro-magnet was. In the first letter Prof. Jackson writes:

"As to my connection with the invention of the electro-magnet recording telegraph I would say that the idea of the plan originated with me and was by me communicated to my fellow passenger, Samuel F. B. Morse, Esq., a painter, who took much interest in it and followed me up pretty closely both on board ship and after my arrival in New York. * * * * * * * * * * * * * * * * * I think he did me great injustice, but still I have always been willing to allow him great credit for his mercantile enterprise in getting the government to help him to test the invention between Baltimore and Washington and for causing by his applications, others to make improvements upon my original method; for I have learned that he made no improvement upon it himself. Dr. Gale, Mr. Vail and some instrument makers seem to have effected the improvements for him. * * * * * * * * * * * * * Posterity, I hope, will do me justice, and the evidence of my claims is in print here and in Europe. I am sorry for Mr. Morse, for 'he who does wrong is in the end the greatest sufferer.'"

In those days the Atlantic cable project had few friends and many enemies. Dr. Jackson was confident concerning a proposal which seems rather bold even in these days. He wrote: "We should permit no telegraph between here and England except through the Empire of Russia, and that is by far the most practicable and is sure to be completed in a few years."

The Hon. Harrison Gray Dyar, of New York, is said to have been the first to successfully telegraph legible signals. If this is true, and the fact seems well attested, he antedated Prof. Morse by nearly ten years. About 1826-7 he was engaged with others projecting a line between New York and Philadelphia, but owing to difficulties and annoyances of various kinds, he abandoned the enterprise.

In a letter dated January 17th, 1872, replying to a request for a statement of his experimental work on the telegraph, he writes: "I have no desire to be presented in any way as one more wishing to claim credit of any kind therefor."

But the records of the United States Supreme Court in the case of the Morse partners against the House Telegraph Company, indicates that Mr. Dyar is deserving of recognition as a pioneer in this field. The record reads:

"But the most surprising discovery on the subject about this period was by Harrison Gray Dyar, another enterprising American. In 1827 or 1828 he is proved by Cornwall to have constructed a telegraph on Long Island at the race course by wires on poles, using glass insulators. Dr. Bell fortifies this statement, having seen some of his wires and understood its operation to be a spark, sent from one end to the other, which made a mark on paper prepared by some chemical salts. * * * * * * * * * * *

"He used common electricity and not electro-magnetism, and but one wire which operated by a spark, which, after going through the paper chemically prepared, so as to leave a red mark on it, passed into the ground without a return circuit."

This is an exceedingly interesting paragraph. It apparently relates to the first recorded use of the ground return, the practicability of which is supposed to have been originally discovered by Steinheil in 1837. It is also remarkable that this first telegraph line should have been operated without electro-magnets, making a record on chemical tape, because, after all these years, this is precisely the method, only recently perfected, however, which represents the latest development of telegraphy.

Alfred Vail was associated with Prof. Morse in the development of his apparatus at Morristown, N. J., and later on the Washington-Baltimore line.

The original recording instrument used on that line in 1844, now in the National Museum, once had a paper attached to it bearing the following inscription signed by Alfred Vail: "This lever and roller were invented by me in the sixth story of the *New York Observer* office in 1844, before we put up the telegraph line between Washington and Baltimore, and the same has always been used in Morse's instrument. I am the sole and only inventor of this mode of telegraph embossed writing. Prof. Morse gave me no clue to it, nor did any one else, and I have not asserted publicly my right as first and sole inventor because I wished to preserve the peaceful unity of the invention, and because I could not, according to my contract with Prof. Morse, have got a patent for it."

In a letter to President Adams, of Cornell University, October 18th, 1888, Mrs. Amanda Vail writes:

"We keenly felt the injustice and (I might add also) ingratitude of Prof. Morse. After his decease, from time to time, I received letters from parties who had been associated with the telegraph soliciting the privilege of examining his (Alfred Vail's) papers, with a view to publication, but my confidence in Prof. Morse's assertions that he should write the history of the telegraph and do justice to Mr. Vail and not to allow *anyone* access to his papers, induced me to decline these requests. But an awakening came on the evening of 10th of June, 1871, as I sat in the Academy of Music, New York, and saw Prof. Morse "telegraph around the world" on Mr. Vail's original instrument, which I had taken from the cabinet, where he had so long before placed it, and which (by request) I had loaned for this occasion, and from which I had reluctantly torn that paper (see Mr. Pope's article) and then for the first time read, "I am the sole and only inventor of this," etc., and then address that vast audience with a mere allusion to Alfred Vail's financial aid." * *

Referring to a work, "The Great Industries of the United States," an article on the telegraph by Lyman W. Case, the writer, thus tells of its effect on Prof. Morse: 'I am a living witness of the effect of this article upon Prof. Morse, when visions opened up to him of receding glory. He sent for me and on his dying bed, with the fore finger of his left hand raised and moving to give expression to his words, he said, 'The only thing I want to do now is justice to Alfred Vail.' It was too late."

Mrs. Vail further relates that Mr. F. O. J. Smith, who gave Prof. Morse the first financial aid to prosecute his experiments, presented Mr. Vail's claims to recognition in a pamphlet entitled "History Getting Right on the Invention of the Magnetic Telegraph," a copy of which is preserved in these volumes, and at the time of his death had completed a work, "A Colloquial or Truthful History of the Telegraph," but when persons who had assisted in its preparation called on his family and executors for the manuscript it had mysteriously disappeared and had never been found.

She also says that Dr. Prime suppressed from his biography of Prof. Morse a chapter on Mr. Vail's connection with the telegraph, written by Mr. Smith by request.

There are several letters from the founder of Cornell University, Ezra Cornell. In one dated November 6th, 1871, he says: "It is true that I know much of the early history of the telegraph, which has not been published, and as it would not harmonize with the laudation of Prof. Morse, now so popular, I have thought perhaps it is not best to hurry it up for public attention." In a later communication he tells the story of the first telegraph line.

"Prof. Morse decided to lay the line from Washington to Baltimore, and let the contract to F. O. J. Smith, of Portland, Me., for placing the leaden tube containing the conductors in the earth two feet below the surface between those cities at a cost of $100 per mile. On investigation Smith found that it would cost him much more than $100 per mile to execute the contract and sought means to cheapen the cost of doing the work. At this juncture of the enterprise he appealed to me for aid. I invented a machine and built it for him by which the pipe could be laid at about $10 per mile. Smith engaged me to go to Baltimore to take charge of the work of laying the pipe by the machine. * * * * * * * * * * * While visiting the works where the pipe was made with Prof. Morse, I noticed defects in the pipes which I thought would render them useless." But Prof. Morse said his assistant, Dr. Fisher, had tested them and refused to consider it. I received the pipe at Baltimore and laid it with the machine beautifully. The pipe proved defective and worthless, as I had foreseen, and Prof. Morse proved the defects in the first mile of pipes laid. Before he discovered the defects, however, I had got the pipe laid as far as the Relay House, ten miles from Baltimore, and then I broke the machine for laying the pipe purposely, and to conceal from the public the failure of Prof. Morse's plans for working the telegraph.

"At the Relay House Prof. Morse convened his assistants and contractors, Smith, Gale, Vail and Fisher, and canvassed the situation, which appeared as follows: $22,000 of the appropriation expended, $8,000 only remaining, work all a failure, the wires only of value in further prosecuting the enterprise, and they in the lead pipe, where they could not be used. Prof. Morse and his three assistants, drawing salaries from the fund at the rate of $6,500 per annum."

The result was that Messrs. Gale and Fisher resigned and Mr. Cornell finished the line alone.

There is a specimen of the tape of the rapid automatic telegraph devised by Mr. George Little, and for a time operated by the American Automatic Telegraph Company. The perforations are square and rectangular. It recalls an interesting bit of telegraph history. In July, 1869, Mr. William Orton, president of the Western Union Company, made a report to the stockholders to the effect that a new telegraphic bubble was to be floated, having for the inflating power a wonderfully rapid means for transmitting dispatches by the automatic process. He declared that the Western Union had discarded it as totally impracticable after thorough and exhaustive trials.

In the following year the chief electrician of the Western Union officially reported that he had proved the utter impossibility of attaining by any known means a greater speed than fifty to sixty words per minute automatically on 100 miles of line. But the same year the editor of the *Scientific American* declared that he had in his possession a perfectly legible communication by the American Automatic system sent at a speed of 100 words per minute from Washington to New York, 280 miles.

In 1873 Mr. Orton conceded that the American Automatic system would send an equivalent of about 36,000 words an hour, over 300 miles of line, with one wire, which would require eight Western Union wires and sixteen expert Morse operators.

The Cornell Library has a valuable collection of works on the telegraph in what is known as the Morse collection, being the works collected by Prof. Morse and presented to the library by Ezra Cornell. Many of them contain Prof. Morse's annotations.

The Armature Reaction of Alternators—X.

(Concluded.)

By C. F. Guilbert.

PREDETERMINATION OF LOAD CHARACTERISTICS.

We shall now proceed to apply our diagram to the Paderno alternator of Brown, Boveri & Co. The published results of the tests made of this generator unfortunately do not comprise the wattless-current characteristic, and we are, therefore, limited to the short-circuit characteristic in the determination of the armature leakage e.m.f. and in calculating the armature counter ampere-turns by the formula previously given. The e.m.f. thus obtained will be somewhat greater than would be derived from the wattless-current characteristic, but it will be reduced about 20 per cent. to take count of the influence of the reluctance on the normal flux. If it were a case of the predetermination of the load characteristic for a small power-factor, this method of reducing the leakage e.m.f. from the short-circuit characteristic would be objectionable; it is, however, applicable in the present case, where the power-factor does not go below 0.8.

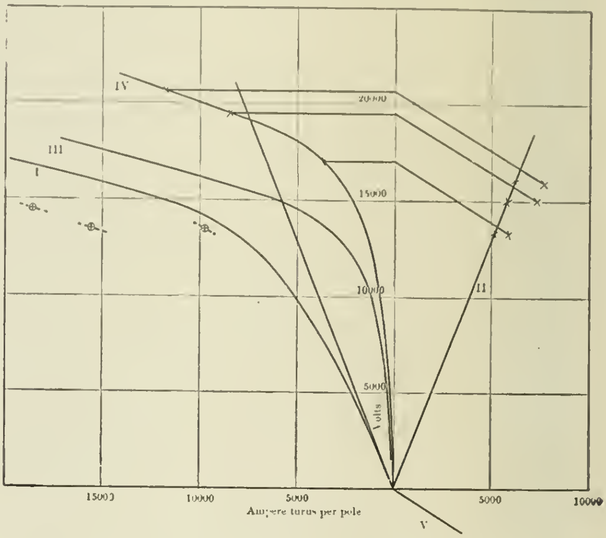


FIG. 1.—ARMATURE AND FIELD CHARACTERISTICS.

The accompanying table gives the different dimensions and data of the alternator here considered, as well as the excitations at no-load and under load. To calculate the armature m.m.f. we have expressed in ampere-turns, the following:

$$F_i = .608 \times N_1 I_0 \frac{a}{b} \sin\frac{b}{a} \cdot \frac{\pi}{2} \sin\psi.$$

Since we can consider $a = b$, $F_i = .608 \times 30 \times 60 \times 1.414 = 1{,}550$ ampere-turns. Assuming the ratio $\frac{r}{R_a}$ to be .03 in short circuit, we will have for the inducing m.m.f. necessary to counterbalance the induced m.m.f. $1{,}550 \times 1.03 = 1{,}600$ ampere-turns.

For the calculation of the leakage e.m.f. the table gives an exciting current of 39.2 ampere-turns corresponding to a number of ampere-turns equal to $39.2 \times 72.5 = 2{,}840$. The difference, $2{,}840 - 1{,}600 = 1{,}240$, corresponds to a leakage e.m.f. of 2,600 volts, or 18 per cent. We will adopt the value of $\frac{18}{1.2} = 15$ per cent.

Next will be taken up the determination of the armature and gap characteristic. The saturation being quite low, the armature characteristic comprising, as we have previously stated, the armature, the gap and the part of the pole pieces traversed for the useful flux, will be a straight line.

Apparent power in kilovolt-amperes		1,500
Power factor, minimum		0.8
True power in kw for minimum power factor		1,200
Nature of currents		3-phase
Terminal voltage		14,500-13,500
Voltage per phase		8,400- 7,800
Current in amperes per phase		60
Revolutions per minute		180
Frequency		42
Field-pole pieces laminated and of rectangular cross-section		
Pole-cores of cast-steel and circular cross-section.		
Number of poles		28
Diameter of field at pole faces	cm.	408
Dimensions of pole pieces	cm.	52x25
Surface of pole pieces	cm².	1,300
Diameter of pole cores	cm.	30
Cross-section of pole cores	cm².	705
Armature of cast steel.		
Armature exterior diameter	cm.	336
Armature interior diameter	cm.	280
Width of armature frame	cm.	47
Number of armature coils		28
Number of turns per coil		73
Number of field circuits in parallel		1
Dimensions of ribbon, field winding	mm.	32x3
Cross-section of ribbon, field winding	mm².	96
Air gap	mm.	10
Armature bore	cm.	410
Radial depth of armature laminations	cm.	30
Exterior diameter of armature frame	cm.	515
Interior diameter of armature frame	cm.	475
Total width of armature frame	cm.	55
Number of perforations (tunnels) per pole		3
Diameter of perforations	mm.	6.5
Number of coils or bars per phase		14
Series grouping.		
Number of turns per coil		30
Number of conductors per tunnel		30
Diameter of conductors	mm.	6
Cross-section of conductors	mm².	28.3
Resistance of armature per phase	ohm	0.9
No-load exciting current	amperes	145-120
Exciting current for normal short-circuit current	amperes	39.2
" " $\cos \varphi = 1$; 13,500 volts; 64.5 amp		135
" " $\cos \phi = 0.8$; 13,500 volts; 70 amp		215
" " $\cos \phi = 0.8$; 14,500 volts; 73 amp		256

Fig. 1 represents at *I* on the left the no-load characteristic; this characteristic will serve, the armature characteristic being calculated, to determine the characteristic of the field alone. To determine the armature characteristic it suffices to have a single point. The no-load e.m.f. is given by the formula,

$$E = k \times f \times N_1 \times 2p \times \phi \times 10^{-8}.$$

The form factor k can here be taken at 2.48 which, it may be added, is the figure given by Arnold. For 1,450 volts, or 8,400 volts per phase, the necessary flux will then be

$$\phi = \frac{8{,}400 \times 10^8}{2.48 \times 45 \times 30 \times 28} = 9.6 \times 10^6.$$

The mean induction over all the surface occupied by an armature pole is then $\mathfrak{B} = \frac{9.6 \times 10^6}{50 \times 46} = \frac{9.6 \times 10^6}{2{,}300} = 4{,}200$. The mean gap supposed to include all the surface of one pole is given by the formula $\frac{46 \times 50}{e} = \frac{25 \times 50}{1} + \frac{4}{\pi} \; log\left(\frac{\pi}{2} \frac{h}{e} + 1\right) \times e_1$, where e is the mean gap, e_1 the real gap under the pole and h the extent of the spreading ($h = 9\ cm$); from this we deduce $e = \frac{46}{25 \times 3.56} = \frac{46}{28.56}$ $= 1.62\ cm$. The number of ampere-turns is then $\frac{4{,}200 \times 1.62}{1.26} = 5{,}400$.

For the armature, the teeth and the pole pieces one can count on about 200 ampere-turns, which make a total of 5,600 ampere-turns. This figure permits us to lay down the armature characteristic *II* on the right of the figure, and from it to deduce with respect to the no-load saturation, the curve *III*. To obtain from this last the field characteristic proper, it suffices to multiply the ordinate of curve *III* by the corresponding values of the Hopkinson coefficient. We will assume that this coefficient remains constant and we will calculate it for the value of the no-load flux. For this purpose we will first determine the permeance of the leakage circuits corresponding to a single pole. The permeance of the leakage circuit between two polar cores is, employing a simple formula given by Wiener,

$$P = 2 \frac{\pi\, l\, a}{c + .3\, d}$$

l being the depth of the core, d its diameter and c the mean maximum distance between two neighboring cores. We have here $l = 27\ cm$, $d = 30\ cm$ and $c = 11\ cm$, whence

$$P_1 = \frac{2\pi \times 27 \times 30}{9 \times 9} = 285.$$

Between the sides facing the pole spread we have a permeance

$$P_2 = \frac{4 \times 52 \times 9}{21} = 90;$$

finally, between the sides not facing, the permeance is

$$P_3 = \frac{4 \times 12.5 \times 9}{21 \times 125 \frac{\pi}{2}} = 10.$$

The total permeance is thus $285 + 90 + 10 = 385$, or say, 400. The Hopkinson coefficient has consequently the value

$$v = \frac{9.6 \times 10^6 + 5{,}600 \times 400}{9.6 \times 10^6} = 1.24.$$

The field characteristic is represented by *IV* in Fig. 1. We can also represent by v the straight line corresponding to the field leakage, which should be such that for same m.m.f. the ratio of the leakage flux to the armature flux is .24.

We are now prepared to calculate with aid of the diagrams and curves the excitation corresponding to different loads. The first case will correspond to a terminal voltage of 13,500, 64.5 amperes per phase and a power factor of .8. If we admit that the resistance of the armature, including therein the effect of foucault currents, is in the neighborhood of 2 ohms per phase, the corresponding ohmic drop will be about 200 volts. The voltage diagram (Fig. 2) is then easily constructed. We have $O\ A = 13{,}500$; $A\ B = 200$; $B\ C = 2{,}170 \times \frac{64.5}{60} = 2{,}300$. The flux actually traversing the armature corresponds to a voltage $O\ C = 13{,}900$, which requires for the armature and the gap a m.m.f. of $O\ C_1 = 5{,}350$ ampere-turns.

If we next draw parallel to $B\ C$ a vector, $C_1D = 1{,}650 \times \frac{63.5}{60} = 1{,}750$ ampere turns (the value of the ratio, $\frac{r}{R_a}$, with respect to the normal flux has been taken at .07), the resulting m.m.f. is then $O\ D = 5{,}900$ ampere-turns, and the difference of magnetic potential between the horns is $O\ E = 5{,}100$ ampere-turns and corresponds to useful flux from the field capable of inducing an e.m.f. of 13,250 volts. Adding to this flux the field leakage for 5,900 ampere-turns, as obtained from the construction before given, we have for the field a m.m.f. of 3,700 ampere-turns. We have thus a total of $5{,}900 + 3{,}700 = 9{,}600$ ampere-turns. The exciting current is then $\frac{9600}{72.5} = 132$ amperes. The value obtained on test was 135 amperes.

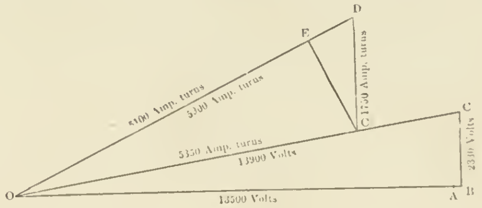


FIG. 2.—VOLTAGE DIAGRAM.

The second case corresponds to a terminal voltage of 13,500, a current of 70 amperes per phase and a power-factor of .8. The voltage diagram (Fig. 3) gives an armature voltage of $O\ C = 13{,}500$. We have $O\ C_1 = 5{,}950$ ampere-turns and $C_1D = 1{,}910$ ampere-turns, whence $O\ D = 7{,}400$ ampere-turns and $O\ E = 5{,}800$ ampere-turns. This last quantity gives by the construction indicated a m.m.f. of

8,400 ampere-turns for the field. The total m.m.f. is then 7,400 + 8,400 = 15,800, and the corresponding exciting current is $\frac{15800}{72.5}$ = 218 amperes instead of 215, the value obtained on test.

In the third case, the terminal voltage is 14,500, the current per phase 73.5 and the power-factor .8. The voltage diagram (Fig. 4) gives an induced voltage of $O\ C = 16{,}300$ volts. We have $O\ C_1 =$ 6,300 ampere-turns and $C_1D = 2{,}020$ ampere-turns, whence $O\ D =$ 7,800 and $O\ E = 6{,}150$ ampere-turns.

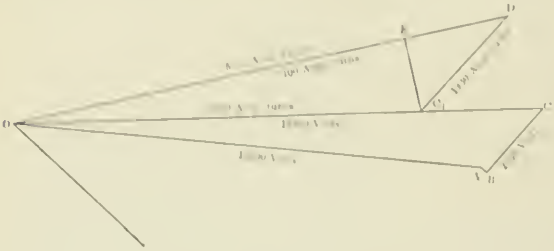


FIG. 3.—VOLTAGE DIAGRAM.

This last quantity gives by the same construction a m.m.f. of 11,700 ampere-turns for the field. The total m.m.f. is then 7,800 + 11,700 = 19,500, and the corresponding exciting current is $\frac{19500}{72.5}$ = 269 amperes instead of 256 as obtained from test. The difference is here greater than in the preceding cases. It may be remarked, however, that in laying down on Fig. 1 the data, that the characteristic corresponding to a power-factor of .8 and 73.5 amperes appears to pass below that for 70 amperes. This seems to indicate a small error in the measurements for the case of 73.5 amperes, and we consequently think that the value calculated is as close to the real value as are the others.

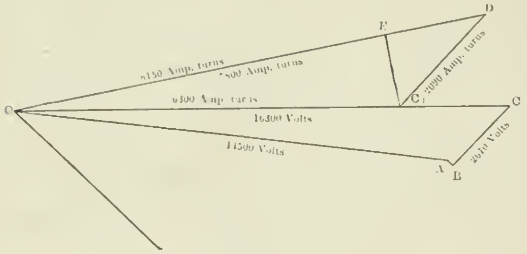


FIG. 4.—VOLTAGE DIAGRAM.

In conclusion, these numerical examples show the certitude that may be given to this method when it is employed with great exactitude; and we do not believe that there has thus far been indicated a method as exact and at the same time so easy of application. We shall be most happy if the method will be of some service to engineers.

Development of Telephony in New York City.

Incidental to the phenomenal growth of telephony lately in New York City, has necessarily been the creation of new exchanges by the New York Telephone Company. During last year we published an interesting article on this subject under the caption, "Housing a Modern Telephone Exchange," by Mr. Herbert Laws Webb, describing several of these exchanges in Greater New York; and within a few weeks an illustrated description was given also of the new Morningside exchange. Now follows the new Harlem exchange, which is virtually a duplicate of the Morningside, and which was opened December 27.

With the opening of this office, the Harlem district was enlarged by the transfer from Seventy-ninth Street of those subscribers within the block bounded by One Hundred and Tenth and One Hundred and Third Streets, Central Park and the East River. The district as it now exists consists of the block bounded by Lenox Avenue, Central Park, East One Hundred and Third Street and the Harlem River. The office is located in a four-story building erected for the purpose on a 50 x 100 foot lot, at No. 127 East One Hundred and Twenty-fourth Street.

The four floors of this building are arranged and used as follows: The top or fourth floor is one large room, which is used as the operating room. This floor, in order to allow the greatest possible amount of light and air, is designed with a high ceiling and with windows in the front, rear and one side of the room, and a skylight in the central portion of the ceiling. The room is kept supplied with fresh air by means of a ventilating plant, and the floor is covered with rubber tiling.

The third floor is devoted to the operators' quarters, and is subdivided as follows: In the rear of the building is the operators' sitting room, to which the operators may retire while not on duty at the switchboard. This is a room 14 x 32 feet, with windows on two sides. It is furnished with easy chairs, and newspapers and current magazines are kept on file for the use of the operators. Next to the sitting room is located the dining room. This room is 20 x 33 feet, and is furnished with a sufficient number of dining tables and chairs to seat one-third of the operating force. Large steam coffee and tea urns are provided in this room and coffee, tea and milk are served to the operators free of charge during the lunch periods. Next to the dining room and with a door opening into the hall, is the locker room. In this room lockers are provided in which the operators leave their hats, coats and lunches while on duty at the switchboard, and where they leave their individual transmitter and receiver sets when they go home. Sufficient locker equipment is provided to furnish one locker for every two operators.

In the front of the building on this floor is located the infirmary. This is a small room, 12 x 16 feet in size, to which the operators are taken in case of sickness. It is furnished with couches and easy chairs, and simple medicines are kept on hand for use in case of emergency. A large toilet room for operators is also provided on this floor. The floors of all the rooms in the operators' quarters, except the toilet room, are covered with linoleum. The toilet room floor is finished with white tiling. The second floor of the building is one large room, and is used exclusively for terminal room equipment. The ground floor is at present not occupied.

The following statistics may be given as to the switchboard and subscriber line equipment at this office:

Ultimate capacity of switchboard	7,200 lines
" number of "A" positions	46
" number of "B" positions	22
" number of operators to be employed	135
Present equipment	4,000 lines
" number of "A" positions	28
" number of "B" positions	12
" number of working lines	1,789
" number of working stations	2,506
" number of operators employed	59

We are indebted to Mr. Frank H. Bethell, contract agent, for the above data, and learn from him that on January 1 the New York Telephone Company had under contract no fewer than 105,388 subscribers.

Large Hydro-Electro Development in Connecticut.

Work has just begun at Bull's Falls, on the Housatonic River, three miles below Kent, Conn., on what is to be the largest water power plant in the State. A dam 200 feet long and 20 feet deep is to be constructed across the Housatonic and an immense water storage reservoir built. The water from this reservoir will be conveyed about two miles through a canal to the power house, where there will be a fall of 116 feet. This canal will be partly blasted through solid rock and will be 30 feet wide by 10 feet deep. The plant will generate 7,000 hp when run at its full capacity. The plan is to generate electricity to sell over a wide area of Western Connecticut for manufacturing purposes, town and city electric lighting and trolley and third-rail roads. The work involves the outlay of fully $2,000,000.

German Ozone Waterworks.

By Dr. Ig. Erlwein.

At the beginning of August the ozone waterworks at Schierstein, Wiesbaden, were handed over to the city authorities for operation. These are the first waterworks in Germany where ozone is electrically produced from air and employed on a practical scale as a sterilizing and at the same time oxidizing agent. The works at Schierstein were erected for the City of Wiesbaden by the Siemens & Halske Company. A report of the electro-chemical department of the Berlin works of this firm published in Schilling's *Journal für Gasbeleuchtung und Wasserversoryung*, 1902, No. 40, states that the plant was designed for a maximum capacity of 250 cubic meters of water per hour. It is, however, only for large demands of water that operation at full capacity will be necessary. For the usual demand the output need only be 125 cubic meters per hour; this leaves a reserve of 100 per cent. always ready.

The plant is divided into two independent units, each having its own machinery, ozone apparatus and towers. To guard against interruption of service the plant was designed so that the machinery of one-half can be substituted for the other, and by the simple closing of a switch the current generated by the dynamos of the first half can be led into the feed wires of the so-called reserve half. Also, the air or rather ozonized air systems of both halves leading to the two rows of towers can be interchanged.

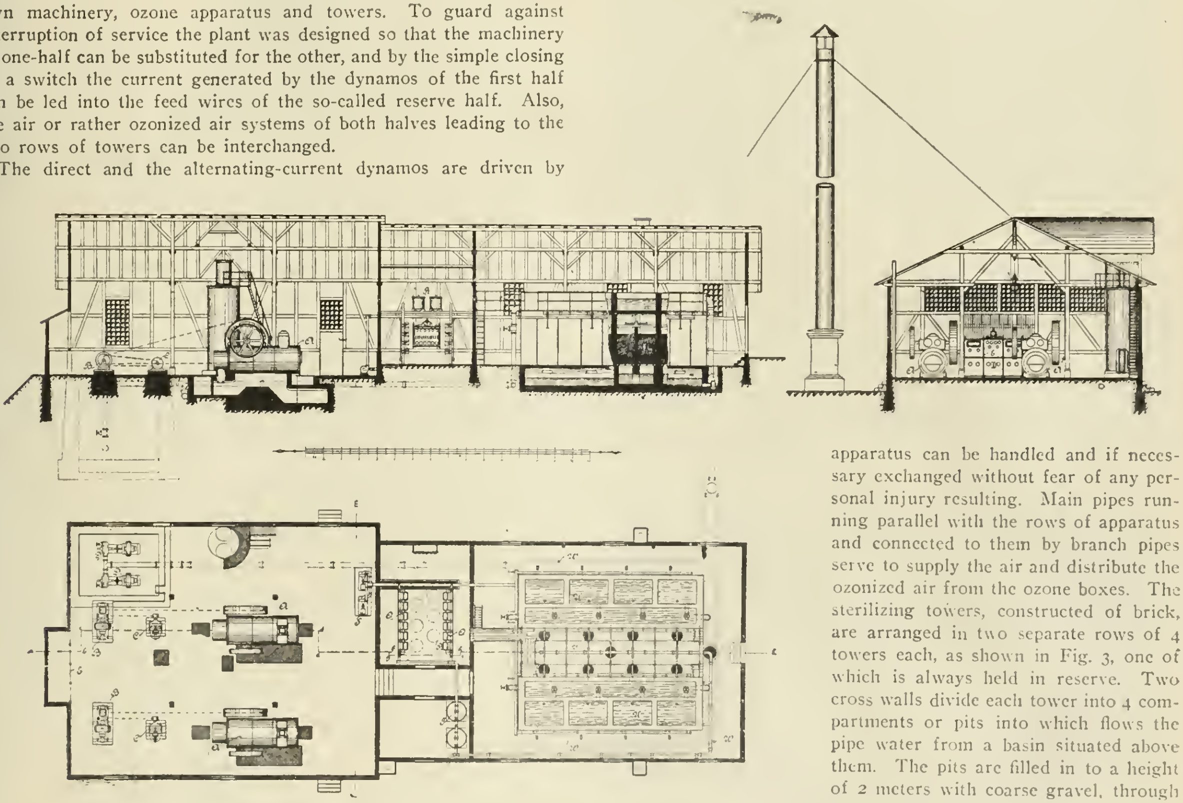


FIG. 1.—ELEVATIONS AND PLAN OF WIESBADEN OZONE WATERWORKS.

The direct and the alternating-current dynamos are driven by locomobiles; the first operating the motor-driven force pumps and the other supplying current for the transformers. The high-voltage coils of the transformers (about 8,000 volts) are connected with the ozone apparatus, the ozonized air from which is forced into the towers. Here, in rising, it comes in contact with trickling water, is partly absorbed and performs its sterilizing function. The clean water flows into collecting wells and from there on to the high reservoir.

The plant covers a ground area of 510 square meters, and as shown in Fig. 1, is divided by walls into a machine room, ozone apparatus and transformer room, and room containing the sterilizing towers. The machine room contains two 60-hp Wolf locomobiles, 2 direct and 2 alternating-current generators, 2 electrically-driven centrifugal pumps, and 2 blowers for the air of the ozone apparatus. The ozone apparatus room is two stories high, contains 48 ozone units, which are divided into two groups by a passageway. Each half, therefore, contains 24 units arranged in four rows, as shown in Fig. 2, and connected with the high-tension side of a transformer in groups of eight. The ozonized air produced by this group of eight ozone apparatus is delivered to one sterilizing tower.

The ozone apparatus employed are of the Siemens tube type (glass one side, metal on the other) with one side of the high-tension circuit grounded, because the discharging surface is water cooled. The ozone tubes are contained in a cast-iron box divided into three compartments; a completely enclosed inner compartment contains 8 ozone tubes tightly screwed in; an upper part acts as an air-distributing reservoir and a lower part forms the ozone-distributing reservoir. The upper chamber also contains the ungrounded terminal of the high-tension line, which is well protected from all contact. On the bottom of the lower part are placed the high-tension cylinders with their rod-shaped glass insulators; also a safety device against short-circuiting from in-leaking water. The cover, ro side and the bottom of the cast-iron case are of thick plate glass, so that the bluish light of the ozone tubes, a sure sign of the perfect working of the apparatus, can be immediately seen by the attendants on entering the usually dark room.

One terminal of the high-tension line being grounded and the ungrounded line and its connections being inaccessible, the ozone apparatus can be handled and if necessary exchanged without fear of any personal injury resulting. Main pipes running parallel with the rows of apparatus and connected to them by branch pipes serve to supply the air and distribute the ozonized air from the ozone boxes. The sterilizing towers, constructed of brick, are arranged in two separate rows of 4 towers each, as shown in Fig. 3, one of which is always held in reserve. Two cross walls divide each tower into 4 compartments or pits into which flows the pipe water from a basin situated above them. The pits are filled in to a height of 2 meters with coarse gravel, through which the water trickles down and comes in contact with the ozonized air, forced upward at a small pressure.

The water supply to each tower can be automatically shut off by an electrically-actuated conical valve, should the operation of its group of ozone apparatus be interrupted. Forty-two cubic meters of water flow through each tower per hour, while 80 cubic meters of air pass in an opposite direction during the same time. Underneath each tower is a basin for the filtered water, discharging by means of an overflow into a common collecting pipe leading to collecting wells and from these the water is pumped to a high reservoir.

To guard against interruption of service through some fault of the electrical apparatus, or should the air to the sterilizing towers be interrupted, appliances are installed to close, in each case, the valve of the water supply pipe leading to the towers. When the current supply is broken, a magnet releases a lever, thus closing the circuit operating the electrically-controlled valve. An accident happening to the blowers and shutting off the ozonized air, releases a flap valve, otherwise held suspended when operating, and thus completing the circuit and closing the supply of water. In both cases a bell rings and continues ringing until the fault is located or remedied. These simple and easily-controlled safeguards, make it, therefore, impossible for any water which has not been subjected to the sterilizing influence of the ozone, to enter the high pressure service

The power consumed by the plant is as follows: Each half has a capacity of 125 cubic meters of water per hour at about 50 hp, of which 27 hp is taken by the ozone apparatus; 22 hp is used by the electrically driven pumps and the balance is consumed by the air and blower system, boiler feed pump and feed water filter.

The cost of operation at Schierstein (on the basis of a 7.7 pounds of steam per pound of coal, at $5.00 per ton, and a capacity of 250 cubic meters per hour), working with Wolf condensing locomobiles, is .3 cent. per cubic meter of water. Of this the ozone production cost is .1 cent for coal. At this price, to which 4 per cent. interest and amortization (3/10 per cent.), amounting to .12 cent. are added, it must be taken into consideration that the Schierstein plant, owing to the fact that for particular reasons it could not be connected with an already existing waterworks, has pumping duties to perform which are not part of an ordinary ozone waterwork.

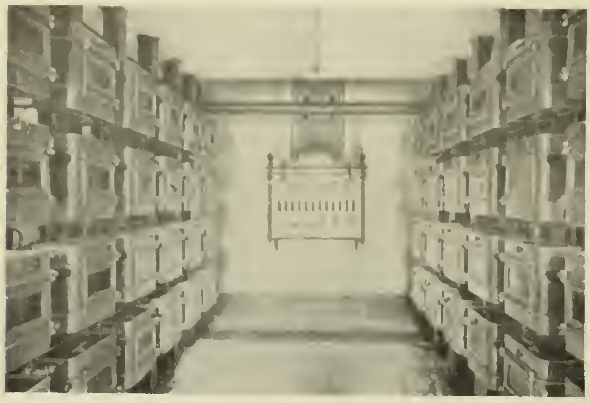


FIG. 2.—OZONE APPARATUS.

Extensive investigations of the bacteriological effects produced by the ozone plant were made at Schierstein during the operation tests by Pro. Proskauer and staff, Dr. Shüder, of the Institute (Koch) for Contagious Diseases, Berlin, and by the Fresenius Institute, which were altogether satisfactory. The results obtained by the above-named investigators verify the results already obtained in Martinikenfelde and those the Imperial Board of Health had also previously gained, namely, that ozone of the concentration as obtained by means of the Siemens apparatus and employed in sterilizing towers with suitable gravel filling, destroys all the bacteria of a pathogenic nature and almost all the water bacteria except a few resisting but harmless ones.

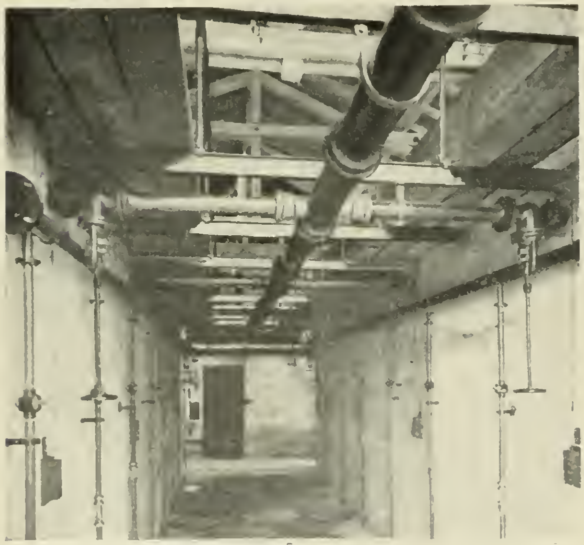


FIG. 3.—WATER-SUPPLY CONTROLLING VALVES.

As an addition to the above account of the ozone works at Wiesbaden Schierstein, brief mention may be made of the ozone waterworks at Paderborn, also erected by the Siemens & Halske Company, and which were placed in operation a month later. The sterilizing parts of the Paderborn plant are duplicates of those at Wiesbaden, except that the sterilizing towers differ a little in the employment of a cascade overflow (Fig. 4), by means of which the water is freed of all traces of ozone.

Reasons of a hygienic-prophylactic nature necessitate this treatment of the Paderborn well water. The ozone works have a capacity of 50 to 60 cubic meters of drinking water per hour. The plant operates 9 Siemens box type ozone apparatus (three being in reserve) with two sterilizing towers. The electrical part, consisting of direct and alternating-current machines, 2 blowers, 3 transformers and the automatic safety devices against interruption, is driven by a gas engine. The cost of operation at Paderborn is a trifle higher than at Wiesbaden; the amount of ozone per cubic meter is, however, on the other hand, less, so that the cost per cubic meter of water is about the same. Taking the cost of a hp-hour at Wiesbaden as a basis, the cost of a cubic meter of water, including interest and amortization, will be about .3 cent. With the establishment of the works at Wiesbaden and Paderborn, the ozone process has advanced from the laboratory to one of practical usefulness, and enters into competition with the old methods of water filtration, especially sand filtration.

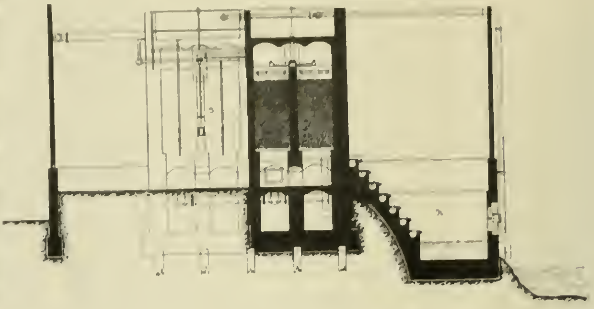


FIG. 4.—STERILIZING TOWERS AND OVERFLOW.

If continued service with ozone, bacteriologically and technically, proves to be that which has thus far been experienced, it will then be a desirable aid to the sanitary engineer and play an important part in many cases of surface water supply.

High-Tension Switching.

By J. N. Kelman.

As the subject of high-tension switching is of considerable interest to electrical engineers generally, and to those who have to handle long lines with their attendant high voltages particularly, it may therefore be of interest to your readers to know that at the Colgate Power House of the Bay Counties Power Company, Yuba County, Cal., several circuits varying in length from 60 to 160 miles are run off the same set of 45,000-volt busbars, and these circuits are switched in or out as easily and with as little disturbance as in the case of an ordinary low-voltage distributing circuit would cause.

There being no switch on the market that would do the work required, special oil switches were designed by the writer, and these handle the high voltage and heavy current so easily and satisfactorily that the power house attendants think no more of opening a short circuit with 12,000 kw behind it than they do in switching a generator on or off the 2,400-volt busbars. The current flowing into a short circuit varies from 200 to 300 amperes at from 40,000 to 35,000 volts, depending on the nature of the short-circuit, the voltage normally carried being 45,000.

One of these switches which has been in service over six months has opened the circuit 97 times in all with never less than 25 amperes, a number of times with 60 amperes, and 6 times under a short circuit with from 200 to 300 amperes. So completely has the carbonizing of the oil been overcome that the oil in this switch, which has never been changed, is perfectly free from carbon and is as clear and good as the day it was put in. These switches have been given a more severe test than any switch on the market to-day, being tested at 60,000 volts under short circuit with 2,000 kw behind them. Three-pole switches are used, experience having proved that they are better than single-pole.

Cooper-Hewitt Static Converter.

It is rare that a new discovery and particularly one having a direct practical application, is so revolutionary in character that difficulty is experienced in assigning a name to the apparatus embodying it. This, however, is a case not only with the apparatus but with the phenomena of a remarkable system for current conversion which Mr. Peter Cooper Hewitt has developed as a result of his investigations of the properties of mercury vapor tubes. Briefly, the system is one for the conversion of alternating into direct current, the central feature of which consists in the utilization of peculiar properties of electrodes sealed in a receptacle containing vapor at a certain degree of attenuation. Under this condition, the electrodes act as electric valves, permitting passage to one portion of the alternating wave and suppressing another portion. The apparatus cannot properly be correlated with the usual rectifier, if for no other reason than that it does not modify the original frequency, the direct pulsating current having the same frequency as the alternating current which is converted; nor with the electrolytic rectifier, since there is no electrolytic action. Until a better name is suggested, the term "static converter" may be applied in view of a certain analogy of conversion with respect to the rotary converter. The remarkable feature of the system is the extreme simplicity of the apparatus. A converter for 200 lamps, for example, is little larger than a 100-cp incandescent lamp, is even more simple in construction than the latter, and weighs but a few pounds. Merely as an interesting comparison, it may be observed that a rotary converter of the same capacity would weigh in the neighborhood of 700 pounds.

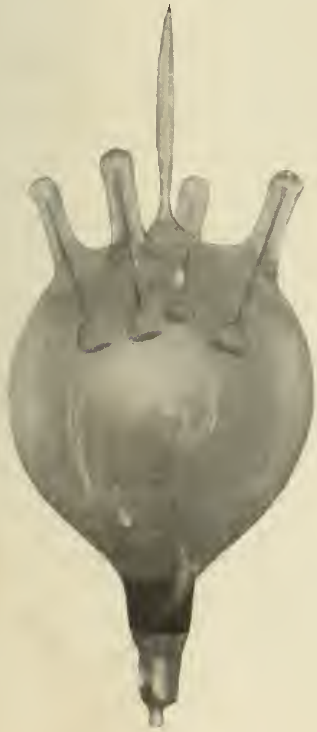


FIG. 1.—STATIC CONVERTER.

Fig. 1 shows a static converter having a rated capacity of 8 kw. The vapor globe is 7 in. in diameter and about 9 in. in extreme length. The weight is about 3 pounds. At the top are four sealed-in electrodes with iron cup terminals. One of these is merely used in starting up, as will later be described, and the other three are for connection to the three leads of a three-phase circuit. At the bottom is a mercury electrode to which one side of the working circuit connects.

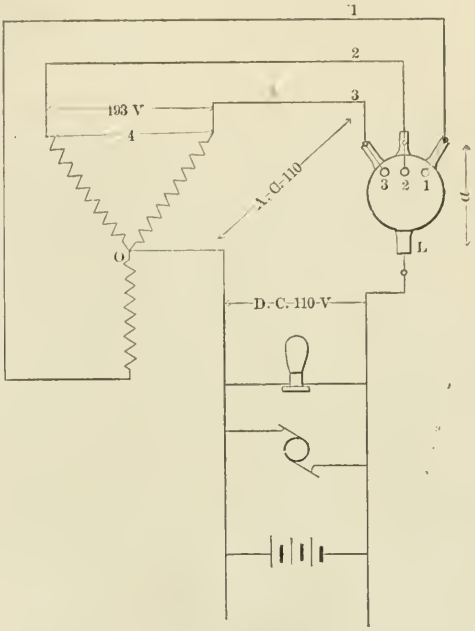


FIG. 2.—DIAGRAM OF CIRCUITS.

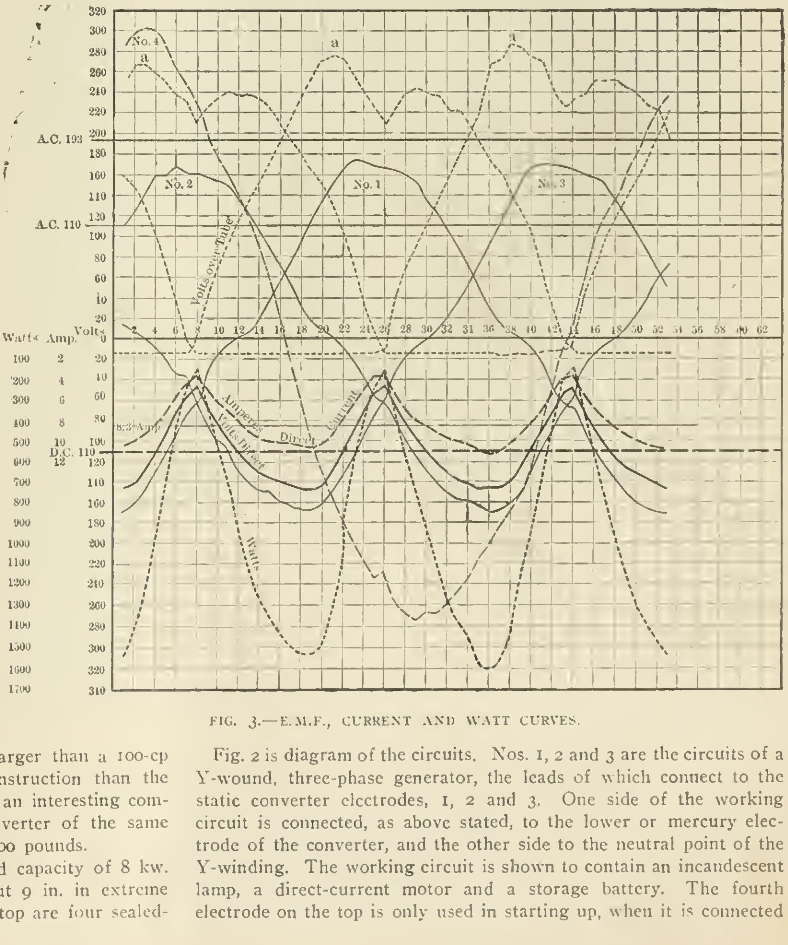


FIG. 3.—E.M.F., CURRENT AND WATT CURVES.

Fig. 2 is diagram of the circuits. Nos. 1, 2 and 3 are the circuits of a Y-wound, three-phase generator, the leads of which connect to the static converter electrodes, 1, 2 and 3. One side of the working circuit is connected, as above stated, to the lower or mercury electrode of the converter, and the other side to the neutral point of the Y-winding. The working circuit is shown to contain an incandescent lamp, a direct-current motor and a storage battery. The fourth electrode on the top is only used in starting up, when it is connected for a very short period to a circuit including a "choke" or "kicking" coil. To start the tube a higher voltage than the normal running voltage is usually required; this voltage is supplied from the auxiliary circuit during the very short period necessary to produce the proper condition in the tube to start up the discharge from the normal circuit. The means may be similar to those employed with the Cooper Hewitt vapor light, and, as in that system, can be made entirely automatic in action.

With the converter shown, as many as 180 16-cp lamps have been operated at full candle-power; this was the limit of the capacity of the generator supplying alternating current, the indication being that the tube could have carried even a larger load. Very shortly after the converter is in circuit it attains a normal temperature at which it will operate indefinitely. The amount of heat to be dissipated at the converter is a direct function of the drop of about 14 volts, and the dimensions of a converter can be quite accurately fixed to dissipate the heat incident to a given maximum load.

A striking peculiarity of the system is the fact that the drop in voltage between the upper electrodes and the mercury electrode is approximately constant at all loads on the converter. That is to say, this drop remains the same whether the current passing is that for one lamp or for 180 lamps. At present this drop is about 14 volts, but late experiments have indicated a possibility of reducing this considerably, even to as low as 6 volts. Assuming the former figure the efficiency of the present apparatus can be very simply determined. The converter illustrated has been operated at a voltage as high as 1,800, in which case the efficiency passes 99 per cent., while at 600 volts it would be about 95 per cent. It follows from the above that the voltage delivered to the working circuit is constant whatever the load on that circuit, and measurements have shown this to be actually the case. Experiments indicate that the converter in its present form is capable of handling commercially voltages up to 3,000, and that with further improvements the range may be extended to 10,000 volts. Up to the present stage, only glass receptacles have been used, but the principle admits of the use of steel shells, in which case the shell would form the negative electrode, the positive electrodes entering through insulating material, such as glass or porcelain.

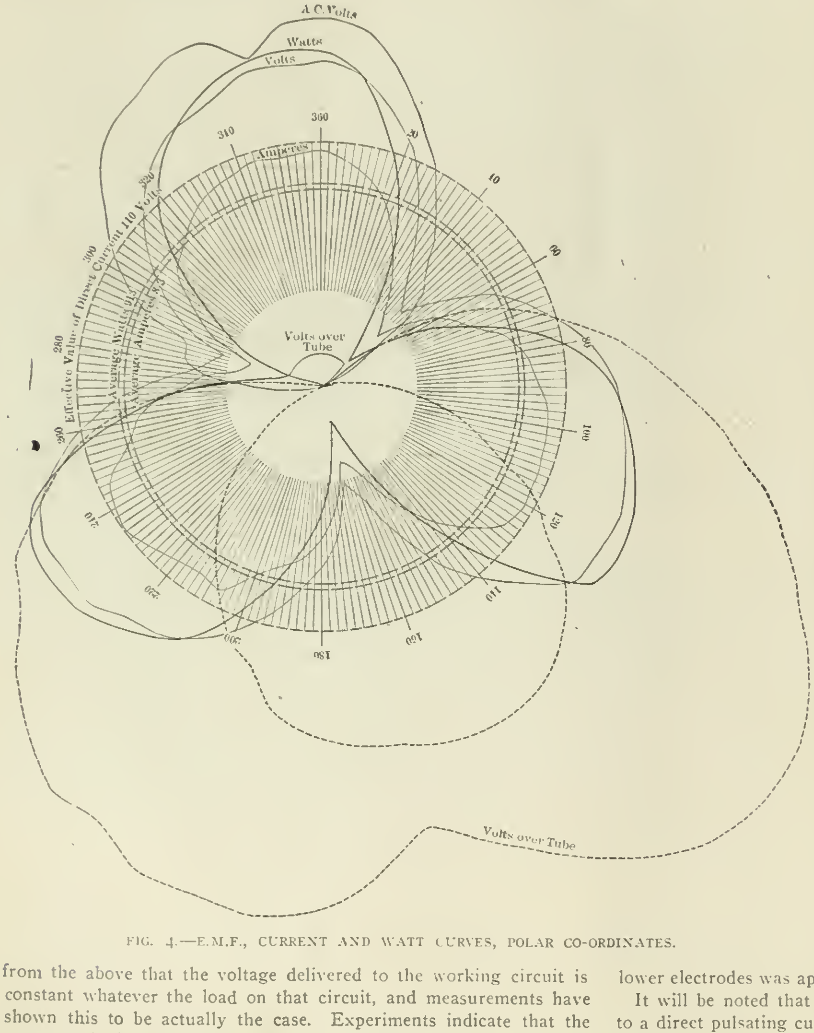


FIG. 4.—E.M.F., CURRENT AND WATT CURVES, POLAR CO-ORDINATES.

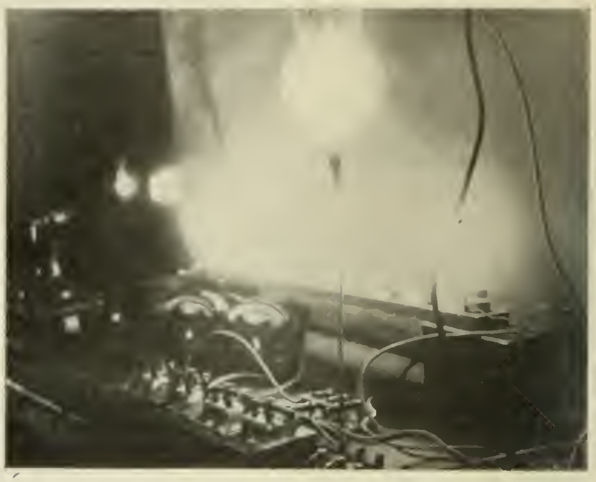


FIG. 5.—STATIC CONVERTER OPERATING LAMPS AND D. C. MOTOR.

Figs. 3 and 4 are curves laid down from data taken with a converter in regular operation, the data being applied to rectangular co-ordinates in Fig. 3 and to polar co-ordinates in Fig. 4. The curves 1, 2 and 3 represent the waves of the e.m.f. generated in the three Y-windings of the generator. Curve 4 is the e.m.f. wave corresponding to the generator terminals of windings 2 and 3, the other corresponding curves of the outer three-phase circuit not being laid down. *a, a, a* are the three e.m.f. waves corresponding to measurements taken across the converter. The e.m.f. curve of the working circuit is shown in heavy line, the corresponding current and watt curves being shown in dotted and broken line, respectively. The same explanation applies to the polar curves.

The form of the curves *a, a, a* indicates very clearly the electric valve action of the electrodes in suppressing one portion of the alternating-current wave. This action is visually apparent at a very low frequency, when the succession of impulses from the several upper to the lower electrode can be followed by observing the vapor streams. It is interesting to note that the mass of mercury forming the lower electrode has a motion of rotation, the angular velocity of which varies with the frequency.

By reference to the curves it will be seen that the effective voltage of the pulsating current corresponds exactly to that generated in the sections of the Y-winding of the generator. In the machine used in these particular tests, the latter voltage was 110, the delta voltage at the terminals of the machine and the upper electrodes 193, and that of the pulsating direct current 110. In this, as in all other tests with similar tubes, the drop between the upper and lower electrodes was approximately 14 volts.

It will be noted that the curve in the working circuit corresponds to a direct pulsating current. If more than three phases were delivered to the converter, the working e.m.f. would, of course, have less difference between its maximum and minimum value—that is, the current would more nearly approach a continuous current. In this respect the action of the converter may be compared with that of a commutator, a three-phase converter corresponding to a three-part commutator, a six-phase converter to a six-part commutator, etc. It has been found that a pulsating current is most efficient in charging storage batteries, and for this purpose the converter in its present simple form is directly applicable.

The Construction of Aerial Telephone Lines—I.

By Arthur V. Abbott, C. E.

The pole line is the oldest form of electrical circuit and is so familiar as seemingly to merit but slight attention. Owing to its cheapness the pole line is universally adopted where but a few circuits are needed and as it is subjected to destructive forces of greater number and intensity than those which prey upon conduit lines, there is more opportunity to exercise ingenuity in the construction of the best line for the least expense.

Two general types of pole lines are now commonly accepted—the city type and the country type. Few towns of less than 35,000 or 40,000 inhabitants require electrical circuits to be placed in underground conduits. In the environs of the largest cities exists a zone of too low a telephonic density to warrant conduit construction, and in which the pole line is the not only permissible, but is the only economic expedient. Pole lines for such locations will necessarily carry, comparatively, a large number of circuits. They must be so designed and built as to be substantial and secure, and must present as neat and trim an appearance as is possible under the circumstances. The restrictions of city streets are such as to render it difficult to secure space for anchoring and guying, which would be common in the open country. These conditions impose so many limitations upon pole line construction as to make the city line require considerable engineering, and that of no mean order. Examples of well constructed city lines are shown in Figs. 1, 2 and 3. Fig. 1 is the beginning of the long-distance pole line on Amsterdam Avenue, New York. The pole in the foreground is the terminal pole on which all of the open wires terminate, and are here connected by bridle wires to the underground cables, which are carried through iron pipe along the side of the pole to about 15 feet above the sidewalk. The cables run into the cable box and thence are bridled to the open wire lines. Such a pole must withstand the entire stress due to the tension of all of the open wires. Fig. 2 is another view of the Amsterdam Avenue line taken further north and shows the line as it passes over some of the hilly portions of the city. Fig. 3 is portion of a pole line in Chicago, running south on Indiana Avenue, carrying a branch line running east and west and is a good example of the best type of city construction.

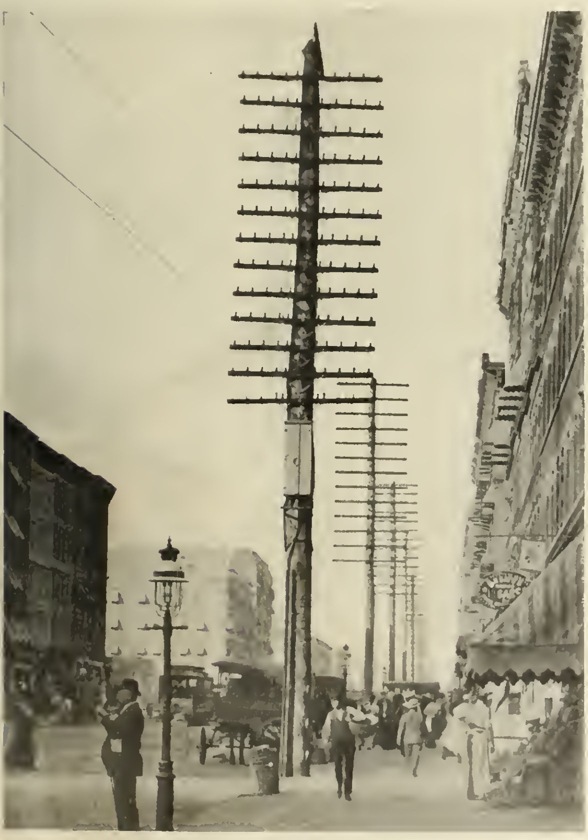


FIG. 1.—POLE LINE, AMSTERDAM AVENUE, NEW YORK CITY.

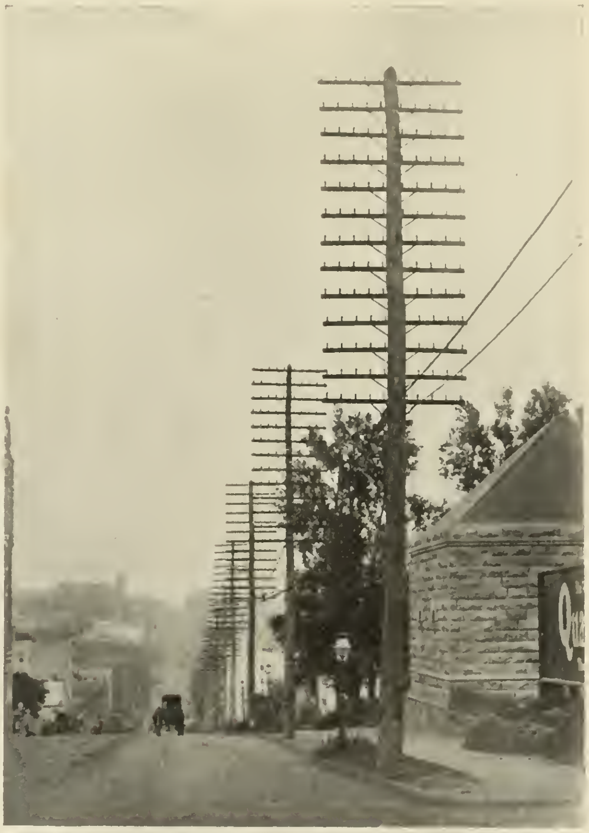


FIG. 2.—ANOTHER VIEW ON AMSTERDAM AVENUE.

The average city line is expected to carry from 50 to 100 wires. It must be high enough to give ample room beneath the lowest of its circuits, for the most extraordinary city traffic. Such a line is sometimes burdened with the weight of half a dozen aerial cables, so that the stresses which it is called upon to resist, particularly during a winter blizzard, are considerable. City lines, therefore, must be designed from an entirely different standpoint from 'cross country ones; they must be higher, stronger and better appearing. 'Cross country lines average half or less than half as many wires, they extend along rural highways or over private right of way where there is ample room for guying and staying at corners and curves, and owing to sparsity of settlement it is unnecessary to pay as much attention to appearance as in a town.

During the recent marvellous development of telephony a very erroneous, though equally plausible idea of the requirements of the telephone plant has arisen. For example, a few of the inhabitants of some rural district, decidedly in advance of average in intelligence, activity and enterprise, perceive the advantages of mutual intercommunication. They buy half a dozen telephones and installing them, themselves, in series on possibly the strands of a barb wire fence, can, under favorable circumstances, succeed in talking with each other. Encouraged by this success, they proceed to gather in their neighbors, imagining that because half a dozen telephones *sometimes talk* an exchange of perhaps 200 or 300 subscribers can be served in a somewhat similar fashion. But now the conditions are completely changed. A man who is riding a hobby will accept with delight annoyances and discomforts that he will not for a moment tolerate in a service rendered to him by others, and for which he is expected to pay. The difficulties and expenses of a telephone system vary nearly with the square of the number of instruments installed. A service, which might be perfectly satisfactory to a few co-operative owners, is totally inadequate when applied to a larger number, from whom rental is demanded. Many telephone companies are created by the combination, and amalgamation of a number of isolated groups of stations, that in a greater or less degree have come into being by the process described. When such an incorporation occurs, it has been the universal experience that it is necessary almost immediately to rebuild the entire plant, particularly the aerial portions thereof, in order to render a service that shall be even remotely acceptable to subscribers who are now expected to pay a fair remuneration for the service rendered to them. In a rural district the wire plant is on the whole the most important part of the entire installation. The switchboard may be compressed within a few square feet of surface in the rear of an office or drug store. It is of comparatively simple construction, easily supervised and not liable to many difficulties, but the pole line ramifies through all the surrounding country and unless it is built in a strong and substantial manner so much time will be spent in clearing trouble, and there will be so much complaint and dissatisfaction from subscribers that the debit side of the profit and loss account will, at the end of the year, assume most alarming proportions. "What is worth doing at all is worth doing well" is one of the truest aphorisms, and is truer of a pole line than almost anything else. But like every other structure the pole line is subservient to the laws of design, and that line is the best, which, while entirely adequate to the purpose, requires both the least investment and least annual expense. Now the foundation for the pole line is the pole, and it must be sufficiently to its burden, therefore the strength of poles is the first consideration.

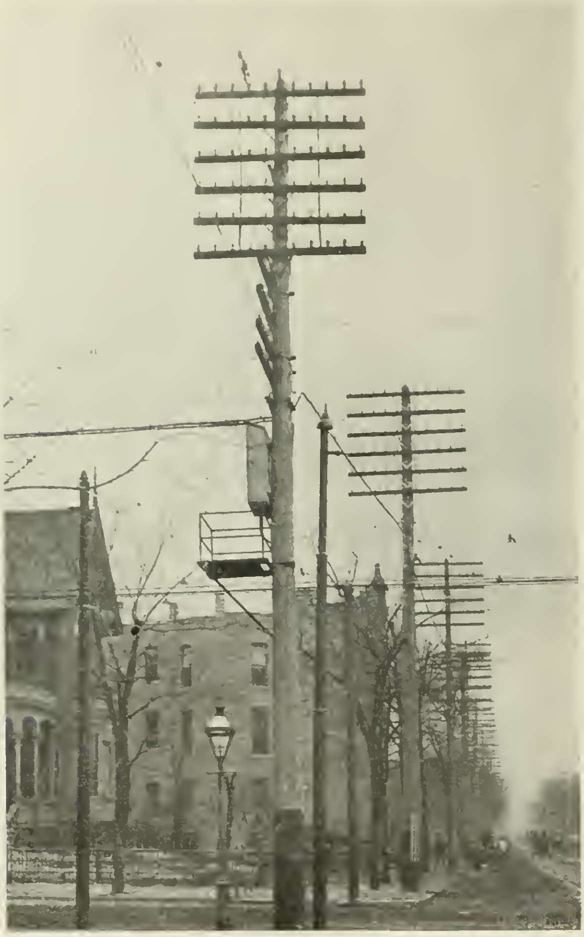


FIG. 3.—POLE LINE IN CHICAGO.

Stresses. The poles of an open wire line are subjected to four stresses. 1st. Each pole must, as a column, support the weight of all the wires, cables, cross arms, pins, insulators, etc., with which it is burdened plus all the weight of snow and sleet, which may accumulate on its circuits. 2nd. Each pole may be subjected to longitudinal strain, due to the tension of the wires and cables forming the circuits which it supports. In well constructed pole lines the tension upon the various circuits should be neutralized before the wires or cables are fastened on the cross arms, by allowing each to slip to and fro until it adjusts itself in such a position as to bring nothing but vertical stress upon the cross-arm. But either from carelessness in adjustment, or from subsequent changes in tension due to various causes, upon the spans on either side of the pole, it is not uncommon to find the poles subjected to quite a severe longitudinal strain. 3rd. Wherever there is any change in direction in circuits, such as is required by a curve, or the turning of a corner in the location of a route, all of the resultant tension of the circuits will fall upon the poles, planted along such portion of the line as is included in this change in direction, and must either be met by the actual resistance to bending offered by the pole or cared for by proper guying. 4th. Each pole will be subjected to a lateral stress due to the wind pressure against the surface of the poles, cross-arms, etc., due to the heaviest gale that may blow. It is this stress that usually wrecks a pole line, for it is very rare that either of the other causes is sufficient.

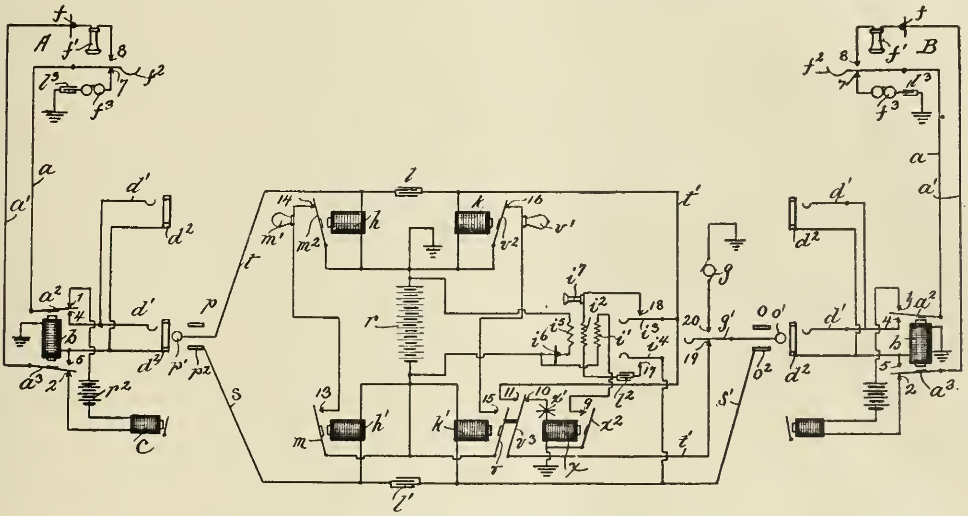
New Telephone Patents.

The first issue of the United States Patent Office of the new year, that of January 6, brings forth three patents relating to the field of telephony. "Automatic Conversation Counter" is the subject of one granted to J. H. Meyer, a subject of Germany, and consists of a message counting device at the subscriber's premises and certain keys and relays at the central office whereby a subscriber receives notice, when the desired party is waiting for him, to operate his counter, thus automatically completing the talking circuit. This system as developed evidently applies only to magneto systems, although one of the claims could be so construed as to apply to common battery systems. Mr. Meyer accomplishes his desired results as follows:

In the line at the subscriber's instrument is placed an indicator adapted when energized by the flow of direct current to display before a window in its case a legend, "Please Call." In addition to the usual instrument circuits, an open branch circuit is arranged so as to include the operating magnets of the counting device, and a normally open contact, controlled by the automatic switch of the hand generator in a manner to be momentarily closed just before the beginning and just after the ending of the generation of current by the magneto. In addition, a contact device is interposed in one side of the line as it enters the subscriber's instrument. This is so arranged that the contact will be momentarily broken at the completion of a count upon the dials of the counter.

At the central office the connecting cord circuit listening keys have associated with them relays and a battery used for counting. The relays have their windings and contacts so arranged that when the relay is once operated the flow of current from the counter battery, through the coil and contact of the relay in series, will cause the relay to be locked in the operated position until the circuit has been broken at some other point. Now the circuit of this relay is completed over the subscriber's line through his indicator, his receiver, the above-mentioned line contact controlled by the counter, and thence back to the counter battery; and the original operation of the relay is performed by a connection, either mechanical or electrical, between the listening key and the relay. This connection is so designed that the act of disconnecting the operator's set from the connecting cords causes the operation of the relay. Thus, when the operator has secured the desired subscriber, in cutting herself from the circuit she operates the relay, locking it up, and through its back contact breaking the talking connection between the two subscribers' lines. Now the flow of current toward the calling party sets his indicator, and instructs him to call, and in complying he closes the branch circuit through the counter magnet. The counter thereupon operates, breaks the line contact associated therewith, and momentarily opens the circuit. This allows the relay armature to return to the normal or unlocked position, thus completing the talking connection.

The chief novelty in a receiver holder patented to J. B. McClain is in the multiplicity of adjustments. This holder consists of a base adapted to be screwed to the wall beside a wall telephone and secured to which by a clamping ball and socket joint is a telescoping arm. At the extremity of this arm a revolvable plate is attached, this carrying forks to hold a hand receiver. Three latches are provided, one to lock the socket joint, one to lock the telescope joint and the last to lock the revolving plate. Probably the point that will strike the practical telephone man most strongly is the question, "Why all this paraphernalia when the head receiver is within the reach of all?"



Dean Testing System.

Fig. 1 shows the circuit of Mr. Dean's busy test system, together with two subscribers' lines of the Kellogg two-wire, central energy, switchboard system, for which the invention is particularly adapted. As evident from the figure, the test rings of the switchboard multiple jacks form part of the subscriber's line circuit, and the shunting of any considerable current from this point to ground for test purposes, will be accompanied by a click at the subscriber's telephone. To avoid this click, a relay, x, of high inductance and resistance and connected to the tips of the plugs of the various calling cords through the back contacts of the relays, k^1, one of which is associated with each such calling cord, is provided. Now, when the operator tests a line with a calling plug, she touches it to the ring, d_2, of one of the jacks of the desired line, when if that line is busy and battery potential, therefore, exists upon the test ring due to the operated condition of the relay, a_2, a current will flow through the relay, x, to ground. This current will be of such small magnitude and will come to its maximum so slowly, because, respectively, of the high resistance and high inductance of the relay, x, it will not cause a disturbance at the subscriber's station. It will, nevertheless, cause the relay, x, to operate and through its contacts close a circuit through the tertiary winding of the operator's induction coil, thus producing the required click or test.

Each individual feature of this invention has been known and used for a long time past, but the combining of them into their present form to serve the specified end comprises the novelty of the invention. Mr. Dean has assigned his patent to the Kellogg Switchboard and Supply Company, of Chicago.

Long Swiss Electric Road.

It is stated that Switzerland is to have still another connection with Italy—an electric railway from Coire to Arosa.

Changes at the Stevens' Institute of Technology.

A number of changes in the roster and the faculty of the Stevens' Institute, Hoboken, N. J., have been made in order to take care of the large increase in the size of classes, and also to generally broaden the course of instruction. The Department of General Physics has been separated from that of Applied Electricity, and Dr. William E. Geyer has been appointed professor of general physics. In addition to the regular lectures on physics, Dr. Geyer will deliver the lectures on electricity, formerly given by the late President Morton, and will also take charge of a physics laboratory course for the sophomore class. Former Assistant Professor Albert F. Ganz has been appointed professor of applied electricity, and former Instructor William Moore assistant professor in the same department. The laboratory work in applied electricity, formerly given in the senior year, will now be distributed over the junior and senior years.

President Humphreys has begun a series of lectures on business methods to the senior class. In the lower classes additional time has been assigned to English and to mechanical drawing. Dr. F. L. Sevenoak, vice-principal of the Stevens' Preparatory School, has been appointed assistant professor of English literature and will assist Prof. Wall with the new work in English. Former Instructors C. L. Gunther and E. R. Knapp were also promoted to the grade of assistant professor.

An extra hour per week has been allotted to the sophomore and senior classes for special lectures on engineering subjects to be given by professional engineers and by members of the faculty. The new roster has also been so arranged as to distribute the work for the students as evenly as possible; Wednesday afternoon has been left free for all classes, so that the students can combine for athletics or make visits of inspection.

During the Christmas holidays a new marbleized slate distribution switchboard was installed in the electrical laboratory and both the laboratory and dynamo room were systematically rewired.

Electrolytic Copper Plant at Shawinigan.

A new copper-producing plant is projected for Shawinigan Falls, Que. This is the determination of Mr. C. K. Milburne, who is backed in the project by English and American capitalists, who are prepared to invest heavily in the production of manufactured copper in Canada. There are no copper works in the Dominion, and it is claimed that by the new electrolytic process, of which Mr. Milburne holds the patents, the manufactured copper can be produced at a fraction of the cost at which it is manufactured in the United States, and it can consequently be sold at a profit at half the price that is now paid for it. The importance of the scheme to Canada lies in the fact that it will lead to practical steps being taken for the utilization of Canadian minerals for the advantage of the country.

CURRENT NEWS AND NOTES.

INSTITUTION OF ELECTRICAL ENGINEERS.—Notices have been received by the members in this country of the proposed trip of the Institution to Italy in April, chiefly to Como, Milan, Paderno and the Valtellina electric road. Circulars give also the changes in the constitution and the increased rates for membership

FOREIGN SCIENTISTS IN PARIS.—The Municipal Council, of Paris, France, has voted $600 for the creation of a bureau of scientific information for foreigners. Many foreign scientists annually visit Paris for inquiry and study in holiday times, when heads of museums, collections and libraries are away. A competent linguist has now been appointed to reply to inquiries, verbally or in writing.

WIRELESS TELEGRAPHY FOR ALL CANADA.—The Marconi Wireless Telegraph Company, of Canada, has given notice of an application to Parliament for an act of incorporation to do business all over British North America, the British Isles, Europe and on the Atlantic and Pacific Oceans, and on the islands and places near the same. Powers are also asked for leasing or purchasing existing telegraph, telephone and cable companies.

FRANCE AND WIRELESS TELEGRAPHY.—As already noted in these pages, a curious proceeding has resulted from the claim of the French Postal Department to the monopoly of wireless telegraphy in France. The Popp Company, which has its headquarters on the Place de la Madeleine, in Paris, having established a station at Cape La Hogue, near Cherbourg, on the English Channel, the Under Secretary of State for Posts and Telegraphs intervened, and all the material has been seized by the Cherbourg judicial authorities. Mr. Popp is to be prosecuted for establishing a post and correspondence without the permission of the Government.

WHITE HOUSE ELECTRICAL INSTALLATION.—As is well known, the President's Mansion at Washington has been modernized during the past year. The electrical installation involved six months' work. The house was rewired, with 168,000 feet of conductor enclosed in iron conduits. The house is lighted by 3,000 incandescent lamps, and a separate plant supplies current for the operation of ventilating motors, pumps and elevators. There are, besides, complete bell, telegraph and telephone systems. In the pantry there is an electrical plate-warmer, having a capacity of 3,000 pieces. It is stated that the electric light fixtures used are the finest in the country.

ALASKAN TELEGRAPHS.—It is said that in spite of the rigors of the Arctic winter, the Government telegraph line in Alaska from Fort Gibbons, up the Tanana River, through Chana City, a distance of 240 miles, and on to join the Eagle City line. will be pushed along and completed about April 1. · Lieut. Gibbs and his party of Signal Corps men and soldiers expect to have a hard time during the winter months. When the snow is deep and the thermometer low their bread reaches them from the camp frozen and their coffee is received ground up. They thaw their bread and water their coffee with melted snow, but every one of them is a Mark Tapley and swears he enjoys the work more the lower the thermometer goes.

ELECTRIC RAILWAY SPEED IN EUROPE.—A cable dispatch from London of January 10 says: "The present year will witness some very interesting developments in locomotion, both on land and by sea. In June next Mr. F. B. Behr hopes a portion of his Manchester-Liverpool mono-rail electric express railway will be opened and that cars will be running on it at the rate of one hundred and ten miles an hour. Mr. Behr is introducing a bill next session for a London-Brighton mono-rail railway, which would take Londoners down to the sea in half an hour. Many big railway companies are electrifying portions of their lines. By the close of 1903 trains will be running by electricity."

CONNECTIONS FOR PACIFIC CABLE.—Now that the cable is finished to Honolulu, the next submarine cable of world interest will doubtless be south of our possessions in the Pacific. This new system would require the co-operation of the Dutch and German governments. The plan would be for the Dutch to connect Java with the westernmost island of the Caroline group, and for the Germans to carry a cable from that Caroline island to the eastern extremity of their possessions, at Bonham Island in the Marshall group. The connection with our Commercial Pacific cable at Guam would doubtless be made from the point in the Caroline Islands where these two cables meet. Such a line would have a great strategic as well as commercial advantage, since the Caroline Islands contain many good harbors and bases for naval operations and naval reserves. To know by cable what is going on there would at times be of the utmost value, even in the absence of conditions which warranted the controlling government from shutting off the transmission of information.

LETTERS TO THE EDITORS.

Conditions on the Manhattan Elevated.

To the Editors of Electrical World and Engineer:

SIRS: The energetic editorial in your issue of December 20th, 1902, under the heading, "Manhattan Elevated Electrics," was inspired by a feeling with which every engineer who rejoices to see the applications of electricity extended and its practical effectiveness demonstrated must sympathize, but your attack upon the executive management of the Manhattan Company is far more severe than the facts justify. I find myself also somewhat at variance with the opinion which you express regarding the third rail, and as the subject is one of great interest to the engineering profession, I avail myself of your courteous permission to use your columns in stating some of my views.

You say, substantially, that the third rail exposed to sleet and snow is all right, but that the management of the Manhattan Company is all wrong. On the contrary, I believe that an unprotected third rail is a make-shift and must be superseded by a construction securing effective protection against snow and sleet and in my opinion the executive management of the Manhattan Company is exceptionally able and successful.

First, as to the management: It is a fact that the first sleet storm of the season found the cars of the company without steel brushes or scrapers. For this failure, the management is, of course, primarily responsible; but the fact that the delay in mounting the brushes upon the cars was due to loss of time in the successful development of an improved method of applying the scraping devices, and the further fact that after the brushes and the mechanism for operating them were ordered, it was found impossible to obtain prompt deliveries from manufacturers, may at least be mentioned as extenuating circumstances. But admitting that this was a serious failure and that the management is responsible, is it not a fact that during the last three years the Manhattan Railway Company has accomplished results which call for praise rather than censure? Where is the system here or abroad that carries anything like the number of people carried by the Manhattan or that has a record in any way comparable with respect to general effectiveness and particularly to safety to the passengers carried? Recently, it has repeatedly happened that within a single hour, more than 100,000 people, practically all bound in one direction, have been carried by the trains of the company. That number of people would fill Broadway from curb to curb from City Hall to Sixty-eighth Street, a column marching 20 abreast and with less than 6 feet between successive ranks. It is a physical impossibility to carry satisfactorily such a multitude in one hour over the limited number of tracks available. Terrific crowding is inevitable and that such crowds have been carried at all without greater discomfort to the passengers and without more accidents is in itself eloquent testimony to the ability of the operating management and the discipline and faithfulness of its employees.

As regards construction, the work of substituting electricity for steam during the last three years has been quietly, systematically and successfully prosecuted upon a scale beyond all precedent. A power plant, capable of putting out during rush hours 50,000 kw, has been constructed and over 900 electrically operated cars, equivalent to a continuous train eight miles long, are in operation. In carrying out this work, it is only just to say that no board of directors could have allowed greater latitude to the engineers and no executive officer representing that board could have more intelligently and helpfully directed and co-operated with those engineers than has Mr. Alfred Skitt, vice-president and general manager of the company. The officers of the company, and particularly Mr. Gould and Mr. Skitt, have at all times impressed upon their engineers the importance of securing for the new equipment the best and in every way most effective outfit of steam and electric machinery that could be constructed, and in no instance that I can recall have the wishes of the engineers been negatived by the management.

In the main, the plans adopted have been splendidly successful. The engines and alternators during periods of maximum load put out 10,000 electrical hp each and in doing so operate as smoothly as engine-driven units of one-tenth their power. More than 125 miles of cable, operating at 11,000 volts, a potential 66 per cent. higher than the highest previously used in plants comparable with this, are to-day distributing energy from the power house to seven sub-stations, located in Manhattan and the Bronx. In power house and in sub-stations, switches and switch gear, necessarily intricate, are successfully handling the enormous power required to operate more than 900 cars of the elevated roads and those cars, two-thirds of which are equipped with motors and with a system of control necessarily complicated and until adopted by the Manhattan Railway Company scarcely tried in practical operation, are making about 120,000 car-miles per day, equivalent, for example, to 130 five-car trains per day in each direction between New York and Philadelphia.

The only part of the system which in my opinion is not, and, unless substantially modified, will not be thoroughly satisfactory in service is the third rail. In saying this I do not mean to imply that the engineers of the company in 1899 made a mistake in adopting the standard form of third rail and the standard linked shoe. Our reasoning was then valid and, indeed, is still valid, because no better plan than that adopted is to-day in operation upon any scale which would justify its adoption by the Manhattan Company. No mere theoretical demonstration of the practicability of an under-running or side-running shoe could have justified the adoption of a device that had not withstood the test of practical operation, and in adopting what was in practical use in all comparable electrically operated elevated railways in America and in Europe, the engineers of the Manhattan Company acted with that conservatism and judgment which the management of the company had a right to expect.

But while the Manhattan Company was not justified in experimenting with a new type of third rail, involving an untried type of collecting shoes, I am personally convinced that an exposed contact rail is not the correct ultimate solution of this part of the problem of substituting a central steam plant for locomotives. I am convinced of this notwithstanding the fact that the great majority, if not all, of those engineers and operating men who have had extended experience in the use of third rail systems elsewhere are asserting to-day that the third rail as it is erected on the Manhattan system is, as you say, "a perfect success in competent hands," and I backed my opinion upon this point more than a year ago in designing and securing for the Wilkesbarre & Hazleton Railway Company a third rail system in which the contact rail is protected against snow and sleet by an overhanging timber guard. The Wilkesbarre & Hazleton Railway is not yet in commercial operation, but for the last month or two one of the cars has been running over a part of the line and during the sleet storm December 11th and 12th, which was very severe on the mountains between Wilkesbarre and Hazleton, the timber guard afforded effective protection and effectually prevented the formation of sleet upon the rail head. The sleet storm, however, although very heavy, was not a particularly driving one, and I do not regard the test as thoroughly conclusive. The side-thrust shoe used on the Wilkesbarre & Hazleton Railway is of a type recently developed by the General Electric Company. The chief engineer of the railway department of the General Electric Company informed me about three weeks ago that recent experiments at Schenectady in running through snow indicate that the new shoe will have to be modified substantially. So far as this guard and shoe are concerned, therefore, while the results thus far obtained are encouraging and while I believe that the shoe can be perfected, they are not sufficiently conclusive to justify its adoption by the Manhattan Company, even at the present date.

Before the end of the present winter it is hoped and expected that some type of collecting shoe that can be used in connection with a rail protected against sleet will have been used in practical operation to an extent sufficient to justify its adoption, provided experience during the remainder of this winter shall demonstrate that brushes, scrapers, brine cars, etc., cannot maintain the contact rail in satisfactory condition. The General Electric Company is systematically experimenting with the new shoe at Schenectady, we are of course gaining all experience possible from the Wilkesbarre & Hazleton Railway, and the Manhattan Company has asked the consent of the Department of Water Supply, Gas and Electricity to the removal of one of the two plank guards which protect the contact rail on the Second Avenue line in order that we may try in actual service several new types of collecting shoe adapted to operation in connection with a protected contact rail. Of the very many designs which have been suggested, we have selected three thus far and if the city authorities consent to the removal of one of the two guard timbers, there is every reason to believe that we shall be able to develop a satisfactory shoe.

In some quarters the Manhattan Company and its engineers have been criticised for erecting the wooden guard planks on each side of the contact rail instead of leaving this contact rail absolutely exposed as is done by elevated roads elsewhere. These guards were required by the Department of Public Buildings, Lighting and Supplies. They were objected to by the management of the Manhattan Company, acting upon the advice of its engineers, who had had the greatest experience in third rail practice, but their erection was insisted upon by the department. Personally, I am of the opinion that the department was substantially right in the position which it took, as I have never been in favor of a contact rail carrying 600-volt current unless such rail be provided with adequate safeguards for life and property. L. B. Stillwell.

New York City.

Inverted Third Rails.

To the Editors of Electrical World and Engineer:

Sirs: I note in your issue of January 3 a letter from W. A. Anthony with reference to the Manhattan third rail installation, in which he states that the entire third rail could be installed upside down and the contact made from underneath.

If Prof. Anthony will secure a clearance diagram and a section of the permanent way, bearing in mind the fact that the shoe must not strike anything on the permanent way, and conversely that all parts of the third rail and its protectors must clear any of the rolling stock, he will find the change of the character he proposed is not so easy as it looks. George T. Hanchett.

New York City.

Electricity in the Army.

To the Editors of Electrical World and Engineer:

Sirs: Permit me to correct a statement in your issue of December 6th, 1902, page 914, to the effect that electricity is only taught at one army training post, Fort Meyer. Fort Monroe, Va., has a class of about twenty-seven officers in the department of electricity, mines and mechanism, and a class of gunner specialists (enlisted men) who are taught practical electrical application; and Willets Point has a school of submarine defense where electricity is taught. There are a number of electrician sergeants graduated from these schools who are giving instruction to from 6 to 20 men.

The reason that Fort Leavenworth does not give an electrical course is probably because the Signal Corps personnel is especially trained for the electrical duties pertaining to mobile troops, namely line construction, telegraphy, telephony, flag signalling, heliography and marching. It appears unnecessary at present to provide infantry, cavalry and light artillery with electricians or an equipment involving the services of more skilled men than the Signal Corps furnishes.

The works at a coast artillery post being of permanent character, are provided with electric light plants, including storage batteries, motors for guns and ammunition, telephones, telegraph, submarine mine, electrical circuits, etc. The electrician sergeant must know how to operate these and instruct others, to make ordinary repairs, estimate on new work, etc. The work he is called upon to do (outside of his professional duties) is generally of a nature foreign to electricity or engineering, ranging from repairing meteorological, surveying and optical instruments, to drawing. For the encouragement of these the more sensible plan and the one that is most favored is to raise to the pay and rank of warrant officer the electricians now in the service and let them go along as they have been doing. To a young man fitted to fill the position, there is now more pay awaiting him in civil life

The army has a chief of artillery, who is a better electrician than many who are operating large installations, who is up to date, and devoted to the service; had this officer considered that the necessities of the service required a course at Leavenworth, it doubtless would have been authorized. It is to be hoped that the powers that be will be more generous and let the existing schools equip in better shape and thus correct to some extent the impression that there is "nothing doin'" in electricity in the army

Fort Leavenworth, Neb. Chas. G Chase.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Design of Polyphase Current Machines.—Bergman.—An article in which he discusses the most important features of the design of polyphase current machines and more especially draws a parallel between different practices in Europe and America. There are several ways to obtain a high power-factor: to distribute the windings in a great number of slots; to make the diameter of the armature large, and keep the length of core small; to reduce the number of conductors and simultaneously keep the no-load current small. These possibilities of increasing the power-factor are not independent of each other; on the contrary, they are closely connected. In order to get the no-load current as small as possible, the motors require closed slots, but this is expensive. Many of the principal American engineers, therefore, decided to use open slots entirely in order to reduce the cost of manufacture of the motors, but in consequence of this the motors had to be built much larger in order to prevent the no-load current being too large; this method gives a good power-factor. In Europe the same result was obtained by making use of nearly closed slots, the manufacture being more expensive, but on the other hand the material costs were reduced. Besides, the Americans succeed in cheapening their motors by making use of the squirrel-cage type for sizes up to 50 hp, while in Europe the polar-wound slip-ring motor was mostly used. The adjoining diagrams show the main results of these differences in design; the first diagram refers to a 15-hp, 50-periods, 6-pole, three-phase motor, with nearly closed slots and a polar-wound motor with slip rings; the second diagram to a 15-hp, 60-periods, 6-pole, three-phase motor, with entirely open slots and a squirrel-cage motor. The power-factor is better in the second motor, but the efficiency is poorer. He suggests that a compromise between the efficiency and the power-factor could be obtained if the product of these two were adopted as a measure of the general excellence of the motors. He then discusses the voltage drop; it may be made small by reducing the self-induction, but only to a certain extent. The drop of voltage in alternating-current generators is dependent not only on the armature reaction directly, but also on the increased leakage of the poles, as well as on the slots in the armature; consequently every designer aims to begin with designing the generators so that the leakage at its loads keeps practically constant, and further to design the cores in such a way as to make it possible to diminish the injurious effect of increase of leakage on the drop of voltage due to the load of the machine; these conditions being fulfilled, a high degree of saturation can also be maintained. Generators designed as prescribed will have a small voltage drop and besides, the costs of material will be considerably reduced. These principles are not difficult to realize with low-speed machines, but will be rather difficult with machines for a large number of revolutions per minute, if the inside pole type is used. Many American manufacturers have, therefore, decided upon the outside pole type of machines with rotating armature, for 500 revolutions and above, this type being very favorable for other reasons also, the efficiency being essentially much better and the cost of manufacture being smaller. This type of machine has been introduced into Europe only to a very small extent.—Lond. *Elec. Rev.*, December 26.

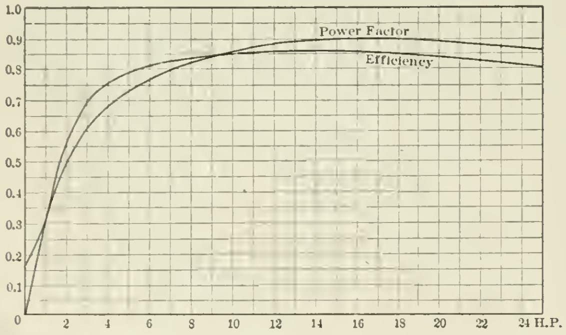


FIG. 1.—NEARLY CLOSED SLOTS, POLAR-WOUND ROTOR.

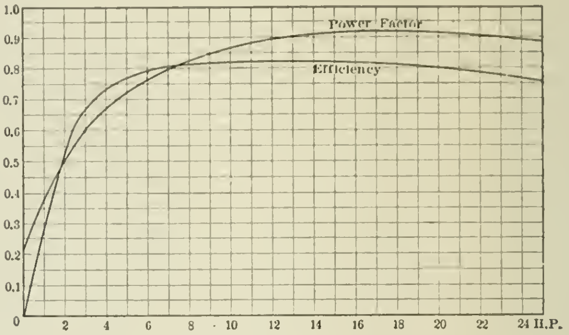


FIG. 2.—ENTIRELY OPEN SLOTS, SQUIRREL-CAGE ROTOR.

REFERENCE.

Slotted Armature Sheets.—Hundhausen.—The first part of a well-illustrated article on the manufacture of slotted armature sheets. —*Elek. Zeit.*, December 18.

Lights and Lighting.

The Problem of Electric Lighting.—Swinburne.—In his presidential address to the (Brit.) Inst. Elec. Eng. he remarks that the obvious goal is direct production of "light without heat," by which is meant producing only the rays of wave lengths which affect the eye. The fire fly, it appears, succeeds in doing this. "There is no thermo-dynamical reason why electrical energy should not be converted directly into radiation of any wave length without loss. I do not know if there is any molecular impossibility, but apparently our limits are practical—that is to say, it may be done, but we have not yet hit on the way of doing it. The vacuum tube appears to be a means of converting electric power direct into radiation. The Cooper-Hewitt lamp, for instance, gives an efficiency of about 3 candles per watt, or something like 0.6. All these figures as to light are a little vague. Unfortunately, the light is of a very bad color. It is very actinic, but the wave lengths are too small. One method is to degrade the light by making it act on silk dyed with matters which lower the radiation to a redder color by fluroescence." Concerning the arc light he says that we do not seem to have reached our limit as to light from pure heating, because a lot of light is lost in the opposite carbon. Many attempts have been made to expose the crater freely. But, far more important than this, the arc is not necessarily only a hot body radiator, but it may also convert electrical power directly into light in the space between the electrodes, and this gives a chance of rising more nearly to the theoretical limit of about 5 candles per watt. "Practically all light is wanted for use by the human eye. The human eye is exceedingly sensitive; it is calculated to see a distant star when receiving 0.000,000,01 erg per second, so that one watt would enable, say, 5,000 billion people to see stars with both eyes, but it would have to be used economically. In reading a book the eye would need much more than this; and then, as the book radiates light in half of all directions, only a little is used by the eye, so even if all light from a source were concentrated on a book, there is enormous waste by useless radiation from the book. But the source of light does not illuminate only the book; the book probably subtends a small solid angle, so there is another source of waste. The eyes reading a book in a fairly good light want something of the order of 2 ergs per second, so that a watt would only work the optic nerves of, say, the inhabitants of London. But the book, say 200 sq cm, would need about 3,000 ergs a second to illuminate it. A candle, which gives a light of 4 cp, radiates about 0.2 watt, or 5 candles a watt; that is to say, at an efficiency of unity we would get 5 cp, or 20 units of light per watt. The efficiency of a glow-lamp is only about 0.25 cp per watt, or 0.65, so there is room for improvement."—Lond. *Elec.*, December 19.

Power.

Governing of Alternators.—De Marchena.—An abstract of a paper read before the International Society of Electricians in Paris, on the governing of engines coupled to alternators running in parallel. The parallel running of alternators is greatly influenced by the action of the governor, which fact is said to have been overlooked by other French writers, who have in the author's opinion attached too much importance to the question of irregularity during one revolution of the fly wheel. According to the author the frequency of pulsation of the power of the engine is too high compared with the frequency of the oscillations proper to the alternator itself, to permit angles of displacement between alternators to attain a dangerous value. On the other hand, the irregularities of power arising from instability of the governor are liable to produce very considerable displacements, resulting in running out of phase or breaking down of alternators. The author also examines the laws which govern centrifugal governors, and particularly the relations which exist between the positions of equilibrium of the governor sleeve and the variations of speed produced by variations of the force acting on the governor. He investigates the oscillations of the system composed of the governor and fly wheel, and gives a formula for the weight of fly wheel to be used for a given work of a governor. From the working conditions of the governor when the alternator is connected to the network, he shows that the oscillations and greatly variable frequencies produced by irregularities of the motive power or by quick fluctuations of load, give rise to oscillations of the governor, the amplitude of which depend upon the natural oscillations of the governor as well as upon its damping. He examines in each case the conditions of resonance which may be obtained and the consequences. In order to obviate these inconveniences, it has hitherto been the practice to employ a relatively strong damping; but, while approving Emmet's arrangement of dash-pot, which he thinks can sometimes give good results, de Marchena considers that a more rational solution of the difficulty is to suppress the cause of these oscillations entirely by making the governor independent of the influence of the oscillations of the alternator. He therefore proposes to drive the governor, not by the engine itself, but by an induction motor connected to the network. This motor, not being dependent on individual oscillations of the machine, will not change its speed, and will only act on the governor when the frequency of the network is modified. The writer mentions a test made with this system in a large water power generating station in the Nice district, including turbines of 1,000 hp each, in which special arrangements were employed for avoiding troubles liable to result from accidental stopping of the motor. The first series of tests gave incomplete results on account of the excessive slip of the induction motor, which was too small. A new series of tests were made, however, with a more powerful motor, and the results are stated to have been entirely satisfactory, the oscillations which were experienced at first having entirely disappeared. It is anticipated that this system is likely to be efficient in general use, and the author expects it to be used shortly for facilitating parallel running of stations separated by long distances.—Lond *Elec.*, December 26.

REFERENCE.

Centrifugal Machine.—An illustrated article on a method of electrically driving centrifugal machines, which retains the advantages of the turbine drive while securing also the convenience of electrical methods of power transmission.—Lond. *Engi'ng*, December 19.

Traction.

Manhattan Railway.—An article on conduit construction and cable installation on the Manhattan Railway. The system consists of one main trunk line which parallels the Second Avenue elevated structure and crosses the Harlem River, where the cables are carried in a specially prepared channel on the bottom of the river. The main line is nearly nine miles long and consists of from eight to forty-eight ducts. There are also six branches which radiate from the main line and extend to the main power house and to the sub-stations. Three of these branches reach entirely across town and connect with the Eighth and Ninth Avenue elevated lines through three sub-stations. Connection is made with the main power house by a heavy trunk line comprising fifty-six ducts laid in two lines of twenty-eight ducts each. The entire system is, therefore, nearly thirteen miles long and is equivalent to 345 miles of single conduit. A map of this system accompanies the article, showing the location of the main power house, the sub-stations and the conduit. There are also several cuts illustrating the special features of the manholes and the arrangement for draining the system. The article contains a detailed description of the work of construction as well as the methods employed. The conduit used is of the single glazed tile type with an inside diameter of 3½ inches. A number of conditions were met with in this work which required special provision, especially in the matter of avoiding obstructions encountered in the form of water mains and gas pipes as well as the drainage system of the city. As a result of these sub-surface obstructions, the layout varies in almost every block. The greatest difficulty was experienced in crossing the Harlem River and building the necessary manholes and approaches on each side. Armored cable was placed in an open trench, and as the government required a depth of 20 feet at low water, it was necessary to dredge the entire river bottom at this point to a depth of six feet. The special construction features of this part of the equipment are very thoroughly described.—*St. R'y Jour.*, January 3.

Train Unit Control.—An illustrated article on the train unit control system on the Berlin Elevated Railway. The trains consist of three cars of which the first and last are motor cars each equipped with three motors, all of which are controlled on the first motor car. The system differs from that used in Paris, and from any system used in America. The motors on each car are always connected in multiple with each other, and those on car 1 can be connected in series or in parallel with those on car 2 by means of the controller. By the positions of the small or motor controller the train can be operated under six conditions, viz., in series with each other, in multiple with each other, by motors on car 1 only, by motors on car 2 only, backwards by motors on car 1, or by electrical braking. By a short circuiting-device, the motors on either car, when not in use, are prevented from working in opposition with each other, as this device, as shown in the diagram, short circuits the armatures.—*St. R'y Jour.*, January 3.

Brakes for Electric Tramways.—A discussion of the different types of brakes. The method of braking is by resistance applied to the wheels and has the disadvantage that if used too strenuously it will skid the wheels and bring about danger of its own. The same objection is true for the method of braking by resistance applied to the axles, if it involves a friction wheel or disc on the axle, but generally the resistance is created by closing the circuit of the armature of the motors through rheostats, and thus converting them into generators; in this case serious skidding is impossible, but this method put extra work on the motors. The track brake has the disadvantage that it takes much of the weight of the car off the wheels at the very time when the danger threatening the passengers lies in the car jumping the track. From trials with the air brake it does not seem likely to become established for tramways. The ideal brake would be one which does not add much to the machinery carried by the car, and which is incapable of skidding the wheels; that is, the pressure which it can exert should be dependent on the state of the rails. The writer thinks that the brake which appears to answer these requirements most nearly is the Westinghouse magnetic brake. Favorable results are given of tests made on the Leeds tramways. But the main merit of the Westinghouse brake is said to be that it almost eliminates the driver from the problem; it leaves him as little to do as is possible under the circumstances.—Lond. *Eng'ing*, December 19.

Augusta & Aiken Railway.—A description of this line which follows an irregular course between Augusta, Ga., and Aiken, S. C. The country traversed by the road is very wild, and the difficulties encountered in construction were very great. The road has been built on steam railway specifications and is intended to carry passenger trains operating at high speed, and also heavy freight trains. The main power plant contains two 450 hp compound condensing engines, and two 300 kw direct connected railway generators. The current furnished by these machines is partly used on that section of the line nearest the station, the rest of it is transformed by means of a 200 kw inverted rotary and step-up transformers, which feeds the farther end of the line. A sub station is located near Aiken where this current is again transformed down to 575 volts, at which it is delivered to the trolley.—*St. R'y Jour.*, January 3.

Electric Haulage on Canals.—Marchant.—An abstract of a paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. and of the discussion which followed. The author reaches two main conclusions. First, that the most suitable method of haulage is by tractors running along the tow path; secondly that the three-phase system is best adapted to the work.—Lond. *Elec. Rev.*, December 26.

Gerard.—An abstract of a paper read before the Internat. Congress on Navigation in Dusseldorf. He gave details concerning installations on Belgian and French canals, most of which have already been noticed in the Digest and in the Electrical World and Engineer. He reaches the following principal conclusions: The "motor-car" system of haulage is very unsatisfactory owing to the heavy working and maintenance expenditure, and to the amount of power required to overcome the imperfections of the road. The "locomotive" system of haulage is practical as far as both the economical and the technical sides of the question are concerned. The "tug-boat" system has given good results, and is to be recommended for service on crowded and sinuous canals. A lighting and power distribution scheme in conjunction with the traction installation would considerably increase the profits of the undertaking.—Lond. *Elec. Rev.*, December 26.

Advantages of the Unit "Car Hour."—In reply to a recent inquiry, the auditor of the Milwaukee company explains the advantages of the car hour as a unit of comparison. He compares a line requiring 30 minutes for each half trip, with average earnings of $4 per round trip and 36 cents per car mile, with a longer line requiring an hour for each half trip and average earnings of $6 for each round trip and 20 cents per car mile. He shows that with the car hour these earnings show a ratio of 4 to 3, which is usually a better comparison than the car mile basis, as the latter does not consider the question of speed. The company with which the writer is connected has used the car hour basis for more than two years and believes it superior to the car mile basis.—*St. R'y Jour.*, January 3.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Isolated Plants.—Moses.—An illustrated article on economy in the design and operation of isolated electric plants. The basis of the design of plants must be the cost. He gives some tables of cost of boilers, engines and dynamos for isolated plants; with such data as a rough basis the design of the plant for economy becomes easier; it involves a load curve showing the amounts of power and light that will have to be supplied during different hours of the day. After this is plotted the plant should be divided into as few units as will enable the boilers, engines and dynamos to work at or near their maximum economy, and at the same time provide a sufficient number so that in the event of the breakdown of one, the others will be capable of carrying the load. The limit of size of one of the units is generally fixed by the day load, which is principally power; the total plant capacity is fixed by the maximum possible load, and the size of the other units by the maximum probable load. A casual study of the load curves of an apartment house, an apartment hotel, or an office building, shows a very light load, from one-fifth to one-fourth of the maximum, during three-fourths of the time, and a heavy load during the remainder, approaching three-fourths of the total capacity connected to the lines. This would indicate a small unit for day work, and two large units, the sizes to be such that either of the large units (together with the small one, in emergencies) could supply the demand for the heavy load period; ordinarily the two large ones would run together during heavy load periods. Where electric elevators are installed, another factor is introduced through the starting current required and the small average running current; here the storage battery comes in. Its cost is largely offset by the saving in boiler, engine and dynamo equipment. In a plant recently designed, the cost of the engines and dynamos required where no storage battery was used (two large generating units and one small one) was $10,200; and the cost of the engines and dynamos required with a battery was only $7,900; the price of the battery was $4,000, making the net cost of its installation only $1,700. The storage battery reduces operating expense and offers numerous inducements, among them steady lights, free from fluctuations, a reserve capacity in case of accident to the steam main or shut-off of water supply, and absence of noise or heat when the electric plant is shut down. Another point in the design of electric plants where large wastes are usual and avoidable, is in the grates for boilers and the methods of fuel burning; cheap fuel well burned is more vital to the cheap production of power than any economy that can be introduced in the design of the engines or other machinery. Another economy less important except where refrigerating machinery is installed, is in the water supply; the water required for steam costs in New York about 25 or 30 cents per ton of coal burned under the boiler; one-fifth of this or less may be saved by using an open feed water heater and returning the water to the boiler. Another economy is the more or less complete use of the exhaust steam from engines for heating, boiling or similar moderate temperature applications.—*Eng. Mag.*, January.

ELECTRO-PHYSICS AND MAGNETISM

Dielectric Constants of Crystals.—Schmidt.—An account of measurements of the dielectric constants of crystals by a method originally described by Drude. It consists in immersing small crystals in liquids of various dielectric constants varying from 2.3 to 80 and composed of more or less dilute solutions of benzol in azetone or of azetone in water. The bath is placed between the armatures of a condenser at the end of a Lecher wire system, and when the liquid has the same dielectric constant as the solid, the immersion of the latter causes no alteration in the position of maximum resonance. He has made this method available for crystals of a high dielectric constant by making the secondary circuit resound to the primary circuit underneath it, thus practically employing the method used by Drude for the determination of inductances. Maxwell's rule for the relation between dielectric constant and refraction index is fulfilled only in sulphur. In the other crystals examined there is no numerical agreement whatever, and there is generally no qualitative agreement either. In some crystals, like pyromorphite, rutile and aragonite, the "electric double refraction" or difference of dielectric constant in different directions may be as high as 50 per cent. Rutile and pyromorphite also show a surprisingly high dielectric constant considering their low conductivity. In beryllium and tourmaline the dielectric constant is much greater at low frequencies than it is at high frequencies.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 19.

Atmospheric Ionization.—Rutherford and Allen.—An account of experiments on the spontaneous ionization of the air inside a closed vessel, which is apparent from the fact that a well insulated charged conductor placed inside a closed vessel gradually loses its charge. They found that the number of ions which are produced in a second per cubic centimeter of the air inside the vessel, may be anything from about 13 to 40, but is often equal to 19; this value is surprisingly small. It is possible that the spontaneous ionization of the air observed in closed vessels may be due, in part at least, to a radiation continuously emitted from the walls of the vessel.—*Phil. Mag.*, December; abstracted in Lond. *Elec.*, December 19.

REFERENCE.

Electric Waves.—Chant.—An account, illustrated by diagrams, of an investigation of the variation of potential along a wire transmitting electric waves.—*Am. Jour. Sc.*, January.

ELECTRO-CHEMISTRY AND BATTERIES.

The Problem of Storage Batteries.—Swinburne.—In his presidential address to the (Brit.) Inst. Elec. Eng. he discusses the problem of storage battery design as follows: We are practically limited to lead, at any rate in acid cells. The plate which is anode during discharge should not dissolve in the electrolyte, which excludes zinc and iron unless a suitable electrolyte is found. On the other plate an insoluble depolarizer is needed, or else a double fluid cell must be used, involving difficulties; it must also be converted into an insoluble body on discharge, and the coating must be a conductor. The depolarizing coating must be connected to a conducting plate, which is not attacked by local actions. Lead and silver are the only available metals and sulphuric and perhaps phosphoric, the only acids, for the nitrate of lead is soluble and hydrochloric acid is decomposed by lead peroxide. "It thus seems as if we were limited almost absolutely to lead and sulphuric acid." What is wanted in the lead cell is lightness, large capacity, cheapness, rapid discharge, efficiency and mechanical strength and durability, but these qualities are mostly antagonistic; large capacity means rapid deterioration, mechanical strength means weight. It is thus of no use to test a cell for capacity without testing the efficiency and durability too; published battery reports are often misleading, because they omit essential information. In alkaline cells, although the e.m.f. is smaller, the metals admit of light plates and grids, and the coating may conduct in both states, instead of only one as in lead cells, so that a larger proportion of the coating may be active. "The future of this type of cell is uncertain, as very little has been published as to results."—Lond. *Elec.*, December 19.

Statistics.—STRUTHERS.—A statistical article on the production of minerals and metals in the United States during 1902. The grand total of the value of metallic and non-metallic substances produced in the United States from domestic ores during 1902, was $1,360,344,147, as compared with $1,198,938,697 in 1901, an increase of 13 per cent. for the year. The production of aluminum was 7,300,000 lbs., valued at $2,284,590 (against 7,150,000 lbs. and $2,238,590 in 1901). The copper produced in 1902 was 669,855,006 lbs., valued at $78,630,453 (against 609,173,212 lbs. and $87,300,515). 358 ounces troy of platinum were produced from domestic ores and 674 ounces were recovered from South African ores; the quantity of platinum imported during the first eleven months of 1902 was 6,467 lbs., valued at $1,766,869. The output of zinc was 158,447 short tons, valued at $14,380,650. The output of carborundum was 3,800,000 lbs., valued at $324,058. The output of artificial graphite was 2,351,491 lbs., valued at $111,251. The quantity of sodium salts manufactured in this country was 528,000 tons, valued at $9,477,600. There are also special articles on antimony in 1902; copper, gold and silver; lead, nickel, platinum, tin, zinc, iron and steel, coal, and on progress made in metallurgy at various places.—*Eng. & Min. Jour.*, January 3.

Statistical.—SCHNATTENBECK.—An article on the chemical and allied mineral trades in 1902 in America. Manufacturers of electrolytic caustic soda are proving hard competitors to sellers of the old process article; imports are suffering severely from this competition. The consumption of bleaching powder is heavy; prices are so low that it is impossible for the older works to compete with the modern plants employing electrolytic processes. The domestic consumption of bleaching powder is now about 75,000 or 80,000 tons a year. A feature in the trade was the appearance of the new electrolytic bleach made by the Solvay Process Company, of Belgium.—*The Eng. & Min. Jour.*, January 3.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometry of Electric Lamps.—FLEMING.—A review of his recent lecture before the (Brit.) Inst. Elec. Eng. In discussing standards he decides in favor of the Vernon Harcourt pentane ten-candle lamp, though due credit is given to the Violle standard. As a secondary standard a glow lamp with a large bulb—to minimize blackening—is recommended. Various photometric processes are described and explained, with special reference to total reflection photometers and rotating disc methods of varying the light. Incidentally he mentions that the potentiometer is the only trustworthy measuring instrument for photometric work, no voltmeter or ammeter being sufficiently accurate. After having pointed out the great importance of the comparison of lights of different colors, he discussed the "discrimination" and "flicker" photometers and concluded that our definitions of luminous intensity are imperfect. As unit, he proposes to discard the candle altogether, to standardize the 10-candle pentane lamp and to measure luminous intensity in "lamp powers" with a "lampmeter" as the unit of brightness.—Lond. *Elec. Times*, December 18; a complete reprint of the paper begins in Lond. *Elec. Times*, December 18, 25.

Magnetometers Free from Disturbances.—DU BOIS.—An article in which he indicates a possible method of eliminating the disturbances of outside magnetic fields from magnetometers, if they obey certain rules, although that elimination is necessarily tedious and associated with a certain loss of sensitiveness. As a rule, the effect to be measured is variable from point to point, and may be calculated for special positions. The disturbing effect is much subjected to variation in time, but when the source of disturbance is at some distance, it may, as a rule, be represented by a uniform horizontal component within a certain space. This indicates the possibility of differentiating the two effects. A rough-and-ready arrangement for thus measuring the magnetic moment of a bar magnet is indicated by the author; two magnetometers are used and placed at different distances along the same line drawn from the center of the bar. The difference of their readings is then proportional to the magnetic moment, and this difference is independent of any disturbance, such as that of an electric railway. He describes various differential suspensions, but admits that the choice of a suspension depends altogether upon the particular disturbance to be combated.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 19.

MISCELLANEOUS.

Sewage Purification.—CORBETT.—An abstract of a paper in which he gives an account of experiments made at Salford with various processes of treating sewage. Among the processes tried was Webster's electrolytic process, and it is said to have been in many points the most unique and most successful of the processes experimented with. Its cost was somewhat high, though by no means the highest considered practicable. In this process the sewage is passed between cast-iron plates, alternately connected with the positive and negative wires of a dynamo. The effect of this is much like that of chemical precipitants, the sewage being separated into clear liquid and flocculent particles, which subside into sewage sludge in ordinary precipitation tanks. The tank effluent is clear and non-putrescible. About half the cost of working is for power to produce the electricity required. The company's offer was to treat the Salford sewage for 20 years at $15.06 per million gallons, they providing all plant, etc. In an appendix the following figures are given concerning this process. The requirements per million gallons of sewage treated per day were as follows: Steam engines of 41.76 ind hp; electric hp therefrom, 33.4; average voltage employed, 41.02; iron used from the electrodes, 428 lbs.—Lond. *Eng'ing*, December 26.

New Books.

THEORETICAL ELEMENTS OF ELECTRICAL ENGINEERING. By Charles Proteus Steinmetz. New York: ELECTRICAL WORLD AND ENGINEER. 323 pages, 144 illustrations. Price, $2.50.

This is the second edition of an excellent text-book. The first third is devoted to general theory, illustrated by practical examples. This deals with magnetism, induction, e.m.f., alternating currents, impedance and phase control. The second part of the book is devoted to an elementary analysis of special forms of dynamos, electric machinery, including synchronous machines, commutating machines, synchronous converters and induction machines.

Although the treatment is elementary, it is very thorough and condensed, so that it is a splendid text-book of dynamo-electric machinery. It is a book which will commend itself to every student of electrical engineering, elementary or advanced. Not a small part of its value lies in the departure in its method and arrangement from the academic text-book, the development and perspective of the subject being those of the engineer and not of the pedagogue.

BOOK RECEIVED.

THE ART OF ILLUMINATION. By Dr. Louis Bell. New York: McGraw Publishing Company. 339 pages; 127 illustrations. Price, $2.50.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Electrically-Operated Oil Circuit-Breaker for High Tension Circuits.

The accompanying illustrations show a three-pole, double-break, automatic oil circuit breaker, operated by electromagnets. The circuit breaker is erected in a masonry structure with each pole and oil tank in a separate fire proof compartment. There are two stationary contacts to the pole, one connected to the incoming lead and the other to the outgoing lead of the same phase, each contact being mounted in a large porcelain insulator. In one of the illustrations one of the porcelain insulators is visible in the right-hand compartment.

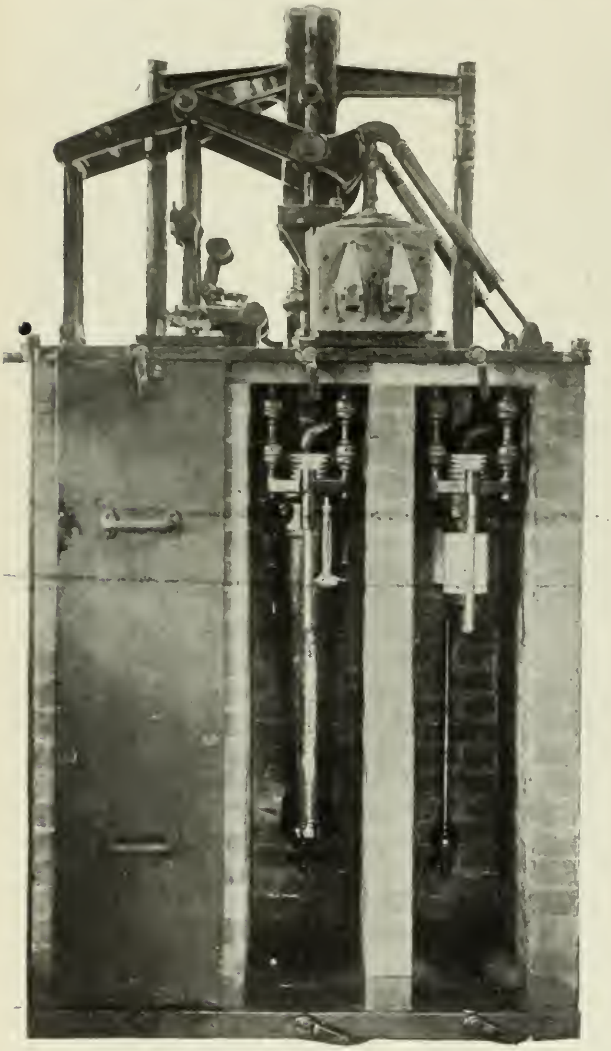


FIG. 1.—ELECTRICALLY-OPERATED OIL CIRCUIT-BREAKER.

The insulators are fastened to a cast-iron frame which also supports the enclosing oil tank. The frame itself is supported from the soapstone slab at the top of the masonry walls by strain insulators. The movable contact for each pole consists of a U-shaped piece of copper fastened to the end of a stout wooden rod. In the closed position of the switch one of these U-shaped pieces electrically connects the two stationary contacts of each pole. The wooden rods are fastened at their upper ends to a common cross bar, which extends over the three masonry compartments and is supported by a system of levers giving a straight-line up-and-down motion. The cross bar is raised by the enclosing magnets, assisted at the beginning of the motion by a pair of balancing springs. The springs and the case containing the magnet are at the upper right hand corner in the illustrations. A toggle joint, shown at the left in the illustration, automatically locks this system of levers when the circuit breaker is in the closed position.

The toggle joint is released by a blow from the tripping magnet, whereupon the cross bar under the influence of gravity, and a powerful spring quickly drops, opening the contacts. The break takes place first at the main contacts and then afterward at a removable plug attached to the stationary contact which enters a hole on the movable contact. The plug thus receives all the effects of any arcing that there may be and, since it is removable, is easily replaced. The current for the closing and tripping magnets is derived from the exciters storage battery or other source of low-voltage, direct-current supply. If necessary the circuit-breaker can easily be operated by hand without disturbing the mechanism in any way.

The oil tanks, one of which is to be seen in the middle compartment of Fig. 1, are constructed of heavy sheet metal and the interior is lined with insulating cement which is moulded to fit closely about the terminals and moving contact piece, leaving just room enough for the free movement of the parts in oil. By this means the amount of oil is reduced to a minimum. When the circuit-breaker is open, the wooden rod interposes an effective barrier between the two terminals of each pole. Suitable levers are provided for handling the tanks, which may be lowered away from the contacts and removed without disturbing the rest of the circuit-breaker. The entire circuit-breaker may be set in place and all parts adjusted before the oil tanks are placed in position. When necessary the tanks may be filled without removing them from their position. The oil level is easily seen by means of a small sight gauge. The tanks are insulated from the circuit and, all the live metal parts being immersed in oil, there is no possibility of receiving a shock from touching the breaker.

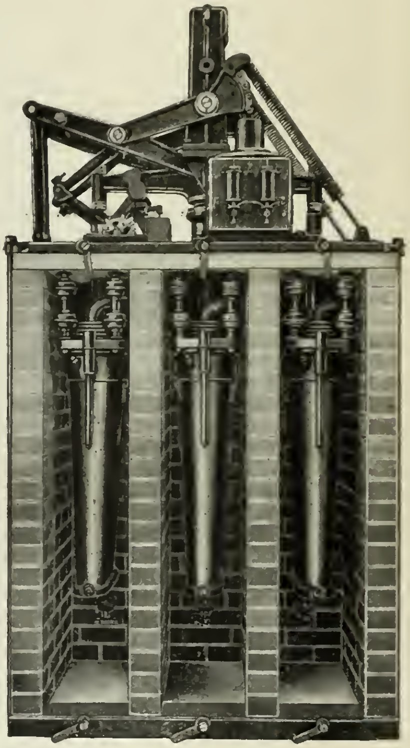


FIG. 2.—VIEW OF CIRCUIT-BREAKER SHOWING ALL OIL TANKS.

Mounted on each circuit-breaker is a small double-pole, double-throw knife switch, which is used with the indicating and tripping circuits, and is operated by the motion of the levers of the circuit-breaker. The controlling and indicating devices consist of a controlling switch, an electro-mechanical, tell-tale indicator, and a lamp. These are suitably mounted at the operating platform. A polyphase overload relay, connected to series transformers in the main circuits, is provided for automatic opening. The controlling switch, which is of the drum type, has three positions, namely, "closed," "off" and "open." It will remain of itself in the "off" or the "open" positions only. In other words, if it is thrown to the "open" position it will remain in that position when the hand is removed, but if it is thrown to the "closed" position it will turn of itself to the "off" position as soon as the handle is free. In the "off" position it connects the control circuit so that if the oil circuit-breaker opens through the action of any of the automatic devices the lamp will be lighted on the operating stand to attract the operator's attention. If the oil circuit-breaker is opened by the operator throwing the controlling switch to the "open" position, the lamp does not light.

The mechanism of the electro-mechanical tell-tale indicator consists of an electromagnet which attracts a pivoted armature through an angle of about 90°. Attached to the armature is a disc with a pointer which indicates to the eye the "open" or "closed" position of the oil circuit-breaker.

In the accompanying illustration the closing magnet is partly hidden by the overload relay. This operates on the principle of the single-phase induction motor. Each of the sectors swings between the poles of an alternating-current electromagnet. Part of each pole is surrounded by a short-circuited strip of copper, which acts to retard the magnetic flux and thus produce a shifting field. This tends to move the counter-weighted sectors which carry a contact closing the tripping circuit of the circuit-breaker. The two sectors are connected in parallel and either alone will trip the breaker. The currents for their magnets are derived from the phases of the main circuit by series transformers. The apparatus described above, known as the "Type C Circuit-Breaker," is manufactured by the Westinghouse Electric & Manufacturing Company.

Columbia Arc Lamp.

The accompanying illustrations show a new type of enclosed series arc lamp made by the Columbia Electric Manufacturing Company, of Newark, N. J. The lamp has a differential winding and the two magnets are secured by four screws to two brackets. The brackets are secured to the top of the plate and the lower shelf plate, and also to the central tube, thus adding a great strength and rigidity and enabling the lamp to stand very rough handling.

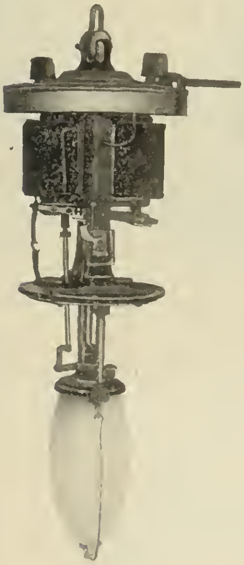


FIG. 1.—SERIES LAMP.

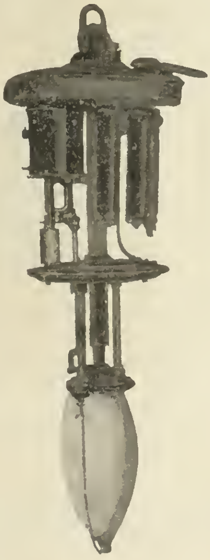


FIG. 2.—MULTIPLE LAMP.

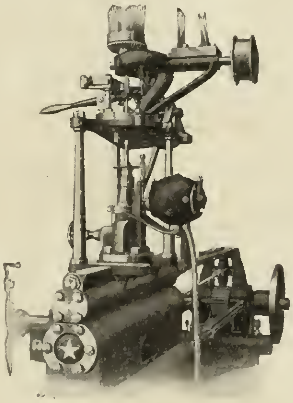
An important feature of the lamp is an automatic valve over the inner globe which opens when an excess of pressure exists and closes when this pressure becomes normal. By this means a constant pressure of the gas is obtained in the inner globe. The cut-out is extremely simple and works entirely by gravity.

It is stated that this lamp will burn on any series arc lamp circuit without changing adjustment, and with a single set of carbons will last one week. Fig. 2 shows a multiple lamp, the form of which is the same as that of the single lamp, the only change being in the magnets and side brackets and dash-pot. The resistance is on the same bracket with the magnets and is wound on four small porcelain spools, any of which can be readily removed. In fact, all parts can be removed from the lamp with the use only of a screwdriver, the main frame not being disturbed.

Electrical Control of Water Wheel Governors.

In the account printed last month of the Sault Ste. Marie water power electrical generating plant, reference was made to the system of controlling all the water wheel governors from a central point, and we are now enabled to give some details of the method, which has recently been introduced by the Lombard Governor Company, of Boston.

The apparatus for accomplishing control from a central point is very simple, consisting merely of two small push buttons on each generator panel on the switchboard or pilot switchboard, which connect through three wires to a little electric motor, similar to those used for driving fans. This motor through suitable mechanism acts upon the valve stem of the governor in such a manner as to lengthen or shorten the connection between the centrifugal balls and the valve itself. The part of the device attached to the governor is shown very clearly in the illustration.



ELECTRICALLY-CONTROLLED WATER WHEEL GOVERNOR.

A small motor of the form commonly used to drive fans is mounted upon a bracket which is clamped to the regulating valve of the governor. This motor, which has the capacity of about 1/16 of a horsepower, is never called upon to exert more than 1/100 of a horsepower. Upon the armature shaft is mounted a small worm driving a worm gear on a vertical pinion shaft. This pinion transmits rotary motion to a gear which, being threaded through its hub, acts as a right and left coupling to draw together or push apart the two portions of the valve stem upon which it rotates. The pinion which drives the gear is long enough so as not to interfere with the up and down travel of the gear, and therefore the control of the valve by the centrifugal balls is not affected in any manner. The whole attachment may be fastened in place on the regulating valve in a few minutes' time.

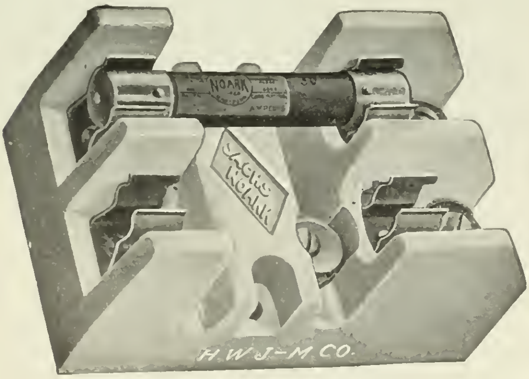
The method of operation is perfectly apparent, the small motor serving only in place of the attendant's fingers to shorten or lengthen the valve stem according to his will. Heretofore in bringing generators into synchronism it has usually been necessary for one man to watch the synchronizing lamps while an assistant stood by the side of the governor, gradually changing its speed according to signals received from the switchboard. Now the services of the man at the machine are not required, for the man at the switchboard with his fingers on the two push buttons can raise or lower the speed of the generator, which is to be thrown in multiple with others, without taking his eyes for an instant away from the synchronizing lamps or corresponding device. Thus there is not only a saving of time but also a more certain action. If it is desired, the man at the switchboard can without leaving his post shut down any generator, bringing it to a complete stop, and afterwards start it again. The gear connections from the motor are such that a delicacy of adjustment is possible, finer even than can be obtained by the fingers. The motion is absolutely positive and there can be no change except by the will of the operator.

Where alternating current generators are in use, current for the proper operation of the device is generally obtained from an exciter circuit. Where it is desirable to use an independent source of energy, special motors are provided, to be run upon a primary or secondary battery circuit. There is stated to be no difficulty in operating the device with two cells of common dry batteries. There is no limit to the distance between the controlling push buttons and the governor. If the space is very great, say several miles, telegraph relays are installed near the governor. Telephone or telegraph wires may thus be used, a suitable switch being arranged to throw them out of service for a few moments while synchronizing. Thus in electrical distribution systems the speed at the generating stations may be controlled from the central distributing station.

Under certain circumstances, although not generally, it is desirable that a signal should be sent back from the governor to indicate the change in length of the valve stem, and thus indirectly the change in speed which takes place. An extra attachment can easily be made which will do this, and will also permit the operator to change the speed by a step-by-step adjustment of a predetermined amount, for example, ½ per cent. for each push of the button.

Branch Fuse Blocks.

The accompanying illustration shows a view of a "Noark" branch fuse block for 220-volt "Noark" fuses, manufactured by the H. W. Johns-Manville Company, New York. In its construction a departure has been made in the usual arrangement for branch block devices, in which the fuses for the branch circuits abut at right angles to the outside of the two or three parallel main wires. In this branch block the object has been to economize space and at the same time produce a branch block in which the arrangement of the wires and fuses should be absolutely safe, in both the operation and manipulation of the device. To obtain this result, the branch fuses are so arranged that each of the terminals in which the branch fuses are received and to which the branch wires are connected are separated from the adjoining terminals by heavy partition walls, high enough above the contacts to prevent anything being laid across from contact to contact and cause short circuiting. The main wires to which the branch block is connected, instead of passing across the block at the end of the branch fuses, are arranged to traverse it in suitable grooves placed in the porcelain block between the terminals of the branch fuses. In this way economy of space is effected, while at the same time the block can be easily and readily installed and the manipulation of the fuse devices for a removal or insertion is entirely safe.



FUSE BLOCK.

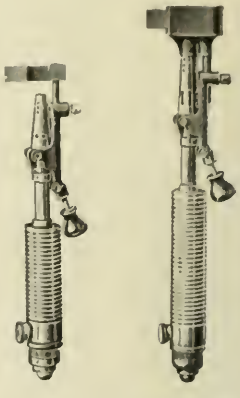
The company furnishes these branch blocks at the present time in single branch only for 2 and 3-wire circuits and in one size, which has a fuse capacity of 1-30 ampere at 220 volts, but larger sizes are being developed.

Combined Soldering Iron and Blow-Torch.

In Figs. 1 and 2 are shown two sizes of a combined soldering iron and blow-torch, which is recommended for general soldering work, electrical work and other purposes calling for the use of the devices represented.

The device is very compactly designed, the handle holding the supply of benzine. The soldering iron is removable when the torch is to be used alone; when it is in use it is attached in the manner shown, thus bringing it into contact with the flame.

Messrs. J. Jones & Son, 64 Cortlandt Street, New York, are handling this device, and state that it is a good, practical tool for linemen, or for use in any place where connections are to be made, such as underground or switchboard work.



FIGS. 1 AND 2.—SOLDERING IRON AND TORCH.

Nail Puller for Electricians.

The Smith & Hemenway Company is putting on the market a very neat and handy nail puller for electrical purposes, illustrated herewith. One form only weighs 2½ ounces, is very small and can be carried in the pocket for pulling small nails with the assistance of a claw hammer. The other can be used in connection with any ordinary hammer and weighs 6½ ounces. Every electrician should welcome this, as it will assist him very materially in taking nails from strips covering insulating wires.

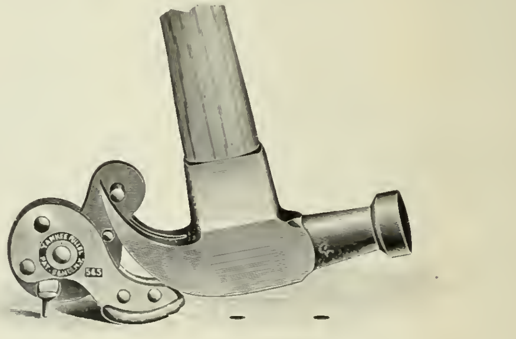


FIG. 1.—NAIL PULLER.

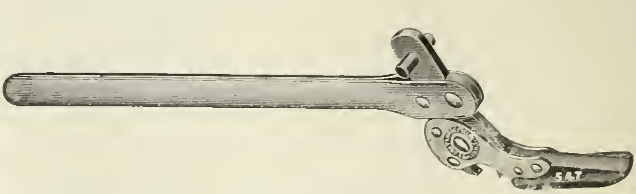


FIG. 2.—NAIL PULLER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money eased throughout the week and at the close was offered with freedom, closing at 5¼ a 5¾ per cent. for all dates from 60 days to six months. In the stock market there were gains in both strength and activity, heavy manipulations being supplemented by a further increase in outside interest. The further easing of money rates developed confidence alike among professionals and the public. The annual report of the United States Steel Corporation produced a favorable influence upon the industrial list. The Steel stocks were quite strong, preferred selling up to 89¾ and common to 39. Amalgamated Copper was quiet and weak, due to the feeling that the improvement in the copper trade had been fully discounted. The traction group showed considerable strength and activity. In Brooklyn Rapid Transit there was good buying, which was, however, attributed to manipulative interests. The sales of this stock aggregated 144,595 shares, at prices ranging between 66¾ and 70⅝, the closing figure being 69¼, a net gain of 2¾. Metropolitan Street Railway made a net gain of ½ point, closing at 141½, and Manhattan 4 points, the closing price being 153. Electrics show advances over last week's figures, General Electric closing at 187¼, representing a net gain of 2¾; Westinghouse, common, 218, and preferred, 224, being net gains of 6 and 9 points respectively. Western Union closed at the highest figure of the week—92—thus gaining 3⅝ over the last previous quotation. American District Telegraph dropped off ¼, closing at 40. In Boston Edison Electric Illuminating closed at 270. Following are the New York closing quotations of January 13:

NEW YORK.

	Jan. 6.	Jan. 13		Jan. 6.	Jan. 13
Amcrican Tel. & Cable	85	85	General Electric	189⅜	185
American Tel. & Tel.	163	164	Hudson River Tel.	..	..
American Dist. Tel.	38	39	Metropolitan St. Ry.	142⅛	141⅛
Brooklyn Rapid Transit	69⅞	68⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	161
Electric Boat	30	22	N. Y. E. V. T. Co.	11	11
Electric Boat pfd.	42	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3⅝	Western Union Tel.	90	91¾
Electric Vehicle	5	6⅞	Westinghouse com.	218	212
Electric Vehicle pfd.	11	..	Westinghouse pfd.	222	212

BOSTON.

	Jan. 6.	Jan. 13		Jan. 6.	Jan. 13
American Tel. & Tel.	163½	161½	Western Tel. & Tel. pfd.	99½	101
Cumberland Telephone	127	..	Mexican Telephone	2	2⅛
Edison Elec. Illum.	.	..	New England Telephone	138	138
General Electric	..	.	Westinghouse	107	104
Western Tel. & Tel	24	..	Westinghouse pfd.	107	109

PHILADELPHIA

	Jan. 6.	Jan. 13		Jan. 6.	Jan. 13
American Railways	52½	..	Phila. Traction	98¼	98½
Elec. Storage Battery	80	79	Phila. Electric	8¾	8½
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	10	9¾	Pa. Electric Vehicle pfd.	..	..

CHICAGO.

	Jan. 6.	Jan. 13		Jan. 6.	Jan. 13
Central Union Tel.	..	..	National Carbon pfd.	97	97
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry.	208	215	Union Traction	15¼	16½
Chicago Tel. Co	..	..	Union Traction pfd.	45	50
National Carbon	26	26			

INDIANAPOLIS TROLLEYS.—It is said that financial Indianapolis is gossiping over the great profits which must accrue to the Widener-Elkins syndicate, growing out of the recent transaction by which the Indianapolis Traction & Terminal Company comes into control of the Indianapolis street railway lines. It is believed the syndicate is in a position to reap millions. The control of the Indianapolis street railway system is vested in the bondholders of the Indianapolis Traction & Terminal Company. In addition, the Widener-Elkins syndicate holds a majority of the stock of the Indianapolis Street Railway, of which there is $5,000,000, which has advanced from 30 to more than 90 cents in less than a year. Heretofore it has been necessary for the Widener-Elkins people to control this stock in order to control the street car system, but, with the lease to the terminal company, the franchise of the old company is vested in the new, and, by retaining control of the new, the Widener-Elkins people continue in control of the old. Holding nearly all the stock of the first-named company the Widener-Elkins people will receive nearly all the $1,500,000 of stock of the terminal company given to stockholders of the street car company, to secure their acceptance of the lease to the terminal company. The other $3,500,000 of terminal company stock has not been offered to the public, and it is believed that the larger part of it will eventually pass to the Widener-Elkins people.

RICHMOND (VA.) TROLLEY DEAL.—The Virginia Passenger & Power Company, the control of which was recently purchased by Frank Jay Gould, had its annual meeting last week and elected the following directors: Frank Jay Gould, Edwin Gould, A. H. Calef, Guy Phillips, Alfred Skitt, New York; F. Sitterding, William Northrop, J. D. Paton, Richmond, and Augustus Wright, Petersburg. The board met at the Western Union building, 195 Broadway, and elected the following officers: President, F. Sitterding; first vice-president, Frank Jay Gould; second vice-president, Augustus Wright; secretary and treasurer, Guy Phillips; assistant secretary and treasurer, William Northrop; general counsel, Charles A. Gardiner. The capital stock of the company is $15,000,000 and bonded indebtedness $15,000,000. It is a consolidation of all the street railway, electric light and power companies in Richmond, Manchester, Petersburg and surrounding territory, and includes the Richmond Traction Company, Richmond Passenger & Power Company, Richmond & Manchester Railway Company, Richmond & Petersburg Railway Company, Virginia Electric Development Company, Westhampton Park Railway Company, and several other similar corporations.

DIVIDENDS.—The directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¼ per cent., payable February 14. A dividend of $3.75 has been declared on the Philadelphia City Passenger Railway, payable January 10. The Standard Underground Cable Company, of Pittsburg, has declared the regular quarterly dividend of 2 per cent. and an extra dividend of 2 per cent., payable January 10. The distribution amounts to about $80,000. Brooklyn City Railroad Company, 2½ per cent. quarterly, payable January 15. The Electric Company of America has declared a dividend of 30 cents per share, semi-annual, payable January 31. This is an increase of 5 per cent. per share. The regular semi-annual dividend of $3 per share has been declared on the preferred stock of the Minneapolis General Electric Company, payable February 22, 1903. Consolidated Traction Company of New Jersey directors have declared a dividend of 1¼ per cent. out of the rental payment made by the North Jersey Railway, payable January 15. A regular quarterly dividend of 2½ per cent. has been declared by the Edison Electric Illuminating Company, payable February 2, 1903.

BALTIMORE TROLLEYS.—The United Railways Company, now controlling all the Baltimore (Md.) street railways, and with one or two exceptions, the suburban lines, will close a deal on January 26 for the Baltimore, Sparrows Point and Chesapeake Railway. This is a corpration that will be formed by the consolidation of the Baltimore, Middle River and Sparrows Point Railroad and the Dundalk and North Point Railway Company. The stockholders of the United Railways will be asked to guarantee the principal and interest of a bond issue by the consolidated company, as well as the payment of an annual rental equivalent to the annual interest and all other charges of the Consolidated Company. This payment is to be made to the Maryland Trust Company, trustee of the mortgage to be created for an issue of $2,000,000 bonds. The bonds will cover the cost of construction of the new road and provide for hotels and summer resort improvements on the shores of the Chesapeake Bay.

GENERAL ELECTRIC GOSSIP.—By way of Boston it is reported that the General Electric Company is now earning at the rate of about $10,000,000 per year or nearly 25 per cent. upon its new capital of $42,000,000. Some months the earnings have been above $1,200,000. The New York directors, it is also alleged, desire the dividend to be raised to 10 per cent., but the Boston directors prefer to keep the dividend rate down and make extra dividends from time to time as the cash warrants, for it is the intention of the company never again to be short of cash.

NEW ORLEANS TROLLEY MORTGAGE.—The New Orleans Railways Company has filed a mortgage in New York in favor of the Uew York Security and Trust Company, by the terms of which all the property and franchises of the various independent street railways are pledged to secure an issue of $40,000,000 of 4½ per cent. gold bonds. The property is to be held in trust. The New Orleans Railways Company is a New Jersey corporation.

KEYSTONE TELEPHONE.—With regard to the Keystone Telephone troubles, noted recently, Deputy Sheriff Cronin has received two attachments aggregating $74,193 against the Keystone Telephone Company, a New Jersey corporation, which were obtained for the National Conduit and Cable Company, of New York, $25,552, and for Charles J. Marsh, $48,641, on an assigned claim of the Standard Underground Cable Company, of Pittsburg, Pa., for cables.

Commercial Intelligence.

THE WEEK IN TRADE.—The new year has made a good start, and the situation in trade is very satisfactory. Among the industries, activity is unabated, the only unfavorable feature being the scarcity of cars and fuel, which limits the production of iron and steel and curtails shipments of lumber and grain. Prices as a whole show aggressive strength, present levels being the highest in over two years. Railway traffic reports show that with the turn of the year previous satisfactory conditions continue, while final returns as to 1902 point to an aggregate excess in gross earnings for the calendar year of 7 to 8 per cent. over the best year previously reported. Collections are fair to good in the West, the best reports coming from St. Louis and Chicago; but in the South they continue slow. Pacific coast trade reports are excellent. In Maine liberal snows are helping lumbering operations. The iron and steel market was quiet, but with a tendency toward activity. Foreign importations of iron and steel are very heavy. In copper there was a stronger market with higher prices, although there was little increase in demand. Lake is held at 12.40c. for spot; 12.10 a 12.30c. for electrolytic and casting stock, and 11¼ a 11½c. for Standard. The number of business failures for the week ending January 8 as reported by *Bradstreet's* aggregated 336, as against 202 the previous week, and 346 the corresponding week last year.

THE BRILLIANT ELECTRIC COMPANY, organized in Cleveland, Ohio, some months ago with $100,000 capital stock, has commenced the manufacture of incandescent lamps in a well-equipped factory. The directors of the company are: N. S. Possons, president; A. B. Foster, vice-president; I. N. Pennock, treasurer; George B. Rodgers, secretary; W. H. Garlock, M. C. Marble, Mathew Smith and M. H. Nason. Mr. Possons, who is responsible for the new features to be shown in the company's product, will be the business head of the company. He is well known to the electrical trade throughout the country and is well qualified to conduct the new industry by reason of his long experience as general superintendent of the Brush Electric Company and later of the Universal Electric Company, both of Cleveland. A. B. Foster is also widely known to the trade, being president of the Electric Supply & Manufacturing Company and of the Nungesser Electric Battery Company, of Cleveland. The other gentlemen mentioned are prominent and wealthy Cleveland business men. The company has spent many months in experimental work and is now prepared to market a high-grade incandescent lamp, which it is claimed will give a brilliant white light without perceptible deterioration. Through the aid of a secret process of treating the filament, a high efficiency is maintained throughout the life of the lamp. A Cleveland bank which was recently equipped with a lot of these lamps reported a considerable saving on its bill for current during December over the previous month, despite the fact that the lights had been used about 15 per cent more hours than during the previous month when the room was lighted with other lamps. The company's factory is now producing about 2,500 lamps per day and this will be increased gradually to 7,000 lamps per day. The factory has been equipped with latest improved machinery for the production of lamps, including a number of devices designed exclusively for the company's use. A number of varieties of lamps will be produced and the company expects to sell its product very largely through jobbers, many of whom have already applied for samples of lamps for testing purposes.

ENGLAND IN SOUTH AFRICA.—A special commissioner of the London *Engineer* in South Africa, discussing the machinery outlook, says: "In electrical plant our position is a very critical one. I believe we do from 35 to 40 per cent. of the total, as far as the actual machinery is concerned, if we include the steam engines for generating the power. In switchboards, lamps and other accessories we are entirely out of the market, owing to the fact that our continental competitors make an equally good thing for, in some cases, only half the money. To revert to the question of electrical machinery, i. e:. motors and dynamos—we have been steadily losing ground in these to Germany and the United States. And the reason for this is that our older and better known manufacturers have failed to keep pace with the times. Every effort has been made by the local merchants here to continue to do business in their machinery, but their prices are altogether too high, and their machines are said to be no better, and their range much more limited than those turned out by our foreign competitors. Switzerland and Germany have cut us out in electrical accessories; Switzerland, Germany and the United States are cutting us out in electrical machinery. With regard to this last item, however, there appears to be one hopeful sign. There is, I am told, a younger set of manufacturers of electrical plant springing up in England—a new school, if one may use the expression. These firms, who have started with new plant and new ideas, have been able to profit by the object lessons set by our foreign competitors, which the older firms have not always troubled to follow. The result is that British made machines, in every way equal to those made elsewhere, and at prices which will enable them to compete in the open market, are beginning to find their way to this country. There are many people here who hope that these firms may save the situation for British electrical plant. It is to be hoped, too, that when our older firms have grasped this fact they will follow suit, and aid in the re-establishing of a trade in a class of machinery which has been steadily slipping out of our hands."

AMERICAN ENGINE COMPANY'S CONTRACTS.—The American Engine Company, of Bound Brook, N. J., through its New York offices, White Building, Liberty Street, Mr. E. S. Boyer, manager, has taken a contract for a 13-in. x 20-in. x 14-in. duplex compound engine to be direct-connected to a 100-kw dynamo for installation in the Hotel Rudolf, Atlantic City, N. J. The equipment will be used for lighting. Grace Church, Eleventh Street and Broadway, is to be equipped for lighting purposes with two simple American Ball engines, 12-in. x 11-in. each, for direct connection to 50-kw American-Ball generators. The Convent of the Good Shepherd, Boston, Mass., is to be installed with a 13-in. x 11-in. simple engine for direct connection to a Westinghouse generator of 60-kw capacity. This outfit is also for light. The Corinth (N. Y.) Electric Light Company has ordered a 10½-in. x 18-in. x 12-in. duplex compound engine to be belted to a 75-kw generator.

ARABIC TYPEWRITING MACHINE.—The Elliott-Hatch Book Typewriter Company, of 256 Broadway, New York, has been awarded a large contract by Selim Chaker, of Cairo, who is now a guest at the Stevens House, 27 Broadway, for typewriting machines which will write in Arabic characters and are intended for various government departments in Egypt, Persia and Turkey. These machines will be the first of their kind. The Elliott-Hatch people have recently taken substantial contracts for machines to be shipped to Germany, Great Britain, Chili and Japan. The orders from the European countries call for machines for general commercial use. The Chilean and Japanese contracts emanate from government railroad offices. Sixty-nine machines have been ordered for the Register's office, New York. The Illinois Central, the Vandalia and the Missouri Pacific roads have also sent in fair-sized contracts.

WAGNER-BULLOCK APPARATUS.—The Mutual Electric Light Company, of San Francisco, has closed a contract with the Wagner-Bullock Electric Company for two 1,500-kw, 3-phase engine type, 2,200-volt generators having revolving fields. Two 75-kw exciters will also be supplied. The automatic engines to which each of the generators is to be connected will probably be constructed in the East. A representative of the Mutual Company has gone East to look up steam plant data. The generators which are to be delivered next August will be constructed by the Bullock Electric Company, of Cincinnati. The Mutual Electric Light Company will soon commence the construction of an additional electric power station. The new site being near the water front gives good facilities for securing a supply of salt water for condensing purposes. Oil fuel will be used throughout.

THE PEOPLE'S HARD RUBBER COMPANY, which was organized in Akron, Ohio, a year or so ago and built a large plant for the manufacture of hard rubber specialties, catering largely to the electrical trade, has made an assignment. The assets of the company are placed at $50,000 and the liabilities at $100,000. The plant has been shut down for some time and it has been rumored that the control of the business has passed into the hands of the American Hard Rubber Company.

DUTY ON CABLE.—In accordance with a ruling by the Treasury Department, the Pacific Commercial Cable Company will be called upon to pay duty to the shore ends of the Pacific cable at the Hawaiian Islands. It is expected that the Collector of Customs at Honolulu will be directed to collect the duty.

GENERAL INCANDESCENT ARC LIGHT COMPANY has opened a new district office, at 601 North American Building, Philadelphia. This office will be in charge of Mr. Wm. F. Geddes 3rd, as manager of sales, and will be equipped with complete facilities for doing business in the various "G. I." lines.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended January 10: Aviles—1 pkg. machinery, $28. Argentine Republic—24 pkgs. machinery, $3,911. Azores—I pkg. material, $26. British Possessions in Africa—57 pkgs. machinery, $3,814; 90 pkgs. material, $13,171. Bristol—31 pkgs. machinery, $1,900. Brazil—151 pkgs. machinery, $24,182; 219 pkgs. material, $8,590. Brussels—1 pkg. material, $49. Bremen—2 pkgs. machinery, $95. British Australia—106 pkgs. machinery, $4,597; 206 pkgs. material, $5,972. British East Indies—5 pkgs. material, $1,325. British West Indies—26 pkgs. material, $622. British Guiana—12 pkgs. material, $340. Colombia—2 pkgs. material, $15; 5 pkgs. machinery, $90. Cuba—78 pkgs. material, $1,207. Copenhagen—5 pkgs. machinery, $1,621. Chili—9 pkgs. material, $410. Central America—5 pkgs. material, $101. Danish West Indies—2 pkgs. material, $17. Dutch West Indies—2 pkgs. material, $23. Dutch Guiana—8 pkgs. material, $196. Ecuador—7 pkgs. material, $324. Genoa—14 pkgs. machinery, $1,500; 1 pkg. material, $20. Havre—11 pkgs. material, $608; 8 pkgs. machinery, $405. Hull—4 pkgs. machinery, $175. Japan—25 pkgs. material, $943. Liverpool—15 pkgs. machinery, $4,201; 371 pkgs. material, $16,342. London—247 pkgs. machinery, $2,000; 72 pkgs. material, $6,776. Lisbon—26 pkgs. material, $378. Manchester—357 pkgs. machinery, $25,741; 5 pkgs. material, $100. Marseilles—20 pkgs. material, $175. Mexico—357 pkgs. material, $8,419; 3 pkgs. machinery, $392. Newfoundland—17 pkgs. material, $286. Nova Scotia—14 pkgs. machinery, $1,282; 6 pkgs. material, $112. New Zealand—2 pkgs. machinery, $95. Naples—1 pkg. machinery, $50. Oporto—2 pkgs. machinery, $337. Peru—62 pkgs. material, $1,886. Rotterdam—1 pkg. material, $25. Stockholm—1 pkg. material, $16. Southampton—1 pkg. machinery, $375; 4 pkgs. material, $156. San Domingo—6 pkgs. material, $206. Venezuela—4 pkgs. material, $254.

GOVERNMENT TELEPHONES.—An important decision has been rendered by Hon. R. J. Tracewell, Comptroller of the Treasury, on an appeal by the Chesapeake and Potomac Telephone Company from the Auditor for the War Department, respecting the amounts to be paid for telephone service in the various bureaus and offices of the War Department. The Comptroller reviews the decisions of the courts in the case of Manning & Co. against the telephone company. The case involved particularly an arrangement of telephones for the department's use, under which seventy-eight telephones, located in various bureaus and offices of the department, were connected to a private exchange switchboard located in the department, which switchboard was in turn connected with the general exchange system of the company. The Comptroller held that the installation was "fairly one where four or more telephones are on the same wire" and should, therefore, be charged for at the rate of $25 per year each. The decision closes as follows: "The company in its settlement under each head charged for certain telephones at the rate of $18 per annum. But these charges, in my judgment, were made and contracted for for the instruments alone. It would hardly be fair to say that the telephone company, in the light of all the facts, agreed with the War Department to furnish a complete telephone service such as it is furnishing for $18 per annum. For instance, I think the company should be allowed, on a second settlement, for all these telephones at the rate of $25 per annum. That for all telephones on a single wire, such as the one at the residence of the chief clerk, at the rate of $50 instead of $40, as allowed by the auditor. And that for private lines as herein described it should be allowed the contract price."

EQUIPMENT FOR DAYTON AND MUNCIE ELECTRIC ROAD.—E. P. Roberts & Company, Cleveland, consulting engineers for the Dayton & Muncie Traction Company, have closed contracts for the greater portion of the equipment necessary for building the road. The Westinghouse Electric & Manufacturing Company will furnish the electrical equipment for power house, sub-stations and cars. The order includes two 500-kw, three-phase alternating-current generators, four 200-kw and one 300-kw rotary converters, with transformers for reducing 15,000 volts and switchboards; also ten four 50-hp motor equipments for cars. The Buckeye Engine Company secured the order for the engines. Eight vestibuled passenger coaches, a work car and a freight car will be furnished by the Stephenson Car Company, the cars to be equipped with Peckham trucks. At each sub-station and at the power house there will be a storage battery of 320 ampere-hours capacity furnished by the Gould Storage Battery Company. The line work will be done by the Chase Construction Company, of Detroit. There will be three sub-stations, at Greenville, Union City and Selma, and the main power house will be at Winchester. The road is in reality an extension of the Dayton & Northern. When the line is completed cars will be operated through from Dayton to Muncie, a distance of 90 miles.

YERKES ON CAR PRICES.—In an interview last week, Mr. C. T. Yerkes, the street railway magnate, said: "I believe that the trusts, as we have them here, will eventually do the country a great deal of harm. Except where our improved machinery makes it possible to undersell foreign products in foreign markets, there's no chance for us to sell our manufactures abroad. This was not the case before the making of everything was in the hands of trusts. More than all that, these combinations of capital will not be able to keep prices at the present high level. We know this already, and when prices go down, where's the money coming from to pay the interest on over-capitalization? When dividends are passed, then look out for squalls. Prices are so high here that, with few exceptions, we are buying all our materials in England. Steel, for instance, is 40 per cent. higher than it was three years ago. Cars that could be bought three years ago for $1,850 apiece now cost $3,600. Europe will not stand such absurd prices and will simply not buy in American markets. There would be some compensation if the American laborer was benefited in proportion, but I know he's not."

ELECTRICAL EXPORTS.—The November summary of the Bureau of Statistics of the United States Treasury shows a very steady maintenance of electrical export trade in good volume. Electrical instruments and telephones and telegraphs amounted to $280,822 for the month as compared with $204,364 in November, 1901, and $3,728,102 for the eleven months of the year in 1902, against only $1,526,398 in the same period of 1901. That is a most cheering growth. The electrical machinery export for the month was $431,338 against $348,306 in November, 1901; and the total for the eleven months was $5,508,112 against $5,264,962 in 1901, and $4,957,308 in 1900. This once more is a good showing, especially in view of the very low prices prevailing in Europe for such apparatus as motors, small dynamos, etc. The total for the eleven months is no less than $9,236,214, and ought to reach well over $10,000,000 for the year. Such a trade is decidedly worth cultivation.

ELEVATORS IN RESIDENCES.—The extent to which the aid of electricity is being invoked in promoting comfort and convenience in dwellings is well illustrated by a recent contract made by the Otis Elevator Company to install five electric elevators in a single private residence. In the house which is now being erected at Madison Avenue and Thirty-seventh Street, New York, for Captain J. R. De Lamar, the elevator equipment is to consist, first, of a passenger elevator, a servants' elevator and a dumb waiter, all to be automatically controlled by push buttons within the cars and at the several landings. In addition the contract calls for a sidewalk elevator for ashes, etc., and an automobile lift for conveying motor cars from the street level to a storage room in the sub-basement.

THE IRONTON ENGINE COMPANY, of Ironton, Ohio, has acquired the rights and business of the Allfree Engine Company, and will hereafter build Allfree engines in all sizes, types and styles in new and modern shops. The very low cost of coal, coke and pig iron there, as well as Ironton's excellent railway facilities, are expected to be of material benefit to the new company and put it in position not only to build the highest grade and most economical engines, but upon a basis which will result in a material saving to the purchaser and increased dividend to stockholders of the company. Mr. D. H. Palmer is secretary of the concern.

ORDERS FOR ELECTRIC CRANES.—Among recent orders for cranes reported secured by the Northern Engineering Works, Detroit, Mich., are the following: Three 70-ft. span electric traveling cranes for Oil Well Supply Company; one 55-ft. span for Saginaw Plate Glass Company; three 40 to 50-ft. span electric traveling cranes for Great Lakes Engineering Works; one 10-ton, 40-ft. span for Detroit Foundry Company; besides a number of smaller electric and hand-power traveling and jib cranes. They also report the recent sale of three electric cranes for export to England, and one for India.

JENNEY MOTORS.—The Jenney Electric Manufacturing Company, of Indianapolis, has developed a specialty in the motor equipment of printing and engraving plants, and have installed 50 motors for the *Chicago Tribune*, 50 large motors for the United States Printing Company, 60 for the United States Lithographing Company, and 250 for the United States Playing Card Company. The Atlas Engine Works ordered last year 70 motors, of which three were of 30 hp and eight of 15 hp. Australia sent for 50 motors of the smaller sizes and a fair trade was done in England.

INDUSTRIAL CARS FOR MEXICO.—M. H. Treadwell & Co., 95-97 Liberty Street, have orders for ten slag cars for the American Smelting & Refining Company, six for their Monterey plant, Monterey, Mexico, and four for their Auguascalientes plant, Mexico. These cars will be operated by electric motors.

THE SPRAGUE ELECTRIC COMPANY supplied a large amount of flexible metallic conduit and steel armored conductors for the new addition to the White House in Washington, and has also received additional orders for ventilating outfits for the same building.

General News.

THE TELEPHONE.

SAN PEDRO, CAL.—The Pacific States telephone company's exchange in San Pedro was recently destroyed by a fire which burned a block of buildings.

LOS ANGELES, CAL.—The County Supervisors of Los Angeles have ordered advertised for sale a blanket franchise as applied for by the United States Telephone & Telegraph Company. According to the requirements of the franchise, a telephone exchange must be maintained in every town which is now supplied with telephones. It is also required that the farmers throughout the county be supplied with telephone facilities. The following classification is provided for: Class 1—For unincorporated cities having exchanges of 100 telephones or under, $36 for office, $[illegible] for residence. Class [illegible]—Exchanges having between 100 and [illegible] telephones, office, $[illegible]; residence, $[illegible]. Class 3—Exchanges having between [illegible] and 1,000 telephones, office $[illegible], residence, $[illegible]. Class 4—Exchanges having from 1,000 to 5,000 telephones, office $[illegible], residence, $30. The life of the franchise is to be 40 years.

WAYNESBORO, GA.—The Waynesboro Strowger Telephone Company has been chartered in Georgia and an organization perfected with Col. W. E. Jones as president. The capital stock is $6,000.

AUGUSTA, GA.—Some misunderstanding arose recently in Augusta regarding telephone contracts. The Strowger Company is a bidder for the contract for 1903, but there seems to be a possibility growing out of recent developments that the Bell Company has a previous claim. Later it was decided that no claim existed to a contract.

CORA, IDAHO.—The Cora Independent Telephone Association has been formed to build a line from here to Garfield, Wash. The officers of the company are: President, David Kidwell, vice-president, J. N. Kilgore; secretary, Luther Kerns, treasurer, Geo. Strong, directors, Wm. Smith, J. N. Kilgore, Luther Kerns, John Drew, C. P. Low.

BOISE CITY, IDAHO.—During the past year the Bell Telephone Company's subscribers increased in number from 460 at the beginning of the year to 673 at the close. Toll lines were built all over the State and direct communication is now available with Salt Lake City, Utah; Denver, Colo.; Butte and Helena, Mont. During the present year the company has planned to build 800 miles of line in Idaho alone and improve the existing service. The independent company in this city has almost doubled the number of its subscribers, as well as its mileage. The actual increase in the number of subscribers was from 702 to 1,325. The "Community Farmers' Lines," introduced by this company, have become very popular.

STERLING, ILL.—The Inter-State Telephone Company is building a toll line from Sterling to Aurora, a distance of 100 miles.

CHICAGO, ILL.—For the month of December, the Chicago Telephone Company gained 1,500 telephones. The total of Bell telephones in Chicago is 60,400.

SWEETZER, IND.—The Farmers' Mutual Telephone Company, of Sweetzer, has been organized. The following persons constitute the board of directors: J. E. Curry, James Dooley, Thos. Johnson, F. H. Stevens and Alfred Burge.

CONNERSVILLE, IND.—L. A. Frazee, of this city, and president of the Indiana Mutual Telephone Association, has appointed a committee to look after the interest of the independent telephone enterprises during the Legislative session.

MUNCIE, IND.—The Delaware & Madison Counties Telephone Company, which has installed a new telephone system in this city, and commenced operation on December 31, has completed the sale of its $300,000 bond issue. The last $40,000 of the issue was purchased by Harry B. Gates, of Indianapolis.

INDIANAPOLIS, IND.—Semi-annual payments of interest on bonds were made, January 1, as follows: The New Telephone 5's, first series, 2½ per cent., and the New Telephone 5's, second series, 2½ per cent. The 1 per cent. quarterly dividend on New Long Distance Telephone stock was declared also.

CARYDON, IND.—The Eureka Telephone Company, a corporation composed of farmers of Washington, Heth and Boone townships, of Harrison County, is extending its lines into Taylor and Posey Townships and will soon connect with the system in this city and thence with a line to Louisville, Ky. The company now has 100 telephones in service.

BLUFFTON, IND.—Stockholders of the United Telephone Company have authorized an issue of $500,000 of bonds for the purpose of making extensions. The Marion Trust Company will place the bonds on the market. The company now has 3,500 subscribers and a large number of toll lines. Officers have been elected as follows: Hon. Hugh Dougherty, president; L. C. Davenport, treasurer; C. H. Plessinger, secretary. The above, with W. B. Cooley, A. G. Lupton, J. W. Sale and D. A. Breed, are directors.

GAS CITY, IND.—The Home Telephone Company, of this city and Jonesboro, was put in operation January 2. It is expected that long-distance communication will be opened soon between Gas City and a number of prominent towns and cities of the State, including Indianapolis. The Jonesboro exchange will be put in operation in a few days and then 350 subscribers will be using the new service. R. D. Haymaker is manager of the new company. Free service will be established between the two cities, Marion and Upland.

DEXTER, IA.—The Mutual Telephone Company will build an exchange at this place; also one at Earlham.

POSTVILLE, IA.—The Grand Meadow Farmers' Mutual Telephone Company, with a capital stock of $[illegible],000, has been incorporated.

LIBERTYVILLE, IA.—The Libertyville Telephone Company has been organized here, with a capital of $1,200. Mr. E. Glotfelty is president.

NEW PINEVILLE, KY.—New Pineville Telephone Company, with a capital of $3,000, has been organized here.

DETROIT, MICH.—The Council has granted a franchise to David W. Simons, James H. Mackey, D. C. Delamater, Joseph Harris and W. H. Ellis. The gentlemen form a citizens' committee which has promised to transfer the franchise to a new company to be made up of a combination of the People's Telephone Company and the Co-operative Telephone Company, both of which have held independent franchises and have done considerable construction work for independent exchanges. It is believed that a new exchange will be built at once.

ANOKA, MINN.—A movement is on foot to establish a farmers' telephone system through the (Anoka) county.

ST. PAUL, MINN.—The Northwestern and Twin City telephone companies have paid their [illegible] per cent gross earnings taxes to the State. The Northwestern Company pays $[illegible], on total receipts of $814,420.92. The Twin City Company pays a tax of $[illegible], on receipts of $185,111.66. Last year the Northwestern's taxes were $[illegible] and those of the Twin City $1,507.35.

ST. JOSEPH, MO.—The Missouri & Kansas Telephone Company will extend its party line service to many farms in this county.

SAVANNAH, MO.—The Andrew County Mutual Telephone Company, of this city, has increased its capital stock from $5,000 to $10,000.

ST. LOUIS, MO.—It is reported from Memphis, Tenn., that the Memphis Long-distance Telephone Company will be projected in a short time for the purpose of allying the telephone companies of Little Rock and Jonesboro, Ark.; Springfield and St. Louis, Mo.; Cairo, Ill., Paducah, Ky.; Jacksonville and Clarksville, Tenn., Dallas, Corsicana and San Antonio, Tex., and other cities in Tennessee, Arkansas, Mississippi, Kentucky and Texas, now operating or proposing to operate independent lines. The object of the company is to furnish a line extending from St. Louis to Jackson, Miss., and from Little Rock as far east as possible. Alliances will then be made with other independent companies, thus furnishing connections with New York, Chicago, and other eastern points. The company will eventually control $100,000,000 of capital. Parties are now in the East engineering the deal.

HEBRON CITY, NEB.—The City Council has granted to C. N. McNeil, of Beatrice, and W. G. Francis, of Kansas City, a franchise to operate a telephone system in this town.

ALBANY, N. Y.—The Ontario Telephone Company, of Onondaga and Oswego counties, has increased its capital from $20,000 to $40,000.

NEW YORK, N. Y.—A direct telegraphic circuit has been established between New York and Havana, Cuba, by the Western Union Telegraph Company. Heretofore messages between the two points have been relayed at Jacksonville, Fla. The total length of the cable is about 150 miles.

GREENSBORO, N. C.—The American Telephone Company will put in a local service in Greensboro, N. C. Fifty subscribers have been secured.

ASHEVILLE, N. C.—The electrical workers of Asheville, N. C., have gone out on a strike because the Asheville Telephone Company did not comply with the union wage scale. Only linemen are involved.

DURHAM, N. C.—The exchange of the Interstate Telephone Company, at this place, was burned, January 1. The company's loss is placed at $8,000, with $5,000 insurance. The fire was caused by the explosion of a kerosene lamp.

BLOOMDALE, OHIO.—Toledo parties have made application to the Council for a telephone franchise.

COLUMBUS, OHIO.—The officers of the Citizens' Telepbone Company are considering the erection of a new plant.

NORWALK, OHIO.—J. F. Laning has resigned the presidency of the Local Telephone Company and has been succeeded by C. R. Callaghan.

ATHENS, OHIO.—The Central Union Telephone Company is preparing to build a line from Pomeroy to Athens by way of Harrisonville.

NORTH BALTIMORE, OHIO.—The National Telephone Company has sold its exchange to Claud Wyant and others, of Toledo. The new company will make many improvements.

BEAVER DAM, OHIO.—The Beaver Dam Home Telephone Company, capitalized at $15,000, has been incorporated by Edwin Fledderjohann, C. C. Miller, Allen Philips, A. H. Miller and W. H. Fledderjohann.

ROCK CREEK, OHIO.—The Rock Creek Telephone Company, recently organized by farmers, has purchased a considerable amount of the old equipment of the Ashtabula exchange. The system will be started at once.

TOLEDO, OHIO.—The Toledo Home Telephone Company is preparing to furnish service to a large number of farmers throughout Lucas County. A number of connections have alreday been made and next spring this branch of the business will be pushed.

NORWALK, OHIO.—Directors of the Local Telephone Company have declared the regular quarterly dividend of 1½ per cent. on preferred stock. The affairs of the company are in a very prosperous condition and a number of improvements are contemplated.

OBERLIN, OHIO.—For the second time within a month the exchange of the Oberlin Home Telephone Company was seriously injured through the trolley of an electric car striking telephone wires and causing them to drop on the trolley wire. The switchboard at the exchange was completely destroyed and a large number of residence telephones were burned out. The service will be crippled for some weeks. The company had just completed the repairs rendered necessary as the result of a similar accident several weeks ago.

SPARTANSBURG, PA.—The Spartansburg Telephone Company has been incorporated, with a capital of $10,000. The directors are: J. K. Wright, W. E. Miller, of Spartansburg, and G. H. Barlow, of Corry, Pa.

MURFREESBORO, TENN.—The Independent Telephone Company will build an exchange at this place.

RICHMOND, VA.—The petition of the Richmond Telephone Company to close out to the Bell Company is now pending before a sub-committee. The telephone people are urging haste.

ELECTRIC LIGHT AND POWER.

WALNUT RIDGE ARK.—S. C. Dowell and others are organizing a company with a capital stock of $50,000 to build an electric light plant and to construct an electric railway connecting with Hoxie.

SONORA, CALIF.—E. J. Landers intends to organize a stock company in Sonora and obtain an electric lighting franchise from the City Trustees. It is proposed to install a steam plant operated by a 150 hp. engine and to use crude oil as fuel.

COLORADO SPRINGS, COLO.— The Pike's Peak Power Company has been reorganized under the name Hydro-Electric Company. The new company will erect two large power stations on the eastern slope of Pike's Peak, to cost about $1,000,000. The company expects to furnish power to Colorado Springs and neighboring places and will have sufficient machinery to generate 5,000 hp. The Pike's Peak Power Company's system was described and illustrated in Electrical World and Engineer of July 26, 1902.

HARTFORD, CONN.—Thos. C. Perkins and others seek incorporation as a power company in Canterbury and Plainfield, and Harold Lawton and others ask for like privileges to operate in the towns of Sprague, Scotland, Franklin and Windham.

TAMPA, FLA.—The John P. Martin Company, of Tampa, has secured the contract to supply electric lights to the city and has begun operations.

WEISER, IDAHO.—The validity of the $40,000 bond issue proposed by the city of Weiser, Idaho, has been affirmed by the Supreme Court. The money derived from the sale of these bonds will be used in the construction of an electric light and water works plant.

INDIANAPOLIS, IND.—The Merchants' Heating & Lighting Company began serving customers on January 1.

COVINGTON, KY.—Prominent citizens have obtained an injunction restraining the City Council from closing a contract with the Union Heat, Light & Power Company for furnishing electricity to the city.

DETROIT, MICH.—The municipal lighting plant is preparing to install a 600 kw generator and an 800 hp engine.

CLAYTON, MO.—A deed transferring the properties of the Missouri Water, Light & Power Company to the West St. Louis Construction Company has been filed here. The transfer has been effective and operative for several months.

TONOPAH, NEV.—The new electric light plant of the Tonopah Light & Power Company is in running order. Over 600 business houses and residences have been supplied already, with the demand increasing daily. The plant, however, is inadequate to supply the demand, as a number of the mines will put in a complete system of lights, besides using the power in the operation of machinery. To meet this increased demand the electric company will put in a larger plant immediately.

ROCHESTER, N. Y.—The Rochester Light & Power Company, of Rochester, has been incorporated to manufacture gas and electricity for lighting, heating and power purposes. The capital is $500,000.

LEETONIA, OHIO.—The Leetonia Electric Light & Power Company has reduced its capital stock from $30,000 to $10,000.

ARCADIA, OHIO.—P. Wheeland has just completed the erection of a lighting plant and the village is to be illuminated by electric lights.

ELYRIA, OHIO.—The Citizens' Gas & Electric Company has succeeded the Lorain Gas Company and the Elyria Gas & Electric Company. The company is capitalized at $600,000, with an authorized bond issue of $400,000. The company has municipal electric lighting contracts in Elyria and Lorain.

PAWNEE, OKLA.—The Pawnee Electric Light & Power Company, of Pawnee, with $50,000 capital, has been incorporated by W. L. Ward and J. S. Moffitt, of Pawnee, and A. Ward, of Sagnache, Colo.

BAKER CITY, ORE.—The Columbia Mine, near here, is being equipped with a 200 hp. electric plant to operate the hoist and the mill.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Railway Company has completed the purchase of the franchise and plant of the Dawson Electric Company, which supplies light and power in the vicinity of Dawson. The plant has a capacity of about 300 hp. Its lines may be extended to Vanderbilt.

HARRISBURG, PA.—Charters have been issued by the State Department to the following electric light corporations: Hampden Light, Heat & Power Company, Hampden Township, Cumberland County, capital $500; Lower Allen Light, Heat & Power Company, Lower Allen Township, Cumberland County, capital $500; New Cumberland Light, Heat & Power Company, New Cumberland, capital $500; Camp Hill Light, Heat & Power Company, Camp Hill, capital $500; Shiremanstown Light, Heat & Power Company, Shiremanstown, capital $500; Upper Allen Light, Heat & Power Company, Upper Allen Township, Cumberland County, capital $500; East Pennsboro Light, Heat & Power Company, East Pennsboro, Cumberland County, capital $500. The office of these companies, which are controlled by the same persons, will be located at Harrisburg.

ANDERSON, S. C.—Judge W. F. Cox, of Anderson, and associates are planning to develop a fine water power two miles from Calhoun Falls, S. C.

NORFOLK, VA.—W. T. Gilchrist, of Norfolk, and others will establish a $150,000 race track and electric park in Norfolk.

NELSON, B. C.—The property owners of Nelson have voted in favor of the new electric light by-law, providing for the expenditure of $150,000 in installing an electric power plant and extending the electric lighting system.

THE ELECTRIC RAILWAY.

HARTFORD, CONN.—The Stafford Springs Street Railway Company has applied for permission, to increase its capital stock to $1,500,000 and change its name to Worcester & Hartford Railway Company. It will remove its offices to this city.

HARTFORD, CONN.—These applications of electric railway companies have been filed: J. T. Pattison and others, permission to build from Farmington to Plainville; also a street railway in Somers and Ellington. East Windsor Street Railway Company and Hartford & Springfield Street Railway, to change the corporate offices to this city. Petition of the United Electric Company, to increase capital stock. Suffield Street Railway, for permission to purchase the water company of Suffield.

MONTPELIER, IDAHO.—Local capitalists are talking of building an electric railway from this place to Laketown, Idaho.

BLOOMINGTON, ILL.—The Bloomington & Joliet Electric Railroad Company has been incorporated, to build a series of trolley interurban roads which will connect the principal cities of Illinois.

WARSAW, IND.—The directors of the Warsaw & Winona Traction Company have completed arrangements to build the road at once. The contract calls for operation by May 1.

NEW CASTLE, IND.—Coulter Bros., of Chicago, have entered into a contract to finance the Muncie-New Castle electric line and the work of constructing the road will be under their direction.

INDIANAPOLIS, IND.—The Indiana & Illinois Traction Company has incorporated with an initial capital of $10,500. The directors are: L. G. Holmes, J. G. Leffler, A. E. Needam, J. H. Boyd and L. A Gutherie

FT. WAYNE, IND.—Traffic will be opened on January 15 on the Muncie, Hartford City & Ft. Wayne Traction Company line. This road will connect with the Indianapolis branch of the Union Traction Company at Muncie.

TERRE HAUTE, IND.—G. F. Wales, representing the Stone & Webster syndicate, which owns the Terre Haute Electric Railway, is placing contracts for the equipment of the new electric road from Terre Haute to Lafayette.

RICHMOND, IND.—It is stated that the Union Traction Company is considering a proposition for the purchase of the rights and franchises of the Richmond & Northwestern Traction Company between Richmond and Newcastle, and between New Castle and Anderson.

ANDERSON, IND.—The Union Traction Company will award contracts the latter part of January for an addition to the power house 60 x 116 feet and another building 30 x 70 feet, each two stories high. A third building for a central car shop will be 90 x 400 feet.

HUNTINGTON, IND.—The County Commissioners have granted a 50-year franchise to the Ft. Wayne & Southern Traction Company for a line between Huntington and Marion, by way of Warren. All necessary franchises in Huntington County have been obtained. The company is essentially the same as the Ft. Wayne and Southwestern.

QUINCY, MASS.—The Old Colony Street Railway Company, Boston, will erect two power plants, one at Quincy, and one at Fall River, Mass. Mr. C. F. Bancroft is engineer.

ST. PAUL, MINN.—One of the bills which will be presented to the Legislature places all electric railways on a gross earnings tax basis. It is expected that the street railway companies will be able to defeat the opposition which will arise in the cities on account of the decrease it will make in tax receipts.

ST. JOSEPH, MO.—Word has been received here from the Philadelphia office of Clark Bros., to the effect that the contract had been let for a new power house for the street railway plant. It is to cost a quarter of a million dollars.

NEW BRUNSWICK, N. J.—Cars of the Trenton and New Brunswick Electric Railway are now running into this city from Trenton.

TRENTON, N. J.—Articles of incorporation of the Augusta & Aiken Railway & Electric Company have been filed. The capital stock is placed at $2,300,000. The company will build electric railways and electric lighting and gas plants. The incorporators are: K. K. McLaren, H. O. Coughlin and Louis B. Dailey.

ELIZABETHPORT, N. J.—The company for which Judge J. Kearny Rice asked the consideration of the Perth Amboy Council in granting trolley rights to the Amboy bridge approach is now in the field. The incorporators are: Judge Andrew Kirkpatrick, of Newark; Edward Furman, of Sayreville, and W. Parker Runyon, of Perth Amboy. The company is known as the Elizabethport, Amboy & Long Branch Railway Company, and its office is in Perth Amboy. The capital is $500,000. The intention is to operate between Elizabeth and Long Branch.

ALBANY, N. Y.—The New York and Long Island Traction Company has increased its capital stock from $125,000 to $1,000,000.

NEW YORK, N. Y.—It is stated that the Interborough Railway Company expects to run trial trains in the subway soon after June 1 next, and that full service will be available to the public in the fall.

NEW YORK, N. Y.—The Interborough Rapid Transit Company will place no obstacles in the way of the New York Central, should that company desire to run its trains through the subway to the Battery, as it is reported the company wishes to do.

ALBANY, N. Y.—A bill has been introduced in the Legislature with the object of preventing overcrowding of surface and elevated cars in New York City. According to its provisions it will be unlawful to carry more than five passengers above the actual seating capacity of each car, the penalty for violation being $50 for each passenger carried above the limit.

NEW YORK, N. Y.—The Metropolitan Street Railway Company will, on Jan. 19, increase the wages of its motormen and conductors on a graded scale, based on the length of service. For motormen the minimum rate (first year's service) is $2.10 per day, and for conductors $2 per day. After five years' ervice the rate for motormen is $[illegible] and for conductors $[illegible] per day. This is a ten cent raise for motormen of all grades and for conductors after five years. The last previous raise, [illegible] per cent., was made in June, 1901.

RICHMOND, VA.—Control of the Virginia Passenger and Power Company has been bought by Frank Jay Gould. The company operates all the street railways in the cities of Richmond, Manchester and Petersburg, as well as a [illegible]-mile electric line which connects the two last named cities, the system at present including [illegible] miles of road.

SEATTLE, WASH.—The Adams County Electric Transit Company, which was recently incorporated in the State of Washington by F. R. Clarke, Col. [illegible], O. R. Holcomb and others, proposes to build and operate an electric railway line between Washtucna and Odessa.

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NEW INDUSTRIAL COMPANIES.

THE CATARACT AUXILIARY COMPANY, of Hamilton, Ont., has been incorporated. The capital of the company is placed at $1,000,000.

THE VICTOR & BURG BROS. MANUFACTURING COMPANY has been organized at Denver, Colo., to manufacture electric fixtures, gas machines, etc.

THE ROCHESTER ELECTRIC SIGNAL COMPANY, Rochester, N. Y., has been incorporated, capital, $50,000. Directors W. F. Atkinson, J. G. Kaelber and F. F. Higgins, Rochester.

THE CLARK & MILLS ELECTRIC COMPANY (electricians), of Portland, Me., has been incorporated, capital, $50,000. President, A. W. Tolman; treasurer, Levi Turner, both of Portland.

THE NATIONAL ELECTRIC PURIFICATION COMPANY, Camden, N. J., has been incorporated; capital, $1,000,000. Incorporators—William T. Henderson, Harry W. Henderson and C. V. D. Joline.

THE IDEAL GAS AND ELECTRIC FIXTURE COMPANY, New York City, capital $10,000, has been incorporated. Directors—Samuel Tepfer and Henry Forendo, Brooklyn; Pincus Burger, New York.

THE MOTOR MANUFACTURING COMPANY, of Indianapolis, has been incorporated to manufacture and deal in motor cars, motors and gas engines. Capital stock, $50,000. Harold O. Smith is president.

THE ELECTRIC CAR LIGHTING COMPANY has been incorporated in New Jersey; capital, $100,000. Incorporators Roswell S. Nichols, Lucius E. Varney, Anthony M. Jeshera, John M. Seoble and John M. Enright.

THE HALSEY ELECTRIC GENERATOR COMPANY has been incorporated in New Jersey by Henry Halsey, Wm. S. Halsey and Howard H. Williams, to manufacture batteries, motors and fittings. The authorized capital is $100,000.

THE AUSTIN LIGHT, HEAT & POWER COMPANY OF NEW YORK, has been incorporated at Dover, Del., capital $2,500,000. Incorporators—Edward C. Dowling and Harry U. Spence, Brooklyn, and Millard H. France, New York.

THE ELECTRIC TRANSIT COMPANY has been incorporated at Albany to operate vehicles propelled by electricity or other power in New York City. The capital is $5,000 and the directors are John Mill, Thomas Steely and Frank E. Taylor, of New York.

THE NATIONAL COAL BURNER COMPANY is being organized at Toledo, O., with a capital stock of $1,500,000, to promote and manufacture the Rowe feeder system, which was described and illustrated in ELECTRICAL WORLD AND ENGINEER of November 15, 1902.

THE CLEVELAND ENGINEERING COMPANY, Cleveland, O., heretofore a partnership engaged in all branches of electrical and mechanical engineering, has been incorporated, with $10,000 capital stock, by H. W. Jones, H. W. Woodward, H. Clay Herrick, C. A. Cadwell and Prof. Charles H. Benjamin. It will continue the business of the old firm on a much broader scale and will devote especial attention to power, lighting and heating systems.

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OBITUARY.

MR. A. B. DE FREECE died last week at Pelham Manor, N. Y., aged only 52. He was at one time publisher of the *Mail and Express*, and was well known as a manager of charitable exhibitions, etc. He had a very wide acquaintance in electrical circles and had taken out many ingenious inventions in the mechanical field.

MR. JAMES OSCAR NIXON.—We are indebted to Mr. Ray D. Lillibridge for the subjoined interesting details in regard to the career of Mr. J. O. Nixon, so suddenly ended by untimely death: In the world of engineering and business, I believe there was never a more promising career brought to so untimely an end than on December 27 by the death of James Oscar Nixon, late engineer and manager of the silent-chain department of the Link-Belt Engineering Company, of Philadelphia. Even in this day of "young men of affairs" it is extremely rare that one of twenty-three years can be pointed out who is endowed with such industry, talent and intelligence as to have achieved a marked success in his work and won the love and respect of a host of friends and business associates. Such, however, was the position obtained by Mr. Nixon. He was from the South—a native of New Orleans and a graduate of Tulane University of that city, class of '97. During his undergraduate days, his energy, perseverance and personal popularity won for him a prominent position in the college world. He was manager of the foot ball team, editor-in-chief of the college annual and of the college weekly and he held a prominent position in his fraternity, Alpha Tau Omega. After taking his degree in mechanical engineering, he took up post graduate work in sugar chemistry, occupying at the same time the position of chemist on a large plantation. After leaving the university he spent a year in Wilmington, Del., as a manager for one of the branches of a large foundry. Three years ago Mr. Nixon became connected with the Link-Belt Engineering Company and was almost immediately assigned to the testing and mechanical development of the work of that company, and in this line he showed unmistakable genius. Later he was assigned to the important work of the commercial and mechanical development and introduction of the Renold Silent Chain. The rapidity of introduction of this device, it having been first presented in this country just more than a year ago, pays a remarkable tribute to Mr. Nixon's possession of that rare combination of qualities—those of a good business man and an engineer. Mr. Nixon's paper presented in December, 1901, before the American Society of Mechanical Engineers on "A Silent Chain Gear," and his letter appearing in the "American Machinist" of Jan. 2, 1902, on "Faulty and Correct Wheel Constructions for Standard Roller Chains," are exemplary of his clear perception of points at issue and of his vigorous manner in expounding those in which he became interested. Less than a year ago, Mr. Nixon married and last October he and his wife had begun housekeeping in a modest and charming little home. While thus all the world seemed bright to him, he was taken ill with typhoid fever and passed away on the night of December 27, 1902. His remains were interred at New Orleans.

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PERSONAL.

MR. E. P. GRIFFITH has succeeded Mr. F. L. Blendinger as superintendent of telegraphs on the Erie Railroad.

MR. THOMAS C. PERKINS is interested in getting a Connecticut charter for a power company at Canterbury and Plainfield, in that State.

MR. FREDERICK P. FISH has been elected a director to fill the vacancy in the Boston Edison Company's board caused by the death of Mr. Edward D. Maltby.

HON. SAMUEL JONES, Mayor of Toledo, Ohio, has been elected president of the Toledo & Indiana Railway, in place of Hon. C. P. Griffin, who died a few days ago.

MR. G. MARCONI leaves Canada for Cape Cod this week to carry out his plans for exchanging wireless messages between the United States and Europe from that point.

MR. W. W. KER is delivering for the New York Board of Education a series of eight popular evening lectures on electricity, at various centers. Mr. Ker is electrical instructor at the Hebrew Technical Institute.

MR. CHARLES B. HORTON, assistant superintendent at Denver, has been appointed to succeed the late J. J. Dickey, recently deceased, as superintendent of the third district of the Western Union Telegraph Company.

MR. JOSEPH RIPPON, general manager of the Halifax & Bermuda Cable Company, arrived in New York this week on the *Ivernia*, with the object of looking up the cable business of the company and improving it.

MR. W. E. BAKER, the well-known electric railway manager and engineer, has been engaged to serve on the committee of experts formed by the Merchants' Association of New York to study possible improvements in the transportation system.

MR. W. E. ATHEARN has resigned his position in the electrical engineering department of the Western Union Telegraph Company to accept one of like nature with the American Telephone & Telegraph Company. Mr. Athearn will remain in New York for the present.

MR. T. E. MURRAY, consulting and designing electrical engineer for the power houses of the Brooklyn Rapid Transit, stated last week that he is now supplying the deficiency of power by the equipment of a new power house which will furnish 54,000 hp of current to the system.

MR. HENRY C. MEYER, JR., M. E., has announced the removal of his office to 114 Liberty Street, New York City, where he will continue to practice as consulting mechanical engineer, making a specialty of the design of steam power plants and the mechanical equipment of buildings.

MR. O. W. BRAIN, electrical engineer to the Board of Railway Commissioners for New South Wales, has been on a tour of inspection of the chief railway centers of Canada. For some time past he has been visiting the railway centers of England and the Continent, with a view of gathering the latest information in the way of new electrical appliances.

MR. A. L. BAGNALL, of the American electrical engineering and contracting firm of Bagnall & Hilles, Yokohama, left New York on Monday, en route for San Francisco, from which place he will sail on the 20th for Japan after several weeks' visit to the United States. As mentioned elsewhere, Mr. Bagnall left some substantial contracts behind him for various electrical equipment for Japanese lighting and traction plants.

PROF. FRIEDRICH NIETHAMMER, of Brunn, Austria, who has been visiting the United States during the past month, returned home during the present week. His stay was devoted chiefly to the inspection of electrical apparatus and plants. For some time the Professor has been associated with part of the technical work of the Union Elektricitaets Gesellschaft, of Berlin, in addition to carrying on his duties of professor of electrical engineering.

MR. LOUIS J. COSTA has severed his connection with Walker & Kepler, Philadelphia, and has joined forces with Mr. E. L. Nash, manager of the Philadelphia branch of the Jandus Electric Company, Real Estate Trust Building. The management of the Eastern District of the Buckeye Electric Company has been discontinued and Messrs. Nash and Costa will devote their energies exclusively to furthering the sales of Jandus arc lamps, fan motors, inner globes, etc.

MR. RUSSELL SAGE has an article in *Railroad Men* on the Manhattan Railway system. Electric traction, which he fought so long, receives recognition at his hands, as he points out that the company can save one motorman per train.

MR. F. E. DRAKE since his return from Germany has discussed some of the advantages of the metric system in electrical manufacturing in the technical press so ably that the *New York Tribune* last week devoted a leading editorial to a review of his ideas and statements in respect to foreign trade development.

MR. C. T. YERKES has been in Boston inspecting the elevated lines to ascertain how the passengers were handled in the subway during the rush hours and to look over the company's terminals and power stations. He was asked as to the outcome of his London transportation schemes and replied that there were 6,000,000 of people in London proper and 2,000,000 people in the surrounding country, but that the people in London had in the past been in the habit of walking a good deal.

VREELAND AND YERKES.—The London *Globe* of January 8 says: "Notwithstanding the denials of Mr. R. W. Parks, M. P., the solicitor for Mr. Yerkes, that he is about to resign the chairmanship of the Metropolitan District Railway tube system, there is reason to believe he will do so almost immediately, and that his successor will be A. L. Stride, of the London & Tilbury Railway. It is stated that Mr. Vreeland, president of the Metropolitan system of New York, is coming to London to manage the Yerkes lines, and that C. H. Tweed, formerly chairman of the Southern Pacific Railway, will be responsible for their financial control." This has been denied again.

MR. E. C. NOE took charge, on January 15, of the Lake Street and the Northwestern Elevated Railroads in Chicago, as general superintendent. He has been for several years engineer of the Chicago office of the General Electric Company, and has been connected in responsible technical capacities with electrical work in Chicago for twenty years past. It is the general consensus of opinion in Chicago that the elevated companies were wise in selecting so quickly Mr. Noe as successor to Mr. Frank Hedley, who becomes general superintendent of the underground lines of the Interborough Rapid Transit Company in New York.

MR. CHARLES DAY, of Dodge & Day, the modernizing engineers, has been very deservedly complimented on his valuable paper read before the New York Electrical Society on motor drive in machine-tool operation. Not only has the paper been copiously quoted in all the leading technical papers, but it has been printed by the Society for distribution among its members. The demand is so great otherwise that a large edition has also been prepared for general circulation. Prompt recognition does not often come to a young engineer, but in this case it was thoroughly deserved. Mr. Kern Dodge, his partner, had a valuable article in the New Year issue of this journal on a kindred topic, the firm having made a specialty of such problems.

MR. ANTHONY N. BRADY, vice-president of the People's Gaslight & Coke Company, of Chicago; Mr. George O. Knapp, its president, and Mr. C. K. G. Billings, chairman, are now stopping at the Hotel Ritz, in Paris. On being interviewed by the Paris *Herald*, Mr. Brady said: "We take pleasure in stating that we have come to Paris at the invitation of some Parisian friends, who requested us to look over the gas situation here for the purpose of giving our views and possibly taking a concession for supplying gas to the city of Paris. We have been looking over the manufacturing interests of the city and by courtesy of the present gas company, have visited its works and inspected its methods. We are pleased to find that the gas works are in fair condition, though the methods employed are not as modern as might be desired, and that the class of workmen employed is most excellent."

LORD KELVIN.—In an article inquiring whether the British aristocracy is on the wane, Sir G. Arthur, in the January *North American Review*, says: "Of late years, the system of selection has, to an increasing extent, been based on better principles, and it is not too much to say that promotion to the House of Lords is, in these days, a means of making the Upper Chamber thoroughly representative of all that is best and worthiest in the community. The titled aristocracy has everything to gain by such additions to its numbers as Lord Wolseley, Lord Kelvin, Lord Armstrong, Lord Kitchener, Lord Goschen, Lord Avebury, Lord Strathcona, Lord Rothschild—men who seek to maintain at its highest point the standard of English tradition in all its purity, and who contribute to the national credit their great assets of valor, of intellect, of statesmanship, of culture, of experience, of political and commercial honor; men who, indeed, were by nature and in the strictest sense of the term aristocrats before ever they were formally ennobled by letters patent. So long as the leaders in the land base their claim to lead on a sense of responsibility incurred and duty to be done there is little fear that they will find themselves bereft of honor and support."

Trade Notes.

THE BURT MANUFACTURING COMPANY, of Akron, O., announces that it has just made a shipment of six oil filters to Stockholm, Sweden; five to Buenos Ayres, Argentine Republic, and six to Yokohama, Japan.

BRANCH FUSE BLOCKS.—The H. W. Johns-Manville Company, New York, describes and illustrates its "Noark" branch fuse blocks, for 220-volt "Noark" fuses, in a recently issued bulletin. This device is described and illustrated on another page of this issue.

THE MANSFIELD ENGINEERING COMPANY, Mansfield, O., is making extensive improvements and among other new equipment, the Phoenix Electric Company is supplying a large generator. A 25-ton electrically-driven crane is to be installed.

THE CLEVELAND ARMATURE WORKS, Cleveland, O., will move into new quarters and will increase their general repairing facilities by the installation of several new winding lathes. They will occupy a portion of the shop vacated by the Snyder-Hughes Company.

ROCK-CRUSHING PLANTS.—Constructing engineers and contractors will be interested in Catalogue No. 5 of the Allis-Chalmers Company, Chicago, Ill., which contains illustrations and descriptions of rock and ore crushing plants. Much information on the general subject is given.

METERS.—The line of direct-current meters and shunts manufactured by the Jewell Instrument Company, Chicago, is described and illustrated in a booklet issued by the company. These meters are of the D'Arsonval type, and possess many features of construction and utility which commend them to electrical people.

THE KNAPP ELECTRIC & NOVELTY COMPANY, 507 West 51st Street, New York, sustained a slight loss by fire the latter part of December. This accident, however, will not seriously impair the splendid facilities which the company has for manufacturing the various specialties which it is putting on the market.

SALAMANDERITE is a new fireproof construction material introduced by H. W. Johns-Manville Company, of Hartford, Conn. The company has issued a booklet and a folder in regard to it that give many interesting details of interest to electrical people. The booklet contains six illustrations and can be obtained on application.

WATERTOWN ENGINES. The extensive use of Watertown engines, manufactured by the Watertown Engine Company, Watertown, N. Y., is shown in a pamphlet just issued by the company, giving a list of "references," i. e., users of Watertown engines. These engines are found everywhere in this country and in many foreign countries.

CROCKER-WHEELER MOTORS.—Bulletin No. 29 of the Crocker-Wheeler Company is devoted to semi- and fully-enclosed motors, both of which types are illustrated in detail. A considerable portion of the Bulletin is occupied by illustrations of applications of the motors to machine tools, nineteen such applications being shown by excellent engravings. In addition the motor controller is described and illustrated.

CASE ENGINES.—The New Britain Machine Company, New Britain, Conn., has just issued a well-illustrated catalogue of its automatic high-speed engines. These engines are made in the pedestal type, throttle hanger type, and bracket type, and are admirably adapted for the driving of electric generators of small and medium outputs. On several pages are shown a number of outfits of Case engines direct-connected to various makes of dynamos, pumps, fans, etc.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., which, as is well known, does a large and extensive business in heating and ventilating apparatus, has just issued a well-illustrated booklet describing briefly and illustrating its heating, ventilating and drying apparatus. Among the illustrations are several of large school buildings, churches, hospitals, etc., heated and ventilated by this company's fan system. The illustrations are very clear and artistically executed.

THE FOSTORIA BULB & BOTTLE CO., of Fostoria, Ohio, wishes to correct the impression that its plant has been destroyed by fire and that it is not in a position to furnish inner globes. On the contrary, its production of inner globes is greatly increased and it is in a position to take the best possible care of all business that comes its way. Another glass factory at Fostoria, Ohio, which manufactured outer globes and shades for arc lamps, was destroyed by fire.

SHULTZ CALENDAR.—The Shultz Belting Company, of St. Louis, Mo., reminds its patrons of the flight of time by issuing a handsome illustrated calendar for 1903. Mr. A. B. Laurence New York manager of the company recently took an order for a 48-inch, 3-ply belt, 117 feet long, for the Stamford Electric Light Company, Stamford, Conn. The Shultz Company reports doing a large business, especially with foreign countries. It built a new factory at St. Louis last year.

MICHIGAN ELECTRIC COMPANY'S BANQUET.—The second annual banquet tendered by the Michigan Electric Company, of Detroit, to its employees was held at the Hotel Cadillac, in that city, Saturday, January 3, and was attended by 50 employees. The affair evidenced a great deal of good feeling between the officers and employes. After the banquet the party witnessed a theatrical performance. A very neat menu was gotten up for the banquet and all present had a very enjoyable time.

THREAD MILLING MACHINE.—The Pratt & Whitney Company, Hartford, Conn., in an artistically gotten up pamphlet, describes and illustrates its thread milling machine, which is designed for the manufacture of precision screws, worms, lead and feed screws, spiral gears for high-grade machine tools, etc. A very complete description of the machine accompanies the illustrations, which are of high artistic merit, and altogether the subject is very comprehensively covered. Copies of this pamphlet can be had on application.

THE STOREY MOTOR & ELECTRIC COMPANY reports a busy season in its line and in view of many improvements in shop details and the broadening of its line of motors, the concern expects to be in a position to accommodate a largely increased number of purchasers, who, it would seem, find the Storey "variable speed" motors quite up to the requirements where reference is had to machine-tool driving. Mr. Thos. J. Fay, general manager of the Storey Company, gives his personal attention to motor applications to lathes, planers, shapers, etc., thus saving to machine-tool builders much trouble and annoyance.

ROEBLING CALENDAR.—Whatever the John A. Roebling's Sons Company undertakes to do it does well, however large or small the task may be. The company has just issued a calendar for 1903 which is gotten up with taste and with a view to real utility. The calendar is headed with a half-tone view of the cable and wire work on the new East River bridge at New York, and shows very clearly some of the difficulties in carrying out the great project. The calendar itself is very clear and is not subordinated to a great mass of advertising matter. This is a great advantage. Mr. Henry L. Shippy, treasurer of the company, in presenting the calendar, sends with it a very neat little card containing seasonable greetings.

SILICON COPPER.—This alloy as produced by the Cowles Electric Smelting & Aluminum Company, Lockport, N. Y., and is offered to foundrymen as a most desirable material for use in the production of pure copper castings. The silicon, it is stated, acts upon copper in almost the same manner as phosphorus, and is more active in clarifying, refining, hardening and strengthening copper and its alloys. It is put up in ingots weighing about 14 pounds each, from 1 to 2½ pounds of the metal being used to every 100 pounds of melted copper. The resulting castings, it is stated, are clean, solid and free from blow-holes, swellings, etc., and possess strength superior to those made by other processes. Silicon-copper is available as well in the manufacture of high-grade castings in tin-bronze and brass. A booklet just issued by the company gives much valuable information about this metal, the advantages of which should be looked into by all interested.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 6, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

[illegible]4. TROLLEY HARP; F. J. Caswell and C. C. Wood, Woodsville, Mass. App. filed Feb. 10, 1902. Details.

[illegible]. DIAPHRAGM FOR BATTERIES; E. A. Decker and W. P. Divine, Philadelphia, Pa. App. filed April 9, 1902. A plate of baked porous material is cut or ground down to a thin diaphragm in which strengthening ribs are left.

[illegible]4. MACHINE FOR CLEANING, STRAIGHTENING AND REINSULATING OLD WIRE; F. W. Henninger, Detroit, Mich. App. filed June 13, 1902. The wire is led through a machine which cuts or scarifies the old insulation, which is afterwards scraped off and the new insulation applied.

[illegible].583. TROLLEY POLE AND STAND THEREFOR; W. H. Kilbourd, Greenfield, Mass. App. filed March 13, 1902. Means for preventing the upward movement of the pole in case the trolley leaves the wire.

[illegible].584. METHOD OF CONTROLLING THE SUPPLY OF ELECTRIC ENERGY TO TRANSLATING DEVICES; H. W. Leonard, East Orange, N. J. App. filed Feb. 6, 1897. The field of a motor is supplied from a main source and the armature with a variable e. m. f. controlled by a second source located between the motor armature and the main source, to vary the speed of the armature.

717,607. ELECTRODE FOR STORAGE BATTERIES; L. Paget, New York, N. Y. App. filed Sept. 8, 1899. A thin corrugated plate of compressed arborescent crystals of lead.

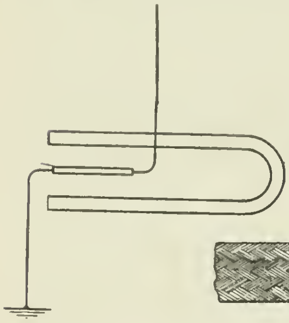
717,608. METHOD OF PREPARING STORAGE BATTERY ELECTRODES; L. Paget, New York, N. Y. App. filed Oct. 19, 1899. Process of making a plate consisting in pressing finely divided lead into a thin corrugated plate.

717,609. STORAGE BATTERY ELECTRODE; L. Paget, New York, N. Y. App. filed Jan. 10, 1900. A thin lead plate having on each side successive thin layers compressed to the density of sheet lead.

717,610. STORAGE BATTERY AND METHOD OF PREPARING ELECTRODES THEREFOR; L. Paget, New York, N. Y. App. filed Jan. 10, 1900. The active material or material to become active, consists of finely divided lead compressed to a density of sheet lead.

717,656. BRUSH HOLDER; W. W. Beeler, Baltimore, Md. App. filed April 26, 1902. Details.

717,675. SWITCH TERMINAL; G. W. Hart, Hartford, Conn. App. filed June 26, 1902. A post having saw cuts in opposite sides, into which plates or clips are inserted and held by upsetting the metal of the post between the cuts.



717,772.—Signalling System.

717,778.—Electric Conducting Cable.

717,724. ELECTRIC SWITCH; W. R. Thompson, Norwalk, Conn. App. filed May 28, 1902. Details.

717,755. AUTOMATIC CONVERSATION-COUNTER FOR TELEPHONE EXCHANGE SYSTEMS; J. H. Meyer, Magdeburg, Germany. App. filed March 28, 1901. (See page 124.)

717,765. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa., and G. W. Pickard, Boston, Mass. App. filed June 22, 1901. The invention comprises a chemical recording device controlled by the received impulses and described as a non-inductive recording circuit.

717,766. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Dec. 7, 1901. The relative movement of the elements of an electrostatic receiver is communicated to microphonic contacts included in the recorder circuit to amplify the received impulses by calling into action a local source of energy.

717,767. MULTIPLEX WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Dec. 23, 1901. Accomplished by the synchronism of commutators at each station. Each transmitting instrument has use of the radiating conductor in a certain order of succession and at the same instants the associated receiving instrument is in communication with the receiving conductor.

717,768. SYNCHRONIZER; H. Shoemaker, Philadelphia, Pa. App. filed April 25, 1902. Commutating devices whereby the receiving circuits are brought alternately into action with such rapidity that each receiver is independent of the others and selects out the impulses intended for it.

717,769. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed May 12, 1902. Means for shielding the wave responsive device from the influence of nearby radiations, comprising a metallic case, a shielded connection through the walls of the case and a plate in contact with a connection, forming a condenser with the walls of the casing.

[illegible]70. WIRELESS SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed June 16, 1902. A plurality of generators, an interrupter in the circuit of each generator, and means for controlling the interrupter to render the generators successively operative.

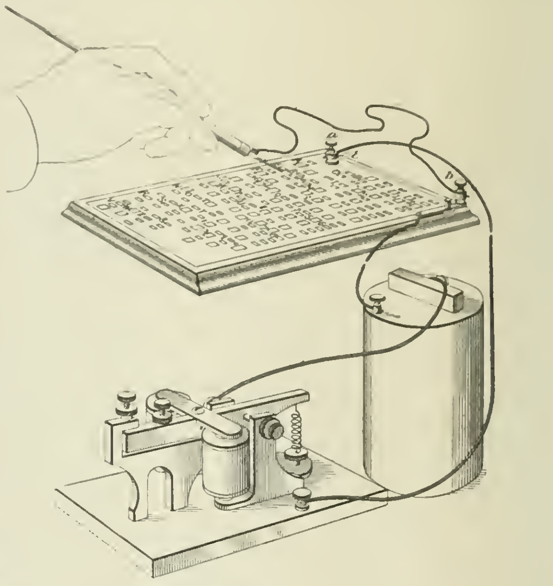
[illegible]71. SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Aug. 11, 1902. The radiating and receiving conductors of a wireless system are one half or a full wave length, in length, and are entirely insulated from the earth.

717,772. SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed August 19, 1902. A material whose conductivity is altered by magnetism is subject to a magnetic field varied by the received impulses. The material is included in the local circuit.

717,773. SIGNALING SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Aug. 19, 1902. The rate of operation of the tapper in a wireless system is regulated to correspond with the rate of succession of the transmitted wave, a telephone being used in the receiving circuit to indicate the groupings of the tappings.

717,774. OSCILLATOR; H. Shoemaker, Philadelphia, Pa. App. filed Nov. 10, 1902. A portable oscillator comprising a freely oscillating circuit including an adjustable condenser whereby the wave length of the transmitted energy may be varied within certain limits.

717,776. QUADRUPLEX TELEGRAPH SYSTEM; J. F. Skirrow, East Orange, N. J. App. filed Nov. 8, 1901. A differentially wound double acting relay having two separated cores, one pair of adjoining ends of which form the neutral relay and the other pair the polarized relay, whereby one instrument will serve the same purpose as the neutral relay and the independent polarized relay of the old form.



717,966.—Telegraph Transmitter.

717,778. ELECTRIC CONDUCTING CABLE; R. Spaulding, New York, N. Y. App. filed Feb. 5, 1902. A braided core and an insulating covering.

717,821. TROLLEY FOR ELECTRIC CARS; W. A. Daggett, Vineland, N. J. App. filed April 22, 1902. Details of a spring-mounted harp.

717,895. TELEPHONE RECEIVER HOLDER; J. B. McClain, Washington, Pa. App. filed October 6, 1902. (See page 124.)

717,918. ELECTRICAL REGULATOR; C. P. Philbrick, Wymore, Neb. App. filed June 13, 1902. The fuel supply of a boiler furnace is controlled by an electro-magnet in a circuit opened and closed by boiler pressure.

717,966. TELEGRAPH TRANSMITTER; C. T. Bourk, Lima, Ohio. App. filed Jan. 26, 1901. A device for beginners, consisting of a stylus to be moved over metallic segments in a tablet, representing the signals and in circuit with a sounder.

717,973. TESTING SYSTEM FOR TELEPHONE LINES; W. W. Dean, Chicago, Ill. App. filed April 5, 1901. (See page 124.)

717,978. WIRELESS SELECTIVE SIGNALING SYSTEM; C. D. Ehret, Rosemont, Pa. App. filed July 3, 1902. A method of cyclically generating different frequencies and cyclically receiving different frequencies to reproduce a signal.

718,024. TROLLEY; J. T. Rice, Hot Springs, Ark. App. filed March 20, 1902. Two poles controlled by a single spring.

718,045. ELECTRICAL STORAGE BATTERY; H. K. P. Barham, Portsmouth, England. App. filed Dec. 2, 1901. Lead strips bent into zig-zag fashion, having absorbent material inserted between the folds and an intermediate portion in the form of a tray.

Electrical World and Engineer

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CONTENTS.

Editorial 143
Telegraph Lines along Railways 146
Municipal Ownership and Public Franchises 146
Water Power on the Winooski. By Alton D. Adams 147
Stresses on Frames of Alternating Current Generators. By P. J. Frenell 148
The Evolution of the Modern Telephone System. By L. A. Lindsey 150
Results with Third Rail in Boston 151
The Underground System of the Chicago Edison and Commonwealth Electric Companies 152
Berliner Decision 154
The Street Railways of Massachusetts 155
Solution of a Vexatious Problem in Street Railway Work. By W. B. Arthur 155
The Construction of Aerial Telephone Lines—II. By Arthur V. Abbott, C. E. 156
Opinions on the Berliner Decision 158
Recent Electrochemical Developments. By Clinton Paul Townsend 159
New Telephone Patents 159
Wireless Telegraph Message from President and King 161
Current News and Notes 161
LETTERS TO THE EDITORS:
- The Making of Electrical History. By Charles Herman 162
- Electric Roads in Sweden. By Arvid Westerberg 162

Digest of Current Electrical Literature 163
Bitumenized Fibre Conduit 167
The Annual New York Automobile Show 167
Richardson Automatic Scales 170
Incandescent and Arc Lamp Fittings 170
DEPARTMENTS:
- Financial Intelligence 171
- Commercial Intelligence 172
- General News 174
- Trade Notes 177
- Record of Electrical Patents 178

THE AUTOMOBILE SHOW.

The magnitude of the automobile show at Madison Square Garden this week, and the great attendance, must be a source of intense gratification to all interested in the art, whatever may be the particular branch to which they devote attention. There is no denying that gasolene types predominate greatly and exhibit marked improvement in every respect, but as they depend in no small degree on electrical accessories, their increasing number is a help to those branches; while the newer form of combined gasolene and electric machine presents many hopeful aspects. It does not seem to us that steam is making much headway, although it is undeniably a good power for a stiff hill. We regard the general outlook for electricity as still excellent, and any one familiar with the subject cannot but note the steady improvement in vehicles of the electrical class, with the known and standard appliances now available. The resources of the art are far from being exhausted, however, and as has been pointed out in regard to steam locomotives, electricity is virtually beginning where steam has left off, having in most respects completed all its possible cycles of improvement in the matter of transportation on land. Be this as it may, the automobile show is most encouraging to all who wish to see the horse relieved entirely from work within city limits, where its presence becomes less and less desirable, or even tolerable. That which the trolley car has done, the automobile must second; and if electricity can play as large a share in the newer art, we shall be fairly well satisfied.

THE BERLINER DECISION.

The decision rendered in Boston last week in the Berliner case terminates in all probability a *cause celèbre* which, within and without the Patent Office, has had a term of more than a quarter of a century. It is true that the case could be reopened by the United States Supreme Court—either by accepting a certification to its jurisdiction or by ordering such certification—but as the Boston case just decided appears to have involved only a determination of facts and not a great principle in law, the probability of such an eventuality is very remote. Indeed, one might well believe that in view of the short remaining life of the patent, rather than having a desire to reopen the case, the Bell Company feels an immense relief at the removal of the burden of an issue which has entailed enormous expense with no return—at least in recent years—and has evoked intense hostility against the company. The history of the Berliner patent begins with an application filed June 4, 1877, the application having been preceded by three caveats dated respectively, April 4, April 30 and May 9, of the same year. It was not until more than fourteen years later, namely November 17, 1891, that the patent was issued. During this long delay in the Patent Office, the application was constantly the subject of proceedings, which subsequently gave rise to direct charges of fraud that figured very largely in the course of the litigation just closed. The issue of the patent, controlling as it did the entire art of telephony for a period of seventeen years, naturally produced a sensation, and force of public opinion led the government to institute in February, 1893, a suit for its annulment.

Judge Carpenter, of the Circuit Court, sitting in Boston, handed down on December 16, 1894, a decision in this suit invalidating the patent on the grounds that its issue from the Patent Office had been dishonestly delayed, and that both in function and device the invention covered is identical with that described in another patent issued to Berliner in 1880. Seventeen months later—May 18, 1895—this decision was reversed by the Circuit Court of Appeals, the opinion in this instance holding that the delay in issue must be ascribed to the Patent Office system; that no proofs of gross error or fraud were shown, and that in the absence of any showing of fraud the government was barred from contesting the validity of the 1891 patent on the grounds of its identity with the patent of 1880. It is interesting to note that Judge Colt, who wrote the opinion of last week, concurred in the above decision. Owing to the important questions of law involved, the Supreme Court ordered the issue within its jurisdiction and on May 10, 1897, handed down a decision sustaining the position of the lower court, the grounds taken being that the government in its case had not established the existence of fraud; that the patentee could not be held responsible for dilatory action on the part of Patent Office officials; and that as to the 1880 patent, the government is bound by the decision of its Patent Office, which was that the 1880 and 1891 patents cover separate inventions. This ended the government case, the outcome of which was predicted from the start, and the issue was left in practically the same condition as when the patent was granted six years before.

In the meantime, several actions charging infringement of the Berliner patent had been brought; these were finally consolidated in one case and on the issues involved, Judge Brown handed down an opinion February 27, 1891, declaring the Berliner patent invalid. The grounds taken were that Berliner at the date of the patent application had not made the invention covered by the patent as issued; that the invention in the patent is radically different from that in the application, the transformation having been made after the Edison carbon microphone was invented and described; that the invention described in the 1891 patent is identical with that described in the patent of 1880; and finally, that Edison is the prior inventor of the microphone. The case then came, in due course, before the United States Circuit Court of Appeals sitting in Boston, and the decision of last Friday marks the last stage of the celebrated litigation.

This final opinion is the most interesting of any that has been rendered in the case, for it not only goes to the heart of the matter by considering the underlying principles of the microphone, but also treats the work of Hughes in great detail. As will be seen in the summary of the opinion printed elsewhere in this issue, the court ignores the esoteric theories that have been advanced to sustain the "constant-contact, variable-pressure" view of microphonic action, and ascribes it solely to a loose and varying contact. We are inclined to believe that this verdict from a non-scientific tribunal will stand as against the varying-infinitesimal-gas-film theory, the variable-molecules-in-contact theory and the varying-carbon-resistance theory. The opinion in no uncertain terms assigns to Hughes the discovery of the microphonic principle and no less decidedly credits the invention of the commercial microphone to Edison. It will be recalled that the Edison carbon microphone patents were issued May 3, 1892, but were void *ab initio* owing to the expiration previous to their grant of an English patent on the same invention. The course of the previous litigation had appeared to indicate so clearly the ultimate fate of the Berliner patent that the effect of the recent decision has been largely discounted. It seems likely, however, to strengthen the independent movement by removing a doubt which has had some influence with the more conservative class of capitalists.

Stresses on Frames of Alternating-Current Generators.

A few years ago dynamos were of such relatively small dimensions and power that when enough iron was employed in them to meet magnetic requirements, they were generally structurally strong enough to resist the mechanical forces of operation. As soon as the magnetically satisfactory structure was mounted on a conveniently shaped bed plate holding the bearing pedestals, the machine was ready for business. Now, however, dynamos are acquiring such large dimensions that some of them are built with the aid of transit instruments, and the mechanical structure calls for special engineering in addition to the electromagnetic design. The modern large dynamo touches upon the work of the bridge-builder in its mechanical design, as well as on the work of the electrical engineer. In other words, the designing electrical engineer has to study the properties and principles of large arched structures. The article on page 148 of this week's issue, by Mr. P. J. Frenell, deals with this question of mechanical design for the purpose of reducing unnecessary weight and cost in the construction of large machines.

Papers on Telephony with the American Institute of Electrical Engineers.

It is noteworthy that a paper on telephony as applied in the Bell system was read this week before the American Institute of Electrical Engineers. There has been a very noticeable and regrettable dearth of such papers in the past, and it is to be hoped that the new example will esablish a new precedent and precept. Telephony has been a rapidly growing science and art, and to stifle its technical aspirations by wilful suppression of intelligent information is to commit a barbarous anachronism. The day has long gone by when the scientific facts of commercial enterprises could be concealed. If history speaks truthfully, the secret of the compounding of Greek-fire was kept successfully in the arsenal at Constantinople by the Moslem sachems for six hundred years, although the substance had value in warfare and gave an appreciable advantage to Mahommedan ships in naval conflicts. In the present age such a secret could hardly be kept for six weeks. It is notorious that the only secret processes that can be safeguarded are those capable of being carried out by a single individual. In telephony any device employed must necessarily be known or at least accessible to numerous persons, and the essential facts about such devices are, therefore, obtainable whenever sufficient earnest attention is directed to their scrutiny.

Many of the problems which the telephone engineer encounters are akin to those met with in heavier electrical engineering, and the methods and experiences of the engineer who directs microamperes may be instructive as well as interesting to him who directs kiloamperes. Consequently it is only fair that the technical knowledge of the one should be placed at the disposition of the other. The telephonists have not hesitated to employ and import the dynamos of their more electrically energetic confrères, and in nearly every telephone central station the dynamo reigns supreme in the basement or power room. It is at least but just that the utilities that peculiarly pertain to telephony should be equally made available to the power engineers. The independent telephone men realize the advantages to be gained by the dissemination of accurate information, even among themselves. They convene, read papers and contribute articles to periodicals with manifest mutual satisfaction and support. The great advance of the art of telephony since the independent movement has gained strength undoubtedly owes much to this enlightened policy. Much might yet be gained by the art and science of telephony if all the votaries acted in this manner; and it is to be hoped, in the interests of civilization, that the sphinx-like reticence of the past will be overshadowed by a broader future policy.

PATENT OFFICE EXAMINERS.

It is a somewhat singular fact that notwithstanding the great output of our technical schools, the United States Patent Office finds difficulty in recruiting its corps of examiners. As raw material, the technical graduate is pre-eminently qualified for the duties, and the entrance examination should for one of his training not be viewed with trepidation. It is true that as a life career, the position of patent examiner holds forth no particular attractions, but as a training for a subsequent career in other walks, it offers most decided advantages. Many well-known engineers laid the foundation of their success in the Patent Office, and the most successful recruits to the ranks of patent attorneys and technical experts have in recent years come from this source. It happens very fortunately that the night course in law in the Columbian University offers an admirable opportunity to those who would add the knowledge necessary to fit for the legal branch. The authorities of those schools which keep on the lookout for openings for graduates could not do better than investigate this avenue in the interest of their protegés.

EXCITATION OF ASYNCHRONOUS GENERATORS BY CONDENSERS.

On page 109 of last week's issue we published an article on this subject by Mr. A. S. McAllister. It is well known that the asynchronous induction machine requires field excitation similar to that of an ordinary alternator, whether the machine acts as a motor or as a generator. The field excitation is nearly in quadrature with the working current, and is therefore a "wattless current." It is this relatively large wattless current of excitation that constitutes an objection to the use of induction motors. Various plans have, from time to time, been suggested for exciting induction motors locally, so as to obviate the necessity of supplying them with wattless currents, and thereby to increase their power-factor. Nevertheless, nearly all the induction motors employed up to this date have no excitation except that due to wattless line currents. The plan outlined in the article referred to consists in connecting condensers with induction machines in such a manner that the condensers will locally and automatically cause the exciting quadrature currents to flow, and thus enable the machine to operate without line excitation. The broad plan was suggested some years ago by Leblanc, but we are not aware that it has been practically developed, though recently several patents involving the principle have been issued to Mr. Charles S. Bradley. The details of auto-transformer connection with machine and condenser, in the article of last week, appear to constitute an improvement over the Leblanc fundamental arrangement. There can be no doubt that if alternators could be constructed as cheaply and conveniently in the asynchronous as in the synchronous type, there would be simplicity of parallel operation in favor of the former, since no particular skill would be required to throw two generators or motors in parallel. Considerable care is required in connecting two large synchronous machines together, so as not to throw them out of step.

MANHATTAN ELEVATED APPARATUS.

In connection with our recent discussion of experiences on the Manhattan Elevated road since electric traction was adopted there, we published last week, as our readers will have noted, a very interesting and able letter from Mr. Stillwell, written in general defence of the management, and advancing some figures as to the remarkable traffic done on the road, in spite of all drawbacks and delays, since the electric service went into operation. There is no denying the fact that Mr. Stillwell makes out a good case, even while admitting the slackness or want of foresight that permitted the road to get stalled in such a terrible and punishing manner. The management of the elevated is charged at all times with a very grave responsibility, and in view of the direct and intense suffering that can be inflicted on the community, the duty to the public cannot be discharged with too keen and sensitive a conscience.

The main item in this discussion, for us, however, is the relief of the electrical apparatus concerned, from the obloquy and doubt cast upon it during the recent unfortunate episodes. As we said before, it is not our wont to rail at corporations, but rather to justify them if the facts warrant. In this instance the harm done to the electrical cause was deep and serious, and there was nothing left for us but to rise in protest. Not only have we heard scores of New York professional and business men criticize the system, but we happen to know that deprecatory accounts were cabled abroad, likely, and possibly calculated, to do costly injury to electric traction as an industry. We suppose that every piece of electrical apparatus made is susceptible of higher perfection than is now afforded, but it must be a matter of common observation to every one of our readers living in New York or visiting the city, that the electrical apparatus has operated most admirably, affording intrinsically greater pleasure and comfort to elevated road passengers than they have known in a decade. Generators, motors, controllers, multiple unit details, fuses, lights and heaters have all functioned excellently well, and any one who affirms to the contrary has either misunderstood the situation or has been misinformed. There have been one or two curious stories of mishap in the newspapers, but they have had an obvious explanation as to the trouble for all familiar with the mechanism, and in no case has the electrical apparatus been at fault. We have heard some complaint of the "jerk" on the Sixth Avenue trains, due to assumed faulty acceleration or sharp arrest. But those who have traveled on the Third line and, better yet, the Second Avenue, know that the personal equation cuts a considerable figure, and that when once the knack of handling the control system is learned, the smoothness of motion obtained is most agreeable. At the worst, the fact that by means of the control system the time of an ordinary trip of forty or forty-five minutes can have a quarter of an hour saved on it, would condone a much acuter jerking than anything we have, ourselves, felt from inexperienced motormen. Besides, there is for the road the economy of one man, and the system is absolutely automatic in throwing off current at critical moments, should such occur.

We are constrained to make these few remarks not only because of the palpable injustice done electricity in the incident, but because at no distant date another great electrical equipment will be working for transportation purposes in the Subway. The public need have no fear about electricity there, provided it be given a fair show and fair play, as in other notable spheres of action where it has demonstrated its splendid utility, availability, flexibility and safety. After all, the complaints against electricity simmer down to such trivialities that even our passing discussion treats them above their real merit. The electrical multiple unit system has not been the direct or indirect cause of any accident or delay. It is a complete and undeniable success, and vindicates the judgment of engineers like Mr. Stillwell, who staked a high professional reputation on its adoption, as against the locomotive method. There is absolutely no warrant for the idea that parts of the contacts have stuck through fusing or freezing, so that the current could not be shut off; and the experiences we have quoted from Chicago, Boston and the Albany & Hudson show that the third rail is even at this early stage a feasible, workable contact device of very wide application.

Telegraph Lines Along Railroads.

Judge Kirkpatrick in the United States Circuit Court for the District of New Jersey, has handed down a decision making permanent the injunction restraining the Pennsylvania Railroad from interfering with the lines of the Western Union along the Pennsylvania right of way. He said:

"Two suits have been brought in this court, the one at law to condemn lands of the defendant company sufficient for the construction, maintenance and operation of the telegraph lines of the complainant under provisions of the act of 1866; and the other in equity to restrain the defendant from interfering with the telegraph lines of complainant now erected upon and along defendant's right of way until the question of the complainant's right to condemn the said lands upon the payment of compensation has been determined by the court. It appears by the record that the complainant company has maintained its telegraph poles and lines upon the right of way used by the defendant for more than 40 years, and that on September 20, 1881, an agreement was entered into between the complainant and defendant companies for twenty years for the rent therein reserved, by which the defendant granted complainant a right to place, maintain and use upon the right of way of the Pennsylvania Railroad Company and the roads owned, operated or leased by a single line of telegraph poles, and to maintain thereon such wires as the telegraph company might from time to time elect.

"The agreement also contained a provision that if no new agreement were made the telegraph company should, at the termination of the contract, or at any time thereafter, upon receiving written notice from the railroad company, remove within six months its poles and wires, and leave the property of the railroad in good condition and free from encumberance; and if not so removed, the railroad company was to have the privilege to remove them at the expense of the telegraph company. In accordance with this provision the railroad company on May 15 gave notice to the telegraph company that it must remove its poles and wires on or before December 1.

"The bill recites that the wires strung on the defendant's right of way are part of a main trunk line used in the interchange of communication between people dwelling in different States of the Union; that their destruction would seriously interfere with such communication; that the lines have been erected at great cost, and that their worth in the present condition is in the neighborhood of $350,000; and that if the wires should be removed from the poles and the poles cut down, their value would be less than $50,000. Upon this statement of facts the complainant asked that the defendant company be restrained from removing its poles and wires until the right of condemnation could be heard and determined and the court granted a rule to show cause why such preliminary injunction should not issue according to the prayer of the said bill, which said rule now comes to be heard.

"Upon the case now presented, Congress in 1866 enacted that any telegraph company shall have the right to construct, maintain and operate telegraph lines over and along any of the military or post roads of the United States, but such lines of telegraph shall be so constructed and maintained as not to interfere with the ordinary travel on such roads. That act provided that any telegraph company before exercising the powers or privileges conferred by the act should file with the Postmaster General its written acceptance of the restrictions and obligations required by the act. This act, the bill alleges, was accepted by the complainant company, which has conducted its business in accordance therewith. All railroads of the United States are by law declared to be post roads (revised statute) and the right of way of the defendant companies thereby becomes subject to the provisions of the act of 1866.

"The latter question has not received judicial interpretation by the court of last resort, but the statute of July, 1866, as applicable to post roads, has several times been before the courts for their construction. It has been held that because of this law one company having exclusive privileges under the State law cannot prohibit the erection of the telegraph lines of another company on the post roads of the United States, where such other companies have accepted the provisions of the act of 1866, when those in control of such roads had given their assent. It has been decided that no railroad company owning a post road of the United States, over which interstate commerce is carried on, can bind itself by agreement to exclude from its roadway any telegraph company, incorporated under the law of a State, which accepts the provision of the act and does not interfere with the ordinary travel of the road.

"If a State cannot, by legislative enactment, prohibit a foreign corporation which had complied with the act from erecting its poles and wires over a post road belonging to a railroad company which has given its assent thereto; and if a railroad company cannot by agreement with one telegraph company bind itself to exclude another telegraph company from the use of its right of way because it is a post road, how can a railroad company (being a post road) nullify the act by arbitrarily refusing to grant them a right which the law confers? Surely if the railroad company cannot bind itself by agreement to exclude the telegraph company it cannot do so arbitrarily.

"If the act gave a telegraph company the right to erect its poles upon post roads, it prohibited the owners of such roads from doing anything which might be hostile to the object contemplated by Congress and render its acts ineffectual. The suit of Postal Telegraph against Oregon Short Line to condemn a right of way has been passed upon by the court of last resort and is therefore binding upon this court. The decision held that the right of condemnation existed and the court proceeded to assess damages.

"Enough has been said to show that the contention of the complainant of its right to condemn is not without force. The only question now before the court upon the return of this rule is whether the defendant shall be enjoined, pending the determination of the complainant's right to condemn, from interfering with the status quo and doing to the complainant an injury which may be irreparable. It is not necessary that the court should determine that the complainant is entitled to a final award in its favor; it is enough that the case presented seems sufficiently meritorious to warrant the court in preserving the status quo until the real merits of the controversy have been finally determined.

"To grant the injunction asked for in this case would result in irreparable injury to no one, while the refusal to do so, from which there would be no appeal, would result in the destruction of complainant's property, for which they would receive no compensation.

"If the right of condemnation exists, complainants should not be subjected to that loss while exercising it. The defendants say they have entered into a new contract with another telegraph company, and that there is not sufficient room on their right of way to permit of the maintenance and operation of the lines of more than one telegraph company. This question ought, I think, for the reasons above given, to await the final determination of the court. To compel the complainant to vacate the premises would entail a great destruction in value of property, without compensatory benefit to any one.

"In view of the facts presented, and for the reasons above stated, I have decided to make permanent this injunction. In this way the defendants will have an opportunity to appeal to the next term of the Circuit Court of Appeals; while should the rule be discharged the complainant would have no appeal and the injury to its property would have been accomplished before the case had been properly considered."

As an offset to this decision, Judge Buffington, in the United States Circuit Court at Pittsburg, has handed down a decision refusing to grant the Western Union petition for condemnation proceedings to condemn a right of way along the lines of the Pennsylvania Railroad. The Kirkpatrick decision is to be appealed at once.

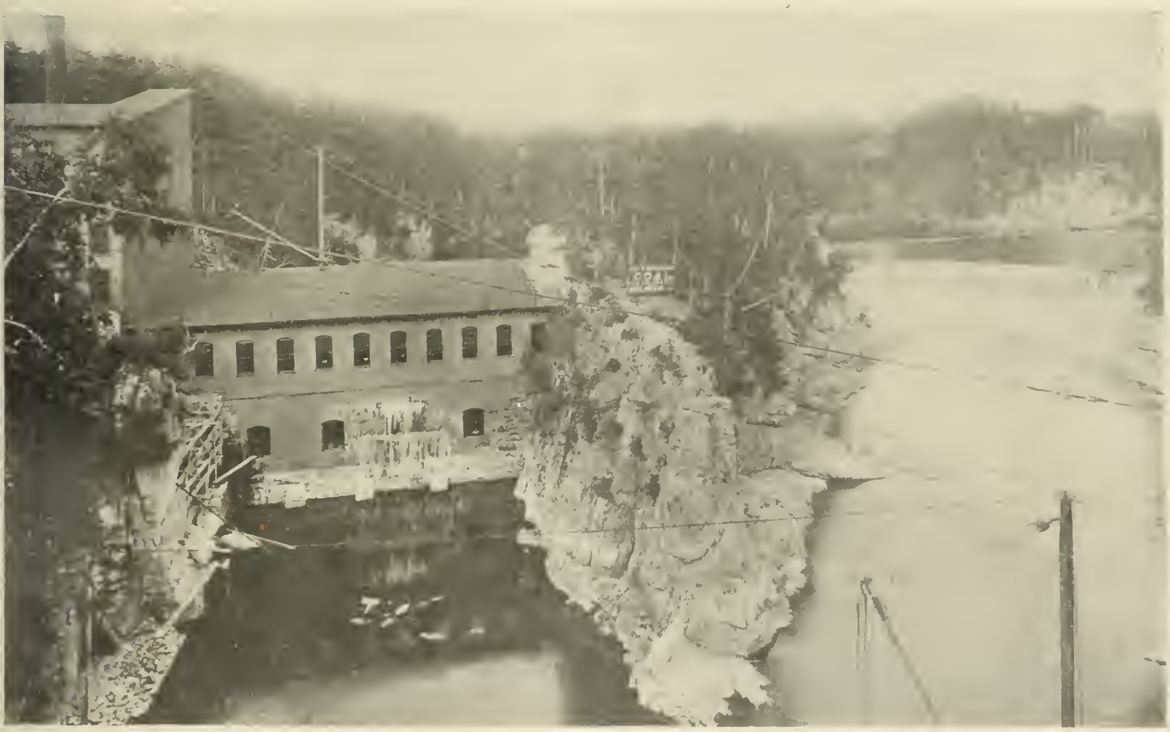
Municipal Ownership and Public Franchises.

Under the auspices of the Committee on City Affairs of the Reform Club of New York City, the convention on municipal ownership and public franchises will be held at the rooms of the club on Fifth Avenue on a Thursday and Friday toward the end of February. The exact date cannot be fixed until word is received from English administrators who have been invited to attend. Addresses are already promised by Mr. Robert P. Porter on "The Recent History of Municipalization in Europe"; by the staff of the School of Commerce of New York on "The Recent History of the Municipalization in the States"; by Frederick Howe, of Cleveland, on "Taxation of Franchise Values," and by Lieutenant James B. Cahoon on "Municipal Ownership of Gas and Electric Lighting Plants." A number of other addresses will be announced later.

Water Power on the Winooski.

By Alton D. Adams.

It is a rugged spot. During uncounted ages the soft hand of the Winooski, armed with cutting points of sand and gravel, has gradually carved a narrow gorge 100 feet deep in the solid rock that forms its bed. In the center of this gorge is a great monolith that divides the waters. A few rods below this monument to the untrained forces of nature is a narrow, single-track railway bridge, over which express trains pass to and from Burlington, Vt. If a train ever goes through that slender trestle—well, the water 100 feet below is shallow, but the bottom is hard. Some ten years ago Dr. W. S. Vincent, the pioneer in electrical enterprises at Burlington, Vt., saw the value of this site for a power station and secured the entire water privilege. The foresight required for this move at a time when electrical supply from water power was a thing of questionable expediency has recently had a full reward, for Dr. Vincent has sold the entire holdings of his company to capitalists of Philadelphia at a handsome advance on their original cost. Meantime the late Vermont election has made Dr. Vincent a member of the State Legislature, and, having demonstrated the value of water, it is now thought that the Doctor will help residents of the Green Mountain State to the benefits of a stronger liquid, and thus fill a long-felt and depressing want.



General View of Water Power Electric Plant at Burlington, Vt.

An electric power station across a river, in a river, and, if the sensations produced by a descent to the wheel level are to be believed, under a river. This is the situation in which electric power is generated for the city of Burlington. The structure which occupies the entire cross section of the gorge between one main bank and the rocky island is at once a dam and a power station. Rising from bedrock in the river, 110 feet long between the banks, and 60 feet wide, the station forms a rigid mass of masonry. The wall on the upstream side of the station takes the pressure of 33 feet of water, and this water after flowing through the station by way of the wheels flows out on the down-stream side.

Across that half of the river not occupied by the power station there is a timber crib dam filled with stone and based on solid rock. This crib dam is 100 feet long and 25 feet high. The water power afforded by these structures has been in use during ten years to operate the entire light and power system of the Vermont Electric Company, and in all this time steam has been used only two days because of lack of water. The dam and power house set the river water back three miles, thus giving fair storage capacity. At times of moderate flow there is 2,500 hp available in the electric station. This water power and the electric station are about three miles from the business center of Burlington, and in view of future extensions the company has recently acquired another water power of about equal capacity a few miles further upstream on the Winooski. At the electric station the full head of water is 31 feet, and it is utilized by four horizontal turbine wheels having an aggregate capacity of 2,200 hp at 130 r.p.m. Three of the wheels are of the Hunt make, one being rated at 350 and two at 635 hp each. The fourth wheel is of the Hercules pattern and is rated at 680 hp. All the turbines are located on the lower floor of the station and are connected by belts and clutch pulleys with the main shaft on the upper floor. This shaft is 7 inches in diameter, 110 feet long and extends the entire length of the station, operating at 225 r.p.m. Regulation for constant speed is had with a Lombard and a Schenck water wheel governor. At one end of this shaft and directly mounted on it by clutch is a 500-kw General Electric three-phase generator of 32 poles, which operates at 225 r.p.m., 60 cycles and 2,300 volts. At the other extreme end of this shaft is direct-coupled by clutch a McIntosh & Seymour, single-cylinder engine, rated at 500 hp, with 100 pounds steam pressure. The remaining dynamos are connected at intervals along the shaft by belts and clutches. Two of these dynamos are of Westinghouse make, each having a capacity of about 200 kw, and operating at 2,300 volts, 60 cycles and 450 r.p.m. These Westinghouse dynamos are three-phase and have 16 poles each. The remaining dynamo equipment is made up of six series arc machines with an aggregate capacity of 360 2,000-cp arc lamps. Five of these arc dynamos are of the Brush make, four having a capacity of 65 lamps each, and one of 45 lamps. The remaining arc dynamo is a 55-lighter of the Thomson-Houston make.

On the river bank adjoining the water power station is an extension which contains the boiler plant and also storage, supply and repair rooms. Four horizontal return tubular boilers rated at 150 hp each, with 100 pounds gauge pressure, make up the plant. These boilers and the engine above mentioned are retained simply for use in case of accident to the water power equipment, as the flow of water is ample to carry the load at all times of year. Service from the station is continued during the entire 24 hours daily, it being the practice to disconnect any one of the water wheels or dynamos from the main shaft by means of the clutches when they are not required. This electric plant is about one-half mile from the public highway leading to Burlington and the pole line between the plant and the highway passes over a private way. All of the electric light and power service in Burlington is derived from this water power plant and the distribution lines are all run directly therefrom. Besides the series arc circuits, the pole line from the water power plant to the business center of Burlington carries nine No. 0 wires for the alternating service. These nine wires form three three-phase circuits. One of these circuits is devoted exclusively to the supply of induction motors and the other two circuits to commercial lighting. All three circuits operate at 2,300 volts.

As may be seen from the foregoing, no sub-station is employed at Burlington. The lighting load of the system includes about 200 street and 40 commercial arcs all of 2,000 nominal candle-power. Commercial lighting includes about 15,000 incandescent lamps. Owing to the moderate rates at which electric power is sold, the motor load of the Burlington system is relatively large, aggregating 550 hp in motors, which range from one to 50 hp each in capacity. All motors are of the three-phase induction type and operate at 220 volts. Nearly all of the incandescent lamps are connected through meters. The Philadelphia interests which have recently acquired the electric system at Burlington are also owners of the gas plant there, so that the two are operated in harmony.

Burlington, the largest city in Vermont, should be especially interesting to electrical interests. The new water power to be developed higher up on the Winooski will ultimately involve a large amount of electrical equipment. In contrast with general electrical supply, the street railway facilities of the city are in a comparatively undeveloped state. At present the electric railway is of only moderate extent, mostly single track, and its equipment from power station to rolling stock is such as will require extensive renewals and additions at no distant day.

These facts have been collected through the courtesy of Dr. Walter S. Vincent, the nestor of the electric lighting and telephone service in Burlington.

Electricity on Canals.

Governor Odell, of New York State, in his annual message to the State Legislature, discussing plans for improving the Erie Canal, says: "Suggestions have been made, and it is only fair that they should be presented to you, that if the canal were enlarged to a nine-foot level and by the use of the water powers of the State and by the introduction of electric motors that not only the same object could be accomplished, but that sufficient revenue could be derived from the sale of power to almost maintain the canal. The cost of electric equipment and providing water power would be much less than under the thousand-ton plan, and perhaps would accomplish the same results. If this be feasible I am sure that all who are interested in the welfare of the canals would be glad to give it consideration. If this plan should be adopted, the canal could be constructed within two or three years and the constant withdrawal of commerce could be checked much more rapidly than under the thousand-ton barge plan, and it could be provided for under the present constitution. The former would require an amendment." The Governor has recommended the abolition of the State tax on franchises granted to corporations.

St. Louis Exposition Rules.

The rules to which exhibitors, concessionaires and state and foreign governments must conform in the erection and maintenance of structures on the St. Louis Exposition grounds have received the final approval of all authorities concerned. The rules govern the erection of buildings and structures on the exposition grounds other than those erected by the Louisiana Purchase Exposition Company; the treatment of the grounds around buildings; sewer connections; water supply; plumbing; gas supply; fire protection by the high-pressure water system; supply of electricity; supply of steam; supply of compressed air, and the disposal of garbage.

Stress on Frames of Alternating Current Generators.

By P. J. Frenell.

EVERYONE dealing with electrical apparatus has doubtless noted that certain parts of alternating-current generators have considerable weight, especially the stationary parts of generators of the rotating field type. These are in the most cases of very heavy construction, and the amount of material actually needed to resist the external forces might be reduced in many cases to half of its actual value. This means, of course, less cost for building and for the transportation of the machine. The following investigation of this subject may be of interest to those who are not familiar with the calculation of stresses. As the theories are of a general nature they can be applied to any kind of stationary frames. That is, they can, with good judgment, be used as well for alternating as for direct-current machines.

Suppose a curved beam having an invariable cross-section is under the action of balanced forces. These forces can be divided into one force normal to the cross-section, and another in the same plane as the section, and one moment of force.

The influence of the force in the plane of the section or, as we may call it, the shearing force, can be neglected in comparison with the stress due to normal force and moment.

In Fig. 1 N is the normal force, positive when positive with respect to tension and negative with respect to compression. M is the moment of force, positive when turning clockwise and negative when turning counter-clockwise.

Let p and p' be two cross-sections of the beam infinitesimally close to another. These intersect the neutral line (the stress here is O) of the section in the points O and O'. The planes p and p' extended intersect each other at a straigght line in c. This is the central axis of the beam. r is the radius for the neutral line of section, CO and $y = OP$ is the distance from the neutral line to the points P and P'.

Under the influence of the normal force N (positive), the beam is deformed as follows: The plane p' turns relative p with C as an axis to a new position p''. See the dotted narrow line in Fig. 1.

In addition to the force N is the moment of force M (positive). This acts to decrease the radius of the neutral line. Hence the new central axis for the beam is at C_1, instead of C. The final deformation is indicated by dotted lines.

The theoretically derived formula for the stress in the section is, if $P =$ area of cross-section, and $\sigma =$ stress per square inch of section,

$$\sigma = \frac{N}{P} + \frac{M}{rP} + \frac{r}{r+y} \cdot \frac{My}{\mathfrak{J}}$$

$$\text{whence} \quad \mathfrak{J} = \int r \frac{y^2}{r+y} \, dP$$

The value of the stress can be found for any part of the section by means of this formula, if the external force and moment, the radius of the neutral line, the area of section and the quantity I are given. This quantity I differ very little from the moment of inertia for the section. For rectangular and circular sections the difference can be calculated mathematically, and is if $h =$ height of cross-section, $I =$ moment of inertia less than 1.01 I for $\frac{r}{h}$ larger than 4.

Hence we can with a slight approximation introduce the moment of inertia I in the formula instead of I. The neutral line for the beam is in this case the same as the line through the centre of gravity of the section; therefore, the radius r is the radius to the centre line of gravity.

$e_1 =$ max. distance from centre of gravity to outside fibre.

$e_2 =$ max. distance from centre of gravity to inside fibre.

Substituting y for e_1 and e_2 in the formula we get the value of maximum fibre stress, or

$$f_s = \frac{N}{P} + \frac{M}{rP} + \frac{r}{r+e} \cdot \frac{Me}{I} \qquad (1)$$

This formula can be applied when figuring the stress due to weight and unbalanced magnetic pull.

For figuring the stress due to equally distributed magnetic pull, the frame is to be considered as a ring of uniform section, the problem being of the same nature as in the case of a cylinder with outside pressure, except that instead of having a normal pressure outside we have a normal tension inside the ring.

The magnetic pull can be considered as distributed because of the large number of poles of alternators. This cannot be done, of course, in the case of direct-current generators.

Let t = tension per square inch on the inside diameter of the ring; $a = r - e_2$; $b = r + e_1$, then the formula is

$$f_t = -\frac{t\,a^2}{b^2\ a^2}\left(.4 + 1.3\,\frac{b^2}{x^2}\right)$$

Substituting for the outside fibre stress, $x = b$, and for the inside fibre stress, $x = a$, then the outside fibre stress is

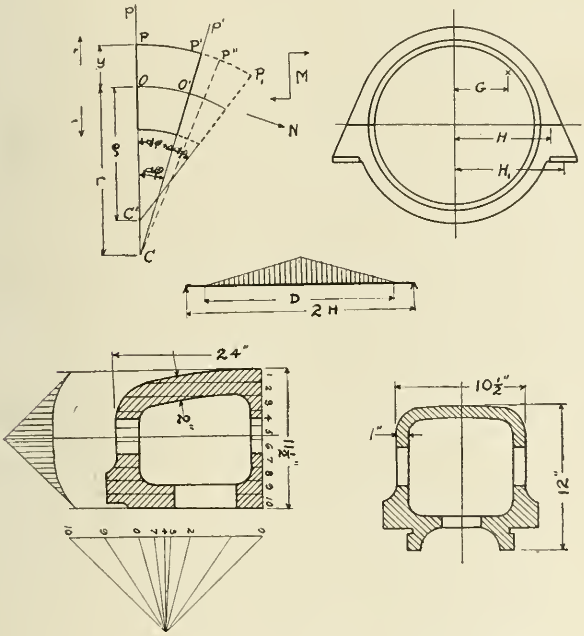
$$f_t{}' = -1.7\,\frac{t\,a^2}{b^2 - a^2} \qquad (2)$$

and the inside fibre stress is

$$f_t{}'' = -\frac{.4\,a^2 + 1.3\,b^2}{b^2 - a^2}\,t \qquad (3)$$

Since we now have all necessary formulas for our calculation, they will be applied to an actual example.

For this purpose we will select a frame for an alternating-current generator of the rotating field type. The generator is of ordinary size and appearance. The frame has a horizontal split, as shown in Fig. 2. Following are the data:



FIGS. 1 TO 5.—ILLUSTRATING STRESSES ON GENERATOR FRAMES.

Rating, 500 kw; diameter inside lamination, 84.5 inches; outside diameter of frame, 120 inches; width of lamination, 16½ inches; width of frame, 24 inches.

The cross-section of the frame is shown in Fig. 3. This figure also shows the method of finding the moment of inertia of the section and the centre of gravity. The method is well known, and does not need any explanation. The area of section multiplied by the polygon area gives the moment of inertia; and the intersection between the first and the final side in the polygon gives the position of the centre of gravity.

Area of cross-section, 95.64 square inches.

Area of polygon, 17.38 square inches.

Moment of inertia $= I = 95.64 \times 17.38 = 1662$ inches.

Max. fibre distance outside frame $= e_1 = 5.58$ inches.

Max. fibre distance inside frame $= e_2 = -5.92$. inches.

Radius of center of gravity $= r = 54.42$ inches.

Span of upper frame part $= 2H = 116$ inches (see Fig. 2).

Span of lower frame part $= 2H_1 = 136$ (see Fig. 2).

If g is the centre of gravity of one quadrant of the frame, including the weight of frame, laminations, winding, etc., the distance from g to the vertical centre line for the frame is $G = 32.1$ inches, and the same for the upper and lower quadrant.

We will first consider the stress of the upper part, due to weight of frame, laminations, winding, etc.

Weight of frame, upper part = 6,300 pounds.

Total weight of upper part = 10,000 pounds.

Reactions at split = 5,000 pounds.

The maximum stress is, of course, at the top of the frame

Moment $M = -5{,}000\ (H - G) = 5{,}000\ (58 - 32.1)$.

$M = -129{,}500$ pound-inches.

Normal force $N = O$

Using formula (1) we get

$f_s{}' = -420$ pounds per square inch for outside fibre stress.

and

$f_s{}'' = +492$ pounds per square inch for inside fibre stress.

The stress of the upper part due to unbalanced magnetic pull, with the rotating part 1-32 inch out of centre it 7,500 pounds.

We will suppose that the rotating part is 1-32 inch out of centre in a vertical direction upward and that the total magnetic attraction between the field, and the armature is unchanged, the distribution only being different. That is to say, the increase of magnetic attraction at the upper half of the generator is equal to the decrease at the lower half. Hence the unbalanced magnetic pull is equally divided between the upper and lower part. The unbalanced magnetic pull for upper part equals 3,750 pounds.

The distribution of the pull around the frame can be figured mathematically, but as it would take considerable space and is not necessary for determining the stress, some close assumptions will be made instead. The pull is zero at the split and reaches its maximum at the top of the frame. Therefore we may consider the magnetic pull as a triangularly distributed load on the frame. This is diagrammatically shown in Fig. 5, the load being projected on the diameter of the frame.

The moment for the top section is

$$M = -\frac{3750}{2}\left(H - \frac{H}{3}\right) = -72500$$

Normal force $N = O$ (appr.)

$f_u{}' = -235$ pounds per square inch for outside fibre stress.

$f_u{}'' = +276$ pounds per square inch for inside fibre stress.

Next will be taken up the stress due to equally distributed magnetic pull. The generator has 32 poles and a magnetic pull per pole of 2,640 pounds. The total magnetic pull is 84,480 pounds, and the pressure per square inch of armature diameter $= \dfrac{84480}{\pi \times 184.5 \times 16.5} = 19.25$.

The laminations 16.5 inches wide, and the pressure per square inch of frame diameter is $19.25 \times \dfrac{84.5}{97} = 16.8$.

Using formulas (2) and (3) we get

$f_t{}' = -54$ pounds per square inch for outside fibre stress.

$f_t{}'' = -75$ pounds per square inch for inside fibre stress.

The total fibre stress for the upper part of the frame for the top section is

$f' = -709$ pounds per square inch for outside fibre stress.

$f'' = +692$ pounds per square inch for inside fibre stress.

Outside there is compression, inside tension.

The total weight of the lower frame part is 11,620 pounds, and the total stress is

$f' = +1{,}087$ pounds per square inch outside fibre stress.

$f'' = -1{,}413$ pounds per square inch inside fibre stress.

The outside is under tension and the inside under compression.

It is apparent that there is considerable waste of material in this frame. For comparison is given the stress of another frame of which the section is shown in Fig. 4

Rating, 300 kw, 36 poles; diameter inside lamination, 87 inches; outside diameter of frame, 117 inches; area of section, 36.38 square inches; moment of inertia, 612 inches.

Unbalanced magnetic pull, 4,500 pounds total; balanced pull, 1,500 pounds per pole.

$2H = 2H_1 = 105$ inches. $G = 31.8$

$e_1 = 6.35$; $e_2 = 5.65$.

The weight of the upper part is 3,800 pounds, and the total stress

$f = -875$ pounds per square inch outside.

$f = +703$ pounds per square inch inside.

The weight of the lower part is 4,200 pounds and the total stress

$f = +771$ pounds per square inch for outside fibre.

$f = -951$ pounds per square inch for inside fibre.

The stress is very low, even in this frame, but it is better designed, because we have approximately the same stress in the upper and lower frame parts.

The Evolution of the Modern Telephone System.

By L. A. Lindsey.

TELEPHONE systems, although of comparatively recent origin, have been the subject of numerous patents and designs, each system having some feature or features different from any other. As a consequence, at this stage of their development, we rarely find two large exchanges constructed in exactly the same manner, something being learned from each installation that causes the next to be changed in some particular detail.

The prime idea in a telephone switchboard, which is essentially the greater part of the system being to connect and disconnect any one line with any other line at will in as short a time and at as small an expense as possible, many devices have been used to accomplish this end, each sacrificing, one or the other or both, the time and expense element to a certain extent, in order to reach some particular end or to avoid some particular obstacle. Some engineers have used electro-mechanical apparatus, and while the remarkable simplicity on the part of the subscriber by which any desired number may be called, incident to the best of these systems, is a great tribute to their skill, they have yet problems to solve before the automatic exchange can displace the "Hello Girl." Although some of the automatic systems give excellent service in places suited to their respective capacities, they still lack some of the good features that demand the human element at the central office; and while subscribers using the best of these make their own "busy" test, do their own connecting and ringing, and have no operator to complain to of slowness of service, to ask the time of day, or to bother with numerous other questions which the shrewd operator soon learns to answer with an assumed air of pleasure, the great majority of systems use the familiar "Central Operator," who is supposed to be always ready to comply with the wishes of the subscribers by giving the location of fires, the results of elections and to act as a general "Bureau of Information."

The manual systems necessarily divide themselves into two distinct classes—the trunking or transfer system as it is sometimes called, and the multiple system. Either of these may be used in connection with the magneto type, local battery or common battery system of transmission, or with the various combinations of these.

The object in any system is to provide means by which the subscriber may call the attention of the operator, inform her of the number wanted and give her some means of knowing when the conversation has ended, and whether another connection is wanted or the line is to be left idle, and the degree of success attained by any system is measured by the simplicity and ease with which these functions are performed.

The means employed to get the attention of the operator have been *(a)* the call wire, with which it is necessary for the subscriber to operate a switch which will connect his talking circuit with that of the operator; *(b)* the magneto system, with which it is necessary to operate a small generator supplied at each station, which is connected to some electro-magnetic device, usually a drop, or with a relay in connection with a miniature incandescent lamp or small secondary electro-mechanical device which may be placed directly in front of the operator, thereby economizing switchboard space, which will be seen to be very valuable in large switchboards; *(c)* the automatic signalling systems, with which it is only necessary to lift the receiver from its support, which operates a switch allowing the current to flow through the drop or relay at the central office, thereby actuating the lamp or other secondary device. In connection with these secondary signals in which the primary part of the signal is not within reach of the operator, it becomes necessary to restore this to its normal condition or disconnect it temporarily from the line.

In magneto systems the called subscribers' bell is usually rung by the calling subscriber, but in other systems it is rung by the operator, who has one or more ringing keys connected to each pair of cords, these keys being connected to a small alternating-current generator. In such cases it becomes necessary for the operator to know when the called subscriber answers, and the apparatus which gives the operator this information also serves to indicate the fact when the conversation has ended. This signal is known as the clearing-out or disconnect signal, and is very similarly transmitted to the calling signal; that is, by speaking over the call wire, ringing the magneto, or replacing the receiver.

Returning to our subdivision into trunking and multiple systems, in the transfer system it is necessary for an operator receiving a call to transfer it to the trunking or "B" operator handling the called number unless this number happens to be within reach of the operator receiving the call, known as the "A" operator. It is evident that this requires an average of nearly twice the time required if the "A" operator could, in all cases, reach the called number. These trunking operators are placed at every third operator's position throughout the entire board and have a number of trunks to each "A" operator's position which she can connect with any line coming into one "A" operator's position on either side of hers; thus any number may be connected to any other number. Two great disadvantages in this system are the necessarily slow service and the employment of fifty per cent. more operators and a larger switchboard than would be required could the "A" operators reach any number in the system. The limit to the number of subscribers that can be handled in one of these boards is reached when the "B" operators have no more room within their reach for trunks, though I have never heard of this limit being reached.

In the multiple system every number is multiplied or multipled so that one terminal of the line comes within reach of each operator. We can, therefore, dispense with the "B" operators, except in case of two or more exchanges in one system, in which event the "B" operators handle the business between different exchanges in a very similar manner to which the "B" operators handle it between different "A" operators' positions in the trunking system. The trunking business is divided into outgoing and incoming; that is, all calls originating in an exchange are known as outgoing at that exchange and as incoming at the exchange in which the called subscriber's line is located. The outgoing trunks are multipled throughout the board, while the other end of these same trunks, known as incoming, terminate in plugs at the "B" operator's position at the second exchange. She can thus reach any subscriber in that exchange by inserting these plugs into the corresponding multiple jack.

It is in this way that any one of the seventy-five thousand subscribers in New York City and its immediate vicinity can be connected with any other in less than ten seconds. In any one of these exchanges the greater part of the business will be handled wholly within this exchange, since the exchange will necessarily contain all the telephones in this portion of the city, and by being handled by the operator receiving the call, the time and expense is reduced to a minimum, and it takes no longer for a subscriber in one exchange to reach a subscriber in another than it takes to reach a subscriber in the same exchange using the trunking system. The number of subscribers that can be handled in an exchange of this kind is limited to the number of multiple jacks that can be placed within reach of an operator, which, with the most favorable conditions, is not less than twenty-four thousand; and this is one of a number of units composing a system, so it is difficult to imagine the exact limit in numbers of subscribers that can be successfully handled in one system of this kind.

It is evident from the foregoing that the multiple system is the ideal one for exchanges having more than a few hundred subscribers, and we will now consider the different methods of the transmission of speech. Since the magneto transmitter which was first used gives such inferior results as compared to the battery transmitters, the only types we have to consider are the local battery, in which a battery of one or more cells is placed at each telephone, and the common battery, in which the battery consists of a number of cells at the central office which are common to all telephones, hence the name. In the local battery system, since the work required of the battery is intermittent and during only a small per cent. of the time, the batteries used are, with very few exceptions, of the open-circuit type; unfortunately, there is not yet a battery of this class known that will not polarize in a short time, which means that it has temporarily exhausted itself and must rest for awhile before it is as efficient as it was at the beginning of its work. This answers very well for telephones that are not used many times each day, but evidently serves a poor purpose where the telephone is used almost continually, as is the case with those in large business houses. Besides this disadvantage, it requires a great deal of time and expense to visit periodically the stations and replenish the parts of the batteries as necessity demands, in addition to the liability of the jars getting broken and spilling the solution of walls, floors, etc., the solution used in some cells being very destructive.

The common battery system, while possessing none of these disadvantages, is more economical to install, and can be kept in condition at a very small expense compared to the numerous batteries used in the other system; and since current from storage batteries is cheaper than current from any kind of primary batteries, lamps may be used for signals which operate noiselessly and occupy a small amount of switchboard space. Another point in its favor is its ready adaptation to automatic signalling, as all signals can be transmitted by simply removing the receiver from its support or replacing it.

Taking all the above in consideration, the common battery, lamp signal, multiple system is evidently best suited for large systems, in which conclusion experience bears us out; and the different detailed constructions of these are more or less perfect inasmuch as they perform the required duties with simple, durable and inexpensive apparatus.

Results With the Third Rail in Boston.

Since June 16, 1901, the date of starting, the elevated tracks of the Boston Elevated Railway have been in continuous operation without material interruption. The total length of the elevated railway line is 6.644 miles and the length of second main track 6.468 miles, making the entire length of main track 13.112 miles, to which must be added 2.431 miles of sidings and switches, so that the elevated structure carries 15,543 miles of track. Over this entire length of track cars are operated exclusively from a third rail mounted at one side of the traction rails. The famous Boston subway, owned by the city but leased and operated by the railway company, connects two points on the elevated structure, one being at the North Union Station and the other at Pleasant Street. The length of this subway connection is only 1.201 miles, but it has proved to be an element of some trouble in the operation of the system owing to its curves and grades. At this point it may be stated that the cars which operate on the elevated tracks and on their connecting link through the subway never pass to the surface tracks, but simply swing back and forth between Sullivan Square at one end of the elevated structure and Dudley Street at the other end, or else cover a part of this run and also that part of the elevated track known as the Atlantic Avenue loop. The round trip between Sullivan Square and Dudley Street, which includes a passage through the subway in each direction, represents a run of 10.077 miles. The sum of curves made on this round trip run amounts to 9.43 complete circles. The Atlantic Avenue loop represents 3.96 complete circles per round trip, making the complete number in the system over which the elevated cars pass 13.39. On the combined elevated and subway system used by the elevated cars there are ten grades of 5 per cent. each, and the subway contains one grade of 8 per cent. Over the system thus outlined trains of three cars each are operated during the greater part of each day, and trains of four cars each during rush hours. Each car is equipped with two motors of 150 hp each, giving a motor capacity of 900 hp on three-car trains and 1,200 hp on four-car trains. Two contact shoes of cast iron carried by each car press on the top of the third rail and conduct the current for its motors. One of these contact shoes is mounted on a wooden fixture secured to each truck, and this gives rise to some delay while the fixture is being detached, when it is necessary to change trucks. For this reason the fixtures carrying the contact shoes on new cars will probably be attached to the under side of the car body. Until recently the cast-iron contact shoes have been held down on the top of the third rails simply by their own weight, which is only a few pounds for each shoe. Now, however, springs have been applied to hold down many of the contact shoes, but these springs do not seem to admit of any very accurate adjustment of the pressure between shoe and rail.

As far as can be learned, there appears to be no trouble caused by any failure on the part of contact shoes to maintain good electrical connection with the rails while trains are in motion. These three and four-car trains are each operated by a single motorman located at the forward end of the first car of each train, so that electrical connections in the form of cables must pass from car to car in order to control the motors.

Owing to the grades and curves mentioned above the most frequent source of trouble in the operation of the elevated trains is the breaking of the coupling pins or links that hold the cars together. The short radii of some curves on the subway and elevated line is made apparent by the fact that it has been found necessary to give the adjustable lattice iron gates that extend from car to car at their ends a width that varies from 10 inches to 5 feet 10 inches in extreme positions. The perfection of control exercised by the motorman over all the cars of a train is well illustrated by the fact that frequently when the mechanical coupling between two cars of a train parts, the train will continue its run past several stations, including as many stops and starts, without breaking the electrical cables that pass from car to car, and even before it is discovered that the train is mechanically in two parts.

The absence of any serious trouble from short circuits between the third and traction rails on the elevated structure and in the subway seems to be due in large measure to the fact that the third rail is used mainly as a trolley wire rather than as a feeder. In other words, the third rail is divided into sections of moderate length and several independent feeders are laid to each section from the power station. If a heavy short circuit occurs at any point between the third and traction rails, the circuit-breaker of the nearest feeder connecting with that section of the third rail opens. This increases the resistance through which current passing to the short circuit must flow and thus tends to reduce that current. If the short circuit has so low a resistance that the other feeders connected to that particular section of third rail are in turn overloaded, their circuit-breakers also act and the section is entirely disconnected from the generating machinery. Owing to the use of the third rail for contact purposes merely, its weight and resistance as a conductor are of minor importance, and a light rail only is necessary. The matter of rails divided into sections, each of which thus has its own feeders, has the further advantage that when repairs of any sort on the third rail are necessary the section involved may be quickly disconnected from and reconnected with the source of power. In the nineteen months during which the third rail has been in use only two persons have lost their lives by

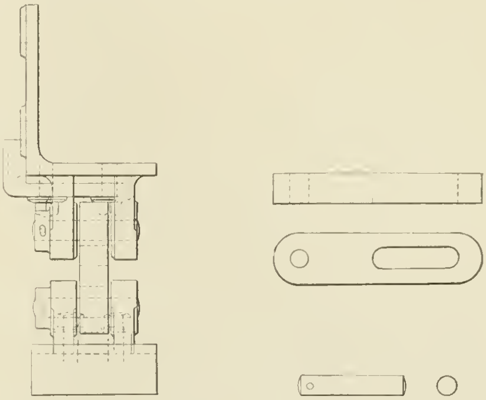


FIG. 1.—END ELEVATION OF CONTACT SHOE, LINK AND PINS.

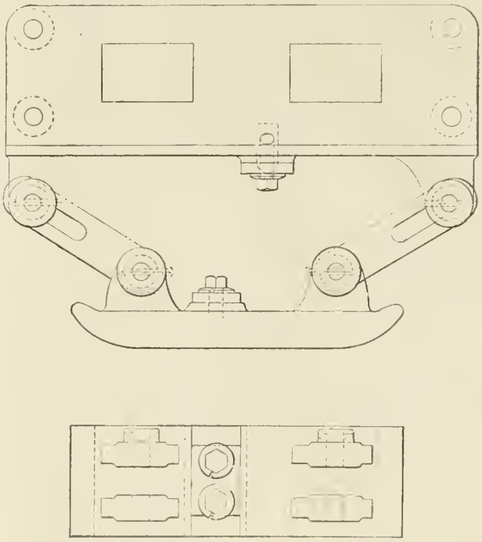


FIG. 2.—SIDE ELEVATION AND PLAN OF CONTACT SHOE.

contact with it, each of these persons being employed by the railway, and both of these deaths occurred during the first month of operation.

The third rail is mounted in an upright position at one side of the traction rails and at an elevation suitable for contact with the cast iron shoes on the cars. Each shoe is so mounted on its wooden fixture that it has some vertical motion to correspond with changes in the relative elevation of the third rail and the traction rails. Electrical connection between the cast iron shoe and the wires on the car that extend to the controllers and motors is made by means of a short flexible cable, and this cable has been found to be much subject to breakage. As all of the third rail is either in the subway or on the elevated structure, it is a comparatively easy matter to keep it free from snow, and no snow storm thus far has interrupted travel on the elevated system, though surface lines have had a hard time in several instances. The only weather conditions which has thus far appeared as a serious menace to operation by the third rail is that of sleet storms or of rain that freezes as it falls. Storms of this sort cover the top of the third rail with a thin coating of ice that is very hard to remove. Any sharp instrument mounted on a car so as to come in contact with the third rail has its edge quickly destroyed and simply slips over the surface of the layer of ice without cutting through it. Thus far the best results in the removal of a thin layer of ice on the contact surface of the third rail have been reached with stiff brushes of flat steel wire, one such brush being set in front of each cast-iron shoe. While operation by the third rail has not been interrupted by these formations of ice on its surface, it is not certain that the steel brushes as now developed can keep the contact surface clean with such storms as might occur.

In the subway the third rail is mounted simply on wooden blocks, which are not, of course, exposed to storms or water. On the elevated structure the third rail has been generally mounted in iron chairs, which are attached to the wooden ties. Each of these chairs is made of two iron castings, one of which fits over the other with a layer of insulating material between them. From the edge of one casting to the other over the exposed surface of the insulating material is only a fraction of an inch, and the layer of moisture which forms in wet weather on this short, exposed surface of insulation forms a path through which the operating pressure of 500 to 600 volts forces enough current to set up an arc and destroy the insulation of the chair. This burning-out process goes on gradually and a chair may sometimes be seen smoking for several hours on a wet day before the insulation is entirely broken down. Current from the third rail passes over the wet surface of the wooden ties to the traction rails and steel structure as soon as the insulation of a chair is destroyed. Because of the defects thus developed in the cast-iron chairs it seems desirable to replace them by others in which the path of leakage over the wet surface of insulation will be much longer. In one of the designs under consideration for this purpose the main body of the chair consists of a solid cylinder of made granite approximately five inches in diameter by six inches high. An iron casting secured at one end of this granite block is intended to receive and hold the third rail.

The problem of effective insulation for the third rail seems to be in large measure one of isolation, whereby the path for leakage over the wet surface of insulating material should be made as long as possible, and the third rail removed as far as possible from the traction rails and the steel structure. It is not necessary to maintain a very high ohmic resistance between the third rail and the traction rails and earth, but it is highly important that a moderate resistance in this position shall be of a character that cannot be broken down by leakage of current. This experience of one and one-half years in the hard climate of Boston goes far to demonstrate the absolute reliability of third-rail electric traction in all sorts of weather.

Power on the Chicago Drainage Canal.

President Smyth, of the Chicago Sanitary District Board, in an article in the *Chicago Tribune* of January 11, states that there will be available along the river between Lockport and Ottawa 150,000 hp for turning turbine wheels to generate electricity. At Lockport there may be developed about 22,000 hp and at Joliet 12,000 hp. This water power along the Illinois River valley is of course the result of the opening of the Chicago Drainage Canal. The only actual utilization of the power at present has been made at Joliet.

The Underground System of the Chicago Edison and Commonwealth Elecrric Companies.

W. G. Carlton, assistant to the chief operating engineer of the Chicago Edison Company, read an interesting paper on the above subject before the Chicago Electrical Association the evening of January 16, 1903. The following is an abstract of the paper, which was illustrated by lantern slides.

Service is furnished by these companies at 115 or 230 volts on a direct current, three wire system and also on the 60 cycle single or three-phase alternating system at the same voltages. These two classes include about 85 per cent. of the total business of the two companies. A considerable part of the direct current is distributed from rotary converter sub-stations fed through 9,000-volt, 25-cycle lines. These 9,000-volt lines are all underground. Until 1895 all of the low-tension direct-current lines of the company were of Edison tube. Since that time lead-covered cables have been used for feeders and in many cases also for mains. Illustrations were given showing sections of the feeder and main tubes. These tubes come in 20 ft lengths and consist of iron pipes containing three copper rods. These rods are wound with a rope on a coarse spiral and the bunch of three is also wound with a rope. The rope acts as a separator. The tube is then filled with asphalt. The ends are closed with hard-rubber plugs. The Edison tube is convenient to use for mains on account of the ease with which services may be installed. It is also cheaper than cable in conduit where but a single line is wanted. Some of the objections to its use are that its carrying capacity is less than that of a cable of the same cross-section, owing to the low melting point of the compound used on the tube and boxes. The life of the iron pipe is comparatively short, depending largely on the nature of the ground in which it is laid. It also usually requires longer to locate and repair tube on a tube than on a cable line. In the main tubes the three conductors are of the same size, while in the feeder tubes the neutral conductor is approximately one-third the cross-section of the others.

When cables were first installed rubber was used for installation, but for several years paper-insulated cable has been used exclusively, except for submarine work. Paper cable is cheaper than rubber and also has a greater overload capacity. The cable is laid entirely in conduit and not in the ground as is a common practice in Europe. The cables vary in size from 26,000 to 2,000,000 circular mils. The thickness of insulation on low-tension cables is regulated by mechanical reasons, while on high-tension cables, the thickness of the paper wall is determined by the voltage to be used. A low-tension feeder cable as installed would, if the ends were satisfactorily protected, operate safely at 2,000 volts. The insulation on low-tension cables is from four to six thirty-seconds of an inch thick.

Services vary in size from number six to 2,000,000 circular mils. When a large load is to be taken care of, additional services are generally installed. In the case of Marshall Field's retail store, nineteen services were required.

The total number of feeders required to take care of the entire low-tension load of the Edison Company is 175. The total cross-sections is 140,000,000 circular mils of each side of the three-wire system and 29,000,000 circular mils on the neutral. The 25-cycle, 9,000-volt, three-phase lines are all run in three conductor cables. Most cables simply feed a single sub-station, while others are looped into two or more sub-stations. As the single cable may carry as much as 3,000 kw, it is necessary to take all means possible to install it in a safe manner. Where cables pass through manholes, they are covered with two layers of heavy asbestos paper and this is wrapped with brass tape .025 inches thick and 1 inch wide. This is to protect the cables from fire caused by short circuits on other cables or by gas. The more important sub-stations are fed by two or more lines.

Joints on these cables are covered with paper tape and a lead sleeve, the sleeve being wiped to the lead sheath of the cable and filled with paraffin or an insulating compound called "minerallac." The making of one joint including the fire-proofing of the cable costs from $10 to $15. As soon as cables are put in the ends are sealed to keep out moisture, but the making of the joint requires several hours and during that time more or less moisture is absorbed by the jute filling from the air and from the jointers' hands. This mosture is eliminated by "boiling out" as it is called. The sleeve is filled with the insulating compound heated to about 175° C., the pouring being continued and the compoupnd being allowed to overflow from the went until the joint is heated throughout and all moisture driven out. After the joint is cooled a final pouring is made to be sure the sleeve is full and the openings through which the pouring was done are sealed. Out of six or seven hundred joints made up in this manner in the past two years, we have had but one failure in new cable and that occurred when the line was first tested out. It was found that this trouble was started from moisture.

Specifications for the 9,000-volt cables call for 6/32-in. paper wall over each conductor and 4/32-in. over the three conductors. We have cables originally installed for 4,500 volts that have insulations 5/32 and 3/32 in. These are operating satisfactorily at 9,000 volts. After the 9,000-volt cables are installed they are tested at 18,000 voltage between conductors and 11,000 volts between conductors and ground for about ten minutes. The neutral points of machines supplying the 9,000-volt system are grounded and consequently the voltage between conductors and ground is only 58 per cent. of that between conductors. Insulation tests are made weekly with a galvanometer and show an insulation resistance of about 400 megohms per mile. These tests include the insulation of switches at each end of the lines, so it is fair to assume the insulation of the cable is considerably higher. The loop method is used for locating trouble and has been found satisfactory, the trouble being generally located to the nearest manhole.

In connection with the subject of high-tension cables it may be of interest to compare our work in Chicago with that in other cities. Of four companies in New York City, two are using 6,600 volts and two 11,000 volts. Providence is using 12,500, Buffalo 11,000, Milwaukee 13,200, and St. Paul 25,000 volts. So far as I know, St. Paul is using a higher voltage than anyone else on underground cables. Of the companies included in the above list, nearly all are using paper-insulated cable, although some have both paper and rubber. It is, I think, generally conceded that paper cable is generally more satisfactory than rubber for high voltages.

Comparing the thickness of insulation per thousand volts on the paper cables used by the different companies mentioned, we find that it ranges from 67 to 22 mils between conductors and from 57 to 19 mils between conductors and ground. The average thickness per thousand volts is 40 mils between conductors and 38 mils between conductors and ground.

For the star-connected, three-phase, four-wire, high-tension transmission, some two and four-conductor cables have been used for this work, but single-conductor has been found to be more satisfactory. Trouble with these cables is most apt to develop at the point of connection with the overhead lines, and it is easier to make a safe job on a single than on a multi-conductor cable.

Various materials were used for conduit several years ago. Vitrified clay is apparently the best material now in the market. For electric light and power purposes, a single duct tile is better than multi-duct, since it allows the breaking of joints, although it is more expensive to lay. Conduit is laid at various depths, but never closer than 30 inches to the surface. It is laid on cement mortar and surrounded on all sides by a three-inch layer of concrete. It is not a good plan to concentrate too much power in one line and for this reason more than 30 ducts are seldom laid in one line. Manholes vary in size, but will average 6 x 6 feet. If the conduit line is intended for carrying a number of through cables, the corners of the manholes are cut on a diagonal. This is a safer construction than with square corners. In hanging cables in a hole with square corners, they are apt to be bent too short in order to make a good looking job and later trouble will develop at the short bends. The organization of underground systems is in three divisions, the high-tension, low-tension and conduit systems. A large part of the work is done by contract under the supervision of the company's engineer. The company has had but little trouble with electrolysis except occasionally, where an Edison tube has been laid near the rails of the trolley line. We expect to break the lead sheaths on our 9,000-volt lines and insert insulating joints at intervals of possibly 3,000 feet and will also ground the lead sheath on each section in two or three places to guard against electrolysis.

DISCUSSION.

Following the paper, many questions were asked Mr. Carlton regarding matters taken up, in the paper. Mr. Carlton explained that a large number of ducts in a conduit line are not desirable, not only because of danger from interference with service, but because of the amount of heat given off where many cables are bunched in one line. The insulating compound, "minerallac," was devised by one of the company's engineers, and was considered better than paraffin, because of its greater dielectric strength.

Prof. Woodworth, in referring to the small amount of moisture that will break down the joint insulation cited some tests which he had carried on upon the influence of moisture on the dielectric strength of oil used for transformer insulation. Some oil submitted to him for test had shown itself to be sixteen times better than air as an insulator. Later when this oil was put into practical use, some of the results seemed to show that it was not as good as air. Some of the oil was brought back for a test and found to average only twice the strength of air as an insulator, some of it being less than this. Although water in the oil could not be detected by the sodium test, it was nevertheless suspected that the trouble was due to the moisture in the oil from condensation, inside the transformer case before the oil was poured in. It was found that the addition of a few hundredths of 1 per cent. of moisture to insulating oil would produce the same results in lowering its insulating qualities that had been observed on the oil under test.

Electric and Steam Traction in New York State.

The New York State Board of Railroad Commissioners, in their annual report remark: "At the time of writing this report the board is just in receipt of a complaint as to scarcity of cars for shipment of freight on steam railroads, which complaint it is to investigate. In its hearings on applications as to the building of new electric railroads witnesses have often repeated that they had been delayed and annoyed and out of pocket in their business through failure to get freight cars as needed from steam railroads. The steam railroad companies always answered that these happenings (if they occurred) were at times of unusual demand for cars. Admitting this, it would seem that there has been experience enough gained in late years by the companies to lead them to have heretofore provided what informed and intelligent judgment would consider sufficient freight carrying capacity, both in cars and engines, even though the cost for rolling stock which might be idle for part of the year would seem to be more than prudence would allow. That they are to some extent doing this is shown by increased expenditures for equipment. This general comment is to be in no manner considered a prejudging of the complaint on this subject just referred to.

"The proposal of the Pennsylvania Railroad to enter New York City by tunnel is a matter which should be noted here. It is not necessary to comment thereon as the result in benefit to the city of New York is patent. So, too, should be noted the great improvements to be made at the New York Central & Hudson River Railroad Company's Grand Central terminal in New York City, and the substitution of electricity for steam in its Fourth Avenue tunnel and further north with resulting benefit to the public. But little new steam railroad building has been done in the State during the year—only 62 miles.

"Passengers carried by steam surface roads numbered 87,388,825; grade crossings abolished were 105; total State's appropriation to date for separation of grades, $405,000. Not as much progress as should be, says the report, has been made in lighting cars.

"June 30, 1892, the length of street surface railroads in this State was 739.291 miles; June 30, 1902, it was 1,746.015 miles. Capital stock in 1892 was $71,634,449.32, and bonded debt, $65,822,452.88; in 1902 the capital stock was $204,591,357.50, and bonded debt, $218,508,474.10. The cost of road and equipment in 1892 was $135,506,415.74; in 1902 it was $420,888,704.51. Gross earnings in 1892 were $24,238,172.94; in 1902 they were $46,905,187.87. In 1892, 487,611,009 passengers were carried; in 1902 1,209,510,539 were carried, an increase of 721,899,530. These figures include the elevated railroads in Brooklyn and also include 'transfers.'"

Automobile for Wireless Telegraphy.

An interesting exhibit at the recent automobile show in Paris was a wagon for the wireless telegraph. In form it resembles a small omnibus; there is room inside for two operators and the receiving and sending machines. Fixed in a socket by the side of the wagon is a tall, jointed bamboo pole, nearly 60 feet high, which is supported by wire stays fastened to the roof of the wagon.

Berliner Decision.

The United States Circuit Court of Appeals for the First District, sitting at Boston, on January 16, handed down an opinion in the case on appeal of the American Bell Telephone Company *vs* the National Telephone Manufacturing Company, in which priority of discovery of microphonic action is assigned to Hughes, and the claims in suit of the Berliner patent are limited to metallic electrodes. The opinion was written by Judge Colt, Judges Putman and Aldrich concurring.

It will be recalled that a decision by Judge Brown, of the United States Circuit Court, in the same case, was handed down February 27, 1901, which was adverse to the Berliner patent, and the recent decision appears to finally dispose of the microphonic issue In Judge Brown's decision it was held: First, that Berliner's caveat of April 4, 1877, did not establish invention, and does not count as reduction to practice; that it was a project and that later caveats, the application and the record in the Patent Office show the failure and abandonment of this project. Second, that the invention described in the patent is radically different from the invention described in the application. Third, that the invention of the patent in suit was previously patented by Berliner in 1880. Fourth, that Edison was the prior inventor. In conclusion, the court said that the defendant's transmitters are inventions substantially distinct from that disclosed by the Berliner patent; that the conception by Edison of the use of carbon for speech transmission preceded Berliner's conception of the use of solid metallic electrodes; that from his first conception Edison diligently proceeded upon a line of experiments that led to an invention of remarkable character which borrows nothing from Berliner, has no substantial resemblance to what is shown in the Berliner patent, and cannot be identified with it by any ingenious use of language.

The recent decision is along quite different lines, and is based almost entirely on the work of Professor Hughes, who is declared to be the prior discoverer of microphonic action, and that he embodied his discovery in the instrument which he was the first to term a microphone.

The opinion discusses the art of telephony from the time of Reis and give descriptions of all the types of transmitters revised down to the time of Hughes' discovery. It is stated that Reis failed because he had not discovered that a continuous current, which requires a constant contact between electrodes, was essential to transmit speech. Bell's discovery was that of the undulatory current, the only known current which will transmit speech. Bell thus supplied the current and what remained was to devise a better way of varying the resistance than was pointed out by Bell. This problem was solved by two discoveries which are now embodied in every commercial transmitter. The first was the discovery of the peculiar properties of carbon in varying the electrical resistance; and the second was the discovery of the remarkable effect of sound waves in varying resistance at a loose contact between solid electrodes. Edison made the first discovery and the fundamental question before the court is whether Berliner or Hughes first made the second discovery.

The opinion then proceeds to describe in detail the Reis transmitter, the Bell mercury transmitter, the Edison plumbago film and plumbago cylinder transmitter, the Berliner transmitter in suit, the Edison carbon transmitter, and finally the Hughes instrument, the consideration of which latter occupies the greater part of the opinion.

Contrasting the inventions of Berliner and Hughes, it is stated that the Berliner invention consists in a method of varying the resistance by variation of pressure at the point or points of contact between solid electrodes in constant contact. Professor Hughes's discovered the sensitiveness, the adaptability of the current at a loose or light contact to vary its resistance in conformity with the vibrations of the air produced by sound waves. His discovery lay in loose initial contact between the electrodes, and this is the essence of the microphone. With loose initial contact there is microphonic action; without loose initial contact there is no efficient microphonic contact. The discovery of Professor Hughes relates to the direct effect of the sonorous vibrations upon a loose contact, and a diaphragm is not essential. It will be impossible to find in the Berliner caveat or patent any conception of Hughes's discovery. Berliner's conception extended no further than the stage of Hughes's experiments in which the latter placed the broken ends of a wire in contact, and began his experiments on the effect of sonorous vibrations at different degrees of constant pressure, which finally led to his discovery of microphonic action.

Referring to Berliner's account of his conception of his invention, the opinion says that this conception is not that of Hughes, because the essence of microphonic action which resides in loose contact is entirely wanting Berliner's conception does not reach to the character of the initial contact, and therefore does not even approach microphonic action. If Professor Hughes had stopped his experiments when he placed the ends of his severed wire in contact, he would not have discovered microphonic action. The conception of Berliner, by reason of the absence of any comprehension of microphonic action, when embodied in a transmitter produces an instrument which is sometimes operative and sometimes not Berliner's conception of varying pressure at the contact point or points of contact is meaningless as a conception of microphonic action. A conception of microphonic action which omits loose contact leaves out the very essence of the thing to be conceived. Berliner started with a firm initial contact between electrodes, and his theory was that the vibrations of the diaphragm would lessen the contact. This, however, is the reverse of microphonic action, which starts with a loose initial contact, and, consequently, a greatly diminished flow of current.

In referring to the Berliner application of June 4, 1887, the court states that an intelligent and satisfactory interpretation of this document bids defiance to the human understanding; and assuming that Berliner when he filed his caveat on April 14, 1877, had already made Hughes's discovery of microphonic action, his caveat of May 9, and his application of June 4, become incomprehensible. It was not until more than a year after the publication of Hughes's article of May 9, 1878, that Berliner described the necessity of loose initial contact between electrodes.

The court controverts the claimant's contention that Hughes's discovery of microphonic action is disclosed in the Berliner caveat What Hughes disclosed to the world, as stated above, was not varying the pressure at the point of contact; nor did the essential thing which he discovered lie in the difference of pressure at different points of contact. His discovery resided in loose contact; or rather, in the remarkable effects of sonorous vibrations in varying the resistance at the loose contact. "Variation of pressure at a point of contact" may be descriptive of Berliner's invention, but, to say the least, it is a mistaken and misleading description of microphonic action and of Professor Hughes's discovery.

The opinion reiterates that Berliner had no conception of Hughes's discovery of microphonic action; that he does not disclose such a discovery in his caveat or patent, and that if his transmitter operated as a microphone, it was without any knowledge on his part of the microphonic principle. Professor Hughes's discovery cannot be read into the Berliner caveat or the claims of the Berliner patent. It was Hughes and not Berliner who discovered the "transition resistance" upon which the complainants dwell, and it was the former who introduced it in the microphonic art, and the effects of sound waves in varying such resistance. It cannot be said that Berliner made any discovery of pressure or variation of pressure, which has proved of any utility in the art. His discovery of the variation of pressure at a point of contact between metallic electrodes in the telephone transmitter possesses little utility and was practically worthless.

The opinion closes with the following summary of the conclusions of the Court respecting the variable-resistance transmitter:

We find that Bell, in March, 1876, discovered that the minute atmospheric vibrations due to sound waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure between a solid electrode and a liquid electrode in constant contact, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Edison, in February, 1877, discovered that the minute atmospheric vibrations due to sound waves, would cause the diaphragm to vibrate, which vibrations, by varying the pressure between two solid electrodes of different conductivity in constant contact, one metallic and the other hard rubber-covered with a plumbago film, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Edison, on April 1, 1877, discovered that the minute atmospheric vibrations due to sound waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure between two solid electrodes in constant contact, one metallic and the other compressible plumbago, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Berliner, on April 14, 1877, discovered that the minute atmospheric vibrations due to sound waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure at the point of contact between metallic electrodes in constant contact, produced variations of electrical resistance, whereby speech may be transmitted.

All of these discoveries, when embodied in transmitters, were inventions, but none of them was a commercial instrument, or solved the problem of a practical long-distance speech transmitter.

We find that, in the fall of 1877, Edison discovered the carbon electrode; that this discovery represents the first marked advance in the transmitter art since the 1876 Bell patent; and that the carbon electrode is found in every commercial battery transmitter.

We find that in May, 1878, Professor Hughes discovered microphonic action, or the fact that sound waves produce remarkable variations of resistance at a loose or feeble contact between solid electrodes in constant contact, whereby speech may be transmitted; that the principle he then made known is utilized in every practical battery transmitter; and that he embodied his discovery in an instrument, which he was the first to term a microphone.

We also find that Edison's discovery of the carbon electrode and Hughes's discovery of microphonic action solved the problem of a variable-resistance transmitter, whereby speech may be transmitted long distances; and that both these discoveries are embodied in the defendants' transmitters.

We also find that the two claims of the Berliner patent in suit, although upon their face open to the objection of excessive breadth, may be sustained when read in connection with the specification, provided they are limited to metallic electrodes; and that, when so limited, the defendants' transmitters do not infringe.

The final conclusion is that the decree of the Circuit Court must be affirmed on the ground of non-infringement, and costs were awarded to the appellees.

The Street Railways of Massachusetts.

From the advance sheets of the Massachusetts Railroad Commissioners' report, covering operations of Massachusetts steam railroads for year ended June 30, 1902, and street railways for year September 30, 1902, it would appear that the trolleys are gaining over the steam roads in mileage, earnings and net earnings. The trolleys have gained 11 per cent. in the year in mileage; the steam roads declined 1 mile. The gross trolley earnings increased 7.5 per cent.; the steam, 5.5. The net trolley earnings increased 4.5 per cent.; the steam, 1.8. Below follow the street railway statistics for four years past:

	1902.	1901.	1900.	1899.
Gross	$24,918,684	$23,179,304	$21,387,641	$19,519,338
Op. ex.	15,912,852	14,565,141	13,159,947	12,378,487
Net	$9,005,309	$8,614,163	$8,227,694	$7,146,851
Charges	5,616,458	5,215,980	5,190,192	4,637,909
Balance	$3,388,851	$3,398,183	$3,037,502	$2,502,942
Dividends	3,138,711	3,417,117	2,409,874	2,318,398
Surplus	$250,140	Def. $18,934	$627,628	$184,544

Gross assets of Massachusetts street railways, gross liabilities including capital stock and surplus, with percentage outstanding capital, compare as follows:

	Assets.	Liabilities.	Surplus.	% sur.
1902	$123,200,558	$119,441,792	$3,758,766	6.26
1901	107,250,656	103,598,042	3,652,614	6.76
1900	98,700,075	95,062,946	3,637,129	7.43
1899	85,764,845	83,279,891	2,484,954	6.01
1898	77,607,325	75,889,625	1,717,701	4.41
1897	67,509,976	66,483,414	1,026,502	3.14
1896	62,187,775	61,198,746	889,028	3.48
1895	56,641,581	55,357,081	855,590	3.06
1894	53,641,581	53,020,295	621,286	2.30
1893	50,120,273	49,589,688	540,585	2.09

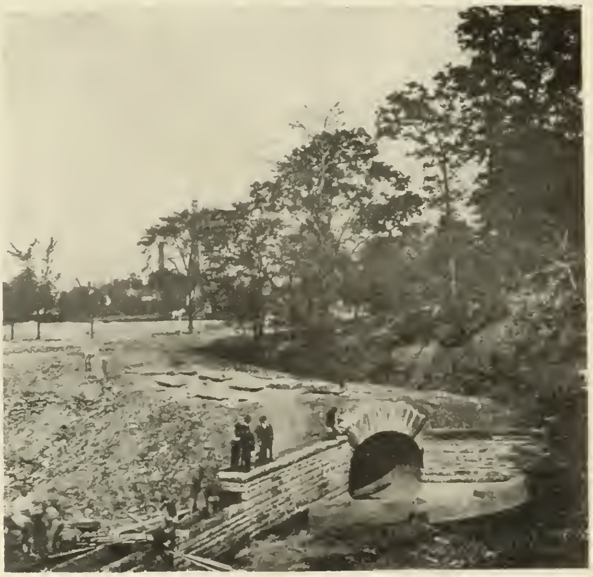
The board makes no important recommendations. It says: "The question of cheap morning and evening trains in this commonwealth is a business problem, to be solved upon business principles, and not one of enforced contribution to a public charity, either from the railroads or from the most prosperous part of the community to the less prosperous. An extended inquiry into fares upon railroads outside of this State seems to show that, however unequal and unscientific the present arrangement of fares upon the railroads having terminal in Boston may be, as a whole, our suburban fares are among the lowest of such rates to be found anywhere."

Solution of a Vexatious Problem in Street Railway Work.

By W. B. Arthur.

There are standing problems confronting some street railways which year by year bring about more intolerable conditions, and seem more difficult of solution. In many localities, street railways are annually inundated by spring freshets, and car barns and power houses are damaged, tracks undermined, bridges weakened or swept away, and general havoc wrought by what is at most seasons of the year but an insignificant brook. Such a condition of things has existed for many years in the city of Cleveland, Ohio, where damage to property has resulted annually from the overflow of Giddings Brook, on the east side of the city, until Mayor Tom L. Johnson, who is, as everybody knows, an experienced street railway man, set about procuring needed practical relief, which had been ineffectually talked of in various ways for more than fourteen years.

The first step was to lift an injunction which had for years discouraged all endeavor. This done, steps were at once taken to turn the waters of the brook from its accustomed course into the waters of Doan Brook, some half mile or more northward. At a point where high hills on either side afford natural retaining walls, and at an angle in the channel, a dam was constructed, consisting of a rock-faced wall of Amherst stone, filled in with concrete, 120 feet long. The wall is built with an angle in the center, as shown in the accompanying illustration, the two wings converging to the mouth of a tunnel in the angle. This brick-lined tunnel is 9 x 11 feet in its interior measurements throughout its entire length, which is 3,000 feet. The mouth at the exit flares to 9 x 14 feet, and is protected by a weir wall from rocks and debris brought down the ravine. The tunnel excavation has been made through shale rock throughout its entire length, and the work, which is now practically completed, has been for a year under construction.



PROTECTING ELECTRIC RAILWAY PROPERTY AGAINST FRESHETS.

The illustration herewith given may prove suggestive to railway companies in other localities where need exists for the curbing of brooks and the lessening of their destructive force, and may lead to the solution of a problem which has been puzzling some other street railway managers as the Giddings Brook question had done those of Cleveland.

Wireless Telegraphy at Key West.

The government, we are informed, is preparing to establish a wireless telegraph station at Key West for the purpose of maintaining communication with Havana.

The Construction of Aerial Telephone Lines II.

By Arthur V. Abbott, C. E.

THE POLE AS A COLUMN.

THE vertical stress to which poles are subjected due to the weight of the line and snow is the least important of all they are called on to resist, and while lines have been known to fail by the simple crushing of the poles such cases are rare. Each pole must carry its own weight plus that of its cross arms, half the weight of each span of wire and cables on either side of it, plus any burden of snow and sleet. The weight of various sizes of poles will average about as in Table I.

TABLE 1

WEIGHT OF POLES.

Height in feet.	Weight lbs.	Height in feet.	Weight lbs.	Height in feet.	Weight lbs.
25	400	40	650	55	1500
30	450	45	1000	60	2000
35	550	50	1250	65	2700

A ten-pin cross arm in place with half the weight of the wire in either adjacent span (allowing 42 poles per mile) will be from 80 to 100 pounds for .080 or .104 copper wire. Iron wire lines are from 10 per cent. to 15 per cent. heavier as larger gauges are common. The weight of aerial cable per pole, including messenger wire will be about 650 pounds for 25-pair cable, 800 pounds for 50-pair and 1,000 per 100-pair. Snow load is the most difficult to estimate. Ice coatings on a No. 10 wire 6 in. in diameter are veraciously reported, but are fortunately of the rarest occurrence. One and two inches of sleet are by no means uncommon, and there are many instances annually when the sleet load is sufficient to rupture the wire itself. So 150 to 200 pounds per wire and 700 to 2,000 pounds per cable are well within the range of each winter's possibilities. Thus each pole of 25-ft. line with two ten-pin arms is burdened as follows:

Pole	400 lbs.
Arms	200 "
Snow	3,000 "
Total	3,600 "

A 65-ft line with 12 ten-pin arms and four cables would impress on each pole base the following load:

Pole	2,700 lbs.
Arms	1,200 "
4 Cables	3,450 "
Snow	20,800 "
Total	28,150 "

The pole is column fixed at one end (the base) and unsupported at the other (the top). Hodgkinson shows that the strength of such a column made of white pine is given by the formula:

$$W = 4\frac{d^4}{l^2}$$

in which W equals the supporting power of the pole in tons of 2,000 pounds, d the diameter of the pole in inches at the base, and l the length between the ground and the lowest arm in feet. For a 25-ft. line, $W = \frac{4 \times 8^4}{20^2}$ (approximately) 40 tons. This is the ultimate strength; and a factor of safety of at least 10 should be allowed, so the working crushing strength is 4 tons or 8,000 pounds, a little over double the load imposed as shown above. Similarly for a 65-ft. line.

$W = \frac{4 \times 12^4}{30^2}$ = (approximately) 92 tons, or say ten tons for working load, which is a little less than the actual line load. Tall, heavy lines, therefore, have much less safety factor than low, light ones. This deduction corresponds with experience, for the large lines are usually the sufferers. If any other wood be used the formula may be corrected by the data of Table II.

Thus white pine is allowed a crushing strength of 5,000 pounds per square inch and yellow pine 5,300 pounds, hence a yellow pine pole will be $\frac{53}{50}$ as strong as a white pine one.

2nd. *Longitudinal Tension.*—It is common practice in building pole lines to pull each wire up to a tension of 150 pounds at average temperature of say 60° F. The messenger strands of aerial cable carry a tension of from 3,000 to 4,500 pounds. If, therefore, a wire or cable is dead-ended, or so secured by the tie or other fastening that it cannot slip, the cross arm and pole may be subjected to this stress. So a ten-pin arm on which all wires are dead-ended carries a stress of 1,500 pounds. In straightaway work even when lines are dead-ended for transposition the tension of one span practicaly balances that of the succeeding one, and the arm and pole is released, but where a wire or messenger actually stops the entire tension must in some way be taken up, as will presently be shown.

TABLE 2

CRUSHING STRENGTH OF TIMBER.

Variety.	Crushing Weight in lbs. Per Square Inch.
Ash	5,000 to 8,000
Cedar, red	4,500 to 5,900
Chestnut	5,350
Elm	6,000 to 10,000
Oak	4,000 to 9,000
Pine, yellow	5,300 to 6,500
Pine, red	6,000 to 7,500
Pine, white	5,000 to 6,000
Spruce, white	4,500 to 6,000

3rd. *Tension Due to Curves or Corners.*—When a pole line changes its direction as at curves or corners the longitudinal tension of the circuits manifest themselves in a most striking manner. Problems in pole line stress are most conveniently solved by graphical method. Fig. 4 is a plan of a line with one ten-pin arm *B C* attached to the pole, *A*. Suppose the various wires represented by 1, 1, 2, 2, etc., to be dead-ended on the pins and to be drawn up to a tension of 150 pounds each, what is the force exerted on the pole and which way does it pull? Evidently each wire pulls 150 pounds in the direction it runs. If, therefore, a scale of pounds be assumed (in this example 350 pounds to the inch) and such a distance be laid off along each wire as represents the pull of the wire according to this scale, a series of lines are obtained which represent in magnitude and direction the tension of each wire on its pin. These lines are represented at 1, 2, 3, 4, etc. As the wires are parallel all the tensions are parallel, and a line, *A D*, parallel to the wires, whose length is the sum of all the separate tensions, represents the total tension, and further as all the separate tensions are equal the resultant is applied at the middle of a line drawn through all the pins, or at the point *A*, where the arm is bolted to the pole, and the pole is pulled in the direction *A D* with a force of 1,500 pounds. Suppose that only eight wires had been placed on the cross arms of Fig. 4, wires 9 and 10 being omitted. The point of application of the resultant will be midway between wires 4 and 5, at *E*; that is, at the middle point of the line drawn through the center of the pins to which the wires are attached. The magnitude of this resultant

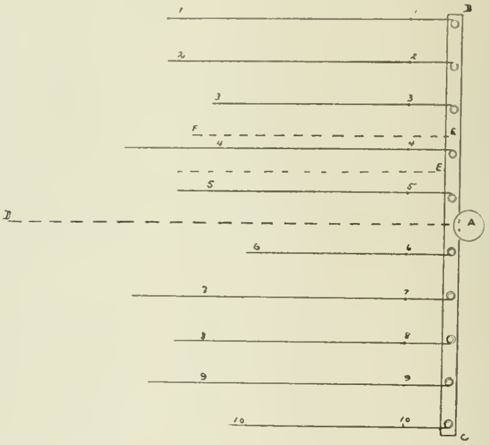


FIG. 4.—PLAN OF POLE LINE.

evidently will be the sum of 1, 2, 3, etc., up to and including 8, or 1,200 pounds. As all the wires are parallel to each other the direction of the resultant will be parallel to the direction of the wires. But now the resultant does not pass through the center of the pole but is 16 inches away from it, and hence tends to twist the pole in its hole. As the resultant is 16 inches away from the center of the pole; this twisting effect is found by multiplying the intensity of the resultant, 1,200 pounds, by 16, the distance that it is away from the center, giving a force of 1,500 foot-pounds as the tendency to turn the pole around in its socket. A sheet of cross section paper is most convenient for plotting stress diagrams, for the lines of the paper enable one to draw and read results directly. Fig. 5 is an example of a corner in a pole line. The various wires, 1, 2, 3, etc., to 10, are assumed to reach the pole, *A*, in direction parallel to the lines in the paper and to turn on the pole and depart in the direction 1′, 2′, 3′, 4′, etc. The tension on each wire is assumed at 150 pounds and is represented by one of the large squares of the paper. As already described, the resultant of the tension in all the circuits leading *to* the pole is represented by the line *A B*. Similarly the resultant of the tension of the lines leading away from the pole is represented in magnitude and direction by the line *A C*. Draw the line *A D* a continuation of, and equal to, *A B*, and draw *A E* a continuation of, and equal to, *A C*. Complete the parallogram, *A E F D*, by drawing the line *E F* equal and parallel to *A D*, and the line *D F* equal and parallel to *A E*, draw the line *F A*, then *F A* represents in magnitude the resultant of all the tension in such a corner pole. This stress the pole must resist either by its own intrinsic stiffness or by the aid of a guy. The tension of the circuits tends to pull the pole toward the inside of the curve or corner, hence to resist this the guy must be set away from the corner in the line *A F*. Such a diagram then shows both the tension on the guy and the direction in which it must be placed. It is easy to see that by making an elevation drawing of a pole line the same method may be used to determine the magnitude, direction and point of application of the resultant of the forces that act on the line in a vertical plane. In a line carrying open wire only, the resultant in a vertical plane will, if the arms are all filled, lie on the center of the arms and be equal to the sum of all the tensions of the individual wires. If there are aerial cables the point of application of the resultant will move toward the cable arm just in proportion as the stress on the messengers exceeds the stress of the open wire.

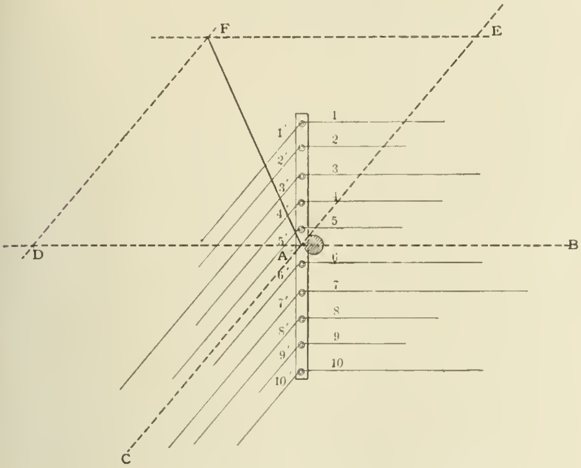


FIG. 5.—PLAN OF CORNER IN POLE LINE.

Resistance to Bending.—When a pole is subjected to a horizontal force, in any direction, it tends to bend in the direction toward which the force is directed, the fibres of the wood lying on the side of the pole toward the direction of the force are compressed, while those on the opposite side are stretched. If the pole be cylindrical it can be shown that the section along which rupture will take place will be at the surface of the ground, when the diameter of the pole, at the point at which the force is applied, is equal to, or greater than two-thirds of the diameter at the ground surface. When the diameter of the section at the point of application of the force is *less*, the rupture takes place above the surface of the ground at that point where the diameter of the pole *is* two-thirds of the diameter at the point of application of the force. The horizontal stress, which will cause rupture, when the section of rupture coincides with the ground level, is given by the formula, $F = \frac{\pi R^3 T}{4 L}$, where *R* is the radius of the section at the surface of the ground, *L* is the height above the soil to the point of application of the force, *T* the resistance to rupture per unit of section of the material composing the pole, and *F* the force causing rupture. To find the diameter of a pole to resist any given tension, with say a factor of safety of 10 this formulæ may be transformed and will appear as follows:

$$R = \sqrt[3]{\frac{40 F L}{\pi \times T}}$$

In case the diameter of the section of the pole at which the resultant of all the forces acting upon it is applied is less than two-thirds of the diameter at the level of the ground, the section at which rupture will take place will be above the ground, and the force, *F*, necessary to break the pole, can be found, but the formula is much more complicated and is given below:

$$F = 27 \frac{\pi R^2_1 (R - R_1) T}{16 L}$$

in which R_1 is radius of the section at which the force is applied, while the other symbols have the same meaning as before. The values of *T* in the preceding formulæ are the tensile strengths of the various kind of wood used for poles. For the purpose of calculation the values shown in Table 3 are fair to assume.

TABLE 3.

TENSILE STRENGTH OF TIMBER.

Variety.	Breaking Weight per Square Inch in lbs.
Ash, American	5,500 to 17,000
Cedar, American	11,400
Chestnut	7,000 to 13,000
Cypress	6,000
Elm	6,000 to 10,000
Oak	10,000
Pine, yellow	5,000 to 12,000
Redwood, California	10,800
Spruce	5,000 to 10,000

As a practical illustration assume a 30-foot line with two ten-pin arms all full.

Case First.—Suppose all wires to be dead-ended, the tension of the line will be 3,000 pounds; the point of application of the resultant is in the center of the pole midway between the two arms, or say 28 ft. from the ground. The radius of the point of application of the resultant is about 3¾ in. (7-in. top pole), the radius at the ground (standard pole) about 4 in., hence the upper diameter is more than three-fourths of the ground diameter and the pole will break at the ground and

$$F = \frac{3.14 \times 3.75^3 \times 11{,}400}{4 \times 28} = 16{,}800 \text{ lbs.}$$

as the stress applied is 3,000 pounds the pole would hold, but would have so little margin as to probably fail with the first sleet storm.

Case Second.—Assume a similar line, but with only one cross arm to turn a corner, as shown in Fig. 5. For one cross arm the resultant stress tending to bend the pole is shown by Fig. 5 to be 1,275 pounds. The strength of the pole is the same as previously found, thus showing a factor of safety of thirteen. Such a pole in a sheltered location would be sufficient, but would be better if reinforced with a guy. From these examples it is easy to see that when a number of wires are dead-ended, or when there is an angle or curve of any magnitude, the horizontal stress soon rises to such proportion as to be far beyond the resistance to flexure presented by any ordinary pole.

Wind Stress.—Of all the forces operating against a pole line wind is far the most difficult to evaluate, and the very best estimates frequently go astray. Some lines which have withstood the attacks of the elements for years will suddenly, and under seemingly slight provocation fail. Recorded tests on wind pressure are fragmentary and misleading. Some well-received data show that a gale blowing 70 miles per hour exerts about 25 pounds per square foot of area normal to the wind. On a sleet-covered line of 50 wires this would amount to about 4,500 pounds. But it is common experience for lines that should successfully withstand a greater stress to fail at presumably less wind velocity. Two explanations have been advanced, one that occasional gusts cause far greater instantaneous pressure; the other that such gusts set the line swinging and vibrating in a manner to hasten its destruction. Probably both of these causes operate, and very possibly to a far greater extent than is usually imagined. Wind pressures attack the line from every conceivable direction, but in a general way they may be relegated to the category of the horizontal forces that act transversely to the line. Thus intensity is so difficult to estimate that in exposed locations about the only method is to build as strongly as possible, and then rebuild when the line goes down. Thus it is shown that all the forces acting on a pole line may be either resolved into vertical or horizontal ones. For the vertical ones strong straight poles form the only resource; but the horizontal stresses, particularly those which are developed at curves, angles and terminal poles, may be resisted by guying.

Opinions on the Berliner Decision.

President F. P. Fish, of the American Telephone & Telegraph Company, is quoted as follows by the Boston News Bureau:

"President Fish, of the American Telephone & Telegraph Company, says the decision of the United States Court of Appeals in the Berliner patent case leaves the situation in relation to this patent just where it has been. The court holds that the instruments manufactured by the National and Century Telephone Companies do not infringe upon the Berliner patent. Mr. Fish says, however, that the Berliner patent has been of no practical validity for a great many years, hence the decision is of no great importance. He is not prepared to say whether or not the case will be carried to the Supreme Court."

Judge James M. Thomas, president of the Independent Telephone Association of the United States of America, said that the Court of Appeals sustains the court below on the ground of non-infringement, holding that Berliner is entitled to his patent so far as the use of metal electrodes is concerned. All the commercial telephones, however, employ carbon electrodes, which do not infringe the Berliner patent, so that the decree is a complete victory for defendant and is of great interest all over the United States, as it involves the investment on the part of anti-Bell companies of two hundred millions of dollars, which has been invested in the opposition to the American Bell Telephone Company. He considers that in the successful termination of this great case, due recognition should be given to the parties who have been bearing the burden of the fight. After the decision in the government case in which the Supreme Court sustained the decision of the Court of Appeals, refusing to cancel the Berliner patent on the grounds of fraud and other claims contained in the bill of the government, nothing remained to be done but for those interested outside of the American Bell Telephone Company who had invested in telephony, to bend their efforts towards the defeat of the Berliner patent, so far as it related to what is known as the carbon microphone. Immediately after the organization of the Independent Telephone Association of the United States of America at Detroit, in 1897, a committee was appointed consisting of Hon. H. D. Critchfield, of Chicago, formerly of Ohio; Judge Savage, of Pennsylvania, and himself, who undertook to assist the defence in the three cases brought against manufacturers by the American Bell Telephone Company in the city of Boston. The National Telephone Manufacturing Company, which has been the prominent party in all this litigation, had previously retained Mr. Edward P. Payson, of Boston, as its counsel; and arrangements were effected whereby the three cases (on account of involving the same issues) were to be considered as one, and that Judge R. S. Taylor, of Fort Wayne, Ind., should be accepted as a representative of an outside interest to assist in trying this case.

"Only those who have been through similar experiences can appreciate the amount of work that was expended in the preparation of the defence and in financing a plan whereby this great victory has been brought to the independent telephone interests. Mr. Edward P. Payson has devoted years of study to the troublesome legal and technical questions involved in this case. He has worked faithfully and deserves the everlasting esteem of all the investors of the $200,000,000 which were jeopardized by this suit. Judge R. S. Taylor, having been on the government case, and being more or less familiar with the questions involved, immediately took up the work, and has proven a master in the handling of the legal and technical questions involved therein. No case ever had more devoted lawyers, and the courts have had no case involving greater and more universal interests than this famous Berliner case. The Litigation Committee of the association, consisting of Hon. Hugh Dougherty, Bluffton, Ind.; Hon. S. P. Sheerin, of Indianapolis, Ind.; Hon. H. D. Critchfield, of Chicago; E. B. Fisher, of Grand Rapids, Mich., and myself, have worked and contributed in every way possible to the support of those who had undertaken the defeat of this patent."

Mr. E. P. Payson, of Boston, chief counsel of the National Telephone Manufacturing Company, et al., gives the following information as to the bearing of the decision:

The second defence, namely, the insufficiency of the Berliner application, is not specifically passed upon. The fifth defence, double patenting, is not alluded to. The Bell mercury transmitter operated by variations of pressure is affirmed, but the apparatus is not held to have been sufficiently practical to be an anticipation. The third (Edison) defence is affirmed as to the Edison (1877) discovery and his April 1st apparatus, and his carbon electrode, which, in the fall of 1877, "represents the first marked advance in the transmitter art since the 1876 Bell patent; and the carbon electrode is found in every commercial battery transmitter"; and the value of the work of Prof. Hughes with reference to "variations of resistance at a loose or feeble contact between solid electrodes in constant contact," is considered at length. The defence upon which the opinion mainly rests is the fourth defence, namely, that Berliner really contributed nothing to the art of telephony; that his rights are purely technical; and that the defendant's transmitters contain nothing derived from Berliner and are not within or an infringement of his patent, even if the patent be valid; as to which defence at page 238 of the brief we said that even if Berliner tried his metal electrodes before Mr. Edison invented carbon, considering that carbon was not implicit in Mr. Berliner's work, but was produced by Edison, "the Berliner patent in suit must be given a narrow scope so limited as to not include either form of the defendant's transmitters. It is submitted that this view presented under the fourth defence is in every respect a conservative view of the premises; that it leaves to Mr. Berliner the very utmost that can be reasonably claimed by him; that it concedes to Mr. Edison only that of which he was evidently the discoverer and the inventor." We have thus gained in this court all that was hoped to be gained in having them affirm the decision of Judge Brown in this way, and it leaves nothing of the Berliner invention of any practical commercial value, as all the commercial telephones used throughout the world have carbon electrodes.

President Sheerin, of the New Long-Distance Telephone Company, of Indiana, said "that if the Berliner patents had been sustained 90 per cent. of the equipment used by telephone companies other than the American Bell and its tributaries would have been infringement of the Bell Company's patents. The independent companies of Indiana have 75,000 telephones and they would all have been sufferers by an adverse decision. The importance of the decision is great to them because their ability to continue in business was involved in their right to use the independent manufacturer's products."

Wireless Daily Papers.

With reference to recent reports, a cable dispatch from London of January 16: Daily papers will not be published for the present, at least, on Atlantic steamers. The Marconi Company will undertake only to send messages forty miles seaward, and news bulletins simply will be displayed in various parts of the incoming steamers. It is stated that Mr. Marconi is at work upon a new form of wireless instrument, the purpose and object of which is to definitely locate the whereabouts of ships at sea which may be drifting helpless by reason of some derangement of its machinery. The object of this instrument is for use in just such an emergency as that in which the St. Louis was involved. By means of this instrument the exact latitude and longtitude of the helpless ship may be determined and its course followed from day to day. With this information in hand, vessels may be dispatched to the aid of the helpless steamer, and by means of the usual form of wireless instrument the relief steamer may be kept posted as to the changes of position of the drifting vessel from day to day. It is understood that by means of the new instrument greater possibilities are open to shore stations in the matter of communication with vessels than by means of the ordinary form of wireless instrument now in use.

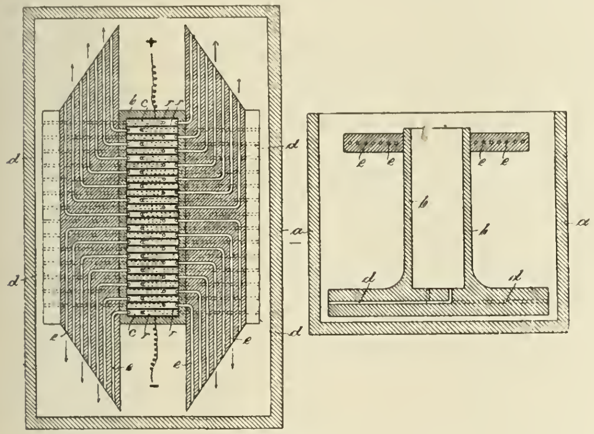
Recent Electrochemical Developments.

By CLINTON PAUL TOWNSEND.

PRODUCTION OF BLEACH LIQUORS.

The "series" arrangement of electrodes for electrolytic work has been applied chiefly to the refining of copper, and the production of hypochlorites and of chlorates by the electrolysis of chloride solutions. These are not the sole applications of the bipolar system of connections, for electric furnaces, both arc and incandescent, have been constructed according to this plan; but they are the branches of the art in which no disadvantage is to be apprehended from the mixture of the soluble anode and cathode products of the electrolysis, in which a close juxtaposition of the electrodes is both feasible and desirable, and in which, therefore, the arrangement affords substantial advantages.

In the series system the end electrodes only are connected to the source of current; the intermediate, unconnected or "bipolar" electrodes constitute partitions or partial partitions separating the electrolyte into successive bodies. If these several bodies of electrolyte are absolutely distinct, the current can only pass from one to the other through the separating plates, which accordingly assume an opposite polarity on opposite sides. If, however, as is always necessary for continuous work, these bodies of electrolyte communicate with one another, either directly or indirectly through a common supply or discharge main, the current will pass in part through the electrolyte around the intermediate plates, and the part of the current which so passes is largely wasted. Hitherto this fact has been generally disregarded, and numerous patented devices for the production of bleach liquors, etc., comprise so-called bipolar electrodes consisting of perforated plates, wire cloth, or even assembled plates lying loosely in a large tank. Such devices are, of course, almost inoperative.



HORIZONTAL AND VERTICAL SECTIONS OF ELECTROLYTIC VAT.

Mr. Max Haas, of Aue, Germany, describes a series of constructions in which account is taken of this current loss. These devices are without doubt the most efficient vats for the electrolytic production of hypochlorites which have been offered. In all cases the principle is to afford communication between the several bodies of electrolyte contained between the plates, but by means of passages so narrow, long and tortuous that the current loss occasioned thereby is negligible for practical purposes.

One form of the apparatus is shown in the accompanying figure, which shows a horizontal and a vertical section. The electrolytic vat, *b*, is divided by the carbon plates, *r*, into a series of compartments, *c*, and the end plates are connected to the source of current. Each compartment, *c*, communicates at its bottom through narrow passages, *d*, with a containing vessel, *a*, which holds the main body of the electrolyte, in this case a sodium chloride solution. Each compartment, *c*, also communicates at its top with the same vessel, *a*, through long, narrow and curved conduits, *e*, as shown.

When the current is passed there is considerable evolution of gas at the electrodes, and the specific gravity of the electrolyte in the compartments, *c*, is thereby reduced; these portions of electrolyte are, therefore, displaced continuously by the heavier liquid entering through channels, *d*, and overflow through channels, *e*, descend through the external vat and return again to the compartments. A continuous circulation is thereby maintained, and the several channels are of such form and size as to prevent any substantial loss of current by short-circuiting between opposite sides of the intermediate electrodes. In the above construction the electrolyte passes through the compartments simultaneously; it is often desirable, however, that the electrolyte should pass in succession through the compartments, and several arrangements for accomplishing this without loss of current are suggested. In every case, however, the principle is as above stated, to afford communication between the compartments by long and narrow channels.

ANODES FOR ELECTROLYTIC WORK.

The basic principle of two methods recently patented to Herbert H. Dow, of Midland, Mich., for the manufacture of carbons suited particularly for electrolytic work, is to coat each particle of ground coke or other carbonaceous material with the minimum quantity of such binding agent as coal-tar, etc., which will serve the purpose of binding the particles into a coherent pencil or rod. This gives a carbon of the maximum density and electrical conductivity.

The inventor states that if carbon particles be mechanically mixed, however intimately, with pitch, the quantity of the binding agent which will adhere to the particles will vary, and especially that the smaller particles will receive more than their proportionate share. According to the present invention, the cold ground carbon is dropped through the heated vapor arising from the binding agent, and the latter condenses upon each individual particle, coating them intimately; and what is more essential, the amount of coating is proportionate to the size of the particle. This is because the action is one of condensation, and the larger particles are able to condense a quantity of the binder in proportion to their weight before they are themselves heated to the temperature at which no further condensation occurs.

An alternative method which gives intimate distribution of the binder over the coated particles depends upon the use of the binding agent, tar, pitch, etc., in the form of an emulsion with water. This method of course secures a uniform distribution of the binding agent, and therefore a uniform conductivity of the resulting electrode; it does not, however, limit the quantity of the binder to the practicable minimum, as is the case with the other method.

New Telephone Patents.

The present-day increase in what may be called "the telephone density" is gradually making itself felt at the Patent Office. With this increase of this density, i. e., increase in the number of telephones per unit of geographical area, in order that a prohibitive number of central offices may not be required, switchboards of larger and larger capacity must be constructed. Unfortunately, the size of operators does not keep pace with the increasing central office unit, and consequently to bring the entire multiple of large switchboards within reach of the operators, smaller and smaller apparatus must be used. To meet this requirement, the metal frame jack was devised, specimens of which have been appearing from time to time.

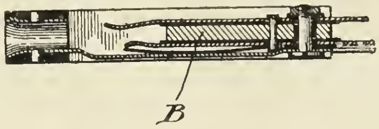


FIG. 1.—CLAUSEN TELEPHONE JACK.

In the patent issue of January 13 a patent granted to H. P. Clausen describes another design for such a multiple jack. In Fig. 1 this jack strip is shown in section. As will be seen, the jack is of the type known as "three point"; that is, it is adapted to register with its plug to control three contacts. The body of the jack strip is entirely of metal. This is given a U-shape, so that it forms both the supporting and clamping lugs at the ends of the strip and the rear plate shown at *B*. Upon the front of the legs of the U the usual hard rubber face-strip, carrying the jack thimbles is mounted; while the jack springs are mounted upon the metal rear strip through the agency of a bolt and steady pin, the necessary insulation being maintained by the use of suitable sheets, strips and bushings of hard rubber. This is well shown in the figure. The excessive number of pieces of insulation to be provided and maintained in position appears to be objectionable, but the inventor must feel rather sure of his position, for the chief claimed novelty is in this very design of metal strip with its allied insulating pieces.

Two new telephone transmitters appear in this patent issue of January 13. One of these is the invention of M. R. Hutchison, while the other was devised by C. C. Cadden. These two transmitters are very different, the first being based upon the same principle as Edison's inertia transmitters of some years ago; while Mr. Cadden's invention consists chiefly in a novel form of flexible joint between the movable electrode and the carbon chamber.

Fig. 2 shows views of both of these transmitters. To the left is a diagrammatic plan and a section of Mr. Hutchison's transmitter and to the right is a sectional view of that of Mr. Cadden.

Referring first to the inertia transmitter, it is seen that the diaphragm is placed horizontally and carries at the center of its upper surface a symmetrical group of electrodes of carbon cemented to an insulating support affixed securely to the diaphragm. In the figure the electrodes are shown as concentric rings, but other forms equally good readily suggest themselves. Between the electrodes insulation is placed and about them a closed chamber, partly filled with carbon granules is arranged. The electric circuit is led to the electrodes and is completed through the granule contacts, maintained by gravity. The variation of resistance necessary for transmission depends upon the pressure variation caused by the inertia of the particles, when the diaphragm vibrates.

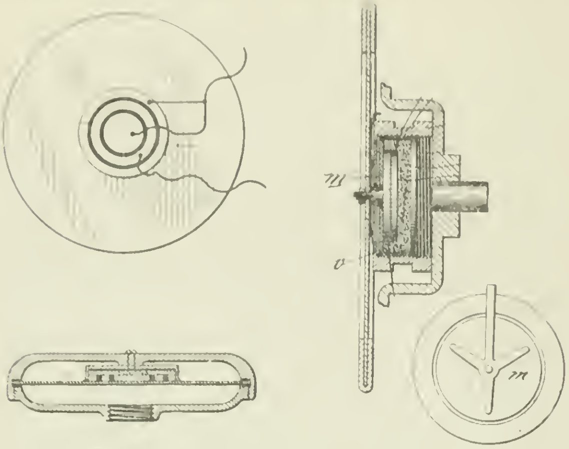


FIG. 2.—HUTCHISON AND CADDEN TRANSMITTERS.

Observing now Mr. Cadden's transmitter, the usual general arrangement of parts is adhered to, but the details of construction are novel. Instead of the usual flexible diaphragm joint of fabric or mica, between the movable electrode and carbon chamber, there is in this case provided a sliding joint. The head of the chamber is provided with an aperture and the spindle of the movable electrode slides in this, the joint being virtually packed to prevent the escape of the granules from the chamber proper into the space behind the electrode, by the use of the fabric packing disc, *V*. At *m* a second fabric disc is placed, outside the chamber, and the tripod spring, shown enlarged in elevation, resting with its center upon the diaphragm and its legs upon this external fabric, serves to maintain a sensitive, flexible connection between electrode and diaphragm.

Another attachment for transmitters for so holding a sheet of paper that it forms a germ-proof partition between telephone users and the infection supposed to exist in transmitter mouthpieces, is the subject of a patent issued to J. F. Logue. This latest attachment, the most compact for its purpose thus far seen, is a wire ring and clamp so designed that when the clamp is sprung over the base of the mouthpiece, the ring lying concentric with and in a plane parallel to the edge of the mouthpiece, forms therewith a channel of sufficient width to receive and hold the paper in position.

Still another patent relating to the transmitter portion of the telephone instrument is that bearing the title, "Coil-Box for Telephones," wherein is described a modification of that type of transmitter arm so familiar a few years ago when the magneto system was in vogue, having a receptacle or enlargement at its base in which the induction coil is mounted. The present modification consists in providing a base plate for such a transmitter arm and in so hinging the arm to the base plate that the former, normally held in position by a latch, may be swung aside to expose the induction coil to view. The theoretical advantages of this are without doubt very much greater than the real ones, for the necessity of access to the induction coils is rather remote. The possibility for a decided advantage does, however, exist in this transmitter arm in that the arm proper is made hollow, and therefore may be used to carry the transmitter cord concealed and not in a position to be toyed with by the telephone user. This point, however, is not mentioned in the present patent, which is granted to W. E. McCormick and assigned to the International Telephone Manufacturing Company.

A polarized bell is the subject of a patent granted to E. E. Yaxley and assigned to the American Electric Telephone Company. The novelty in this bell lies in the reversal of the customary positions of the armature and yoke piece. Thus, instead of the armature being placed between the poles and the yoke, this latter is perforated to admit the passage of the poles through it, and the armature is hung outside the yoke. The only advantage which can be claimed for this novel arrangement of parts is such additional rigidity as is imparted to the magnet by the poles being thrust through the yoke.

Of the remaining patents, both relate to intercommunicating systems; that is, telephone systems in which all switching is performed manually at the different stations. Both of these are so designed that it is possible for but two stations to be connected at one time, and therefore privacy is guaranteed. One of these systems is adapted to single wire, dial-switch working, while the second is for true metallic or balanced line working. Both systems are the inventions of Messrs. S. H. Parsons and T. Sloper, of England.

In the first system the completion of a connection is dependent upon the action of two relays, one at each of the stations to be connected, and which control receiver circuits of the respective stations. When one station desires a second the dial switch is first properly placed and a signal sent. In answering, the called station must hunt for the calling station by revolving his switch arm. When the correct point is reached, that of the calling line, this fact is indicated to both parties by the click coincident with the closing of the receiver circuits by the operation of the two relays. This desired result is accomplished by the arrangement of circuits shown in Fig. 3, from which it will be seen that in order to operate either relay, the switches at both stations must be properly set.

The second system depends upon maintaining the receiver and transmitter circuits of each station entirely independent of each other, and yet so connecting both circuits to the lines that by the agency of plugs and jacks the transmitter circuit at one station may be directly connected to the receiver circuit of the one desired and vice versa. On receiving a signal, the desired station, as with the previous system, must hunt for the calling line and when he has found it the existence of his plug in his jack of that line, connects his transmitter to the distant receiver. Thus it is seen a completed connection depends upon the mutual actions of both calling and called stations toward the same end and privacy is therefore guaranteed.

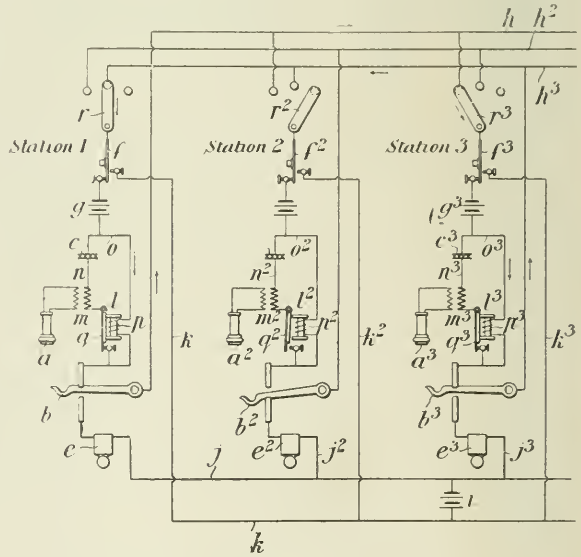


FIG. 3.—PARSONS AND SLOPER TELEPHONE SYSTEM.

Wireless Telegraph Message From President to King.

It is announced from the Marconi wireless telegraph station at South Wellfleet, Mass., that the following message was transmitted on January 19 by the Marconi system of wireless telegraphy between Cape Cod and Cornwall, England, from President Roosevelt to King Edward:

His Majesty, Edward VII,
London, England:

In taking advantage of the wonderful triumph of scientific research and ingenuity which has been achieved in perfecting a system of wireless telegraphy, I extend on behalf of the American people most cordial greetings and good wishes to you and to all the people of the British Empire. Theodore Roosevelt.

Wellfleet, Mass., January 19, 1903.

King Edward replied by cable as follows:

Sandringham, January 19, 1903.

The President,
White House, Washington, America:

I thank you most sincerely for the kind message which I have just received from you, through Marconi's transatlantic wireless telegraphy. I sincerely reciprocate in the name of the people of the British Empire the cordial greetings and friendly sentiment expressed by you on behalf of the American Nation, and I heartily wish you and your country every possible prosperity.

Edward R. and I.

A great deal of secrecy has been maintained in regard to the Wellfleet station and the apparatus it contains; and it is reported in the newspapers that Mr. Marconi complains of the stealthy movements of spies and strange watchers in the vicinity. No technical data have been forthcoming, but a reporter of the *New York Journal* quotes Mr. Marconi as follows: "The severest part of my work at Glace Bay was the responsibility for so many lives while we were making our experiments," said Mr. Marconi. "A single mistake, the touching of a wire at the wrong moment, might mean sudden death. At Glace Bay we have a current of 100,000 volts. That is much more than we need, so here we use only 50,000 volts, but that is enough to kill a man, or a dozen men. Long-distance wireless telegraphy is simply a question of power, or rather a question of power combined with height of tower. The higher the tower, the less power is required. We have built our towers on this side as high as practicable in their exposed conditions, but we still have to use a current of very high potential energy."

The same reporter gives the following graphic description indicative of the amount of power used:

Mr. Marconi touched a lever. There was a blinding flash and a deafening report as a spark several inches long jumped from the disk at which the aerial wires conveyed to another disk connected with a wire leading into the ground. Although employees, officials and visitor alike had stuffed their ears with plugs of cotton wool, the sharp, explosive sound was painful in its intensity.

Crack! There was another flash as another spark jumped from one wire to the other.

"That was a dot," said Mr. Marconi. "A dash would be made by a longer interval between the electrical discharges. If our apparatus were properly adjusted that signal ought to be observed at our stations at Cornwall and at Cape Breton."

Some of the other newspaper reports speak of the blinding flashes of light seen in the Wellfleet building and the concussive discharges that literally shake the ground in its vicinity, and can be heard half a mile away.

The directors of the Marconi Wireless Telegraph Company of America held a meeting on January 20 and exchanged congratulatory messages with Mr. Marconi, who was then at Cape Cod. Only routine business was transacted, and further steps with a view to putting the wireless system on a commercial basis were discussed. "The possibilities, however," said John Bottomley, the manager of the company, "are practically illimitable. In sending the President's message from Cape Cod to Poldhu, only one-sixth of the available power was used, and I believe that right now it would be just as easy to send a message to New Zealand.

"The King's message was sent here by cable, as the apparatus at Poldhu is not sufficiently strong. Many new stations are contemplated, but on account of opposition I cannot make the plans public just now. Some of them, however, will be on the Pacific coast, and in time doubtless we shall have the world pretty thoroughly covered."

"There is already wireless communication between the Island of Santa Catalina on the California coast and the mainland, fifty miles distant. The intervening water is too deep for a cable, and previous to last summer, when the wireless system was inaugurated, communication between the island and the mainland was intrusted to carrier pigeons."

A dispatch from Wellfleet of January 20 says: "Signor Marconi continued his experiments with the station at Poldhu last night and received acknowledgment that the transmission was smooth, regular and satisfactory. He is now trying to ascertain the minimum of power required to propel vibrations across the Atlantic. He is using less than one-half the voltage employed in his earlier experiments at the Table Head station, and this afternoon he sent instructions by wireless to England that to-night he would try for results with less power than last night. Regarding the disturbances to the local telephone wires caused by the wireless experiments, Marconi said that all trouble could be remedied if the people who complained of interruptions would place an exhaust device on one of the telephone poles near the station."

CURRENT NEWS AND NOTES.

GERMAN AUTOMOBILE SPEEDWAY.—One feature of Emperor William's plans for transforming the Grunewald Forest into a great public park for Berlin is an automobile speedway seven and a half miles long and twenty-one yards wide.

THE TELEGRAPH IN CHINA.—The Chinese government recently confiscated the telegraph lines in that country, but by an edict the owners are given the option of retaining their stock. The management of the lines will reside in the government.

CHESS BY WIRELESS TELEGRAPHY.—A three-hours' chess tournament was played by wireless telegraph at sea last week, between teams on board the *Lucania* and the *Philadelphia*, the winners being on the latter ship, which was a good many miles from the other. The game went very smoothly.

CHICAGO DRAINAGE CANAL POWER.—The trustees of the sanitary district of Chicago have authorized their engineer, Isham Randolph, to advertise for bids to build hydraulic works at Lockport and at Joliet to make use of the power from the drainage canal for electric transmission. About 18,000 hp is available at Lockport, where there is a 32-ft. fall and 11,000 at Joliet, where the fall is 20 ft.

AN OCEAN EYE-OPENER.—A cable dispatch from Kiel, Germany, of January 13 says: The naval authorities here are making preparations to test Signor Pinos's hydroscope, by means of which, it is said, human eyesight is enabled to penetrate the sea to an incredible depth and for an enormous radius. A naval official who witnessed an experiment with the hydroscope in the Mediterranean says that the instrument can be operated from the deck of a ship, making visible cables, torpedoes, etc. It is said that the invention ought to nullify the dangerous character of submarine boats. The inventor is an Italian.

PENNSYLVANIA RAILROAD PLANS.—The Pennsylvania Railroad has given out more of its plans for the construction of its tunnel under the rivers. A commission of engineers is to design and supervise the construction of the tunnel. McKim, Mead & White, architects, are to have charge of the terminal structure; Westinghouse, Church, Kerr & Co., engineers, as already noted, are to have charge of the electrical and mechanical equipment, and the chief engineer's department of the Pennsylvania Railroad is to bring the lines of the railroad into and through the tunnels. The commission of engineers consists of Col. Charles W. Raymond, U. S. A., engineer of New York Harbor, chairman; Charles M. Jacobs, chief engineer of the North River section of the tunnel; Alfred Noble, chief engineer of the East River section; William H. Brown, chief engineer of the Pennsylvania Railroad Company, in charge of tracks and terminal yards; Gustav Lindenthal, Bridge Commissioner of New York City, and George Gibbs, first vice-president of Westinghouse, Church, Kerr & Co., in charge of mechanical engineering, electric locomotives and traction.

WIRELESS TELEGRAPHY IN CHINA.—It is proposed to establish the Marconi system of wireless telegraphy between Pekin and Taku.

TELEPHONES FOR GERMANY.—A cable dispatch from Berlin of January 17 says: "The Postal Department has ordered 20,000 American automatic telephones as the result of experiments, which have turned out successfully. The ammunition factory at Karlsruhe has bought the patent rights." The name of the American maker is not given.

THE TOWN OF SPRAGUE, CONN., is promised an electric company for power, light, electric railway work, etc. This has a very fair and pleasing sound, for if any place in America has a right to electric power, etc., it is surely the one bearing the name of Sprague. The special appropriateness of the plan ought to remove any obstacles from its way, and the installation ought to be the very best of its kind.

CANADIAN NIAGARA POWER.—The Ontario Power Company promises delivery of electrical energy from Niagara Falls in Toronto, Ont., by the end of 1903. The company by that time, it is stated, will be in a position to furnish Toronto with about 15,000 hp, and if more is needed it can be had. A double-pole line will be built from Niagara to Toronto, so that, in the event of one line being disabled from any cause, a second line will be available. The company will eventually develop 150,000 hp.

MERCURY VAPOR LIGHTING.—An interesting dispatch from Schenectady, in the *New York Sun* of January 18, describes work that Mr. C. P. Steinmetz is doing in following up the line of investigation pursued by Dr. Arons, of Germany, on mercury vapor lighting, and confirming the ideas and data given through our own pages to the public by Mr. Peter Cooper Hewitt, whose pioneer work in this field has attracted so much attention all over the world. It is stated that the light as developed by Mr. Steinmetz is now used in that engineer's famous house for his laboratory and conservatory, where the latest novelties of electrical science dispute the visitor's attention with rare plants and tame alligators.

RAILS AS TELEPHONE CIRCUIT.—It is stated that experiments were made last week on the Dedham branch of the New York, New Haven & Hartford Railroad by a representative of the American Telephone & Telegraph Company in telephoning between stations, utilizing the railroad tracks instead of a line of wire for the transmission of messages. Telephones were placed in the stations at Roslindale, Highland and Dedham and connections made with the rails. The experiments were quite successful, except when cars on the local electric street railway crossed the overhead bridge of Beach Street, when the voices at the telephone became indistinct because of a "leak" on the electric car line. The New Haven company is said to be considering the advisability of equipping all of its stations with telephones if the telephone company can make its instruments work successfully.

NERNST LAMP GLOWER.—In a patent issued January 13 to M. W. Hanks, it is stated that if a Nernst lamp glower made in accordance with current practice is used on a direct-current circuit, the potential difference between its terminals and also its candle-power are usually found to be variable. When new there is a substantially uniform degree of light emission throughout its entire length, but gradually the portion next the negative terminals decreases in brilliancy until it becomes entirely non-luminous; and as the length of service increases the dark portion increases in length. While this change is in progress the current taken by the glower will generally vary to a greater or lesser extent and either the life of the glower is shortened or its efficiency is decreased. To remedy this defect the patent provides that a glower intended for use on direct-current circuits shall be first heated to conducting temperature and then subjected either to a normal or an overload alternating current for a comparatively short time. This treatment results in a minimum variation of potential difference and candle-power.

THE STEVENS INSTITUTE OF TECHNOLOGY.—A series of interesting events in connection with the formal inauguration of Mr. Alexander C. Humphreys as president of the Stevens Institute of Technology, Hoboken, N. J., will take place on February 4th and 5th. On the evening of Wednesday, February 4th, there will be held in the Carnegie Laboratory of Engineering a reception given by the alumni to President Humphreys. This will take the place of the usual mid-winter meeting of the Alumni Association. On Thursday, February 5th, at 2 o'clock, the inauguration ceremonies will be held in the Carnegie Laboratory. At 7 P. M. there will be a reception and dinner, tendered by the alumni, at Sherry's, Forty-fourth Street and Fifth Avenue, New York City. Many distinguished guests are expected to be present at this dinner. Those of the alumni who remember the dinner given celebrating the twenty-fifth anniversary of the Stevens Institute, which was held a few years ago at the Waldorf, and the more recent dedication of the Carnegie Laboratory of Engineering, will know what to expect at the forthcoming dinner. Acceptances have already been received from the presidents or other representatives of many leading universities and technical institutions of the East.

BRADLEY ALTERNATOR.—Two further patents were granted January 13 to Charles S. Bradley on his system of alternating-current generators, the peculiarity of which is that the alternator has not a separate exciting winding. The machine is of the induction generator type, the driven part having short-circuited windings. The stationary part has a distributed winding and in case it supplies three-phase currents, is tapped at three equidistant points by the working circuit, and at three other equidistant points midway between the above by the exciter circuit. In the exciting circuit are condensers, which have such capacity with respect to the inductance of the alternating circuit that they will supply magnetizing current of proper phase. The short-circuited element of the alternator is driven above synchronism with relation to the rotary field, and may be cut into a distribution circuit supplied by another generator without the necessity of bringing the two generators into synchronism. The present patents refer to details of the exciter element exterior to the alternator, and relate to such a selection and arrangement of the condensers that a small exciter of low e.m.f. may be employed. The exciter circuit being resonant or approximately so a large magnetizing current will flow in the rotary field winding. Another patent relates to means whereby a single exciter may supply a number of alternators. The applications for both the above patents were filed June 22, 1896.

LETTERS TO THE EDITORS.

The Making of Electrical History.

To the Editors of Electrical World and Engineer:

SIRS: I have been a constant reader of your valued paper for some years past, and I cannot refrain from writing to congratulate you upon the important article published in the January 17th issue on the Cooper-Hewitt Static Converter. I believe in newspaper work, when you get a good "story" exclusively for your own paper you make what you call a "scoop." This is certainly a genuine "scoop," and I am glad to see that the great metropolitan daily papers have recognized it and given you due credit for it.

Speaking of "scoops," I notice in the same issue of your paper that you have an editorial entitled "Telegraphic Anec-dotage," which refers to the fact that one of your esteemed contemporaries recently went up in air over the discovery of Mr. Morse's diary and a wonderful prophecy contained therein. The diary never having been lost, and its contents or most of it having been published over and over again, and the prophecy having appeared in the book published by Prime twenty-five years ago, there was not very much cause for elation over the "discovery" (?), and certainly no excuse for the flourish of trumpets which accompanied it. I realize the delicacy of your position in referring to this matter, but like every fair-minded man I am glad always to see this sort of thing cleared up, and I wish to congratulate you upon the exposé you make. Trusting I have not trespassed too much upon your valuable time. I remain,

NEW YORK CITY. CHARLES HERMAN.

Electric Roads in Sweden.

To the Editors of Electrical World and Engineer:

SIRS: As to the adoption of electric traction on the government-owned railroads of Sweden, Mr. J. Gust. Richert in a letter to me, dated Stockholm, December 19, 1902, states the following, according to an interview with Mr. Nördstrom, general director of the Swedish royal railroad direction:

"The question is at present being energetically pushed. In charge of the investigations is Mr. R. Dahlander (at present with the 'Allmänna Svenska Elektriska Sktiebolaget i Vesterås'), who from January 1st is engaged by the railroad direction for the study of electric railroad traction. Monday, December 22, he is to submit his report, as well as the reports of the State's peat engineer and myself as to the use of the turf pits (in south Sweden) and the waterfalls, for motive power. Further than this the question has not yet gone, and the rumors seen in the press have probably their origin in Mr. Dahlander's inquiries addressed to several firms."

NEW YORK CITY. ARVID WESTERBERG.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo Design.—DAVIES.—An article on some special points in direct-current dynamo design. The drum armature is superior to the ring type for several reasons; the toothed drum core affords the economy that the length of the air-gaps is reduced, thus requiring a smaller number of ampere-turns on the field magnet; in a toothed armature machine, the commutation is improved by working at a high induction in the armature teeth; this is owing to the armature reaction being reduced. High induction in the teeth may be obtained by making them narrow; but the hysteresis and eddy current losses are thereby increased with the result of undue heating of the core; but it is not necessary to reduce the section of the teeth in order to minimize armature interference; this result may be attained equally well and without those disadvantages by simply increasing the length of the air-gaps. In an open type machine it pays to provide means for ventilating the armature, but in an enclosed machine the introduction of ventilating ducts in the armature does not materially reduce its temperature. The number of poles of the field magnets is important; an increase in this number permits a decrease in the length of the air-gaps and a corresponding reduction in the size of the magnet and in the number of ampere-turns on it; moreover, the armature of a multipolar machine offers better facilities for ventilation than does the armature of a bipolar machine; the limit of the number of poles is, however, given by the hysteresis and eddy current losses in the armature and by the cost of manufacture. The use of non-concentric poles prevents distortion of the field and therefore improves the commutation. The yoke ring of a magnet of the iron-clad type, if of the same material as the cores, should be one-half of the cross-sectional area of one of the cores, or, if of different material, should be of sufficient area to carry one-half of the lines of force carried by one of the cores. It is well to make the carcase of a motor sufficiently large to allow ample room for attending to the brushes and the brush-holders, even if the machine has to be made somewhat larger in consequence. The cost of labor is comparatively high and the cost of material low in small machines; the smaller sizes of machines should, in order to attain the maximum economy, be designed so as to necessitate as little labor as possible, even at the expense of material. The larger sizes of machines should have as simple castings as possible and should be made of a large number of different parts.—Lond. *Elec. Rev.*, December 19.

LIGHTS AND LIGHTING.

Nernst Lamp.—BOSE.—An account of an experimental investigation of the behavior of the Nernst lamp when worked with direct current. In this case electrolysis sets in, and under favorable circumstances the products of this electrolysis may be isolated. At the same time, the space around the pencil is filled with an extremely bright blue light; he agrees with Stark that this light is due to metallic vapor. It ceases in a few seconds when an alternating current is substituted and the electrolysis also ceases. When direct current is used, metal is deposited at the negative pole and this gives rise to branch currents having some analogy with the blue flames in incandescent lamps. The author also investigates the behavior of non-metallic bodies as cathodes, in vacuum tubes, thinking that "with such electrodes the anode rays should behave like cathode rays from metals; selenium and tellurium, however, behave just like metals; lead peroxide does not emit cathode rays when used as a cathode."—*Ann. d. Phys.*, No. 13; abstracted in Lond. *Elec.*, January 2.

POWER.

REFERENCES.

Power Plants.—The whole issue is devoted to illustrated articles on power plants. Among them are special articles on various details of steam engine and boiler practice and descriptions of the power plants of the Boston Elevated Railroad, the Metropolitan Railway, of Paris; the Berlin Electric Railway, the power transmission at Kalgoorlie, Australia; the Rand Central Electric Station at Johannesburg, Transvaal; the power plants of the Milano-Gallarate-Porte Ceresio Railway; also articles on special points of hydraulic power generation, with descriptions of hydro-electric plants in California and in Switzerland.—*The Eng.*, January 1.

Governing of Engines for the Parallel Operation of Alternators.—DE MARCHENA.—His very long paper in full, an abstract of which was recently noticed in the Digest.—*Bull. Soc. Int. des Elec.*, November.

TRACTION.

Long-Distance Electric Railroading.—LOUIS DUNCAN.—A lecture in which he discusses the difficulties of the problem of applying electric power on railroads at present operated by steam locomotives. The conditions are entirely different from those of the tramway and suburban railway; for through passenger service a single car, or even two cars, are not enough to give the comfort to which the traveling public is accustomed; this requires heavy trains consisting of a number of cars. 500 to 600-volt direct-current motors, receiving current either directly from a central station or from sub-stations, are not applicable. The possibilities of congestion of traffic especially of freight congestion, make the capacity of sub-stations enormous as compared with the average power required on the line, and there is required in addition an immense amount of copper for the feeders. Another difficulty is the large amount of switching to be done, much of it of a complicated nature. If electricity is to be used in terminals and freight yards, a locomotive must be designed which is economical at all speeds and which is under perfect control, and current must be supplied to these locomotives by some means which will not endanger the lives of the train hands. He then discusses the use of alternating currents for traction. "The roads in Switzerland show practically nothing except that a three-phase alternating motor can drive a car—a thing which was very well known before. There is no railroad problem involved in their operation. The cars are small and the voltages used are in no case above 750 volts." Regarding the Lecco three-phase railway in Italy, he says that the Ganz Company has had difficulties which are shown to be serious by the fact that the company is over a year behind the proposed date of operation. "The service required is not the heavy service that we need in our railroads, and if it was, the great uncertainty of operation that has been shown would make the system impossible of operation." A great and almost fatal difficulty with such a scheme is said to be in the liability of trouble with overhead wires. "A two-track system, with four wires overhead, these wires having a great difference of potential between them, is almost certain to cause trouble even on a straight track, and when there is switching the complication becomes enormous." Concerning the system of the Oerlikon Company (described in a paper by Haber, which was abstracted at length in the Digest) he says that it has some advantages in that it requires but little trolley wire over the track and affords an excellent means of regulating the motors. "Its disadvantages lie in the fact that it interposes between the trolley and the motors a transforming station which is not only expensive, but adds greatly to the complexity of the system." For heavy railroad work, between this and the three phase system, he would unquestionably choose the Oerlikon method. Concerning Arnold's proposition, he says it affords "an ingenious, if doubtful, solution of the railroad problem," but he is afraid that its complexity will prevent its adoption; "without going into any particular reason why, it does not sound like an operative system." The Westinghouse system is said to promise much in the way of simplicity and applicability to the heavy problems of steam railroad traffic; a series motor has the advantage that it is to a certain extent self-regulating. One disadvantage is in the low period which will require large static transformers; but it this is the only difficulty, it may be overlooked.—*Tech. Quart.*, December.

REFERENCES.

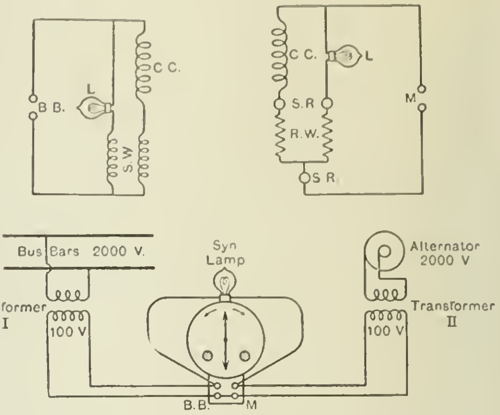
European Tramways.—An article in which the possibilities for capital investment in European tramway enterprises is discussed.—*St. R'y Jour.*, January 3.

Municipal Ownership.—DONALD.—The first part of an article in which he denies that municipal tramways and other municipal enterprises have proved a failure in Great Britain. He acknowledges that his arguments apply to British conditions only.—*St. R'y Jour.*, January 3.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

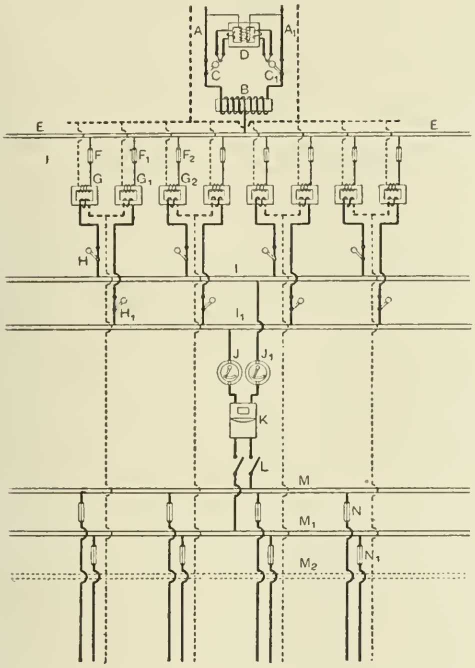
British Central Station Statistics.—A long statistical article with numerous tables and diagrams, on British central station costs in 1900 and 1901. The municipal stations are first discussed. The Bolton station has given the best results in showing lowest total costs simultaneously with the lowest relative capital expenditure; the city is favorably situated for cheap fuel and a large proportion of the output is supplied for traction purposes; the center of the town is served by direct current on the three-wire system, with a pressure of 460 volts between the outers; the outlying districts are served by single-phase, alternating current at 2,000 volts, transformed down to 100 and 200 volts by transformers in houses and sub-stations; the station has been in operation for seven years; for this plant the total cost per unit sold was 1.92 cents in 1901, and the total cost plus 6 per cent. of the mean expended capital per unit sold was 3.46 cents in 1901. The same values for the average of all municipal stations discussed were 3.90 cents and 7.36 cents. Other interesting averages are those showing the actual prices of supply per unit; the mean price to ordinary consumers for lighting and power supply was 8.32 cents in 1900 and 8.12 cents in 1901; for public lighting the price was 4.66 cents in 1900 and 4.72 cents in 1901; and for traction supply 3.52 cents in 1900 and 3.36 cents in 1901; the average total receipts for current for all uses was 7.12 cents in 1900 and 6.78 cents in 1901. The average figure representing 6 per cent. of the mean expended capital per unit sold, is very nearly equal to the total cost per unit; in other words, of the total charges on the revenue of a concern, half is roughly the total working cost and half the capital charges. The variation of the various items of cost during the last seven years is plotted diagrammatically. Diagrams are also given showing the influence of output and load-factor on costs of working; below one and a half million units the output is the most governing factor, while above that output the load factor becomes comparatively more and more important in its effect on the expenses, especially on the capital expenses. Company undertakings are then discussed; the St. James station heads the list again, as in former years; here the total cost per unit sold was 4.18 cents in 1901, and the total cost plus 7 per cent. of the mean expended capital per unit sold 6.52 cents. The corresponding figures for the average values of all the stations are 5.42 cents and 12.02 cents. Curves are given showing the variation of the average values in the last years; the curve of total revenue is everywhere below the curve of total costs plus 7 per cent. of the mean capital, and since 1897 the former curve has fallen more rapidly than the curve of total charges, so that in 1901 the difference between these two values was 2.2 cents per unit. The final conclusion is that the total revenue from all sources was equal to the total costs plus 5.3 per cent. of the mean capital in the case of municipal concerns, and in the case of companies to the total costs plus 4.7 per cent. of the mean capital expended—Lond. *Elec.*, January 2.

Paralleling Alternators.—An illustrated description of a "rotary synchronizer" used at the Hastings station which is essentially a two-phase motor consisting of a laminated core running in ball bearings and carrying a pointer; this core is wound with an ordinary two-phase winding connected to three slip rings; outside the rotor is the laminated stator, which is likewise provided with a four-pole, two phase winding. In the case of both rotor and stator, one circuit is connected across the full voltage with a lamp in series with it, while a choking coil is inserted in the other; thus two rotary fields are produced, and the connections are such that they rotate in the same direction; obviously they will tend to rotate "in step." The connections of the stator are shown in Fig. 1 and the connections of the rotor with the incoming machine in Fig. 2; Fig. 3 shows the total arrangement. *B B* are the terminals connected to the busbars, if necessary through a transformer; *M* are the terminals connected to the incoming alternator, if necessary through a transformer. *L* is a lamp forming a non-inductive resistance, *C C* are choking coils, *R W* is the rotor winding, *S W* the stator winding and *S R* slip rings and brushes. The action is as follows: If the frequencies in both circuits are the same, the two fields will be rotating at the same speed and the motor will stand still. If on the other hand the frequency—i. e., the speed of rotation of the stator field—is greater than that of the rotor, the latter will have to revolve in the same direction as the flux in order that the two fields may keep in step. Thus, for example, a clockwise rotation will show that the frequency of the incoming machine, and therefore its speed, is too great, while a counter clockwise rotation will show that it is too small. The speed of rotation is an indication of the difference between the two frequencies, one complete revolution representing a difference of two cycles. Another important feature is the arrangement of two lamps, a red one and a green one, which are automatically exposed to view according to the direction of rotation of the spindle; the result is that the engine driver can see from a considerable distance whether his machine is going too fast or too slow. The whole apparatus is surmounted by an ordinary synchronizing lamp, as a guide to the engine driver. The switching in or out of the colored lamps is accomplished by means of a small lever which is carried friction-tight on the spindle and actuates a two-arm shutter.—Lond. *Elec.*, January 2.



FIGS. 1, 2 AND 3.—PARALLELING ALTERNATORS.

Line Protection Devices.—An illustrated article on some experiments made at the Hastings electricity works before invited engineers. A demonstration was given of short-circuiting a high-tension feeder by driving a nail into it midway between the generating station and the sub-station, which are about 1½ miles apart. The feeder in question was duplicated and worked in conjunction with a "discriminating" transformer and choking coil, the arrangement being shown by the adjoining diagram of sub-station connections. The secondaries of an auxiliary transformer, *D*, are short-circuited by copper fuse wires which support the weighted levers that tend, when released, to disconnect the respective feeders from the choking coil, *B*; the high-tension primary of this transformer is connected between the duplicate feeders. Under normal conditions there will be no difference of pressure across the terminals of either secondary winding, but should a feeder fail, current will flow from the healthy feeder to the faulty feeder through the primary winding of this transformer, and the construction of the transformer is such that a heavy current will be induced only in the secondary supporting the weight of the switch controlling the faulty feeder. In the diagram *A* and A_1 are the high-tension feeders supplying the sub-station; *B* is the "discriminating choking coil"; *C* and C_1 are switches for disconnecting either feeders; *D* is the "discriminating transformer" for operating these switches; E are high-tension busbars; F F_1, etc., high-tension fuses; G, G_1, etc., 20-kw transformers; H and H_1 low-tension "discriminating cut-outs"; I and I_1 low-tension busbars; J and J_1 main ammeters; K main three-way wattmeter; L a double-pole main switch for disconnecting secondaries of transformers from the distributing busbars, M M_1 and M_2; N and N_1 are fuses on distributors. The arrangement was shown to give absolutely satisfactory results. Among other things it was shown that the duplicate feeders cannot be satisfactorily protected by fuses alone; the discriminating choking coil was left open-circuited, and the feeders were paralleled through fuses at both ends of the line; if both lines were protected by fuses of equal sectional area one of the fuses on the healthy line must have blown before the fuse on the distributing end of the short-circuited line, as these fuses have to carry any load on at the time, in addition to the current necessary to blow the fuse of the disabled feeder, consequently a short-circuit on either of the duplicate lines is bound to interrupt the supply; and this was shown to happen. The fuses at the distributing end of the line were then removed and the switches connecting the lines through the "discriminating choking coil" were closed, as shown in the diagram. If either line is earthed while the other line is maintained at approximately 2,000 volts above earth, a sufficiently heavy current to instantly blow the fuse controlling the switch on the end of the faulty feeder, is induced in the secondary to which this fuse is connected.—Lond. *Elec.*, December 26.



LINE PROTECTION DEVICES.

REFERENCE.

Regulating Rheostats.—Koenig.—An article on the calculations of adjustable resistances. He describes a graphical method which enables one to follow the calculation in a very simple way and to find out the influence of the various determining factors.—*Elek. Anz.*, December 21, 25.

Wires, Wiring and Conduits.

Economizing Wire in House Wiring.—Tatlow.—An abstract of a brief paper read before the Dublin section of the (Brit.) Inst. Elec. Eng., on a modified system of house wiring as an improvement on the "looping-in system." The looping-in system of wiring avoids all joints in the circuit, connections being made only at the switches, ceiling roses and fuse boards; it involves in certain cases the use of an excessive quantity of wire which not only increases the expense, but also the voltage drop on the more distant lamps. In the author's system, as ordinarily used, a wire is carried from one pole to the fuse-distributing board through one terminal of all the ceiling roses of a group of lights, and the wire from the other pole is carried from switch to switch, the remaining terminal of each ceiling rose being fed by a separate wire from its own switch. This system involves three wires, being carried down to each switch when the switches are not arranged in groups, and it also involves the whole current being carried up and down to each switch. By the use of ceiling roses with three terminals, it is possible to carry both wires from the fuse board through from ceiling rose to ceiling rose, and to take a feed for one switch off one terminal and to bring the switch wire back to the third terminal, the lamp being connected to the other side of the circuit. Using this system, only two wires are required between the ceiling rose and switch, and these need only be large enough to carry the current for the one point. Moreover, the length, and therefore the drop on the main circuit is reduced.—Lond. *Elec.*, January 2.

REFERENCE.

Fuses.—Sachs.—A well illustrated Franklin Institute paper on safe and accurate electric safety fuses, their evolution, principle, operation and application. He showed striking experiments in which plain wire fuses and enclosed fuses of the same capacity were blown. While the blowing of the plain wire fuses produced a blinding flash and loud report, the blowing of the enclosed fuses was scarcely noticeable and was neither accompanied by a report nor by flash.—*Jour. Frank. Inst.*, January.

Electro-Physics and Magnetism

Formation of Ozone.—Warburg.—An investigation of the electric discharge producing ozonization in a closed volume of oxygen. The formation of ozone then has a limit varying with the conditions of the experiment. There exists besides the ozonizing effect a contrary effect which counterbalances it after a time; it is the electric discharge itself which produces this contrary effect. He endeavors to obtain a measure of both effects. The maximum percentage of ozone is about three times as high for negative as it is for positive discharges; the decomposing activity is the same for positive and negative electricity; the effect of temperature on both discharges is the same.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 19.

Magnetization of Liquids.—Piaggesi.—An account of experiments in which he endeavored to decide the question as to whether the magnetic susceptibility of liquids changes with the temperature. The demagnetization of water decreases as the temperature rises in a linear manner; there is a distinct influence of the temperature, although only a small one. The magnetic susceptibility of a solution decreases as the temperature rises. The temperature coefficients are nearly the same for all solutions studied, including nickel chloride, cobalt chloride, manganese or iron chloride, sulphate and nitrate, and are of the same order as the coefficient of expansion of a gas. The product of the magnetic susceptibility into the absolute temperature is a constant whose value depends solely upon the nature and the concentration of the solution, in accordance with the law discovered by Curie for oxygen and for an aqueous solution of ferrous sulphate. The product diminishes as the solution becomes more concentrated.—*Nuovo Cimento*, October; abstracted in Lond. *Elec.*, December 26.

Electro-Chemistry and Batteries.

Conversion of Amorphous Carbon to Graphite.—Fitzgerald.—A Franklin Inst. paper giving an interesting critical summary of the systematic work done in this direction by various investigators, notably Despretz, Berthelot, Moissan and Acheson. By the Acheson process the conversion of amorphous carbon into graphite is complete; the density is thereby increased considerably, the mean value of densities of six electrodes before graphitizing being 1.90 and after graphitizing 2.19; the electric conductivity is at the same time greatly increased; Lincoln found it to be increased four times. The purity of the graphitized carbon is greater than that of the amorphous from which it is made, for a greater or less quantity of the contained impurities is volatilized. In summarizing the more important work done by the various investigators, the author remarks that their results are by no means in agreement. The conclusion to be drawn from a comparison of Berthelot's and Acheson's researches seems to be that while all true graphites yield graphitic oxide, all bodies yielding that compound are not necessarily graphites suitable for practical purposes. In view of the fact that various kinds of hard and soft graphites produced by artificial means are now being put on the market, and that varieties of amorphous carbon (notably retort carbon) are also sold under the name of graphite, the author thinks it would be advisable to revise the nomenclature of carbons, reducing it to a more rational and practical form free from all ambiguities.—*Jour. Frank. Inst.*, November.

Solubility, Electrolytic Conductivity and Chemical Action in Liquid Hydrocyanic Acid.—Kahlenberg and Schlundt.—An account of the investigation of the electrical conductivity of solutions in liquid hydrocyanic acid, which is of special interest because this solvent has a high dielectric constant, rendering an exact examination of the Nernst-Thomson rule possible. While some salts dissolved in liquid H C N conduct electricity better than in water, many others have a much higher resistance than in their corresponding aqueous solutions. In the face of these facts, the Nernst-Thomson rule can clearly not be considered as substantiated by the conductivity of solutions in liquid H C N. The authors conclude that the conductivity of a solution is not determined by the dielection constant of the solvent, its state of polymerization or its spare valences, but rather by the specific nature of the compound formed when solute and solvent act on each other to form the solution.—*Jour. Phys. Chem.*, October.

Influence of the Solvent in Electrolytic Conduction.—Patten.—A long account of an investigation the principal results of which are: that the lowering of the specific electric conductivity of non-aqueous solution by addition of a pure solvent is approximately proportional to the number of gram molecules of solvent added and depends also on the solvent; the application of this principle offers a new method of molecular weight determination; that electrical conductivity is probably the resultant of the tendency of some molecules to transfer the charge produced by an impressed e.m.f., and the resistance offered to this transfer of charge by other molecules; that Konowalow's conclusion that the small molecular volume of water stands in a definite relation to the power of aqueous solutions to conduct electricity is unwarranted; also his conclusion that the magnitude of the electrical conductivity of solutions is proportional to the intensity of chemical combination between solvent and solute as measured by the heat effect.—*Jour. Phys. Chem.*, November.

Alloys of Lead, Tin and Bismuth.—Shepherd.—An account of a very long experimental investigation of the alloys of lead, tin and bismuth, with reference to the principles of physical chemistry, especially the phase rule. From alloys containing lead, bismuth and tin, the tin pure crystallizes, but often in an unstable, denser form. Lead and bismuth form two series of solid solutions, in each case with contraction. When the fused alloys are cooled fairly rapidly, the saturation concentrations are not reached.—*Jour. Phys. Chem.*, November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

"*Quantometer.*"—An illustrated description of what he calls an "electric quantometer." The measurement of induction in large masses of iron by the ballistic method is rendered difficult owing to the gradual character of the growth or decay of magnetism following the application or suppression of the magnetizing force and the consequent "tailing off" of the induced current in the exploring coil. The quantity of electricity to be measured is thus conveyed by a current lasting, perhaps, 30, 60 or even more seconds, and the use of an ordinary ballistic galvanometer is entirely out of the question. His "quantometer" is designed to take the place of the ballistic galvanometer and to do what it fails to do, i. e., to sum up in a single throw quantities conveyed by currents lasting an appreciable time. It is said to be useful for flux-measuring work in connection with dynamos, etc. The principle is to use a moving coil, shuntless ammeter with a coil which is wound as usual, on a closed metallic frame to secure strong electromagnetic damping, and to replace the controlling springs by similar ones made so weak as to exert an inappreciable controlling force; springs of the phosphor bronze strip type as used for galvanometer suspension, are said to serve excellently. As a result the coil will remain permanently in whatever position it may be placed, and if the quantity to be measured be passed through it, it will move forward into another position and remain there, the regular distance moved over being a measure of the quantity. He gives a theory of the instrument, based upon the fundamental equation which states that the instantaneous value of the driving couple is equal to the sum of the instantaneous values of all the resisting couples. The latter are the couple producing angular acceleration of the moving coil, the couple due to air resistance, the couple set up as a result of the induced current produced in the coil due to its motion, the couple due to the current induced in the metallic frame on which the coil is wound, and the couple due to pivot friction. He shows that the throw is strictly proportional to the quantity only when the pivot friction is entirely absent or the discharge instantaneous. But as a small amount of pivot friction is unavoidable, the indications in an actual instrument fall off as the duration increases, and a correction has accordingly to be applied. An instrument for laboratory use and a portable instrument are described.—Lond. *Elec.*, December 26.

REFERENCES.

Phase Meter.—Johonnott.—An illustrated description of an alternating current phasemeter which he was constructing for the use of students in the laboratory, after the pattern of Lord Rayleigh's instrument.—*Phys. Rev.*, November.

Magnetic Measurements.—Armagnat.—A very long illustrated paper, read before the Internat. Soc. of Elec. in Paris, in which he describes the industrial methods of making magnetic measurements.—*Bull. Soc. Int. des Elec.*, November.

Localizing Faults.—Janet.—A brief paper in which he describes a method and illustrates the connections by diagrams, for localizing a fault in an underground three-phase cable.—*Bull. Soc. Int. des Elec.*, November.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Selective Wireless Telegraphy.—Bull.—A long, illustrated description of a system which is based entirely on mechanical principles. Instead of using simple wave impulses in transmitting signals as by other systems of wireless telegraphy, a series of a fixed number of wave impulses, succeeding each other at pre-arranged short intervals of time, is used, and thus it is possible to give the signals from each separate transmitter a distinctive feature of their own. For instance, if each series consists of five impulses there are four intervals between them and any values may be given to these four intervals; the variation of these intervals seems to be the fundamental requirement; it is evident that it is easy to produce a great variety of series; the receivers at the different receiving stations are tuned to these lengths of the intervals. The conversion of the Morse signs into such a series of intervals at the transmitting station, as well as the reconversion of the series into dots at the receiving station, is accomplished automatically by two instruments, the "disperser" and "collector" respectively, which are described. Sending is carried out in the usual way by pressing down a Morse key for short or long periods. The system is said to work remarkably well in the laboratory. In an editorial discussion which is rather favorable, it is said that one defect, common to all modern telegraph systems, remains, namely, the ease with which the receiving station can be incapacitated, an unbroken succession of impulses in the neighborhood of the receiving apparatus being quite sufficient for this purpose. Another difficulty is that the "dispersers" must revolve synchronously with one another; the greater the number of stations, the greater is this difficulty. Finally the speed of transmission appears to be low.—Lond. *Elec.*, January 2.

New Book.

The Town Trouble. By Adolph F. Hamacek. Sturgeon Bay, Wis.: Adolph F. Hamacek. Price, $1.00.

A lucubration on wattmeters by a Western author noticed in these columns some months ago appeared to the reviewer to have touched the depth of worthlessness, but the present publication—it cannot be dignified with the name of book—reaches still a lower level. Its only claim to notice aside from its most absolute worthlessness, is as a gem of the "English as She is Wrote" class of literature. As a specimen of book making, the thing is also a curiosity. The binding is apparently home-made, and the letter press is only on one side of a sheet, probably to eke out the slim text, which occupies less than 20 miniature pages, and would scarcely fill three columns of this journal. And what a text! As usual with this type, there is a portrait frontispiece of the author and some opening pages of "fine writing" of which the following is a specimen: "It heeds not the effect or result whether it raptures the heart with joy or whether it rends it with grief, no matter by whom it is sent; by pirate or king."

Subtracting the verbosities of the practical man who turns author, the equivalent of about a half column of the matter appears to be devoted to meter wiring, but what it is all about would baffle a Bacon-Shakespeare expert turned electrician. Aside from the ludicrous nature of the contents, to offer such a piece of book-making at a price of one dollar is nothing less than an attempt to obtain money under false pretences.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23rd, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Bituminized Fibre Conduit.

The American Conduit Company was recently formed to take over the business formerly conducted by the Electrolysis Proof Conduit Company of Chicago and the Asphalt Paper Pipe Company, of Los Angeles. Both of these companies have done an extensive business in their respective territories in the past in bituminized fibre conduits for underground electrical work. In addition to the Chicago and Los Angeles factories, a large plant for the manufacture of these conduits is just being completed at Chester, Pa., and a Philadelphia office will be opened.

This conduit is made by rolling paper which has been passed through hot asphalt, on to a mandrel, making a pipe which is a combination of paper fibre and asphalt, and which is absolutely waterproof and a remarkably good insulator. The pipe is made in seven-foot lengths and joined together with a machine-fitted, countersunk slip joint dipped in hot asphalt just before joining. This makes a conduit practically water-tight from end to end. This conduit has been used with great success around Los Angeles, not only for conduit duct but for conducting irrigating water, as it will stand low water pressures continually and very high pressures for a short time. The conduit itself is a very good insulator and will puncture only at extremely high voltages.

It has been the standard in underground construction of the Pacific States Telephone & Telegraph Company for its conduit in all the large cities of the Pacific Coast, and has now been adopted by the Chicago Telephone Company. Tests made several years ago in Oakland, Cal., under identical conditions on terra cotta conduit and bitumenized fibre showed a large amount of electrolysis on the cable sheath in the terra cotta duct and practically none in the bituminized fibre. The lightness of the duct in addition to saving transportation charges makes it cheaper to lay because of the rapidity with which one man can handle long lengths. Another practical advantage with this conduit is the accuracy of the alignment at the joints and the smoothness of the surface presented for the drawing in of a cable. Although the conduit is very tough, it has no sharp fins or edges and there is nothing in its composition that is hard enough to injure the lead when the cable is being drawn in. Although somewhat higher in first cost at the factory than vitrified tile conduit, the weight per lineal foot of duct is so much less that for shipments to any distance bituminized paper is cheaper because of the saving in freight. This form of conduit originated in Los Angeles, and the patents owned by the Asphalt Paper Pipe Company of that city were recently decided valid in a suit in which the two companies forming the present consolidation were opposed. The president of the new company is John S. Cravens, of Los Angeles, president of the Southwestern National Bank. The vice president is George H. Barker, of Pasadena, Cal., formerly president of the Edison Electric Company, of Los Angeles. The Chicago office and factory will remain under the charge of W. T. McCarthy, who has been the president and manager of the Electrolysis Proof Conduit Company at Chicago for several years. A. W. Buchanan, secretary, is the mechanical engineer and manager of the new factory at Chester, Pa. George H. Barker, vice-president, is now in the East arranging for the opening of the main Philadelphia offices in connection with the Chester (Pa.) factory, and being a man accustomed to the management of large affairs through his previous experience, will give his attention for the present to the organization of the company's business on a large scale. The general sales agent will be W. J. Barrett, who has represented Roeblings and formerly the Westinghouse Company in Los Angeles, and is one of the well-known men of the Pacific Coast. Mr. Barrett will have charge of the sales over the entire country. The company is thus making a vigorous entrance into the conduit duct manufacturing field.

The Annual New York Automobile Show.

The annual automobile show given at Madison Square Garden under the Automobile Club of America and the National Association of Automobile Manufacturers began on Saturday, January 17th, with great eclat. This is the third regular show of the kind and its success and popularity are evidenced by the crowd of exhibits as well as the number of visitors and their great desirability to inspect everything new and meritorious on view. On the opening night some seven or eight thousand persons were present, making circulation difficult, and the attendance through the present week has been of the most flattering character. The difficulty of providing for all the exhibits has been considerable in spite of the fact that not only is the large auditorium fully occupied as well as the complete upper box circle, but that exhibits have overflowed into and filled up both the ordinary restaurant and the basement. The main hall, handsomely decorated and brilliantly lighted by electricity, supplemented by numerous electrical signs, has been a dazzling spectacle, and the reports are that the visitors present representing Society have been very liberal in their purchases of the more expensive machines. At the same time much interest has been evinced in the various industrial types, and the manufacturers who have devoted their attention to these have felt very much encouraged at the outcome of their work in the patronage extended to them. We illustrate herewith the leading groups of electrical vehicles shown, there being all told some eight exhibitors of vehicles of the electrical class.

Some disappointment has been expressed in electrical circles that electrics are so few, but it should be pointed out that the makers of them are about as numerous as those of steam, and that the great predominance is enjoyed by gasolene, which at the present moment is undoubtedly the chief source of motive power, particularly for heavy vehicles of the touring class. In this connection, it is worthy of note that leading electrical engineers like Messrs. A. L. Riker, H. Ward Leonard and E. T. Birdsall in turning their attention to automobilism have concentrated their energies of late on gasolene types of vehicles, deliberately neglecting steam, for which they see no hopful future. It may be also noted in passing that combination vehicles wherein a gasolene engine is used to drive a generator for charging batteries and in which the generator becomes the motor to be driven by the batteries is seen to be a development of considerable interest and importance; and the work of Mr. Knight Neftel, another electrical engineer now working in this field, has been studied during the week very closely and carefully by automobilists of all kinds.

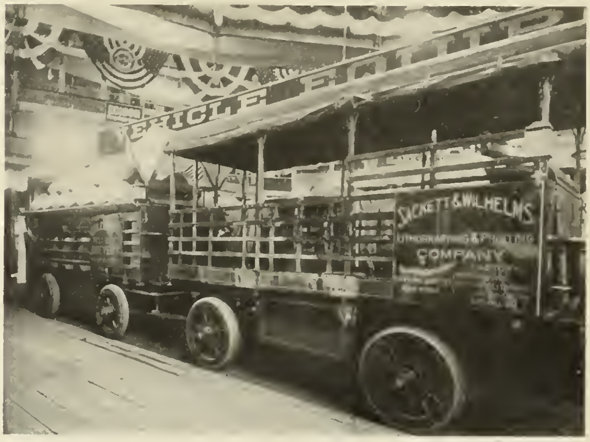


FIG. 1.—VEHICLE EQUIPMENT CO.'S EXHIBIT.

The week has been a busy one outside of the show, which constitutes one reason why automobilists from all parts of the country gather together in New York at this season The National Association of Automobile Manufacturers has met for trade purposes and the American Automobile Association, representing the various clubs of the country, has also convened at he headquarters of the Automobile Club of America, the officers elected being as follows: President, Dr. Julian Chase, Rhode Island; first vice-president, Honore Palmer, Chicago; second vice-president, F. F. Schryon Reese, Cleveland; third vice-president, Charles B. Judd, Grand Rapids; treasurer, Harlan W. Whipple, Automobile Club of America; Frank G. Webb, Long Island; Dr. Milbank, Albany; William J. Stewart, New Jersey; F. C. Lewin, Philadelphia; M. C. Fleischman, Cincinnati; A. R. Pardington, Long Island. On Friday evening the National Association of Automobile Manufacturers held its annual banquet at the Waldorf, and on Saturday evening the Automobile Club of America followed at the same place with its annual banquet, attended by a large number of men of the first distinction in public life.

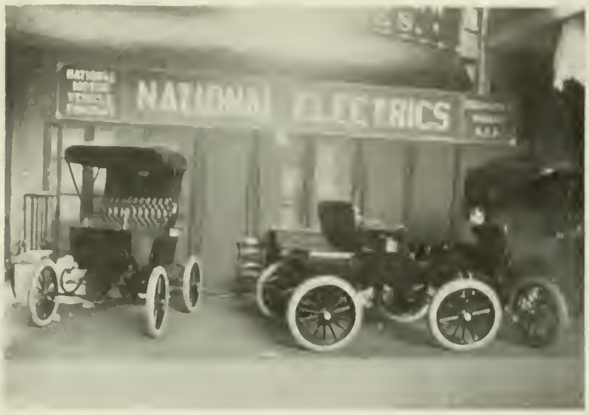


FIG. 2.—NATIONAL ELECTRIC VEHICLES.

STUDEBAKER ELECTRIC VEHICLES.—It is a matter of no small significance that a well-known carriage building concern like the Studebaker Bros., of South Bend, Ind., should concentrate their energies on the electric type of vehicle, and of these they have several examples in their large space at the show, as illustrated in one of the accompanying cuts. In these the motor used is a standard Westinghouse vehicle motor, suspended above a spring from the running gear, on which the body rests. It is so arranged as to be swung backward and forward and fastened in position, thus securing perfect chain adjustment. The transmission is by roller chain from countershaft built into the motor heads to a balance gear on the rear axle. The pull of the chain is taken by distance rods attached to the steel bars on the running gear frame and the main rear axle bearings. Twenty-four cells of standard and economical storage battery are used, so arranged as not to be directly over the motor. The controller is at the end of the seat and has four speeds, equally divided, the highest being thirteen miles per hour on good level road. The motor reverses by pressing a heel lever. There is also a cut-out emergency switch operated by the foot and fitted with removable handle so that it cannot be operated when the handle is removed. The steering is affected by a side lever knuckle jointed, and there is a band brake on the rear axle. The gears are well made and the gear frame is built of high-grade tubular steel. The indicating meter reads directly the amount of energy in the battery instead of the ordinary volts and amperes. There is a charging receptacle plug and two electric side lamps are furnished.

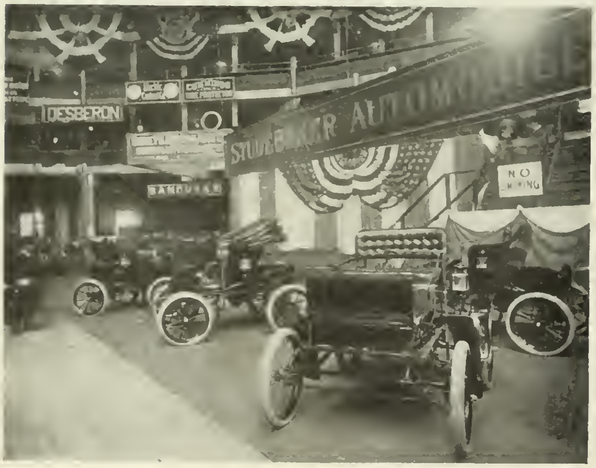


FIG. 3.—STUDEBAKER EXHIBIT.

THE ELECTRIC VEHICLE COMPANY, of Hartford, has quite a large display of its various types of automobiles, including its new hansom and new draying truck. The hansom has a more roomy top and larger windows. There is an incandescent lamp in the dome fixture. The running and operating parts are similar to those of the broughams made by this company. The motors give a speed of fourteen miles and the batteries a radius of forty miles on one charge. A special feature of the vehicle is the wheel steering arrangement, which is entirely new in hansom construction. The truck has a chassis, which will accommodate any kind of a platform or body, and is furnished in two sizes having load capacities of 10,000 pounds and 5,000 pounds, respectively, as well as a smaller size for delivery wagons and other vehicles for business and institutional uses. The running gear is of the reachless type with three-point body suspension. The truck exhibited is of two and one-half tons capacity. The two motors are each of 5 hp. A special feature is the vertical controller operated by a small wheel beneath the steering wheel. There are two foot brakes, the regular brake being of the band type acting on the outside of the drum, and the emergency brake of the internal expansion pattern. There is also an electric brake in the controller. In addition to these safety appliances, there is a heel kickout emergency switch by which the current can be cut off instantly. The underslung batteries are put in from below, being held by an ingenious automatic device which reduces the trouble of changing batteries to the minimum. The forward speeds are 2, 4, 6 and 7½ miles per hour, respectively, and there are three reverse speeds.

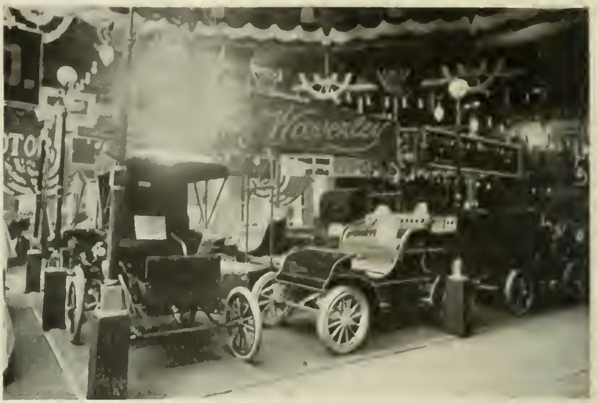


FIG. 4.—WAVERLEY EXHIBIT.

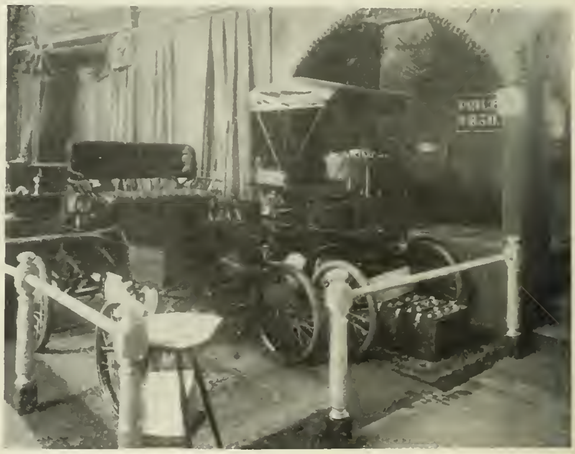


FIG. 5.—AJAX VEHICLES.

Ward Leonard Electric Company has a splendid exhibit in the gasoline high-powered automobile designed and built by its president, Mr. H. Ward Leonard.

Vehicle Equipment Company and the Rainer Company have an excellent display of their well-known electric vehicles, particularly those of the industrial type. One example is a brewer's dray loaded with barrels. The exhibit also includes Mr. Knight Neftel's combination gasoline and electric automobile for self-charging—a very likely looking "proposition," in regard to which Mr. Neftel has to answer innumerable questions. Several have been ordered.

Baker Electric Vehicle Company, of Cleveland, Ohio, had a very interesting exhibit of their well-known electric vehicles, in which the low-voltage type of motor and small battery equipment has been very thoroughly developed. The earlier Baker machines were of low price, and these are still made, but as shown at the Garden the concern has been tempted by orders received to launch out into the production of more luxurious carriages. These embody, however, the familiar Baker principles of design. The particular types brought to attention are the physician's chapelete, the imperial and the Stanhope.

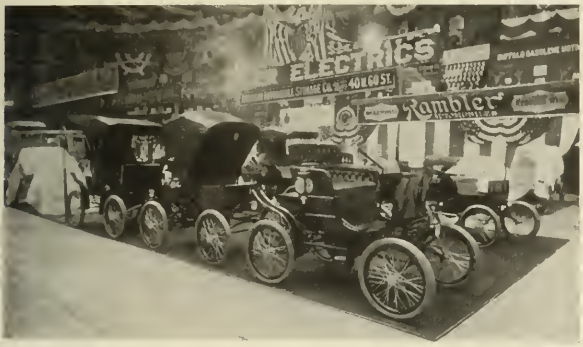


FIG. 6.—BAKER ELECTRIC VEHICLE CO.'S EXHIBIT.

Other types of electric vehicles shown include those of the National and Waverley Companies, more or less familiar to our readers, and those of the Ajax Motor Vehicle Company, a new and very handy type, equipped with Gould storage batteries.

The Westinghouse Electric & Manufacturing Company have a neat exhibit in the restaurant of their popular automobile motor and motor vehicle charging stations, etc., already described in these columns. Messrs. Haydn Eames, of the automobile department, and W. M. Probasco, of the publication department, have been in charge.

Gould Storage Battery Company has a neat exhibit in the main hall of its various types of batteries and plates intended for automobile work and with which excellent results are steadily reported.

The Electric Storage Battery Company exhibited in the restaurant their well-known batteries and plates, laying particular emphasis on the Exide type, which of late has been so generally introduced for automobile work, and the results with which in New York hansoms, etc., of the Vehicle Transportation Company, have been very fully recorded in these pages.

The Edison Storage Battery Company had a small exhibit at first in the east gallery boxes, but the crush around it became so insufferable it has been brought down to the main floor. There are shown details of the battery and a most interesting complete set of 38 cells fixed up as a regular automobile-operating set. There are also some interesting diagrams, curves, etc., bearing upon the subject. Messrs. Mallory, Hill and Bee have been in charge of the set, while Mr. Edison himself has been a keen observer of novelties at the show.

Sign lighting at the show is in notable profusion, and much of it has been done by the Elblight Company of America, under the personal supervision of Mr. Russell Spaulding, its president. In the space of the famous chauffeur, Mr. Henri Fournier, they have furnished a board 16 ft. long and 3 ft. high, on which appears the name Henri Fournier. Below a large photograph, 4 x 8, represents Fournier seated in his racing car. This picture is framed with Elblight cable, into which are stuck lamps representing the national colors—red, white and blue. On either side and over the top of the exhibit are hung numerous festoons of Elblight cable, into which white and green lamps are stuck alternately. Total number of lights used, 1,000. In the basement exhibit of the Central Automobile Company, the entire booth is circumscribed with festoons of Elblight cable, containing red, white and blue lamps in alternation. The cable is draped with hothouse smilax. Several large Elblight signs announce to the public the business of the firm, and a 4-ft. x 4-ft. Elblight board contains a very handsome monogram, surrounded by an Art-Nouveau design. In the exhibit of American Georges Richard Company, Barry & Hayes, agents, a large Elblight sign gives the name and address of this firm. Above it a shield representing the Arms of the French Republic, surrounded with Elblights, and Elblight board with a handsome four-leaf clover in green and white lights. The exhibits of the Baker Electric Company, United States Long-Distance Automobile Company, National Electric Company and Fire-Stone Company all have handsome Elblight signs.

C. F. Splitdorf, 17 Vandewater Street, New York, has an excellent exhibit of spark coils.

Electric Contract Company, 51-53 Maiden Lane, New York, shows dry batteries and is represented by Mr. Skinner.

National Carbon Company, Cleveland, Ohio, makes an interesting and attractive display of dry batteries for automobile work.

L. H. Pignolet, 78 Cortlandt Street, New York, shows a line of voltmeters and ammeters of his well-known handy design.

Standard Welding Company displays its electric welded products.

Dayton Electrical Manufacturing Company, Dayton, Ohio, exhibits the Apple igniter in full operation, drawing a crowd all the time.

American Roller Bearing Company, Boston, Mass., shows its various appliances for easy traction.

Jos. Dixon Crucible Company makes an excellent display of its graphite specialties, as famous in the automobile field as in any other.

Veeder Manufacturing Company, Hartford, Conn., exhibits odometers and tachometers.

Hyatt Roller Bearing Company, Harrison, N. J., exhibits its roller bearings for automobile use and shop equipment.

Rushmore Dynamo Works, Jersey City.—Mr. S. W. Rushmore exhibits searchlights of the well-known Rushmore type.

Locke High-Potential Insulators.

In no way is the progress of high voltage more interestingly illustrated than in the evolution of line insulators. At first it was attempted to meet the new requirements by merely increasing the size of the ordinary insulator, but experience soon demonstrated the futility of such a course. At present the design of high-voltage line material is an art by itself, and each new requirement brings forth designs specifically suited for all of the conditions.

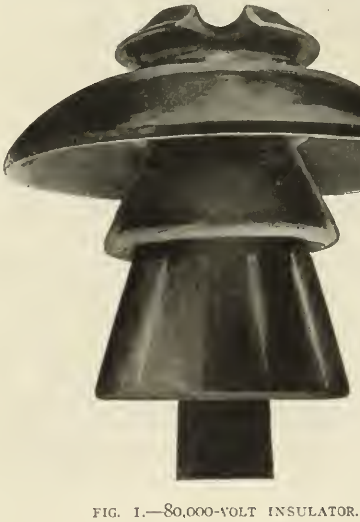


FIG. 1.—80,000-VOLT INSULATOR.

Among the latest types of such insulators we illustrate two manufactured by the Locke Insulator Manufacturing Company, of Victor, N. Y., made for the 105-mile transmission line of the Mexican Guanajuato Power and Electric Company, and the line of the

Spokane (Wash.) transmission plant. In the former case the voltage is 60,000, a 19-strand copper cable equivalent to a No. 1 solid wire being employed.

The insulator of Fig. 1 is tested for 125,000 volts and is sufficient for a working pressure of 80,000 volts. It is 14 inches in diameter, 13 inches high and weighs 15 pounds. The insulator of Fig. 2 is a cheaper form of all-glass, but will withstand a test of 120,000 volts. Its diameter and height are 11 inches, the weight being 12 pounds.

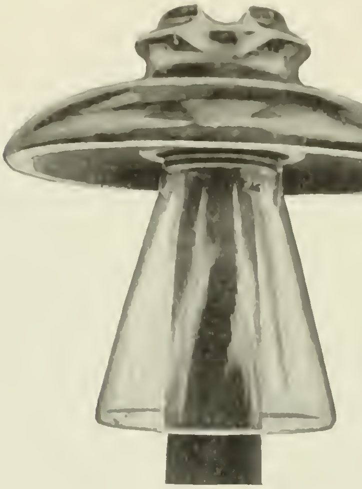
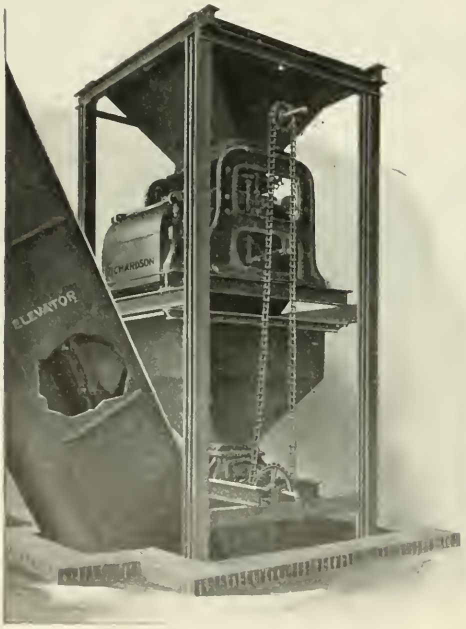


FIG. 2.—GLASS INSULATOR.

◆

Richardson Automatic Scales.

In the accompanying illustration is shown a view of an automatic scale in a large power station in Bristol, England, where it is used to check the coal as it enters the plant. These scales are also used to weigh and register the coal as it goes into automatic stokers.



AUTOMATIC SCALES.

The material to be weighed is supplied from a hopper or bin above the scale, and is admitted into the weigh-hopper by means of a swinging cut off, which, at the beginning of the operation, is open. When the charge is nearly completed, the cut-off, actuated by the increased weight of the weigh-hopper, partially closes and reduces the stream of material. When an exact balance is reached the cut off completely closes, stopping the flow, and in doing so throws up a lever which sets in motion the mechanism which opens the bottom of the hopper. As soon as the charge has been dumped, the hopper is again closed and locked. In the operation of closing the bottom of the hopper the dumping mechanism strikes the lever, throwing it down, and thereby causing the cut off to open and allow a new charge to flow into the weigh hopper. The movement is a very simple one, the only power required being the momentum of the falling material.

It is claimed that there is an accurate balance of every weighing. The drip or column of material which is in the air at the moment the feed is automatically cut off is compensated for by a novel contrivance which works automatically, and without the manipulation of any of the working parts. The hopper delivers its discharge without any rocking or vibration on the delicate knife edges.

These scales, which are manufactured by the Richardson Scale Company, 19 Park Row, New York, are adapted to the weighing of many different materials and are made in various sizes, with hopper capacities running from a few ounces to six tons.

◆

Incandescent and Arc Lamp Fittings.

A type of incandescent lamp cord adjuster is shown in Fig. 1, which is at once both simple and neat, and takes care of the surplus cord in a satisfactory manner. The illustration shows very clearly the method employed in using these spools. The spools are in two sizes, one taking up five feet of cord, while another, suitable for factory conditions, will accommodate 12 feet. They are finished in black enamel.

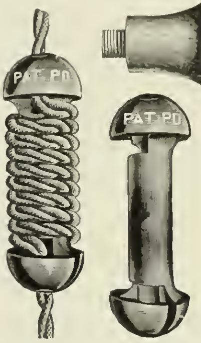


FIG. 1.—CORD ADJUSTER.

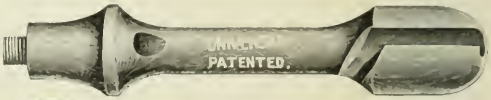


FIG. 2.—SOCKET HANDLE.

Fig. 2 shows an adjustable socket handle. It is made in the regular style with a brass ⅛-in. nipple solidly embedded in one end for the socket, and has a slot cut in the other end, which acts as an adjuster. Between the two ends the handle is so shaped as to fit well in the hand, and will take up 15 feet of cord. The cord is wound around the handle to the desired length and slipped into the slotted end, where it is firmly held.

In Fig. 3 is shown a simple form of arc lamp hanger, known as the McDonald hanger-board. It is made of porcelain, 7 x 4 inches, and is provided with terminal binding posts for the leads and an insulated hook for suspension.

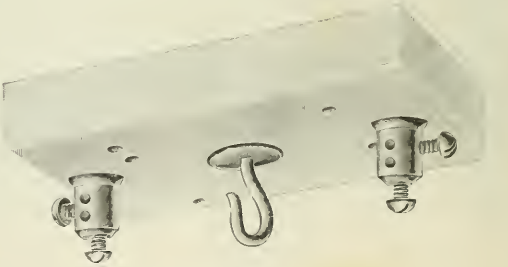


FIG. 3.—ARC LAMP HANGER.

All of these specialties are manufactured by the Crescent Electric Company, Chicago, Ill.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 5 a 5½ per cent. for all dates, it being more freely offered during the week. There was less activity in stocks, the market being dull at moderate concessions, with little public support. The declines were general and regular; Manhattan, however, was strong on investment buying. This stock advanced from 152¼ to 154¼, the lease of the road to the Interborough Company, it may be noted, having been ratified on Friday. The industrials, on the whole, were dull, but the United States Steel stocks, though losing ground to a slight extent, showed considerable firmness. Amalgamated Copper was heavy on the copper trade situation, declining from 65⅜ to 62¼. Among the tractions Brooklyn Rapid Transit closed at 68¼ (⅛ point above the lowest figure of the week), being a net loss of 1 point, on sales of 41,290 shares. Metropolitan Street Railway closed at 141½ on light trading, practically holding its own since our last report. Manhattan closed with a net gain of ⅞, the last quotation of the week being 153⅞. The electric list shared the weakness of the general market, General Electric losing ¾ point net, closing at 186½. The range of prices of this stock was 187, the highest, and 186, the lowest. Westinghouse common and preferred closed at 217 and 220, being net losses of 1 and 4 points respectively. Western Union's closing price was 91½, ½ point below our last previous quotation. American Telephone & Telegraph made a net gain of 5¼ points, closing at 165½, the highest figure of the week. In Boston this stock advanced ½ point, on a fairly active market. Following are the closing quotations at New York on January 20:

NEW YORK.

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
American Tel. & Cable......	85	85	General Electric.	185	185
American Tel. & Tel........	164	160	Hudson River Tel..........	..	..
American Dist. Tel	39	36	Metropolitan St. Ry........	141⅛	140½
Brooklyn Rapid Transit ..	68⅝	67¼	N. E. Elec. Veh. Trns........	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel...........	161	161⅛
Electric Boat	22	22	N. Y. E. V. T. Co....	11	10½
Electric Boat pfd..	37	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	3⅝	3	Western Union Tel...... ...	91¾	90¼
Electric Vehicle...	6⅞	8½	Westinghouse com....	212	210
Electric Vehicle pfd........	.	13½	Westinghouse pfd...........	212	210

BOSTON.

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
American Tel. & Tel...	164½	163¼	Western Tel. & Tel. pfd....	101	101
Cumberland Telephone....	..	..	Mexican Telephone.........	2⅛	2⅛
Edison Elec. Illum...	.	..	New England Telephone ..	138	137
General Electric........... .	..	.	Westinghouse	104	103
Western Tel. & Tel	..	26½	Westinghouse pfd....... ...	109	103

PHILADELPHIA.

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
American Railways.........	..	.	Phila. Traction..	98⅛	98¼
Elec. Storage Battery.. ...	79	80*	Phila. Electric	8⅛	8⅜
Elec. Storage Battery pfd..	..	..	Pa. Electric Vehicle..........	..	..
Elec. Co. of America.	9¾	9½	Pa. Electric Vehicle pfd....	..	..

CHICAGO.

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
Central Union Tel.	.	..	National Carbon pfd........	97	98
Chicago Edison............	..	..	Northwest Elev. com........	..	..
Chicago City Ry....	215	230	Union Traction	16½	16⅛
Chicago Tel. Co	..	..	Union Traction pfd.........	50	50
National Carbon	26	25			

*Asked.

INCREASE OF STANLEY ELECTRIC STOCK.—The directors of the Stanley Electric Manufacturing Company, at a meeting held on January 10, passed a resolution, providing that the capital stock of the company be increased from $3,000,000 to $10,000,000, and the stockholders will meet on February 11 to approve this action of the board. Plans for this great increase of facilities have been under way for some time, to the end of placing the company on a basis to compete favorably with the largest electrical manufacturers in the country. It will be remembered that the Stanley Company recently secured an order from the New York Edison Company aggregating over a half million dollars for dynamos and other electrical apparatus, some of which is to be the largest of its kind ever constructed. This indication of its invading the field of heavy work is now amply verified. Moreover, funds will be provided by this increase of capital for certain important developments which the engineers of the company have been planning for some time. Among these developments is a new system of operation for heavy long-distance electric railways employing electric locomotives, which will use the current directly without rotaries or transformers. The potential and phase to be employed has not yet been announced, but it is stated that the power stations will not have to be located nearer than 50 to 75 miles apart. The system is not that of the Ganz Company, but is due to the work done by the engineers of the Stanley Company on patents on which rights have been secured from engineers in this country and abroad. These patents involve the use of a new form of generator with a new type of motor, which permits the use of high voltages directly on the car and absorbs practically no energy in resistances on starting.

CHICAGO TELEPHONE.—The Chicago Telephone Company has just closed a surprising year's business in matter of gross increase. During December the company installed 1,500 Bell telephones for new subscribers and brought its total number of instruments now in use in the city to upward of 60,000. The gain made during the last two years, or since Mr. Sabin took hold of the company, is nearly 33,000 telephones. The company has made the largest increase in the nickel-in-the-slot machines, which are now located on a remunerative basis in many public places and private dwellings that would have formerly hesitated at paying full rates charged for the service. Attorneys for the company say they have no intimation of when the Appellate Court will render a decision in the maximum telephone rate case. While they are hopeful of winning the suit, they declare that if the ruling is against them an appeal will be taken to the State Supreme Court.

J. G. WHITE & CO.—This English concern reported a very satisfactory year at its third annual meeting. The profit and loss account showed, after including the sum of £3,649 16s 11d brought from last year, a total of £29,480 13s 3d to be dealt with, and this was allocated in payment of dividends, free of tax, at the rate of 8 per cent. per annum on the preference and ordinary shares to August 31, 1902, which will absorb the sum of £7,948 14s 9d, to place to the reserve fund the sum of £10,000, and to carry forward to the next year's account the sum of £11,469 18s 6d. English papers just to hand record the successful opening at Bournemouth of the conduit tramway system installed there for the corporation, with a side slot system, carried out under the direction of Mr. A. N. Connett, chief engineer of the company.

SUSQUEHANNA WATER POWER.—At Baltimore, Md., on January 15, upon the payment of $904,237 the United Railways handed over to the Continental Trust Company the entire common stock of the United Electric Light & Power Company, amounting in par value to $2,000,000. President Warfield of the trust company said the syndicate his company was representing was not ready to announce its plans. This deal is the initial step in the $10,000,000 project to develop electrically the water power of the Susquehanna River and transmit it to Baltimore, Wilmington, Del., and Philadelphia. The Continental Trust Company closed a contract several months ago for its clients to supply the United Railways with power for thirty years, reaching a maximum of 40,000 hp.

NEW STOCK FOR MANHATTAN.—A circular has been issued to Manhattan Elevated stockholders announcing that the company has duly voted to increase the capital stock from $48,000,000, consisting of 480,000 shares of the par value of $100 each, to $60,000,000, consisting of 600,000 shares of the par value of $100 each, and the issue of 72,000 shares of the new stock at the present time has been duly authorized. The opportunity is now offered to the stockholders of the company, of record at the closing of the transfer books on Tuesday, January 27, 1903, to subscribe for $7,200,000 of said increased capital stock at par, to an amount equal to 15 per cent. of their respective holdings. The new stock will be entitled to all dividends declared after its issue.

TELEPHONE STOCK LISTED.—An additional $21,937,000 of the capital stock of the American Telephone & Telegraph Company has been listed on the New York Stock Exchange, making total amount listed $104,740,400. In its application the company stated that it now holds over $120,000,000 of stocks and bonds of telephone companies, eight million and seventy-three thousand of the $9,980,000 stock of the Bell Company, of Philadelphia; $6,240,000 of the $11,993,000 of the Chicago Telephone Company; $19,329,000 of the $30,000,000 of the New York Telephone Company, and $21,440,000 of the $32,000,000 of the Western Telephone & Telegraph Company. It also owns $6,008,000 of the $10,000,000 capital stock of the Western Electric Company.

MACON (GA.) RAILWAY & LIGHT.—There has been filed in the office of the Secretary of State of Georgia a certified statement of the recent bond issue of the Macon Railway & Light Company, which aggregated $1,000,000. The bonds were issued as a deed of trust to the New York Investment & Trust Company.

THE EMPIRE CITY SUBWAY COMPANY (LTD.), of New York City, has increased its capital stock from $2,250,000 to $2,750,000 for the purpose of carrying on new construction work during the year.

CANADIAN MARCONI WIRELESS TELEGRAPHY.—The plans of the Canadian Marconi Company, recently organized, contemplate a vigorous campaign for the installation of the system throughout the Dominion. Mercantile and shipping interests on the Pacific coast are now negotiating with the company for the inauguration of the system upon trans-Pacific steamships and on steamers plying in the Alaskan trade. The dangerous coast of British Columbia and Alaska require some means to prevent accidents and to enable shipping interests to keep in touch with vessels plying in the coastwise trade. In order to secure the immediate application of the Marconi system, these interests have agreed to subscribe to a sufficient amount of stock or bonds to pay for the installation of the land stations. Vessels will also be equipped with instruments by the interests named, and the general adoption of the Marconi wireless system on the Pacific coast is said to be assured. The connection of the Canadian Yukon territory with British Columbia will be among the first important measures of the company. The officers are: Directors—Col. F. C. Henshaw, president; Guglielmo Marconi, vice-president; Andrew A. Allan, of the Allan Line steamships; Rodolphe Forget, Beaumont Shepard, secretary; Willard Reed Green, New York, John D. Oppe, representing Marconi's Wireless Telegraph Company, Limited, of England (the parent company) and managing director of the Canadian company. Representatives of important holdings of shares in Toronto and the far west will be added to the board, it being the intention to have all the important and widely scattered interests concerned represented on the board. The capital (1,000,000 shares) has all been subscribed. The par value of the shares is $5 each in order to correspond nearly with the £1 shares of the English parent company, which £1 shares have been for some time past selling at over £3. The English company has received $3,000,000 in stock for its property rights and patents.

NEW COMMERCIAL CABLE STOCK.—The capital stock of the Commercial Cable Company will be increased to the full amount authorized, $15,000,000, with rights to shareholders to subscribe to 12½ per cent. of their holdings. The amount of capital outstanding now is $13,333,000. It is understood that the stock will be offered to shareholders at par, which will make the rights valuable, as the price of the shares is now ranging near 175. The company pays 7 per cent. regular dividends, and 1 per cent. extra yearly. Last year less than 2,500 shares of the stock were traded in on the local exchange, in the month of December only twenty shares changing hands, at 160, on December 30. The next day 175 was the asked price and 168 bid. Since then a few hundred shares have been traded in here and in Montreal, near 171, and this week a sale was made in Montreal at 174, with bids at 174 and the asked price at 180, at one time. The new capital will be used, it was believed, to pay for the new Pacific cables of the company. The Mackay-Bennett interests in this company are generally recognized as having been kept intact since the death of John W. Mackay.

BOSTON & WORCESTER.—The trustees of the Boston & Worcester Electric Companies held a meeting last week for organization and elected James F. Shaw president and George A. Butman secretary and treasurer. The Boston & Worcester Electric Companies is a voluntary organization formed after the manner of the Massachusetts Electric Companies and the Boston Suburban Companies, with 38,775 shares of stock outstanding, par $100, of which 18,786 shares are a 4 per cent. preferred stock issue and 19,989 shares are common stock. The company owns the Boston & Worcester Street Railway Company, Framingham Union Street Railway Company and Framingham, Southboro & Middleboro Street Railway Company. The companies have been financed. It is now completing the construction of its system between Boston and Worcester, and by April 15 it is expected it will have cars running between Boston and Framingham and to have cars running through to Worcester by July 1. The securities will be listed upon the Boston stock exchange.

PUGET SOUND TRACTION.—The Puget Sound Electric Railway Company has filed in the Hudson County Clerk's office at Jersey City an amended certificate of incorporation, fixing the capital stock at $4,500,000, of which $1,000,000 consists of 6 per cent. non-cumulative preferred shares. The company operates electric railways and light and power plants in the vicinity of Puget Sound. The incorporators are Preston Player, Nathan H. Daniels, Jr., Howard L. Rogers, Henry Reed Hayes, George C. England, Waldo E. Forbes, Alvah K. Todd, Gardner Rogers, and Louis B. Dailey.

DIVIDENDS.—The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 15. Th. .e Hudson River telephone directors declared the regular quarterly dividend of 1½ per cent., payable February 2. The Allis-Chalmers Company, at its directors' meeting, held January 15, declared the regular quarterly dividend on the preferred stock. The directors of Chicago Edison have declared the regular quarterly dividend of 2 per cent., payable February 2.

Commercial Intelligence.

THE WEEK IN TRADE.—Most satisfactory reports as to trade conditions continue to come in, and the "wave of prosperity" shows no other signs than those of increase and plenty. In commenting on the situation, *Bradstreet's* says: "With the much needed expansion in export trade now actively in evidence, one of the few important missing elements of national prosperity has been supplied." Export trade in December proved to be better than anticipated, and so far in January only encouraging elements have developed. The domestic situation also gains rather than loses in strength. Spring trade although hardly opened, is active and steadily increasing, and confidence in a heavy business is expressed. Money is easier, failures are better than usual at this season of the year and railway earnings continue equal to the best for this season. All of the industries are exceptionally active, the possible exception to this being where there are shortages of fuel. The iron and steel trade still holds its strength. The 1902 pig iron production is stated to be not far from 17,750,000 tons, and it is estimated that the current output is the largest in the country's history. The steel rail mills of the country, it is stated, will not accept any more orders at the present time. Structural material, bars and plates are in active demand. Copper has held nearly all of the recent advance despite bearish statistical features. The last quotations were 12.25c. for Lake; 12.12½c. for electrolytic, 12c. for casting stock, and 11.50c. for Standard. According to *Bradstreet's*, the number of business failures during the week ending January 15 numbered 234, as against 336 the week previous and 201 in the corresponding week last year.

BIG EQUIPMENT FOR CANADA.—Several important contracts are about to be let in the United States for the equipment of large locomotive works which are to be built in Montreal. All the machine tools will be electrically operated. Electric traveling cranes will also be installed in the plant, which is to be erected on some 80 acres of land adjoining the St. Lawrence River. The initial equipment to be purchased in the United States will represent an expenditure of more than $300,000. Eventually the concern—the Locomotive & Machine Company, of Montreal—whose offices are in the Street Railway Chambers, Montreal, which will operate the works, propose to construct a ship and bridge building plant. The initial works will consist of machine shop, erecting shop, boiler shop and foundry, to be equipped with the most modern appliances and labor-saving devices. The yearly output will be 200 locomotives. It is intended to reach out for foreign trade. Canadian capital will be employed exclusively in the enterprise. M. H. Haney, of Toronto, who built the major portion of the Canadian Pacific Railroad in the Northwest, and M. Davis, of Montreal, who is also a railroad contractor, are primarily interested in the project. M. Brophy, another Canadian railroad contractor, is to be the general manager of the company. An American will be the superintendent of the new plant, the services of D. R. Shea, formerly of the Schenectady Locomotive Works, Schenectady, N. Y., having been secured. The locomotive plant is expected to be completed by August.

HYDRAULIC PLANT FOR SYDNEY TRAMWAYS.—Private advices from Australia state that the New South Wales Government Railroad and Tramway Commissioners are considering the advisability of developing the additional power required to operate the balance of the Sydney City & Suburban Tramway system, now under construction, by means of water power. The press reports that O. W. Brain, the electrical engineer of the New South Wales government, during his recent visit to the United States, had placed a contract with the Westinghouse interests for the additional power house equipment required, were entirely premature. Mr. Brain was not empowered to arrive at any decision in the matter, as he was only instructed to gather data for submission to the commissioners. In this connection it may be said that in the majority of instances foreign engineers, particularly if they represent government or municipal interests, who visit this side, are not in a position to close contracts, but are sent here to secure estimates and inspect plants, etc.

ALBERGER COOLING TOWER CONTRACTS.—The Alberger Condenser Company, White Building, Liberty Street, has lately taken a contract for a large cooling tower for the Nassau Light & Power Company, of Rosslyn, L. I. Contracts have also been secured for towers for the Pittsburg Reduction Company, at East St. Louis, Ill., and for the Laurel Lake Mills, Fall River, Mass. The latter contract calls for the erection of an especially large tower 20 feet in diameter and 80 feet high. Two large Alberger fan-draft cooling towers have been ordered by the Pacific Light & Power Company, of Los Angeles, Cal.

COPPER FOR GENERAL ELECTRIC.—It is stated that the General Electric Company has just purchased a six-months' supply of copper at the full market rates, about 13,000,000 pounds.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended January 17: Antwerp—8 pkgs. machinery, $6; 95 pkgs. material, $4,544. Argentine Republic—29 pkgs. material, $2,121; 4 pkgs. machinery, $219. Berlin—1 pkg. material, $62. Brussels—3 pkgs. material, $135. British Possessions in Africa—54 pkgs. machinery, $4,784; 6 pkgs. material, $320. Brazil—150 pkgs. material, $6,952; 6 pkgs. machinery, $993. British Australia—18 pkgs. machinery, $970; 33 pkgs. material, $786. British East Indies—14 pkgs. machinery, $949; 11 pkgs. material, $765. British West Indies—18 pkgs. material, $388; 69 pkgs. railway parts, $1,845. Cuba—77 pkgs. material, $1,775. Chili—382 pkgs. material, $3,239. Central America—9 pkgs. material, $235; 22 pkgs. machinery, $4,800. China—7 pkgs. material, $83. Dutch West Indies—2 pkgs. material, $16. Frankfort—6 pkgs. machinery, $1,500. Glasgow—5 pkgs. machinery, $725. Genoa—9 pkgs. material, $430. Hong Kong—46 pkgs. material, $1,770; 58 pkgs. machinery, $2,690. Hayti—1 pkg. material, $21. Hamburg—14 pkgs. machinery, $942; 67 pkgs. material, $1,631. Havre—12 pkgs. material, $520; 17 pkgs. machinery, $1,415. Japan—185 pkgs. machinery, $56,433; 2 pkgs. material, $117. Leeds—1 pkg. machinery, $115. Liverpool—219 pkgs. machinery, $19,812; 50 pkgs. material, $3,831. London—280 pkgs. machinery, $18,664; 382 pkgs. material, $15,932. Manchester—1 pkg. machinery, $50. Mexico—19 pkgs. material, $489; 1 pkg. machinery, $225. Milan—1 pkg. machinery, $9. New Zealand—1 pkg. machinery, $60; 196 pkgs. material, $6,218. New Castle—7 pkgs. machinery, $600. Peru—31 pkgs. material, $1,480. Philippine Islands—946 pkgs. material, $8,415. Siam—1 pkg. machinery, $350. Southampton—30 pkgs. material, $806. Venezuela—2,072 pkgs. material, $8,809. Warsaw—2 pkgs. machinery, $50.

THE INTERNATIONAL SMOKELESS POWDER AND DYNAMITE COMPANY recently made some additions to its plant, and has purchased from the Westinghouse Electric & Manufacturing Company a 180-kw, 2-phase alternator with switchboard and a number of induction motors ranging in size from 7½ hp to 50 hp. The motors will be used to drive apparatus used in the making of smokeless powder, for which purpose the induction motor is especially well suited on account of the absence of commutator, slip rings, or other moving contacts. The first Westinghouse apparatus was sold to this company two or three years ago and consisted of a 60-kw alternator with several motors. Additions were made from time to time in the different buildings and it was soon found that a larger generator would have to be installed. A 120-kw generator was then bought, which has operated successfully up to the present time, when it is found that both machines are very heavily overloaded. The powder company has, therefore, put in the 180-kw alternator mentioned above. The company states that the entire equipment has given perfect satisfaction and that there has not been a time when the machinery has been shut down for a minute.

DECORATIVE LIGHTING CONTRACTS.—Among recent decorations installed with the Norbitt temporary decorative socket, was that of E. S. Brown Company, of Fall River, Mass., the largest department store in New England. The decoration consisted of 2,700 4-cp lamps, and about 1,000 8-cp lamps. The entire equipment was installed in less than forty-eight hours, and most of it by unskilled labor, as the firm did the entire equipment themselves, under the supervision of one of the members of the firm. This shows the simplicity of the device for unskilled labor especially. Another large installation was that installed by a large Baltimore contractor, for the wedding of the daughter of Dr. Emerson, of Bromo-Seltzer fame. This decoration consisted of about 1,500 Norbitt temporary decorative sockets. Among other installations were that of the Delaware Club, December 9th, at Terrace Garden, New York, 2,100 lights, and the Bachelor Circle of the German Liederkranz Society, at their club house in Fifty-eighth Street, January 8th. The demand for these sockets has been so great that the company are working night and day filling orders.

WESTINGHOUSE IN ENGLAND.—A cable dispatch from London of January 9 says: "The Westinghouse Electric Company is making an effort to increase the interest of English railroads in electric traction. The company expects to secure large contracts, especially from the Great Northern and Great Eastern and the two southern lines. For some time the Great Northern has been conducting experiments at the Westinghouse works at Manchester and the Great Eastern has been testing the electric system in a similar manner near London. The chairman and managers of the principal English railways dined in London to-night as the guests of George Westinghouse. The occasion was taken advantage of to exhibit the new Hewitt mercury vapor light and to introduce the general question of electrical developments for railroads. Lords Kelvin, Rayleigh, Allerton and Claude Hamilton and many leading railroad men and scientists inspected the Hewitt light this evening at the Westinghouse offices." The new Hewitt static converter, fully described in these pages last week, was also shown.

FOREIGN TRADE FOR 1902.—Merchandise exports in December, 1902, ran up to the fine figure of $148,000,000, a sum but once exceeded. Total exports for 1902 footed up $1,360,696,355, averaging $108,891,363 a month, a figure which December exports exceeded by $39,115,460. The year's export total is below the figures made in 1901 and 1900, owing to the short crops, showing a decrease from 1901 of $94,679,505, or 6.5 per cent., and from 1900 of $117,249,758, or 7.9 per cent. It exceeds 1899 and 1898, however, by 6.7 per cent. and 8.4 per cent. respectively. The balance of trade in favor of the United States has since 1900 been almost cut in two. For 1902 the excess of exports is $391,426,346, a drop from 1901 of 33.1 per cent., and from 1900 of 39.6 per cent. A comparison of totals for six years past is as follows:

Year.	Exports.	Imports.	Excess exp.
1902	$1,360,696,355	$969,270,009	$391,426,346
1901	1,465,375,860	880,419,910	584,955,950
1900	1,477,946,113	829,149,714	648,796,399
1899	1,275,467,971	798,967,410	476,500,561
1898	1,255,546,266	634,964,448	620,581,818
1897	1,099,709,045	742,595,229	357,113,816

The excess of exports for December of $53,699,619 compares with $57,012,000 a year before and $77,192,000 two years before. During 1902 the balance of trade swung from $50,006,988 in January as low as $9,643,753 in July, then recovering to $55,692,290 in October, a figure not since touched.

EQUIPMENT FOR NEW INGERSOLL-SERGEANT PLANT.—The Ingersoll-Sergeant Drill Company, 26 Cortlandt Street, New York, has just placed some important contracts for equipment to be installed in its new plant at Phillipsburg, N. J., to be electrically operated. The contract for the boilers—1,500 hp—has been let to the Sterling Company, of Chicago. The engines, representing in all a capacity of 1,000 hp, will be built by the C. & G. Cooper Company, Havemeyer Building. The generators will be manufactured by the Crocker-Wheeler Company. The machine tools will be electrically operated in groups. The motors supplied will be Crocker-Wheeler motors.

EQUIPMENT FOR A SULTAN'S PALACE.—The Sultan of Linga's palace at Rheo, Malay Peninsula, is to be equipped with an up-to-date Yankee plant, which will be used for lighting and for operating fans, also of American manufacture. The order was taken by the Singapore office of Bagnall & Hilles. The dynamo—a 75-kw machine—will be furnished by the Sprague Electric Company. The engine is to be built by the Ames Iron Works, Oswego, N. Y. The fans will be of Lundell type. Electricity is also to be employed for the purpose of operating an ice-making and refrigerating plant.

WIRELESS TELEGRAPH PURCHASE FOR NAVY.—The officials of the De Forest Wireless Telegraph Company learn that their plant, which has been operated under the supervision of a naval board between Washington and Annapolis, proved so successful at official tests made that a complete set of apparatus has been purchased for use in the navy. The army, according to Mr. Firth, a director of the company, has already supplanted its cables between Sandy Hook and Fort Wadsworth with De Forest apparatus, which has been in active operation for about three weeks.

ELECTRICAL EQUIPMENT FOR SOUTH AFRICAN OFFICES.—The Mutual Life Assurance Company of New York, 32 Nassau Street, is to erect a $700,000 office building in Cape Town, South Africa, which will be equipped with electrical machinery, etc. The building, designed by Roos & Booraem, will be electrically lighted by a 140-hp plant, the contracts for the supply of which will be let by the Wells & Newton Company, engineers, Seventeenth Street and Avenue B, New York. The elevators will be built by the Otis Elevator Company.

ALLIS-CHALMERS SALES.—Among the numerous sales of large engines by the Allis-Chalmers Company in December we note the following: Hocking Valley Railway Company, Columbus, Ohio, 18 x 36 1890 frame Reynolds Corliss engine; George A. Fuller Company (for Bellevue-Stratford Hotel), Philadelphia, Pa., three 22 x 42 1890 frame Reynolds-Corliss engines; Transit Development Company, Brooklyn, N. Y., two 42 x 86 x 60 vertical cross compound Corliss engine, direct-connected.

BALL ENGINE ORDERS.—The Cleveland Worsted Company, Cleveland, Ohio, is installing a 175-hp tandem compound engine, direct-connected to a Westinghouse alternator. The Ball Engine Company, Erie, Pa., furnished the engine. The Pittsburg Spring & Steel Company, Pittsburg, Pa., is installing an electric light and power plant, consisting of two 160-hp engines direct-connected to Westinghouse generators. The Ball Engine Company built the engines for this installation.

FIRST LIGHTING CONDUIT FOR FAR EAST.—The introduction of interior conduit in connection with electric lighting in the Far East is about to take place. The material, which will be furnished by the Sprague Electric Company through Bagnall & Hilles, Yokohama, is intended to be installed in the new building of the Yokohama Specie Bank.

General News.

THE TELEPHONE.

HELENA, ARK.—The Southwestern Telephone Company will, it is said, install a new system in Helena on account of [illegible] in the present system. A new switchboard and [illegible] new telephones will be included among the improvements.

PASADENA, CAL.—Upon petition of the Home Telephone Company, the City Council has unanimously voted to advertise for sale a telephone franchise of fifty-five years' duration.

MACON, GA.—Work has been started on the Macon end of the new telephone line being constructed by the Southern Bell Telephone Company, from Macon to Savannah, by way of Millen.

GIBSON CITY, ILL.—The Dix Telephone Company has accepted the franchise granted by the City Council.

PONTIAC, ILL.—Ray Blasdel, representing local capitalists, has asked the city for a franchise to construct and operate a telephone line within the city.

ROCKFORD, ILL.—The directors of the Home Telephone Company decided to extend the Rockford line to Freeport, Beloit and Belvidere and to connect with the Inter State Independent Telephone Company's lines.

CHICAGO, ILL.—Fifty-seven persons and business firms were granted leave by Judge Tuley a few days ago to become co-complainants in the injunction suit brought by the Illinois Manufacturers' Association against the Chicago Telephone Company to restrain the latter from charging more than the franchise rate of $125 a year for its service.

HARDIN, ILL.—The directors of the Calhoun Telephone Company have elected new directors, as follows: S. A. White, C. H. Lamar, L. A. DeLong, McC. Johnson and S. J. Merida. A 9 per cent dividend was declared. The company is making efforts to complete a new line from Batchtown to Grafton. When completed a metallic circuit will be established to St. Louis via Grafton.

ELKHART, IND.—The Home Telephone Company has increased its capital stock from $100,000 to $160,000 to provide for improvements.

LAGRANGE, IND.—The Newbury Township Telephone Company has elected the following-named officers: President, J. C. Prough; vice-president, Frank Lupold; secretary, Geo. L. Mishler; treasurer, A. H. Miller.

MADISON, IND.—Application has been made for the granting of a franchise for a telephone toll line through the city of Madison and Jefferson County. It is intended to establish an exchange at Hanover.

EVANSVILLE, IND.—Sherman Davis used profane language over a telephone line in this city and he was arrested and fined by Judge Curry, who held that the statute prohibiting profane language in public places had been violated.

WINAMAC, IND.—The Winamac, Kewana and Knox Telephone plants have been sold to the Winchester syndicate, headed by J. L. Thompson, which will buy a good many of the Northern Indiana exchanges. All these properties will be improved and extended.

KOKOMO, IND.—The Citizens' Telephone Company, of Kokomo, on Jan. 9, certified to the Secretary of State that its capital stock had been increased from $25,000 to $100,000 for purposes of repairing and extending its lines. The increase was accomplished by issuing 1,500 additional shares of the stock of the company at the par value of $50 each. Stephen Tuder is president and Charles A. Jay, secretary.

INDIANAPOLIS, IND.—The Peoples' Co-operative Telephone Company, of Clarkshill, has incorporated with a capital stock of $500. There are 200 original shares of stock and were taken at $2.50 per share. The company proposes to establish, maintain and operate telephone lines in Tippecanoe, Clinton and Montgomery Counties, with an exchange at Clarkshill. Mr. N. J. Baily, president, says the capital stock will be increased.

MENTONE, IND.—The People's Mutual Telephone Company, of Silver Lake, has had a complete change in its management owing to the dissatisfaction of stockholders with the old management. At the annual meeting Carlin Myers, of Mentone, was elected president to take the place of Henry L. Oldfather. The old management refused to turn over the books to the new officers, and the difficulties may be carried to the court for settlement.

GAS CITY, IND.—It is charged that the Central Union Telephone Company is conducting a war on the sly against the United Company, a new concern. The United Company put exchanges in at Gas City and Joneston and many people have deserted the Central Union, although both companies are supposed to make the same rates. It is charged that the Central Union is giving free use of telephones to many people, but officers of the company deny it.

COTTONWOOD, IA.—The German-American Telephone Company is building a branch line to Houghton.

HAMBURG, IA.—The farmers east of town are putting up a telephone line to connect with Page County and Hamburg.

DES MOINES, IA.—The Farmers' Mutual Telephone Company will establish an exchange at Yarmouth to cost $7,000.

FOREST CITY, IA.—The Great Northern Telephone Company, of Forest City, has increased its capital from $25,000 to $75,000.

SALIX, IA.—At a special election a franchise was granted to J. H. Quick, of Sioux City, and R. H. Countermine, of this place, to operate a telephone exchange here.

FT. DODGE, IA.—The capital stock of the Fort Dodge Telephone Company has been increased from $50,000 to $100,000. Extensive improvements will be made to the company's plant in this place.

DETROIT, MICH.—Mayor Maybury has vetoed the telephone merger franchise and there is little chance of its passing.

JACKSON, MICH.—The Peoples' Telephone Company has increased its capital stock from $[illegible] to $[illegible]. The company has recently commenced operations with 1,200 subscribers.

JOPLIN, MO.—The telephone girls' strike, which resulted in 25 girls walking out of the office two weeks ago, resulted in a limited boycott last week. Committees of girls are inducing the subscribers to discontinue the service, and it is claimed that 500 telephones have been taken out.

FREEHOLD, N. J.—The Monmouth Toll Line Company, which was incorporated last fall, has issued a prospectus. The company intends at once to build lines to connect with the present independent Freehold telephone system, also with the Farmers' & Traders' Telephone Company, at Hightstown. From the last-named place it is proposed to connect direct with Trenton, or the State Telephone Company's lines, thus securing connection with Bound Brook, Newark, Jersey City, Trenton, Philadelphia and many small towns. The company also proposes to build connecting lines in various other directions. Mr. C. N. Fuller, of Freehold, N. J., is at the head of the enterprise.

NEW YORK, N. Y.—The Porto Rico Telephone Company has increased its capital stock from $100,000 to $400,000.

NEWTON, N. C.—The Newton Telephone Exchange has been sold to W. T. Love, of the Piedmont Telephone Company of Gastonia, N. C.

GRAND FORKS, N. D.—A telephone franchise has been granted by the City Council to Fred. G. Wells, who represents a Chicago firm.

OTTAWA, OHIO.—The council has granted a franchise to the Farmers' Home & County Telephone Company which will build an exchange.

TREMONT, OHIO.—The Rosewood Telephone Company will build a line to Tremont giving connection with Urbana and other neighboring towns.

OBERLIN, OHIO.—The Oberlin Telephone Company has elected officers as follows: F. P. Johnson, president; C. K. Whitney, treasurer, and A. S. Root, secretary.

CADMUS, OHIO.—I. H. Champer, of Patriot, has organized a company and will establish telephone communication between the two villages, with rural service throughout the district.

COLUMBUS, OHIO.—The Auglaize Telephone Company has increased its capital stock from $5,000 to $15,000. Improvements will be made. Harper Stiles is general manager of the company.

McCOMB, OHIO.—C. Cotterman, of Deshler, has been granted a franchise to establish an independent telephone exchange. The town already has one exchange which is owned by Miss Angie Fruckley, the only woman manager in Ohio.

NORTH LIMA, OHIO.—The Beaver Telephone Company has elected officers as follows: W. H. Ruhlman, president; R. B. Metzler, treasurer, and John Yoder, secretary. The company has recently commenced operations with 100 subscribers.

BELLEFONTAINE, OHIO.—At a recent meeting of managers, J. O. Angell, of the Belle Center exchange of the United Telephone Company, was awarded a prize for the greatest increase in the number of subscribers during the year. The increase was from 52 to 103.

CLEVELAND, OHIO.—It is announced that Henry A. Everett is figuring on buying from the Federal Telephone Company its interest in the Stark County Telephone Company, one of the most important of the Federal properties. The company has about 2,000 telephones, with exchanges at Canton, Alliance and other towns in Stark County. The company has $500,000 capital stock, over half of which is owned by the Federal Company.

WARREN, OHIO.—At the recent annual meeting of the Warren & Niles Telephone Company the following directors were elected: C. C. Clawson, Jules Voutrout, Jr., C. B. DeVoe, C. W. DeVoe, J. J. McLean, Washington Hyde and C. B. Shelby. The company had a very prosperous year and there are now 935 telephones in Warren and vicinity and 400 in Niles and vicinity. The company's earnings will be used for improvements and all iron wire in the two systems will be replaced with copper.

CINCINNATI, OHIO.—C. R. McCracken, president of the newly-organized Cincinnati Telephone Company has applied to the Board of Legislation for what is equivalent to a franchise. In his letter to the authorities Mr. McCracken claims that under the decisions of the Supreme Court in the Zanesville case, the State has already granted by operation of law the use of the streets of the city to this company, and the only duty involving upon the city authorities is to agree with the company on the mode of using the streets. The company proposes to erect pole lines throughout the residence sections and is willing to place wires underground in the business sections. The outcome of the company's demand will be watched with interest since Cincinnati is the only large city in Ohio without independent service. It is claimed to be a serious handicap since there are more independent telephones in the State than Bell. It is claimed that Cleveland with 381,000 population has 20,174 telephones while Cincinnati with 325,000 population has only 6,868.

CHATTANOOGA, TENN.—The new system of the Cumberland Telephone Company, at Chattanooga, went into effect Jan. 1. The company is now occupying its handsome building and every feature of the service is new.

ALBANY, TEXAS.—The Albany Telephone Company, capital $25,000, has been incorporated to construct and maintain a telephone line in the counties of Shackleford, Eastland, Stephens, Haskell, Stonewell, Kent, King, Dickins and Garza. Incorporators, G. T. Renolds, of Ft. Worth; L. S. Hallowell and A. W. Reynolds.

OGDEN, UTAH.—The fight is on in the Ogden City Council between the Bell Telephone Company and the Home Telephone Company over the franchise asked for by the latter people. Public sentiment is about equally divided.

CHIPPEWA FALLS, WIS.—At a meeting of the stockholders of the Chippewa County Telephone Company it was decided to extend the line into the city in the Spring and establish an exchange.

MILWAUKEE, WIS.—The Morley Telephone Company, of Mt. Ida, Grand County, has been incorporated; capital stock, $800. Incorporators, Sylvester Frey, August Walner and H. A. Monteith.

LA CROSSE, WIS.—L. W. Stanton, a Cleveland engineer, has completed plans for the new exchange of the La Crosse Telephone Company. The ultimate capacity will be 3,000 lines and all contracts will be placed at once. Mr. Stanton will supervise the installation.

ELECTRIC LIGHT AND POWER.

PHOENIX, ARIZ.—Arthur Powell Davis, of the Hydrographic Bureau of the Geological Survey, has prepared plans for an enormous dam to be constructed in the Tonto Basin under the National Irrigation Act, provided feasible working methods can be presented to the Secretary of the Interior. The dam will make possible the irrigation of the total area of the Salt River Valley. It will be 240 feet high and will become part of a reservoir that will store, together with the regular flow of the Salt and Verde rivers, an ample supply of water for 250,000 acres. A power tunnel and a power house below the dam will be features of the enterprise, and it is hoped to generate 1,500 hp, more than enough to do the work of construction. Later this power will be electrically transmitted to the valley near Phoenix, where it will be used in pumping underground water, that the greatest possible extension of the irrigated area may be secured.

SAN BERNARDINO, CAL.—Ex-Judge Campbell, of this city, who recently secured a franchise from the Lytle Creek Water & Improvement Company, of Rialto, for electrical power purposes, has succeeded in placing bonds for the development work. The building of a large reservoir for equalizing heads of water in irrigating will be commenced at once.

DENVER, COLO.—An electric light company of Denver, Colo., represented by G. Revallier, has asked the authorities of Canyon City, Ore., for a 25-year franchise for a pole line. It is the company's purpose to install an electric lighting plant to supply the city. It is also intended to light Prairie City and John Day.

RATHDRUM, IDAHO.—A. W. Post, of Rathdrum, is at the head of a project to put in a plant to furnish light to that town. His company owns a water-power site near here.

SHELBYVILLE, IND.—The Citizens Heat, Light & Power Company, of this city has been organized. The capital stock is $100,000. The company will build a substantial plant during the summer.

CHEBOYGAN, MICH.—W. and A. McArthur have secured the right to build a dam and locks in the Black River for the purpose of erecting a large water power plant for the electric illumination of Cheboygan.

ADRIAN, MICH.—The city of Adrian has closed a contract for street lighting with the local company for a term covering five years and the number of lamps has been increased. This is the outcome of an agitation for municipal ownership, extending over a period of six months.

ROCHESTER, N. Y.—New York and New Jersey capitalists have organized the Rochester Light & Power Company. The capital stock is $500,000 and the directors are Edward J. Patterson, of this city; Harry L. Snyder, of Montclair, N. J.; G. L. Wakefield, Francis P. Ross and Samuel S. Perry, all of New York. The incorporation of this company was briefly noted last week.

MT. AIRY, N. C.—The town of Mt. Airy has voted $50,000 for water and lights, including a power plant.

HICKORY, N. C.—M. E. Thornton has bought out the Hickory Electric Company, including the lighting plant and will enlarge and improve the property. The name of the new concern is Thornton Light and Power Company.

CHARLOTTE, N. C.—Samuel J. Stowe, superintendent of roads and bridges in Mecklenburg County, N. C., is organizing a $1,000,000 company for the electrical development of Bluitt's Falls on the Pee Dee River near Rockingham, N. C., to furnish power to neighboring towns. It is estimated that 12,000 horse-power can be developed. C. W. Tillett, Charlotte, N. C., is a member of counsel for the company.

PIQUA, OHIO.—The council has granted Homer T. Bailey the right to construct and operate an electric light plant.

CANTON, OHIO.—The Canton, Light, Heat & Power Company has reduced its rates to take effect February 1. The company has recently installed new equipment in its power house and will make an effort to popularize electricity for family use.

CLEVELAND, OHIO.—Mayor Tom L. Johnson is holding up the contract with the Cleveland Electric Illuminating Co. for furnishing 5,000 street lamps and Professor Bemis, of the water works department, is preparing a report of experiences of cities conducting municipal lighting. Mayor Johnson aims to establish a lighting plant in connection with the new water works station.

YORK, PA.—The sub-station of the York Haven Water & Power Company, near this city, is being equipped with the necessary apparatus. The company is placing everything in readiness for the transmitting of electrical power from York Haven to this city. A large number of the local industries will be run by the electrical power from the York Haven plant.

COLUMBIA, S. C.—The Columbia Water Power Company will put in a new 1,300-hp generator and two turbine wheels to secure additional power.

NASHVILLE, TENN.—The city of Nashville has paid the last installment of $25,000 on the electric light plant, which now comes under municipal ownership.

RICHFIELD, UTAH.—The citizens of Richfield are contemplating the installation of an electric light system in that town. Nelson Baker is promoting the enterprise.

RICHMOND, VA.—There is some talk of establishing an electric light plant in the city hall.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham, Railway, Light & Power Company has let the contract for putting in its steam heating plant to the American District Steam Company, of Lockport, N. Y. The plant will be run in connection with the large central power house of the company, located in Powell Avenue.

DETROIT, MICH.—It is stated that an electric railway between the Soo and St. Ignace will be built early in the spring by the Falk Company, which built Sault Ste. Marie's electric street railway last summer. It is said that the financing of the road will be done by Pennsylvania interests.

FAYETTEVILLE, N. C.—A syndicate will apply for a charter to build an electric railway in Fayetteville.

FARGO, N. D.—The City Council has granted franchises to the Fargo & Moorhead Street Railway Company. The company is capitalized at $250,000.

CLEVELAND, OHIO.—The earnings of the Lake Shore Electric Railway for November were $42,540, a gain of $14,762 over the same month last year.

YOUNGSTOWN, OHIO.—The Youngstown & Sharon Railway Company has increased its capital stock from $600,000 to $725,000, to provide for contemplated improvements.

CINCINNATI, OHIO.—Philip C. Swing, of the Cincinnati & Columbus Traction Company, has applied for a franchise along the Madison Pike, between Oakley and Madisonville.

PORTSMOUTH, OHIO.—At a recent meeting of stockholders of the Ohio Valley Traction Company it was decided to extend the line from Sciotoville to Ironton, where it will connect with the Camden Interstate Railway system.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company has secured a contract from the post office authorities to handle mail to and from Etna, Reynoldsville, Kirkersville and Wagram.

STEUBENVILLE, OHIO.—The Steubenville Traction & Light Company is planning important extensions, including a branch to New Cumberland and an extension of the Toronto road to connect with one building south from East Liverpool.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway Company has obtained a lease upon all the property of the Urbana, Bellefontaine & Northern Railway Company, for a term of 30 years. Both roads are the property of the Appleyard syndicate.

COLUMBUS, OHIO.—It is reported that the Appleyard syndicate, which owns the Central Market Street Railway system of local lines, is planning to absorb the system of the Columbus Railway Company. The report is denied by officials of the latter company.

COLUMBUS, OHIO.—The reported purchase of the Bellaire, Zanesville & Cincinnati Railroad (steam) is denied by the Appleyard officials at Columbus. It was stated that a portion of the road was to be equipped with electricity, giving the syndicate connection with Wheeling, W. Va.

TOLEDO, OHIO.—The Toledo & Western Railway Company has made a contract with the Postal Telegraph Company whereby telegraph offices will be established in all the stations on the line of the road. The dispatching on the road will be done by telegraph, supplemented by the telephone.

CINCINNATI, OHIO.—The Cincinnati Intramural Railroad Company, of Cincinnati, has been incorporated, with $1,810,000 capital stock, by J. H. Woodward, J. S. Trevor, J. G. Wright, Charles B. Wing and W. C. Rodgers, to construct an electric railway within the city limits of Cincinnati.

HURON, OHIO.—The Lake Shore Electric Railway Company has finally adjusted the long standing difficulty relative to the use of the Huron River bridge, which for more than a year has held up the operation of through cars from Cleveland to Sandusky via Huron. As soon as the old bridge can be strengthened, cars will be operated through from Cleveland to Sandusky without change.

CLEVELAND, OHIO.—The Alliance Street Railway Company and the Stark Electric Railway Company have consolidated under the name of the Stark Electric Railroad Company. The capital stock of the consolidated company is $1,000,000, and the principal office is at Alliance. The following officers have been elected: C. R. Morley, Cleveland, president; David Morrison, Cleveland, vice-president; R. S. Cook, secretary; Edward Weibenson, Cleveland, treasurer. The above, with F. Straus, of Cleveland, are directors.

TOLEDO, OHIO.—As has already been announced, the Toledo & Western Railway syndicate, which is headed by Luther Allen and Judge C. M. Stone, of Cleveland, and F. R. and J. R. Seagrave, of Toledo, has in mind a through electric railway from Toledo to Chicago. This has assumed tangible form through the announcement of the successful financing of the Garrett, Auburn & Northern Railway and the Chicago & Indiana Air Line. These roads are being promoted by interests which are closely allied with the Toledo & Western Railway, and in connection with the Indiana Railway, an independent line, will form the desired connection.

COLUMBUS, OHIO.—The Ft. Wayne & Springfield Railway Company has been incorporated, with $250,000 capital stock, by W. H. Fledderjohann, B. H. Fledderjohann, John H. Koenig, Henry J. Hoppel and C. Voght. It is proposed to construct an electric railway from Ft. Wayne, Ind., to Springfield, O. It is believed this is one of the projects of the Bushnell syndicate of Springfield.

CLEVELAND, OHIO.—The final steps in the reorganization of the Northern Ohio Traction Company into the Northern Ohio Traction & Light Company were made at Akron a few days ago. Officers of the new company were elected as follows: Henry A. Everett, president; Will Christy, first vice-president; Charles Currie, second vice-president and general manager; C. F. Moore, secretary, and J. R. Nutt, treasurer. These officers, with E. W. Moore, Barney Mahler and Charles Wason, comprise the board of directors. The property has been formally transferred to the new company.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Railway Company has decided to extend its Leisenring Division to Vanderbilt and thence to

Dawson. The contract will amount to about $70,000. The line will be single track, with turnouts, and will be of steam railway construction.

MEMPHIS, TENN.—A deal has been on for the sale of the Memphis street railway property by F. G. Jones and C. K. G. Billings. Hart Newman, of Newman Bros., New Orleans, is the prospective buyer. The amount involved is about $7,000,000.

CLARKSVILLE, TENN.—It is said that Chicago capital is backing the proposed electric railway from Clarksville, Tenn., to Hopkinsville and Guthrie, Ky. It is further reported that contracts are being made for material and that work will begin early next spring.

RICHMOND, VA.—The Railway and Light Company of America, of which R. L. Williams, of Richmond, is first vice-president, is enabled this year to pay dividends on several acquisitions where no dividends were previously paid. The Knoxville Traction Company will pay a semi-annual dividend of 1 per cent., the Lexington railway will increase its semi-annual dividend from 1 to 1½ per cent. The Macon, Ga., property bought by Mr. Williams and others will pay its first semi-annual dividends of six per cent. on preferred stock. The net earnings on the Macon property are given out at $47,378.44, with a surplus of over $15,000.

CHARLESTON, W. VA.—The South Parkersburg Electric Railway Company has been incorporated, with $100,000 capital stock.

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NEW INDUSTRIAL COMPANIES.

THE ROYAL CARBON COMPANY has been incorporated at Marietta, Ohio, with a capital stock of $100,000, by O. L. Gard, B. B. Stoney, G. L. Lund and Wm. Morse.

THE ELBLIGHT COMPANY OF CALIFORNIA has been incorporated in New Jersey with a capital of $75,000 by Kenneth K. McLaren, H. O. Coughlan and Louis B. Dailey.

THE ELECTRIC IRRIGATION COMPANY, capital $1,000,000, has been incorporated in South Dakota by George J. Reed, J. N. Lucas, Chicago, Ill.; Philip Lawrence, South Dakota.

THE ELECTRIC CAR LIGHTING COMPANY, capital stock $100,000, has been incorporated by Roswell S. Nichols, Lucius E. Varney, Anthony N. Jeshera, John M. Scoble and John Mulford Enright.

THE ELECTRA MANUFACTURING COMPANY has been incorporated in New Jersey to manufacture electrical devices; capital, $250,000. Incorporators: Frederick A. Feldkamp, Frederick C. Fraentzel, Geo. Heinkel.

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LEGAL.

WESTERN UNION FIGHT ON THE PENNSYLVANIA.—The Western Union Telegraph Company has filed a bill in the Federal Court to restrain the Pittsburg, Cincinnati, Chicago & St. Louis Railway from carrying out its expressed intention of preventing the operation of the Western Union Telegraph on its lines after June 2 next. Judge Kirkpatrick's opinion in a like case is given on page 146 of this issue.

TO ENJOIN DAM BUILDING.—Argument is being heard in the United States Court at Indianapolis in the case of the St. Joseph Navigation Company for an injunction against the St. Joseph and Elkhart Power Company to restrain the building of a dam across the river. The power company had up to the time of filing the suit expended $550,000 on the dam and when completed it will cost a million dollars. The purpose of the company is to construct a large electric power plant and furnish electric power to manufacturers and others within a radius of several miles. It is not believed that such a great improvement will be restrained by the court.

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OBITUARY.

M. GOUBET.—A cable dispatch from Paris states that M. Goubet, whose electric submarine boats were refused by the French Government and who was committed to an asylum a few days ago, is dead.

MR. R. POOLE.—Robert Poole, President of the Robert Poole & Son Company, iron founders, died at Baltimore, Md., on January 15, aged seventy-five. Among the larger engineering feats accomplished by the company of which Mr. Poole was the head was the erection of the dome of the National Capitol at Washington from plans drawn by Mr. Poole. During the civil war the firm manufactured many cannon for the Federal army, among them the famous "double-enders," which were invented by the head of the firm. Mr. Poole was noted for his charities.

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PERSONAL.

MR. GEORGE WESTINGHOUSE returned from Europe this week.

MR. J. CHARLES YOUNG, of the Woodward Governor Company, Rockford, Ill., was a recent visitor to New York City.

MR. FRANK WELZ, electrical engineer, has become connected with the department of electricity at the World's Fair, St. Louis.

M. CHOLOGOHOFF, of the Societe Anonyme Westinghouse, St. Petersburg, sailed this week for Europe after a four months' visit to the United States. While here he spent most of his time in the Westinghouse plants at Pittsburg.

MR. AUGUST BELMONT is to become president and Mr. Alfred Skitt will remain in charge of the Manhattan under the Interborough control.

MR. H. C. WARREN has been appointed general manager of the Toledo & Indiana Railway, at Toledo, Ohio. Mr. Warren has had long experience with steam railroading.

MR. CHARLES CLEGG, manager of the Mexico Electric Tramways Limited, of London, which concern operates the American equipped electric traction system in the City of Mexico, was in New York last week. He has now returned to Mexico.

MR. HAYDN EAMES, of the automobile department of the Westinghouse Electric & Mfg. Co., is to deliver an address on Tuesday evening, January 27, before the Automobile Club of America on the situation in regard to the development and introduction of business automobiles.

CHIEF ENGINEER BRAIN, of the government railway lines in New South Wales, recently visited San Francisco. He was the guest of local street railway officials. Mr. Brain will have much to do with the equipping of the extensive electric railway lines projected in Australia.

MR. F. H. PARK, of the Societe Anonyme Westinghouse, St. Petersburg, who has been in America for the last three months, will remain about a month longer. He is making his headquarters at the offices in the Maritime Building, Bridge Street, of Westinghouse, Church, Kerr & Company.

MAYOR TOM JOHNSON, of Cleveland, has been under examination in a suit in which the administrators of his brother, the late A. L. Johnson, and Mayor J. M. Edwards, are suing for $200,000, in connection with the Nassau trolley system, of Brooklyn, N. Y. The Mayor was nominal treasurer of the road.

MR. ANTHONY BRADY, Geo. D. Knapp and C. K. Billings, of the People's Gas, Light & Coke Co., of Chicago, who went over to Paris to look over the gas and electric power situation with the view of a merger of several companies, have started for the United States. They will return to Paris in March.

MR. W. S. CHASE, formerly treasurer of the Cleveland Machine Screw Company, has become sales manager for the National-Acme Manufacturing Company, of Cleveland, Ohio. In his former position Mr. Chase formed a wide acquaintance with the automatic screw machine trade of the country that is of great use to him and his friends.

MR. CHARLES M. WOOD, who has been connected with the California Electrical Works in San Francisco for twelve years, resigned his position as manager of the sales department at the close of last year to accept the position of President of the Century Electric Company. The latter company is doing a good construction and repair business, besides carrying the agency for the Gould Storage Battery and other lines.

MR. THEODORE P. GILMAN, First Deputy State Controller of New York State, resigned his office last week to accept the presidency of the General Electric Inspection Company, of New York. Mr. Gilman, in his letter of resignation, said that he resigned with personal and political regret, but that his recent election as president of the company made it impossible for him to continue in office. In accepting it Controller Miller said the deputy's service had been earnest and efficient. The salary of the office is $4,000, with $1,200 for expenses.

COL. ASHLEY W. COLE.—Representatives of the New York Merchants' Association and others interested in the improvement of general street railway facilities in New York City called on Gov. Odell last week and requested that, if he had any idea of supplanting Col. Ashley W. Cole as Railroad Commissioner, he would wait until the Board had made a decision in the matters now before them of the increase of cars on the various lines in the metropolis. The Governor replied that if he made a change he would certainly see that it did not interfere with the present investigation.

MR. CLARENCE H. MACKAY.—An appraisement of the personal estate of John W. Mackay, who died in London in July last has been completed. The estimated net value of the personal property is $2,451,726, the sum of $50,000 having been expended for executors' commissions and administration costs. All of the personal estate under Mr. Mackay's will goes to his son, Clarence H. Mackay, but a large part of the property is inherited by the widow, Mrs. Marie Louise Mackay. According to the appraisers, there is no real estate listed in New York. The personal property includes: Bonds of the Sprague Electric Company, $279,500; 3,112 shares American Telegraph & Telephone Company, $513,480; 6,676½ Commercial Cable Company, $1,071,578; 1,994½ Commercial Cable Building Company, nominal; 1,639½ Telephone & Telegraph Company, $47,135; 55 Maurice Grau Opera Company, $27,500; 750 New York Quotation Company, $71,250; 425 $1,000 bonds Commercial Cable Company, $425,000; 50 $1,000 bonds Commercial Cable Company, $50,000; cash in bank, $11,018; books, pictures, etc., $5,263.

MR. W. E. RUNDLE, who is connected with the Interborough Rapid Transit Company, of New York City, has recently drawn up for the National Conduit & Cable Company an ingenious form of chart for one of the extensive London installations which this company is making. It shows graphically, by sections, each and every cable throughout a city or town; which duct each particular cable is in; a key map of the section of city shown and number of cables from power house to manholes; cable ordered but not forwarded; cable in town but not laid; cable drawn into duct, with reel number, month, day and year, also foreman drawing in cable into duct; two cables in one duct; numbers of manholes or street names; diameters of manholes; distances between manholes; cable jointed, with month, day, year and name of man making joint; switch pillars, with terminal head, giving date put on and by whom, and without terminal head; also duct length or cable drawn into switch pillars. By the use of two colors the chart shows the exact status of the work as it progresses from day to day, to the jointer, to the superintendent of construction, and to the home office.

EDUCATIONAL.

WELLESLEY COLLEGE is to have, through the generosity of Mr. John D. Rockefeller, an entirely new and up-to-date power plant. Apparatus will be installed for heating all the buildings on the college grounds, which extend over several acres, and the grounds will be lighted by electricity throughout. Electric motors also will be used for operating elevators and blowers for ventilation purposes. Mr. Rockefeller has recently purchased from the Westinghouse Electric & Mfg. Co., for this plant, two alternating-current, engine-type, two-phase alternators, separately excited, one of 150-kw. and one of 75-kw. also a five panel switchboard.

NEW YORK LECTURES.—In the Board of Education popular lectures, Prof. E. R. Von Nardoff lectures on electricity in Cooper Union on Wednesday nights and at the American Museum of Natural History on Saturday nights. Prof. William Hallock, of Columbia University, lectures on physics on Wednesday nights at the Baron de Hirsch Trade School, 222 East Sixty-fourth Street. W. W. Ker lectures on electricity at the Young Men's Hebrew Association, Ninety-second Street and Lexington Avenue, on Wednesday nights and at Columbus Hall, Sixtieth Street and Columbus Avenue, on Thursday nights. Prof. John S. McKay lectures on heat at St. Bartholomew Lyceum Hall, 205 East Forty-second Street, on Saturday nights, and at Public School No. 158, Avenue A, between Seventy-seventh and Seventy-eighth Streets, J. Newton Gray lectures on physics on Friday nights.

LEHIGH UNIVERSITY REGISTER.—The Register of Lehigh University, South Bethlehem, Pa., just issued, shows the attendance of 581 students from 27 states and 6 foreign countries. There are 52 in the teaching staff. Twelve courses of instruction are offered at the university: the classical course, the Latin-scientific course, courses in civil, mechanical, metallurgical, mining, electrical and chemical engineering, analytical chemistry, geology, physics and electro-metallurgy. One hundred and five students take the course in electrical engineering. A list of the graduates of the university, 1,248 in number, during the 37 years of its existence, indicates that this institution is exerting a very marked influence on the industrial development of the United States, and also of foreign countries. The following prize scholarships will be open to competition at the annual examinations in June: Two in the classical course of $150 and $100 each, and one in the Latin-scientific course of $125 annually, in addition to free tuition. Provision is made for worthy and needy students whereby they may postpone payment of tuition until after graduation.

Trade Notes.

THE PRAIRIE CITY ELECTRIC COMPANY, of Prairie du Chien, Wis., has increased its capital stock from $10,000 to $20,000.

THE SIMPLEX ELECTRICAL COMPANY, Boston, Mass., has changed its address from 75 Cornhill to 110 State Street, that city.

THE COLONIAL STEEL COMPANY, Pittsburg, has just ordered a large oil filter from the Burt Manufacturing Company, of Akron, O., for use in the new steel works which it has just erected.

THE MARIETTA MANUFACTURING COMPANY, Marietta, O., has secured the contract for the installation of electric light plants, engines, boilers, etc., for seven new Ohio River steamboats to be built this winter.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has elected the following named directors: T. H. Gillmer, president; C. H. Angstadt, vice-president; E. W. Gillmer, secretary-treasurer; J. W. Holloway and C. B. Selby.

REMOVAL.—The Cochrane-Bly Machine Works, Rochester, N. Y., have removed their factory to larger quarters at Nos. 7-11 Griffith Street, that city. The new plant gives the company the enlarged facilities which it required in order to meet with the increasing demand for its goods. This company manufactures die-making machinery.

THE ELECTRO DYNAMIC COMPANY, of 212 Ionic Street, Philadelphia, has issued in a handsome 4-page pamphlet the article which appeared in ELECTRICAL WORLD AND ENGINEER, illustrating and describing the Pfatischer system of electrical steering gear introduced with so much success on board the Red Star liner *Finland*, and other steamers, as well as in the Russian navy.

THE STERLING ELECTRICAL MANUFACTURING COMPANY has increased its capital stock from $50,000 to $100,000. Mr. G. C. Webster of the company is quoted as saying that it is the purpose of the company to increase its output to 10,000 lamps per day, or about double its present capacity. New buildings will be erected in the spring and new machinery will be installed.

COATING MACHINES.—F. E. Hook, of Hudson, Mich., the originator of the pneumatic coating machine for painting and whitewashing, has succeeded to the painting machine business of the Bean-Chamberlin Manufacturing Company, of the same place, and will in the future sell its machines in connection with his own "Best" pneumatic coating machines and "Stay There" paints.

UNIVERSAL DRAFTING MACHINE.—Draftsmen will find very interesting the catalogue of the Universal Drafting Machine Company, of Cleveland, Ohio, which, by means of excellent illustrations, shows the wide range of application of this handy instrument. This machine was described and illustrated in ELECTRICAL WORLD AND ENGINEER of December 6, 1902.

LOMBARD GOVERNOR COMPANY, of Boston, has issued a very handsome calendar for 1903, which, in view of the fact that it makes a well-known type of successful governor for water wheels, has naturally a water subject for its illustration. The scene is a moonlight view of calm sea and sailing boats, suggestive of the tranquility enjoyed by the man whose wheels are regulated by a Lombard.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has been appointed general sales agent for the Toler system of conduit boxes. This line of boxes is extensive enough to meet every possible condition, no matter what size, shape or style. A complete catalogue now in press will be ready for distribution in a few days. This should be in the hands of every electrical man, and a copy will be mailed upon application.

INCANDESCENT LAMP FITTINGS.—The Incandescent Electric Light Manipulator Company, 116 Bedford Street, Boston, Mass., has issued a descriptive circular of a number of specialties of its manufacture, including a lamp replacer, switch and socket key manipulator, Morse cord lamp adjuster, bulb cleaner and Webster lamp adjuster—all conveniences for users of incandescent lamps.

THE MECHANICAL BOILER CLEANER COMPANY has just received a letter from the Omaha & C. B. Railway & Bridge Company, stating that the Garrigus cleaners put in its boilers in 1898 are still working perfectly. It also says that the cleaners are essential to the economical operation of any boiler and that it has found that by using the cleaners the boilers are more efficient and expense greatly reduced.

TELPHERAGE.—Circulars Nos. 30 and 31 of the United Telpherage Company, 20 Broad Street, New York, have for titles, "Telpherage for Manufacturers" and "Telpherage in Freight Yards." The first-mentioned contains illustrations of telpherage applications for conveying coal, cotton bales, boxes and freight packages. The illustrations in the latter refer to installations made on docks and in railroad yards and freight houses.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., devotes two of its latest bulletins to "Automatic Start Induction Motors" for single-phase current and "Forge and Volume Blowers." The motors are rated at 1-20 and 1-10 hp, and are specially adapted for dental work. The second bulletin relates to centrifugal blowers, which comprise eight sizes for six different frequencies the ratings being from 1-10 to 1-3 hp.

THE W. G. NAGEL ELECTRIC COMPANY, of Toledo, Ohio, has recently taken the agency of the Duncan recording wattmeter. These meters are of the commutator type, direct or alternating current, having an aluminum case and possessing many new and up-to-date features. Duncan meters are direct reading in all sizes and are especially desirable for direct current lighting and power circuits. Prices will be gladly quoted upon application.

NORMAN HUBBARD'S SONS are now located at 265 Water St., Brooklyn Borough, New York. They will continue to manufacture the Packard vacuum pump, so extensively used in the electrical field. Mr. R. D. Hubbard has had an experience of more than twenty-five years in this and kindred lines. The Packard vacuum pump now possesses all the improvements that make it as perfect as skill and workmanship can accomplish. The firm's new price list is now ready.

SAFETY INSULATED WIRE & CABLE COMPANY, of 114 Liberty Street, New York, has got its new factory at Bayonne, N. J., into full swing, and states that it is the largest rubber insulating plant in the world. It laid recently a 550-mile deep sea cable in the Mexican Gulf, and has supplied over 2,000 miles of cable to the Government for the Philippines. It has over 12,000 miles of high-tension cable in use in different parts of the United States and has large orders ahead for light, power, trolley and telephone work.

CRESCENT SOLDERING MATERIAL.—The Crescent Electric Company, Chicago, Ill., is making soldering material which embodies some new and advantageous features. The Crescent soldering stick is a compound moulded into stick form, possessing the advantages of such form and at the same time eliminating the annoyance due to breaking up and crumbling. Being partially flexible it can be carried in the tool bag without danger of its breaking up into small unusable pieces. This material is also made in paste form and put up in 2-oz. tin boxes. Economy is claimed for it, as little is required on each job; another advantage being its freedom from corrosive acids.

ASBESTOS PACKING.—A ring of wire insertion asbestos high-pressure packing that was in constant use for six years, will be shown by the H. W. Johns-Manville Company, 100 William Street, New York, to anyone interested. During its long service the packing, which was recently removed from the steam end of a Worthington duplex compound pump, used in the elevator service of the Woodbridge Building, New York, never caused the engineer the slightest trouble. When removed it was in such excellent condition as to permit of further efficient service, notwithstanding its six years' use. The rod is still perfectly smooth. The packing worked under 125 pounds pressure; pump capacity, 3,000,000 gallons every twenty-four hours.

THE FOUR-TRACK NEWS for January is an excellent issue, as a casual glance over its contents will convince all readers. An idea of its variety may be gained from the following partial list of subjects: "Mount Hood," and "Solemn Barred Owls," and "An Autograph of the Ice Age," and "The Climbing Bear Tree." There are "Vest Pocket Confidences," by the editor, and "How Royalty Travels," by Andrew D. Titus. "In the Trail of the Traveler" will well repay perusal, and there are jokes and poems that will cause the appreciative reader to fancy that his salary has been raised and that everything is gold that glitters. It is fitting literature to peruse while traveling on such trains as the Empire State Express or the Twentieth Century Limited.

ASBESTOS CATALOGUE.—The 1903 Asbestos catalogue of the H. W. Johns-Manville Company, 100 William Street, New York, is a handsome booklet of 100 pages. The half-tone illustrations, numbering nearly 150, show asbestos in many conditions, from the natural state, as it is mined, to the various non-conducting forms into which it is manufactured for both heat insulation and refrigeration; packing for all conditions of service; asbestos paper and millboard for fireproof construction; electrical insulation, heat and cold insulation, fire-resisting cements and sundries, such as fireproof theatre curtains, asbestos gloves, and household articles. There seems to be hardly a trade in which some use is not made of asbestos; in fact, the list of over 300 buildings, manufacturers, etc., using the company's products includes firms prominent in every line of industry. The arrangement of the catalogue is such that quick reference may be made to any article. Each section has its own table of contents and there is also a complete alphabetical index. In addition to the attention given to the technical details the books is attractively printed in two colors, with a striking cover design in blue and white. Additional strength is given to the illustrations by a novel arrangement of rules about them. A copy may be obtained by addressing the company's New York office or any of the branch offices.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 13, 1903

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

12,073. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed May 20, 1902. The object is the provision of means by which the wave responsive device is completely protected from the powerful radiations of the transmitting apparatus located at the same station.

718,068. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. The branch circuits from the main to the sectional conductors, which include the actuating coils of the cut outs, are completed in shunt to the car motors successively by the passing car, said shunt relationship being maintained while the motors are receiving current through the switches controlled by the coils in said circuits.

718,069. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. The switch coils located in the branches connecting the mains with the corresponding sections of the working conductor are connected in series.

718,071. ELECTROMECHANICAL AUTOMATIC SIGNALING AND COLLISION PREVENTING DEVICE; C. S. L. Baker, St. Joseph, Mo. App. filed Aug. 25, 1902. Details.

18,076. BATTERY; L. Begeman, Cedar Falls, Iowa. App. filed Jan. 7, 1902. The depolarizing agent is embedded in the meshes of a wire netting arranged around the walls of the cell.

718,083 and 718,084. GENERATING ALTERNATING CURRENTS; C. S. Bradley, Avon, N. Y. App. filed June [illegible], 1896. (See Current News and Notes.)

718,003. TELEPHONE-JACK; H. P. Clausen, Chicago, Ill. App. filed May 8, 1902. (See page 159.)

718,177. CONTROLLER FOR ELECTRIC MOTOR DRIVEN PUMPS; T. Trolsen, Brooklyn, N. Y. App. filed July 5, 1902. Details.

718,182. ELECTRICALLY CONTROLLED ORGAN BELLOWS; E. R. Whitney, Lynn, Mass. App. filed June 21, 1901. A spring is put under tension by the opening movement of the bellows to give a quick movement to the cut-out switch.

718,183. ELECTRIC RAILWAY SYSTEM; G. T. Woods, New York, N. Y. App. filed Oct. 30, 1896. In an electric railway having electromagnetic track switches controlling the flow of current from the track system to the car motor system, a shunt from the motor system for energizing the magnets of the track switches, and a motor generator on the car having the armature of its motor side in said shunt and having its generator side so connected to the car motor system that the work and therefore the counter electromotive force of the motor generator armature is regulated.

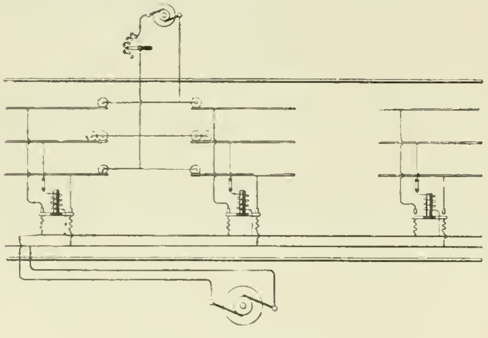
718,204. TELEPHONE; M. R. Hutchinson, New York, N. Y. App filed November 15, 1901. (See page 159.)

718,205. ELECTRIC BATTERY; M. R. Hutchison, Upper Montclair, N. J. App. filed April 5, 1902. Porous material in intimate contact with the plates projects into a reservoir of free liquid in the bottom of the cell, the top of the cell being sealed and provided with a capillary vent for gases.

718,212. ELECTROMECHANICAL MOVEMENT; E. S. Lorimer, Piqua, O. App. filed March 8, 1902. An automatic device for opening the circuit of a clutch magnet when the driven element has been moved to the desired extent.

718,215. TELEPHONE-SYSTEM; I. H. Parsons, Leicester, and T. Sloper, Devizes, England. App. filed February 28, 1902. (See page 159.)

718,220. CONDUCTOR, CONDUIT AND COLLECTOR FOR ELECTRICITY ON RAILWAYS; R. C. Sayer, Bristol, England. App. filed Oct. 7, 1901. Plungers in the rim of a wheel act upon valves regularly spaced along a conduit to open the same successively and give access to a conductor therein.



718,068.—Electric Railway.

718,224. INTERCOMMUNICATION TELEPHONE-SYSTEM; T. Sloper, Wilts, and I. H. Parsons, Leicester, England. App. filed April 18, 1902. (See page 159.)

718,233. ELECTRIC SIGNAL SYSTEM FOR RAILWAYS; J. W. Williams, Spokane, Wash. App. filed May 7, 1902. A combination of track and wire circuits arranged to operate signaling appliances.

718,235. POLARIZED TELEPHONE SIGNAL-BELL; E. E. Yaxley, Chicago, Ill. App. filed March 13, 1901. (See page 159.)

718,249. ELECTROLYTIC APPARATUS; M. Haas, Aue, Germany. App. filed August 6, 1901. To prevent short circuiting of the current through the liquid of the cells, the liquid is caused to flow through elongated tubes of small cross section.

718,264. ATTACHMENT FOR TELEPHONE-MOUTHPIECES; J. F. Logue, Sacramento, Cal. App. filed September 8, 1902. (See page 159.)

718,310. TELEPHONE-TRANSMITTER; C. C. Cadden, Cleveland, Ohio. App. filed September 8, 1902. (See page 159.)

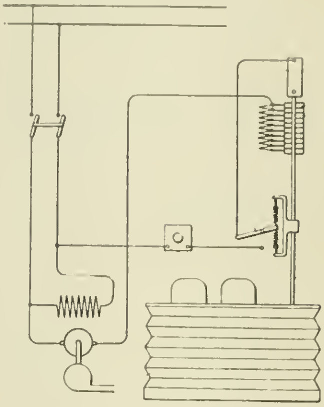
718,31 . VISIBLE SIGNAL TELEGRAPH; W. A. Farrell, Wellsville, N. Y. App. filed April 7, 1902. A switchboard for operating varicolored lights arranged in groups on an upright support to signal letters by different combinations.

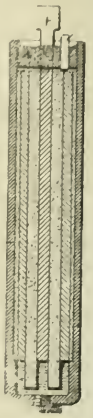
718,371. COIL BOX FOR TELEPHONES; W. E. McCormick, Chicago, Ill. App. filed May 4, 1901. (See page 159.)

718,378. INSULATING LINING AND PROCESS OF MAKING SAME; G. R. Painter, Schenectady, N. Y. App. filed Oct. 6, 1898. The inside of the shell of a lamp socket is lined with a moulded cylinder of sheet fiber.

718,405. ELECTRIC CUT OUT; C. Wagner, Brooklyn, N. Y. App. filed June 25, 1902. A tubular support for an electric lamp is provided at an intermediate point with a cut-out operated by twisting the lower end of the tube.

718,437. METHOD OF MANUFACTURING ELECTROLYTIC OR ELECTRIC LIGHT CARBONS; H. H. Dow, Midland, Mich. App. filed Nov. 6, 1899. A vaporous binder is deposited upon the carbonaceous article and the latter then moulded and baked.





718,182.—Electrically Controlled Organ Bellows. 718,205.—Electric Battery.

718,438. METHOD OF MANUFACTURING ELECTROLYTIC OR ELECTRIC LIGHT CARBONS; H. H. Dow, Midland, Mich. App. filed Nov. 6, 1899. The carbon material is mixed with an emulsion of a binder and a liquid.

718,455. METHOD OF TREATING GLOWERS FOR DIRECT-CURRENT ELECTRIC LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed March 23, 1901. (See Current News and Notes.)

718,460. COMBINED SWITCH AND PROTECTING DEVICE; H. H. Hornsby and E. W. Anger, Jr., Chicago, Ill. App. filed Nov. 25, 1901. A base block carrying fuses and a snap switch is provided with branch connections leading along the back to connecting clips arranged in grooves adapted to receive the main wires.

718,485. APPARATUS FOR PURIFYING WATER; H. M. Livor, New York, N. Y. App. filed May 7, 1902. An electrolyzing chamber made of a single piece of insulating material with one electrode secured to the inner wall of the chamber and the other to the bottom of the same in such manner that all parts of the two electrodes are at all times concentric to each other.

718,489. SECONDARY BATTERY; J. W. Madigin, Toronto, Can. App. filed Feb. 5, 1902. Details.

718,495. SNAP SWITCH; G. A. Mead, Mansfield, O. App. filed Sept. 3, 1901. Details.

718,518. ELECTRIC MOTOR; E. S. Pillsbury, St. Louis, Mo. App. filed July 24, 1902. A self-starting alternating-current motor in which a centrifugal device short circuits the commutator and removes the brushes so that at normal or high speed the machine runs as an induction motor.

718,535. WIRELESS TELEGRAPH REPEATER; H. Shoemaker, Philadelphia, Pa. App. filed June 11, 1902. Means controlled by the wave responsive device for placing the aerial conductor into communication with a transmitter and means for isolating the responsive device during the operation of the transmitter.

718,544. TELEGRAPH SYSTEM; E. R. Storm, New York, N. Y. App. filed July 30, 1897. On the movement of a perforated strip impulses of like polarity but of varying duration acting through an induction coil are caused to induce momentary currents of alternately opposite polarity of equal duration, but at irregular intervals.

718,588. ELECTRIC MOTOR OR GENERATOR; J. A. Titzel, Sr., Franklin, Pa. App. filed Dec. 13, 1900. By an arrangement of a fragmentary field, comprising separate field magnets, the machine can be used as a direct-current dynamo or motor or as an alternating-current dynamo or motor.

Electrical World and Engineer

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CONTENTS.

Editorial 179
Right of Compensation When Franchise to Maintain Electric Wires is Revoked 182
Latest General Electric Combination 182
26,000-volt Installation at Grenoble, France. By C. L. de Muralt 183
A Notable Marconi Celebration in New York 187
Telephone Meeting of the American Institute of Electrical Engineers.... 189
Institute Annual Dinner 190
The Metric System and Export Trade 191
Proceedings of the Northwestern Electrical Association Convention at Milwaukee 192
Recent Electrochemical Patents. By Clinton Paul Townsend........ 198
The Fritz Medal 199
Water Power and High Voltage Transmission Plants as Investments.... 199
Combined Alternating and Direct-Current System. By Eleazar Darrow.. 200
Automobile Manufacturer's Association 200
New Telephone Patents 200
The Federal Telephone Company 201
Current News and Notes 201
LETTERS TO THE EDITORS:
  Improvement of Rapid Transit in New York. By James E. Hewes.... 202
  The Sleet Problem. By J. P. Alexander 202
Digest of Current Electrical Literature 203
New Books 206
New Standard Dry Battery Tests 208
A Four-ported Engine 209
Monoplex Intercommunicating Telephones 210
Steam Turbines in the Rockland, N. Y., Central Station........ 210
Exhibits at the Northwestern Convention 211
Mechanical Oil Cup........ 212
NEWS OF THE WEEK 213

BETWEEN TWO JANUARIES.

Just about a year ago Mr. Marconi was fêted in this city by the electrical engineers because he had signalled the "S" across the Atlantic. For an Italian whose language ignores the "S," and for an s-repelling telephone in the coherer circuit, that was a pretty considerable achievement, worthily celebrated. Last week, as our current columns record, Mr. Marconi was again dined in distinguished environment in New York because he had succeeded by dint of hard work and true inventive genius in jumping the whole alphabet, from shore to shore of the great Ocean around which hitherto the larger part of the effort of the Caucasian race has been concentrated. This latest work of Mr. Marconi is, indeed, something for universal congratulation, and we can only hope that it will stir up American inventors to see if they cannot beat him at his own game. It is pleasant meantime to note his courteous recognition of the cordial attitude toward him and his work of the American press and people. There is, indeed, a curious contrast between that attitude and the position of Mr. Marconi's own half-fatherland, Great Britain. The surly, glum demeanor of the technical press there is not without counterpart in the position of some leaders in electrical science. For example, in his really superb and suggestive address before the English Institution of Electrical Engineers, President Swinburne says: "We can get but few telegraph papers now. This is not because telegraphy is dead; it is because most of its problems are solved, so there is little to discuss." We rub our eyes; or at least, we beg Mr. Swinburne to wake up and rub his. Surely this utterance is not worthy of so keen and alert an intellect, when the great aerial spaces of the world are being spanned by streams of wireless telegraph messages, that must in short order affect profoundly the whole telegraphic industry! The probability is, not that the English mind is hampered and prejudiced by its cable investments, but that it believes Germany is entitled to the credit of it all, as a practical new art, instead of the plucky, steadfast, keen-witted Anglo-Italian, who now receives thanks for his work from the Congress of the United States.

The greater lies before. Mr. Marconi has done much, but even as we write he is discussing the conquest of wider spans of ocean, and training the ether to quiver to a longer thrill from his "thunder stations." A year ago it was St. John to Poldhu, and now it is Cape Breton and Cape Cod, the stride increasing hundreds of miles at a time; and yet only four kilowatts are needed for the jump, which we fancy compares very well with the efficiency of land telegraph and telephone lines as power transmission circuits. Just where all this is going to end we don't know. Tesla said ten years ago that power in big blocks could be loaded onto the ether for safe delivery elsewhere in express packages; and as we watch the work of Marconi, Pupin and Hewitt, the far-thoughted prophecy comes once more to mind. In the meantime, projects are afoot for wireless routes between England and her southward dependencies and colonies; between Italy and the Argentine Republic; and we expect to see them plotted out in the ether like steamship lanes in the great seas. But first of all, getting down to business, we are yearning to use the Anglo-American aerial line at ten cents a word; and Mr. Marconi cannot hurry up too much to please the whole impatient Yankee public in providing it. When all is said and done, we might as well rest right now on Hertz's fundamental work, philosophically considered, unless commercial service can be established. But unless all indications are wrong, we shall soon have it.

THE NORTHWESTERN CONVENTION.

The convention of the Northwestern Electrical Association last week was of the usual value and interest to the owners and operators of small central stations in that territory. It is too bad that there cannot be more local organizations of this character scattered over the country, because they cater to the needs of the very numerous small central stations as the larger national organizations cannot. Whether anything will come of Secretary Mercein's hint, that in the future the various local electric light associations of the country may see fit to become a part of one great national organization, say the National Electric Light Association, cannot be foreseen at present. So far, these associations have got along very well without any organic connection or affiliation, and many belong to several organizations without finding that one interferes in any way with another, as each caters to a certain class of needs.

The main object to be gained by making the local organizations branches of the national would be to prevent a certain amount of overlapping of territory which seems to exist in the Middle West. For example, there are electric light associations in Ohio, Illinois and Iowa. The Northwestern Association at the present time is practically confined to Northern Indiana, Northern Illinois, Minnesota, Northern Michigan, but is mainly a Wisconsin organization. There has never been any real clash as to territory between the Northwestern and the smaller State associations, although the State associations have undoubtedly tended to draw attendance and membership from the Northwestern. It is a good deal to ask of the small central station companies to send men to both the State and Northwestern conventions. Therefore, as said before, the main object of a consolidation of interests, as proposed in a tentative way by Secretary Mercein, of the Northwestern Association, would be distinctly to define territory for the smaller associations and prevent the burdening of the small central stations in any territory with an implied obligation to attend several conventions. As to any conflict between the national and local organizations, there can be none, because the national convention will always naturally be attended by the best from the different States. The advantages of membership in it will always more than compensate for the increased expense and time taken up in attendance, as far as the companies likely to send men to it are concerned. There will necessarily be many small companies which will not send men to the national convention, even though, with the present sliding scale membership fees, they can afford to become members, and take part in proceedings at a distance.

One movement started at the convention last week seems likely to spread until it becomes a national one among electrical interests. We refer to the standardization of sizes of advertising literature. The sizes adopted by the Northwestern Electrical Association are in such common use that there can be little objection on the part of advertisers to adopt them. Indeed, there is no doubt but that the majority of advertisers will reason that there can be no harm in making their literature standard size, and that it may do them a great deal of good, and will at once adopt the standards specified. This is a matter which electrical interests might well have taken up long ago; and now that the Northwestern has made the start other electrical bodies should fall in line. Since the committee having the matter in charge (which committee, by the way, has given the matter very careful and exhaustive consideration) has been continued for another year, it is to be expected that at next convention suggestions will be made as to uniformity of classification of headings for convenience in filing.

As to technical electrical matters, the convention served to bring out little that was entirely new, although the paper by Mr. Ryan on "Modern Illumination" brought out several facts and introduced some comparatively new devices with which all central station men should become acquainted thoroughly, since they have so important a bearing on a station's business. The paper by Mr. Wirt, while primarily for the object of introducing a new device for automatic voltage regulation, was also useful in calling attention to the importance of good voltage regulation on incandescent circuits, a matter which is sadly neglected by small electric light companies, and desperately struggled with by the larger ones. Prof. Shepardson called attention to the great number of details which need checking up around a small plant and are worth going over carefully by the owner of the small station, who imagines that all his sources of loss have been stopped, or that there is no room for improvement with existing apparatus. Papers of this kind have been read every year since the association started, but they are just the kind that are needed to set the manager thinking as to where improvements are possible.

THE RHODES SCHOLARSHIPS.

Within the past week have been taken the initial steps toward putting into effect the beneficent project of the late Cecil Rhodes for international scholarships at Oxford. Dr. Parkin, agent of the trustees of the Rhodes fund, has been in close conference with representatives of New England education, with a view of formulating a coherent plan for the administration of the trust. Before a decision is finally made, Dr. Parkin will round up the English-speaking world, but the preliminary discussion is of importance in directing the spirit of the work. The conception of the empire-builder was little short of a stroke of genius to bring together at his Alma Mater forever a band of picked men from the blood brotherhood of English folk; but their choosing is no simple matter. It involves the very fundamentals of our theory of education. For thirty years American educators have been canonizing the German universities, have caught their form without their spirit, and have half forgotten that England has institutions of learning at all. They have copied with Chinese laboriousness the minute specialization of the Teuton so thoroughly as to undermine the very foundations upon which it should rest by an extension of the process. Oxford and Cambridge, with their rich traditions of learning and their splendid monuments of achievement, have been half forgotten or mentioned lightly as survivals of an outworn past. But the Rhodes scholarships bring us face to face with English ideals in higher education, and we must gain at least a wider view from this broadened horizon.

The year 1904 will see near five-score young Americans in residence at Oxford, and their selection ought to be a matter of national interest and pride. From the single standpoint of technical education the immediate result may not be great, for Oxford has never been a notable technical center, but the indirect effect of a powerful stimulus from other than German sources cannot fail to be beneficial. As to methods of choosing the Rhodes scholars, the New England conferences are significant. The consensus of opinion was in substance that candidates should be between nineteen and twenty-three years of age, should have completed at least the sophomore year in an American college, and should pass the regular Oxford entrance examinations. These requirements look simple, but they are of no small significance. If the American bachelor's degree were given after two or three years' study, what would be its probable importance as compared with entrance at Oxford? To the apostles of sham and promoters of humbug who stand for the degradation of the A. B. degree, we commend the cool judgment of the best educators in New England that the American student should have ended his sophomore year before entering Oxford University. And where will be the American who has dodged his Greek, shirked his Latin, and slunk away from his mathematics, when he faces the Oxford examiners? We hold no brief for the classics, but they have a value in grinding in the principles of thorough study; and whatever equivalent Oxford may ultimately be willing to accept for them, that equivalent will not be the amorphous and invertebrate thing that it has come to be in too many American colleges. Sound higher education even in technical subjects must have a deep foundation, and the grim examination system of the great English university will have a salutary effect.

More than this. In States where there are several colleges, it was judged wise that nominations to Rhodes scholarships should be made in order of seniority by such institutions as the Rhodes trustees may consider fit to qualify students for matriculation at Oxford. This provision we earnestly hope will be finally adopted and vigorously enforced. We can imagine nothing better for American education, technical or non-technical, than the sifting that will be accomplished if the Rhodes trustees do their full duty. The petty institutions that rejoice in high-sounding titles cannot be eliminated or graded into efficiency by purely American influence. They are like quack doctors—none is so reprobate but that others will rally to his defence under the stimulus of a common fear. But a searching examination from without can do wonders in separating the good from the indifferent and the bad, and in helping the two last-mentioned classes to the road of reformation. The sifting process may make some strange disclosures. It is not always the institution with the most students or the most vigorous advertising staff that does the best work. It is thoroughness that counts, whether the students are few or many; and thoroughness is not a function of funds, members or doctrinal soundness. If the requirements of the Rhodes scholarships can be made the touchstone of academic efficiency, the gift of Oxford's great son will serve even a mightier purpose than he had in mind. In any event, the effect of the English influence on our American ideals of education will make itself felt as has never before been possible, and will inspire a broader view of intellectual life. Conversely, the presence of those American lads in England can but prove a leaven that should work for good, in strengthening international relationships and promoting a better mutual understanding, not only on questions of education, but matters of national characteristics and tendencies.

TRANSPORTATION IN GREAT CITIES.

The important report of Mr. B. J. Arnold to the municipal authorities of Chicago, to which we have already made brief reference, falls in with a most interesting account of the preparations for rapid transit in Greater New York just published in *Harper's Weekly.* We have seen many discussions of plans for metropolitan rapid transit, but none that spoke so convincingly as the bird's eye view shown by our contemporary. Mr. Arnold divided urban systems of transportation into three classes—the peninsular class, with water front on both sides of the district served; the valley class, with the territory cut in twain by a river; and the radiating class, with a great stretch of territory on one side of the water front. To the first-named he assigned New York, and yet looking at the subject broadly, this city really belongs to the third class, complicated by all the untoward conditions associated with the three. The great business interests of the city, and the nation as well, center in Manhattan Island, but the population which does business there lives for the most part, if within the insular limits at all, so far toward the north as to be for most purposes a separate community. Residential New York in the broad sense lies mainly beyond the Harlem and the East Rivers. New Jersey, too, holds no mean part of the real population of the city, a part which never gets into the census, but which is just as truly of the metropolis as if it were domiciled in Brooklyn. Could New York extend the grasping talons as has Chicago, its population would press close to London's, though New York can never be America in the same sense that London is England.

This outstretching of population beyond two rivers adds to the situation in New York a complication not found so far as we are aware in any other large city. The Thames, the Seine, the Chicago, are rills compared with the East River. The enormous cost of bridges and tunnels blocks the way that would be easy in dealing with smaller streams. Traffic is, therefore, terribly constricted at important points, and however good the transit facilities at these points may be made, the traffic converging upon the termini of tunnels and bridges is tremendously difficult to handle. Hence comes the need for the three-story transportation system now in process of evolution. Intrinsically it is bad; practically it can hardly be avoided. The adoption of electric traction, which alone makes an elaborate tunnel system practicable, has brought incalculable relief to the situation. The splendid projects of the interborough system, the entrance by the Pennsylvania Railroad under the Hudson to the heart of New York and more than all, the prospect of through suburban trains clear down town from the New York Central, will work a revolution that is scarcely possible to realize. It carries out what is really the fundamental principle of successful urban rapid transit—the multiplication of distributing points. The central position of the proposed Pennsylvania station, for instance, will make it a great independent center of suburban traffic relieving the pressure on the rest of the system. With a proper express service to the Battery, part of the burden of distribution will fall on up-town cars instead of adding to the present congestion. In short, whenever the suburban traffic of a city can work to distributed termini, rapid transit becomes relatively easy, while any attempt to concentrate it at a single point leads to disaster. One of the great advantages of Chicago in the matter of rapid transit is the scattering of termini that breaks up any single general direction of travel, so far as the large suburban lines are concerned.

From Mr. Arnold's report this advantage as regards the steam lines is more than offset by the ineffective state of the surface system. This is a conglomerate of cable, electric and horse cars, without adequate opportunity for common use of tracks, and consequently there is as regards the nearer portions of the city extreme congestion. Part of the trouble is laid by Mr. Arnold upon the old policy of giving franchises to different companies for different divisions of the city. There are certain very obvious advantages in having all the rapid transit facilities under a single control, but we think Mr. Arnold attaches too much importance to them. No private monopoly ever was or ever will be administered on altruistic principles, and while some of the practical problems of transportation can be the more easily worked out when all the lines are owned by one corporation, the only safety of the people lies in the iron-compelling hand that can wring good service from one company or several, willing or unwilling. If ever warring companies realize that they must sink their differences far enough to unite in giving proper rapid transit facilities or else be forced out of business, the dove of peace very suddenly begins to brood over their respective general offices. Chicago has done exceedingly well to take counsel with so competent an engineer as Mr. Arnold, and we earnestly hope that its municipal authorities will have the power and inclination to put his ideas in practice. American city governments are generally too weak to take up these important matters with power and purpose, not to say too unstable and sometimes too corrupt to be trusted with them; but the best results can be reached only by a unity of design and administration that are generally not to be obtained save by radical and sweeping changes such as only far-sighted municipal action can secure.

Right of Compensation When Franchise to Maintain Electric Wires is Revoked.

According to a decision just rendered by the Supreme Court of Massachusetts, the owners of electric wires in the public streets have no right to compensation when the franchise to maintain these wires is revoked by the Legislature. Two cases, that of the New England Telephone & Telegraph Company *vs.* Boston Terminal Company, and that of Boston Electric Light Company *vs.* Boston Terminal Company, were decided in the same opinion. Each case arose on a petition for an assessment of damages for conduits and manholes located in certain public streets that were discontinued and taken for the new South Terminal Station, by an act of the Legislature in 1896. The electric companies each had wires in their conduits beneath the discontinued streets, and these wires were removed, but the conduits and manholes could not be removed without their destruction. The rights of the electric companies to maintain wires in the discontinued streets had been derived from certain ordinances of tlle City of Boston, whose authority to pass these ordinances was not questioned. Some of the ordinances expressly stated that the privileges granted by them were subject to amendment or repeal, but other of the ordinances were silent on these points.

The court says that the privileges granted by these ordinances are all subject to repeal whether there is an express provision to this effect or not. It is fair to presume that these ordinances so far as they did not contain provisions for their termination were in terms perpetual, this being the regular and general form by which rights to maintain wires in the public streets of Massachusetts are granted. The most striking view put forward in the opinion of the court is best expressed in its own words: "A person who walks or drives through a public street does it as one of the public, and not in the exercise of a private right of way. The permanent constructions above referred to (conduits, etc.) are permitted because they are used by the public or a part of the public, or are held and used in private ownership for the benefit of the public. The rights in the streets which are so exercised or enjoyed are not private rights of property, but are a part of the public rights which are shared in common, although used and enjoyed in different ways by the different members of the public who pass through a street, or whose property is carried through it." Having held that the electric companies maintained their wires and conduits in the streets simply as members of the public, the court passes on to the necessary conclusion that the public rights so exercised are subject to the supreme power of the Legislature. The electric companies acquired no property rights in the streets when they erected their wires and conduits there under the ordinances, and these wires and conduits remained personal property, which the companies may remove when the streets are discontinued. As the electric companies acquired no property in the streets, and as they lost their public rights in these streets by legislative action, they could not recover against the terminal company which took the streets. This case brings out strongly the doctrine that the franchise to maintain wires in the public streets is terminable at the will of the Legislature, or of municipal bodies to whom its authority is delegated, even though these franchises are granted in terms that are on their face unlimited. In some other States the franchises granted by municipal bodies to public service corporations to occupy the streets with their structures are held by the courts to be binding contracts, when once acted on or accepted, which neither a municipality nor the Legislature can annul. A strong case supporting this view is that of People *vs.* O'Brine et al., III, N. Y., 1, decided by the New York Court of Appeals in 1888. This case involved the power of the Legislature to revoke a franchise previously granted the Broadway Surface Railroad Company to lay tracks and operate cars on Broadway between the Battery and Fifteenth Street, by New York City. The railway company had accepted its franchise with the condition that a sum of money be paid annually to the city, but these payments were to continue while the franchise was enjoyed. An annual payment of this sort seems to differ little in its nature from conditions often attached to franchises in Massachusetts, as that a street railway shall lay a certain kind of pavement along each side of its tracks, or shall keep the roadway clear of snow. The Broadway company laid its tracks in 1885 and ran its cars over them until the 4th day of May, 1896, when the Legislature revoked its corporate charter. The action under consideration was brought by the Attorney General against the receiver of the Broadway company and others to secure a decree that the franchise to operate a railway on Broadway had been forfeited along with the corporate charter by the Legislative act, as was its plain intent. No limit as to the time of its duration was named in the grant of the franchise to the Broadway company, and the court held that a binding contract for this franchise in perpetuity was completed when the company accepted and acted on the grant. The court further said: "It is, however, earnestly contended for the State that such a franchise is a mere license or privilege enjoyable during the life of the grantee only, and revocable at the will of the State. We believe this proposition to be not only repugnant to justice and reason, but contrary to the uniform course of authority in this country." After this the court went on to hold that the Broadway company had a property right in its franchise to operate a railroad on Broadway which right survived the repeal of the corporate charter and remained for the stockholders or creditors of the company. Furthermore, the decision was that the State had no power to revoke the franchise which had been granted by the city. Much of the apparent conflict between the Massachusetts and the New York cases is due to the fact that the New York court is able to find a binding contract in one state of facts, while the Massachusetts court in a very similar state of facts sees only the exercise of a privilege enjoyed at the will of the Legislature. If a Massachusetts franchise can be secured as part of an undeniable contract, the court will no doubt protect it from legislative revocation.

Latest General Electric Combination.

Various reports and rumors have been noted in these columns as to the important proposed combination between the General Electric and Stanley Electric Companies. These reports have been renewed with great persistence during the present week, and General Electric stock has advanced several points in Wall Street on the strength of them. We should not like to assert that the "deal" has already been consummated at this writing; probably it has not; but the parties directly interested are naturally not inclined to say much one way or the other. The subjoined is a fairly good synopsis of the statements enjoying circulation in the newspapers, and presenting the known facts and plausible inferences affecting the situation:

The Stanley company was practically controlled by the Roeblings until the Whitney-Widener-Elkins syndicate purchased it, that syndicate being already deeply interested in the Electric Storage Battery Company of Philadelphia. They offered the Battery Company to the General Electric Company at a price over $100 per share. On the market the stock was quoted around 90.

Soon after this the Stanley Electric Company was purchased by those interested in the Electric Storage Battery Company. The electrical appliances required by the New York and Philadelphia traction companies had been furnished by the General Electric and the Westinghouse companies, and it was suggested that the Stanley plant would be enlarged so as to furnish all the necessary appliances. The General Electric Company is said to have intimated that it might go into the business of making storage batteries, and certainly did look up the subject.

Strong financial interests identified with the General Electric and friendly to both parties here stepped in and counselled peace. The acquisition of the Stanley by the General Electric was suggested, negotiations were begun, and continued to what seemed a conclusion, when for some reason not entirely apparent they were dropped. It is said the Stanley price was much too high. They were resumed a short time ago and are said to have been carried to a satisfactory conclusion, the details of which will soon be announced, unless the unexpected should happen.

It has been generally understood that the present deal had to be concluded by March 2, since the Brush fundamental patent of the Electric Storage Battery Company expires on March 3. It has been claimed that, with this patent out of the way and certain other patents circumvented, storage batteries could be manufactured and sold at less than 8 cents a pound, while they are now selling at from 20 to 25 cents a pound. By a deal with the General Electric Company the Electric Storage Battery Company on other patents might, it was argued, still preserve its strong position in the field and competition would not be an easy matter. A meeting of the Stanley stockholders has been called to increase the capital from $2,000,000 to $10,000,000, but this increase will have no effect on the consolidation now on foot. If all one hears is true there might be a general holding or securities company, with affiliations even outside the strictly electrical field.

26,000-Volt Installation at Grenoble, France.

By C. L. de Muralt.

High-tension plants are multiplying in Europe and one of the most interesting new installations of this kind is the plant of the Société Hydro-Électrique de Fure et Morge, near Grenoble, France, supplying electricity for power purposes to a number of factories situated in the valleys of the two rivers Fure and Morge, from which the company takes its name.

The water power is taken from the River Drac, a tributary of the Isère. It has a fall of about 21 ft. per mile and its flow varies from 7,000 cub. ft. at low water to 42,000 ft. at high water, but the mean flow is about 11,000 cub. ft.

Near the Pont de la Rivoire, about 11 miles from Grenoble, there is a stone dam across the river about 165 yards long. From there a canal of about 660 yards length brings the water to a reservoir with a total surface area of about 1,000 square yards and some 4 to 5 yards depth. This reservoir is divided into two compartments. The first one is destined to keep back the sand carried along by the water, and special openings are provided in the wall for periodically cleaning it and returning the sand to the river. An overflow separates the first from the second compartment, which is in direct communication with the conduit. The latter is built in the form of a tube, 130 inches in diameter and three miles long. The first 1½ miles of the tube is made of armored concrete, while the remainder consists of a steel tube. The central station building covers a total area of about 1,200 square yards. It is situated about half a mile below the confluence of the Drac and of the Romanche and some 8 miles above Grenoble. The main machinery room is 48 yards long and 13 yards wide and amply lighted by a row of large windows. A crane of 15 tons capacity runs along the whole length of the building in order to facilitate repairs and inspections. In the basement immediately below the alternators there is a vaulted gallery containing the cables which connect the generators to the switchboard.

Figs. 1 and 2.—Outside Views of the Grenoble Power House.

Next to the main room and at a somewhat lower level is the transformer room provided with a system of water pipes under pressure for the artificial cooling of the oil baths of the transformers. A small truck running on rails in front of the transformers allows the easy handling of the latter and their transportation to a special little repair shop placed at one end of the transformer room and provided with a 10-ton traveling crane.

Above this on the first floor is the switchboard in the center, the offices and store rooms to the right and the living rooms of the station superintendent to the left. All the foundations of the building are made of concrete and about 48,000 cubic feet of the latter have been used for this purpose.

The station contains at present five turbo-alternators of 1,350 hp each, two turbo-exciters of 150 hp each and a small 5-hp turbine destined to provide the hydraulic pressure necessary for the turbine regulators. Figs. 1 and 2 show outside views of the power house, whilst Fig. 3 gives a good idea of the interior of the main machinery room. The turbines were supplied by Neyret-Brenier, of Grenoble. They are of the centripetal type with cylindrical distribution and they work with 15 feet of draft tube.

They are coupled with the alternators by means of elastic couplings. The speed of the turbines is 300 r.p.m., and they use something like 40 cubic feet of water per second when working under full load.

Three of the turbines have automatic regulators and are provided with compensating valves in such a manner that when the regulator shuts off water from the turbine it opens at the same time by a corresponding amount the compensating valve, thus keeping the quantity of water used by the turbine constant, the 40 cubic feet passing either through the turbine proper or through the opening in the compensating valve. The flow of the water in the pipes is therefore very regular.

The three-phase, alternating-current generators coupled to these turbines were furnished by Brown, Boveri & Co., of Baden, Switzerland. Each of the five alternators installed at present is capable of absorbing continually the 1,350 hp furnished by the corresponding turbine, and of developing 930 kw when working on inductive loads with a power factor equal to 0.8. They are designed for an e.m.f. of 3,000 volts at 300 r.p.m. and for a periodicity of 50 cycles per second. Transformers are used to raise this tension to 26,000 volts for distributing purposes.

The station has been arranged in such a manner that one generator forms, together with its transformer, a group normally indivisible, i. e., each alternator can under normal conditions only work with its own transformer. This arrangement has been chosen in order to simplify as much as possible the switchboard and all the connections, which is a very important point for any central station using high-tension currents. Besides, as there is always one entire group in reserve in this station, there is in this case no disadvantage connected with the arrangement just described.

The alternators are of the type with fixed armature and revolving interior field, the latter containing 20 poles, corresponding to 50 cycles for 300 r.p.m. The current for their excitation is furnished at 110 volts by separate exciters. The armature is carried by means of two feet on a cast-iron bedplate, which extends on both sides into the two main bearings. The high-tension winding is placed in completely closed tunnels punched into the armature core, and insulated from the iron by means of seamless micanite tubes which are tested before use under double the normal pressure.

Each generator has an output of 223 amperes per phase for $\cos \phi = 0.8$ and 180 amperes for $\cos \phi = 1$. The interior diameter of the armature is about 88 inches, the external diameter of the generator being about 135 inches. Each machine weighs about 30 tons.

Each of the two separate exciters is coupled to a 150-hp turbine and has an output of 100 kw. Each one can supply besides the energy necessary for the simultaneous excitation of the five alternators, all the energy needed for lighting the whole building and the switchboard. The other exciter is always kept in reserve.

These machines have four poles and a drum-wound armature with machine wound coils placed in open slots. At 500 r.p.m. the normal output of one machine is 870 amperes at 115 volts.

Each transformer is made up of three columns of sheet iron connected at bottom and top by two cross pieces. Each column is fitted with a series of high-tension and low-tension spools of cylindrical shape separated from one another by means of a vertical insulating cylinder. There are six high-tension and 16 low-tension spools, which subdivision of the windings has been chosen in order to facilitate repairs.

The whole transformer as described above is completely immersed in an oil bath formed of an elliptical iron tank, 75 x 30 inches filled with oil. The principal object of this oil bath is to ensure a more perfect cooling than would be the case with ordinary air-cooled transformers. In order to heighten the effect and to make the cooling still more efficient, a spiral water pipe is placed in the upper part of the tank and water is continually allowed to flow through this for cooling purposes. The transformers are of 1,150 kv-amp capacity each and their total height is about 8 ft. 4 in. The weight of one transformer including oil is about 9 tons.

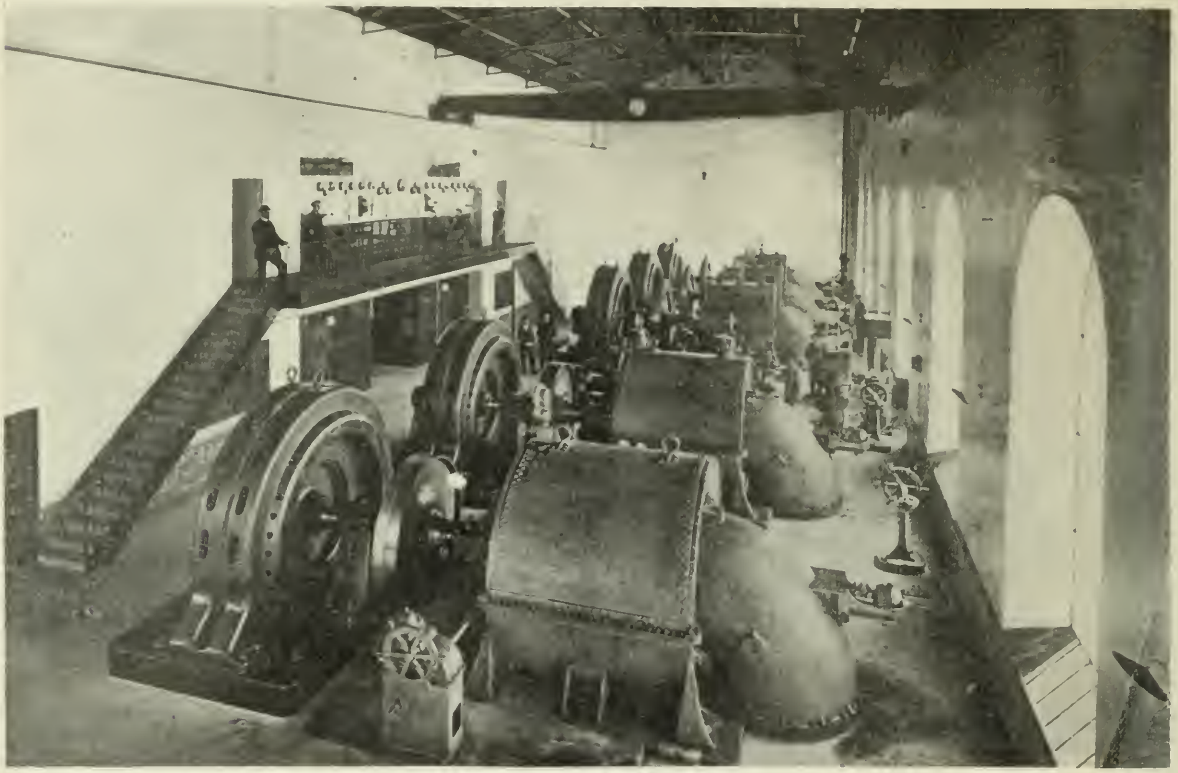


FIG. 3.—VIEW OF INTERIOR OF MAIN GENERATOR ROOM, GRENOBLE.

These transformers have been so arranged that by a simple change of connection, which can be effected at the switchboard, the ratio of transformation can be made to be at will either 3000/15000 or 3000/26000 volts. For this purpose they are provided with three low-tension and six high-tension terminals. The primaries are always connected in triangle; the secondaries are connected in triangle for 15,000 volts or in star for 26,000 volts between line wires. Fig. 4 shows one of the transformers with its oil tank. Fig. 5 gives a view of the interior of the transformer house.

One of the most delicate points of a high-tension central station lies in the difficulty of assuring an absolutely continuous service and at the same time perfect safety to the persons engaged in the station service. This naturally depends greatly on the kind of insulation used, but more perhaps on the general arrangement adopted for the different connections and switching apparatus. Brown, Boveri & Co. have long been known in Europe for their experience with high-tension work, and the way they have solved this problem in the present case is extremely interesting, as can be seen from the following description of the switchboard.

The switchboard is divided into three principal parts, as follows:

(*a*) The first one, which carries all the measuring instruments and from where all the different switching operations are effected, constitutes the switchboard proper. This part is mounted on a balcony on one of the long sides of the machinery hall, and as it is accessible to everybody it only contains such parts as carry low-tension current.

(*b*) The second part, containing the 3,000-volt switches and fuses, as well as the measuring transformers, is situated immediately below the first one between the floor and the balcony. Thus it was possible to chose an arrangement by which the switches can be operated by means of chain gear from the switchboard *a*.

(*c*) The third part is situated behind the switchboard *a* and on a floor on the same height with the balcony. This part contains the 26,000-volt switches and fuses, and, generally speaking, all the apparatus carrying the voltage of the transmission line.

The main switchboard, *a*, is composed of 11 panels, each of which is set apart for the instruments belonging to either an alternator, an exciter or an outgoing feeder; each panel is, therefore, provided with all the necessary ammeters, voltmeters, phase indicators and switches. Besides this, a central panel contains a totalizing voltmeter and a handle by which all the field rheostats can be operated simultaneously when coupled together, whilst each one of them can naturally also be operated singly by means of the handle placed on its own panel.

Each alternator panel contains a field switch. In addition, each of the two exciter panels contains one single-pole switch and one automatic minimum-current circuit-breaker destined to work when one exciter is substituted for the other one, thus avoiding a heavy breaking current if one of the exciters were to be cut out too early.

The board consists of an iron framework carrying all the connections and the rheostats for alternators and exciters and covered on its front side with slabs of white marble.

The 3,000-volt switchboard, *b*, carries the six-break main oil switches, the main fuses enclosed in removable porcelain tubes, and the current and tension transformers. This part also consists of an iron framework, which, however, is covered on all sides by wire netting in order to prevent any involuntary contact with parts carrying dangerous currents. As these nettings are made removable, all the apparatus is easily accessible for inspection and repairs.

The third part of the switchboard, *c*, is composed of nine panels, each corresponding either to a transformer or an outgoing feeder. This part contains the 26,000-volt fuses, separated each one from its neighbor by means of marble slabs in order to prevent a short circuit in case of breaking of one of the porcelain tubes and jumping of the arc formed by the blowing of the fuse. The 26,000-volt switches, also placed on this part of the board, are of the single-pole horn type. They are operated in groups of three, but are supposed to be used only after the main switch of the corresponding alternator has already been opened, i. e., under tension only, the current corresponding to the no-load current of the transformer, and therefore being negligible in quantity. The feeder panels contain also three measuring transformers for the three ammeters.

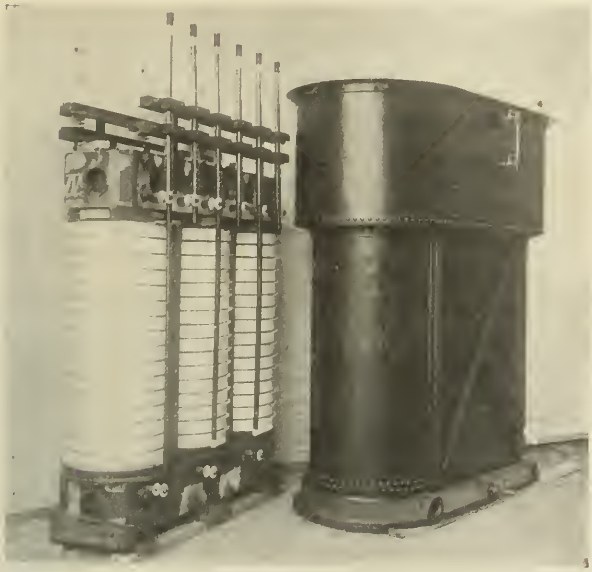


FIG. 4.—TRANSFORMER CORES AND OIL TANK.

The totalizing panel contains, besides the measuring transformer for the totalizing voltmeter, an earth indicator by means of which the insulation of the transmission line can be ascertained at any moment, and in case of accident the line found which is grounded. Fig. 3 shows a front view of the switchboard. Figs. 6 and 7 show some of the details of its construction.

Excepting the connections between exciters and switchboards (870 amperes) and the 26,000-volt bus-bars (125 amperes), which are made of bare copper, all the connections between generators and switchboard, between switchboard and transformers, between transformers and 26,000-volt apparatus and from there to the outgoing lines, are made of cables with specially high insulation. They are supported in the galleries left in the basement by means of special insulators fixed to iron framework. The arrangement is such that inspection of all parts is easy and can take place without any danger at any moment.

Six holes are left in the wall of the building and fitted with earthenware tubes of a large diameter, erected with an inclination towards the outside. Concentric with these tubes are glass tubes of smaller diameter carried by the outgoing insulated wire itself and intended especially to prevent deterioration of the insulation at this exposed point.

Before leaving the building each line passes a lightning arrester which is of the single-pole horn type in connection with a water resistance and a fuse. As these lightning arresters are designed to work at 26,000 volts, the distance between the two horns is fixed at about 10 inches and the three arresters are so connected together that the current following an atmospheric discharge will have to traverse two such air gaps on its way from one line to the other besides encountering earth between the two gaps.

As a supplementary means of safety, auxiliary lightning arresters of the Wurts type are placed between each transformer and generator on the 3,000-volt circuit in order to protect more efficiently the alternators in case of an accident happening to the main lightning arresters.

A very complete set of tests has been made on these machines, first in the shops of Brown, Boveri & Co., and once more after their erection. We give below the figures obtained during the official tests made at the central station by the engineers of the Fure et Morge Company:

(1) Alternators of 1,350 hp each, 3,000 volts, 300 r.p.m., 50 cycles per second.

Efficiency at full load	($\cos\phi = 1$)	180 amp.	94.5%
" " " "	($\cos\phi = 0.8$)	223 amp.	93.8%
" " half "	($\cos\phi = 0.8$)	113 amp.	90.8%

The temperature rise after a continuous run of 6 hours at full load was found to be only 35° C.

The difference in potential between no load and full load for power factors varying between 1 and 0.7 was found to be:

For $\cos\phi = 1$	4.7%
For $\cos\phi = 0.8$	13 %
For $\cos\phi = 0.7$	15 %

The insulation was tested by applying 6,000 volts alternating current during 10 minutes between the windings and the frame.

Finally, the total load was suddenly taken off of an alternator running at full load, which caused the turbines to run away. Thus a speed of 515 r.p.m. was obtained and maintained for some time without causing any trouble whatever.

(2) Three-phase transformers, three columns in an oil bath with artificial cooling by running water, 1,150 kv-amp each, 3000/26000 volts.

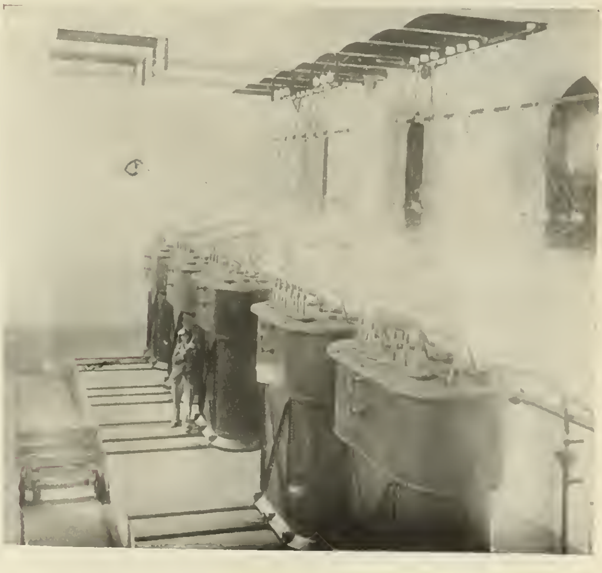


FIG. 5.—INTERIOR OF TRANSFORMER HOUSE.

Efficiency at full load,	925 kw	($\cos\phi = 0.8$)	97.8%
" " half "	473 kw	($\cos\phi = 0.8$)	97 %
" " ¼ "	236 kw	($\cos\phi = 0.8$)	95 %

From the curves taken during the tests at full load it was found that in order to keep the temperature of the oil bath at about 44° C. above that of the surrounding air, a quantity of 6 gallons of water per minute was sufficient, if the temperature of this water was about 5° C. at the entrance and 15° C. at the exit.

The same curves also showed that the transformers could work continuously during 45 hours without any cooling water at all, without any danger of an excessive rise in temperature, provided the temperature of the oil bath was not more than about 12° C. at the start.

The difference in potential between no load and full load was found to be:

For $\cos\varphi = 1$ 1.0%
For $\cos\varphi = 0.8$ 4.5%

The insulation of the transformers was tested by applying a pressure of 60,000 volts alternating current between the high tension windings and the frame and also between high and low tension windings.

(3) Exciters—100 kw, 115 volts.
Efficiency at full load 92%
" " half " 89%

The greater part of the energy produced by the generators is used in the Departement Isère in the industrial region northeast of Grenoble, in the valleys of the Fure and the Morge, the principal centers being Moirans, Voiron, Rives, Charavines, Fures-Tullins.

Moirans is about 22 miles from the central station, Voiron about 4 miles further in the valley of the Morge, Rives about 5 miles west of Moirans in the center of the valley of the Fure about half way between Charavines and Tullins.

The problem was, therefore, to transmit about 3,500 kw to Moirans, about 1,300 kw from there to Voiron and about 1,600 kw. to Rives for further distribution in the valley of the Fure.

Twenty-six thousand volts was adopted for the transmission line, permitting of the use of six copper wires, each of 7 mm diameter, from the central station to Moirans, and three similar wires from there on in each of the two directions mentioned above. The six wires of the line from the power house to Moirans could readily be carried on ordinary wooden poles, but it so happens that this line is exactly parallel to the line of the Société Grenobloise de Force et de Lumière, which company also uses the Drac for power purposes, and the two companies, therefore, agreed to use common supports for their line wires. They chose poles of iron framework carrying at their upper end about 10 yards from the ground three wooden cross arms, the six insulators of one company being fastened to one side, and those of the other to the other side of these cross arms. These poles are placed at about 70 yards apart, and at the place where the line spans the Drac two specially strong poles are placed about 170 yards from one another. The two lines thus go together up to Moirans, where they separate and where the line of the Fure et Morge Society splits up and is carried from there on wooden impregnated poles.

Glass insulators of the Provo type are used and were furnished by the Hemingray Company, of Muncie, Ind. According to the general European custom, they are mounted on iron pins of what is usually called swan neck shape. The insulators have triple petticoats, and each insulator was tested before erection with a pressure of three times normal line voltage.

The fact of having the lines of two different companies on the same poles created the desire to be able to connect the two lines in such a way as to make use of one company's lines for the total load in case of an accident happening to the other line. Special coupling stations have been erected for this purpose at three different points, where a special set of switches allows of any desired connection being made.

According to the size of the customer's motors, a simple transformation from 26,000 volts down to 1,000 volts, or a double transformation from there down to 120 volts is used. The number of transforming stations has been reduced as much as possible, and there are only three types of transformers in use in order to be able to keep a complete set of reserves for cases of emergency. There are 11 stations with transformers of 500, 300 or 150 kw. The two larger types are designed for artificial water cooling, and are of the same type as the transformers in the central station. The 150-kw transformers are of the ordinary type in an oil bath.

The transformer houses are of masonry work and special windows are provided for getting at the primary and secondary fuses used in connection with these transformers. Lightning arresters are also provided for the incoming and outgoing lines, the high-tension arresters being of the horn type and placed outside on the poles, the low-tension arresters of the Wurts type being placed inside the sub-stations. In addition to this, each station is fitted with a 26,000-volt main switch, permitting of cutting off current from the transformer in case of inspection or repairs.

Besides these primary transformer stations, secondary transformers are used for those motors employing low-tension currents. These

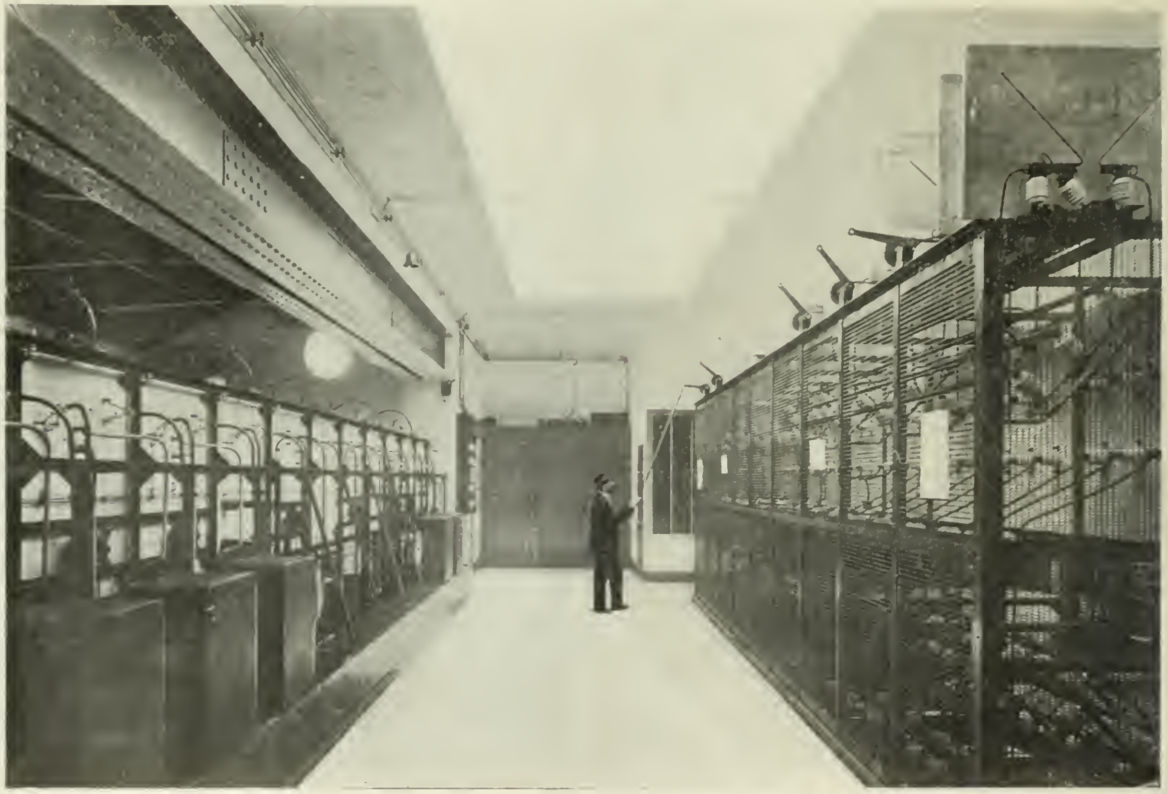


Fig. 6.—View at Rear of Switchboard, Showing the High-Tension Section of Board.

transformers are of the ordinary oil type in sizes of 100, 50 or 30 kw, and are usually placed on the customer's premises somewhere near the motor they are intended to serve. They are usually fitted with a set of primary and secondary fuses only without any lightning arresters.

All of the energy is used for power purposes and the company has not gone in for lighting work at all, as most of the towns traversed by its line have lighting plants of their own. The power is used for a great variety of purposes, the principal use being for the driving of paper mills, silk spinning and weaving mills, cotton and linen spinning and weaving mills, flour mills, mechanical work shops, oil mills, straw hat factories, iron and steel works, etc. Most of these need a very constant speed for driving their machinery, although they are often subject to great and sudden changes in load. The asynchronous motors thus presented a great advantage besides being capable of being handled by men not particularly trained for this class of work. The greater number of these motors are used for driving shafting by means of belts which were formerly driven by steam engines. The sizes of these motors vary between 1 hp and 120 hp.

It is interesting to note the conditions imposed by the Fure et Morge Society on its customers:

(*a*) All motors above 5 hp must have a wound rotor and be provided with a special starting rheostat.

(*b*) These motors shall not use more than normal full load current when starting.

(*c*) The power factor of these motors must be at least 0.85.

The power is rented at the secondary terminals of the transformers in electric hp of 736 watts. The main object of the installation was from the beginning the providing of cheap power to the different industries of the region, and a special contract was therefore entered upon by the syndicated manufacturers of the district by which the Fure et Morge Society hands over its complete installation at the end of 30 years to the customers having signed a power contract for this period. Thus the company can count on a fixed yearly income and the prices for the power could be adjusted as follows:

150 francs per hp per year for use during 24 hours per day.

125 francs per hp per year for use during 12 hours per day.

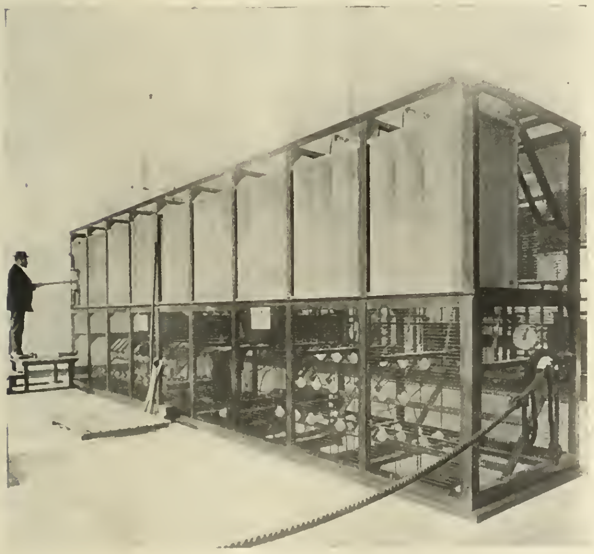


FIG. 7.—A SECTION OF THE SWITCHBOARD.

As the cost of the hp per year furnished by steam engines had hitherto been from 200 to 400 francs, it is easily seen that this tariff meant a great reduction of manufacturing costs, and it will certainly go far towards developing further the industry of the region.

The installation was put into regular service March 1, 1902, and since then has been running continuously without incident. This power transmission shows the great development which this art has of late undergone in Europe, and though higher voltages have been successfully employed in the western part of the United States, yet the voltage used by the Fure et Morge Society is the highest used so far in Europe.

A Notable Marconi Celebration in New York.

JUST a year ago the American Institute of Electrical Engineers celebrated Mr. Marconi's great achievement in "jumping" the letter "S" across the Atlantic by giving him a dinner at the Waldorf-Astoria that will long be remembered by all who were there. In the interval Mr. Marconi, with wonted patience and persistence, has been teaching the ether how to spell all the other letters in the alphabet, and has, like his great Italian forerunners, Cæsar and Columbus, now taken out a fee simple to the biggest space open to the conquest of his genius. After threading the ether with thought, and performing before all the crowned heads of Europe, Mr. Marconi has reached New York, and last week did equal honor to a number of its residents by dining with them at the Metropolitan Club, on the invitation of the directors of the Marconi Wireless Telegraph Company. For those who thus heard in plain and direct description from the lips of the brilliant young inventor last Saturday night, the story of his recent immortal achievements, it will indeed be an ever memorable evening. The party was not particularly large—some fifty strong—but the hosts had brought together a body of men well known and representative in all their respective fields of endeavor and success, including Sir Percy Sanderson, British Consul; Signor Branchi, Italian Consul-General; Dr. M. I. Pupin and Dr. F. B. Crocker, from Columbia University; bankers and financiers like D. O. Mills, Spencer Trask, J. J. McCook, E. R. Morse, C. S. Sedgwick, G. R. Sheldon, R. Goodbody; George G. Ward, vice-president of the Commercial Cable Company; C. A. Coffin, Gen. Eugene Griffin and E. W. Rice, of the General Electric Company; legal lights like Eugene Lewis, John Bottomley, F. H. Betts; prominent journalists like C. R. Miller, Chester R. Lord; S. S. McClure, H. H. McClure, Lt.-Comr. J. D. J. Kelley, Ralph Pulitzer. Arc was represented by men like A. F. Jaccaci and Dr. F. B. Herzog, of the National Arts Club; commerce by Gustav H. Schwab; the church by Rev. Dr. Burrell; wireless telegraph interests and staff by W. W. Bradfield, W. R. Betts, J. D. Oppe and W. H. Bentley. The electrical press was represented by S. H. Goddard and by T. C. Martin, of ELECTRICAL WORLD AND ENGINEER. One of the jolliest and most democratic of the party was that active member of the British nobility, the versatile Duke of Newcastle. The decorations of the rooms and the big oval table were most profuse and in admirable taste, due in no small measure to the arrangement of Mr. Eugene Lewis; American and Italian flags being blended everywhere as well as on the beautiful menu. It is a rather curious and amusing fact, indicative of the wide range of interest in what is going forward in this work on the very edge of the intangible and impalpable, that the portrait used of Mr. Marconi on the menu, as most faithful, was reproduced from a Christian Science publication. It showed him, however, with a trim mustache, whereas his face on Saturday was entirely without beard, bringing out its fine lines, but emphasizing its youthfulness in a very marked manner. It should be noted that the ice cream favors consisted of chocolate confections shaped like the later four-square quadrangle of Marconi towers—highly suggestive of the oil and gas wells from which other wealth has been tapped.

Attorney General Griggs, who is connected with the company, acted as toastmaster, and immediately played a strong hand of royalties in proposing the health of the three sovereigns who had helped Mr. Marconi in his work—President Roosevelt, the King of England and the King of Italy. He mentioned naively the fact that when a boy he had learned the Seven Wonders of the World, but that having forgotten them he found excellent substitutes in modern scientific discovery, and especially in the great results attained by their guest of honor. This neat and happy introduction brought Mr. Marconi to his feet to describe with wonted modesty and forceful effect what he had been doing of late. Unfortunately, though with due regard to club proprieties, what happens at the Metropolitan is done "under the rose," so that a passing summary must suffice of this address and of the oratory in general. He said in effect: "The difference between the work of starting the cable system and that we have to do in wireless telegraphy is very great. One-half of the machine in the wireless system is on this side of the Atlantic and the other half on the other side. During much of the time we have not been able to communicate by cable messages from our stations. We cannot send all our instructions from one station to the other by cable. I do not say anything about the cable company, but the land wires over which our messages would have to go run through villages where they have a mysterious way of letting out one's secrets very readily."

He said that he had been invited to dinners five years ago for sending messages over a distance of two miles, and intimated quietly his hope of earning a few more by improving on his present Atlantic record. In passing, Mr. Marconi took occasion to thank the American daily press for its cordiality towards him and the ready prominence it had given his work. He went so far as to contrast a little bitterly, the difference in the tone of the technical "presses" in England and America, and said it seemed to him that in England they were needlessly hostile and biassed toward what was, after all, irrespective of vested interests, of benefit to mankind in increasing the means of intercommunication. In laying special stress upon the fairness and good will of technical journals in America, Mr. Marconi was good enough to mention by name the editorial staff of Electrical World and Engineer.

"The letter 'S' is a very important letter," he remarked, incidentally. "I don't know but some of the cable companies took it as a signal to sell."

He then spoke of the use of his system by the British Admiralty, which now has sixty warships equipped with it, capable of communicating to distances varying between 75 and 150 miles. "My experiments at Cape Cod and their results," he continued, "justify me in saying that the fact is assured that messages at a high rate of speed and with absolute accuracy can be sent across the Atlantic with no tangible connecting medium except the ether. The fact that stations can be placed on each side of the Atlantic at very slight cost is greatly in our favor. We are under contract with the Canadian government to send messages from Canada to England at an expense not to exceed 10 cents a word. I do not see why that rate should not be a remunerative one to the company."

He said that they will be able to send messages at greater speed than messages can be carried by cable, and that wireless telegraphy does not carry any limitation as to speed or even as to distance, because virtually as the length increased all you had to do was to impress a little more energy on the ether.

Mr. Marconi noted as a happy and significant thing that the President's message, sent from the South Wellfleet station at Cape Cod to King Edward was the very first over the new Anglo-American ether circuit, and went through without a stammer. Here was "Roosevelt luck" again, but it might well be expected that a message from such a source would jump the Atlantic by its own inherent energy. In wireless telegraphy it is "strenuous" that gets there.

Needless to say, the welcome to Mr. Marconi was heartiness itself; and the quiet, cheery amusement with which Cable Manager Ward took the jabs and dabs at the tyranny of the cable kings was in itself a creditable sign that he believed in friendliness toward the new thing, which some day may help constitute a new "combination fixture" in the domain of electrical application. Just at this juncture Mr. Edison came in from the annual dinner of the Automobile Club of America, a fact which in itself testifies to the mental and physical alertness of the veteran. Mr. Tesla has often said to his friends that he didn't think an inventor could do much for his art that was new, after the age of two score or thereabouts; and it is true that electricity calls all the time for new men. A young lady in New York society was being urged recently by her father to marry a well known public man of fifty. She replied that she appreciated the honor, but she would much prefer two at twenty-five. Electricity is somewhat in the same attitude toward those who woo her. But those who were at the dinner last Saturday and saw the "grand old man's" alacrity, good humor and keen enjoyment of it all, must have felt he was still in the twenty-five class, even if he could not find a solitary word of acknowledgement to the toast in his honor.

Governor Griggs then invited Dr. Pupin to tell Mr. Marconi how he did it all, and if Mr. M. is still uninstructed it is not the good Doctor's fault. After Dr. Pupin got through no one believed the theory he advanced that a man's ability as an inventor is inversely proportional to his gift of eloquence. No one in this country has a better right to discourse on the subtle and esoteric ideas underlying etheric phenomena, and it was brilliantly, magnificently done. Everybody felt, indeed, that they were taking a four-year post-graduate course in the lower mathematics of the higher physics. The best part of it all was the analogy drawn by Dr. Pupin between physiological or psychological nerve conditions and those embodied in both submarine cables and wireless systems. It was a charming presentation of the scheme of Providence, and Dr. Burrell gathered in copious ideas for subsequent Sundays. One was reminded, indeed, of the story told of Lord Palmerston when at a reception he was buttonholed and cornered by Sir Charles Wheatstone with a very long account of the way in which the telegraph worked. The genial prime minister had other duties, and seeing the head of the English church advancing he exclaimed: "Why, here is the Archbishop of Canterbury. Just tell all that to him. He will be delighted to work it into his next pastoral"; and with that he fled. They say that Dr Pupin is so busy over the great inventions that are adding such lustre to his own name that he does not have time to prepare any lectures for his classes in Columbia. This must be seriously doubted by those at the Marconi dinner, for he certainly was ready for every scheduled hour of the current week at the University. Incidentally it was a pleasant comment on the catholicity of American life to see Pupin and Marconi side by side, these two fine modern spirits from far-away antique corners in Southern Europe, and to recall the splendid warmth of the reception that has been given them and their inventions on American soil. Equally gratifying was it to hear from Dr. Pupin, the whole-souled praise and defence of Marconi—by one who has the fullest right to express a weighty opinion. Likewise, it did one good to hear from him the well-deserved and suggestive reference to the possibilities involved in the pioneer work now being done by Peter Cooper Hewitt.

Gen. J. J. McCook made a brief but most charming speech, in one movement, full of poetic feeling, but animated with swift and felicitous references to Arago, Faraday, Morse and Henry; and applying to Marconi the simile of Emerson, that he had indeed "hitched his wagon to a star."

Then came Major Flood-Page on behalf of the English Marconi interests. To say he made a frontal attack on cable interests and did not hesitate to give affront, is putting it rather mildly; but it was a genuine, sterling British speech, right from the shoulder, and straight from the heart. It is no wonder his feeling toward Marconi has become one of evident affection, for nothing is so dear to an Englishman as pluck, courage and sheer grit in what he considers a worthy and righteous cause. The stories he told of Mr. Marconi's early efforts were fascinating to a degree and elicited some of the warmest applause of the evening. As one listened to the story of an interview held in the grim dawn of a winter morning at the austere Euston Station, in London, when Marconi told Major Page that he knew he could signal from England to Newfoundland, with the aid of either kites or balloons; and then started right off with their blessing for that bleak and icebound bluff, one could not but marvel how the English ever came to be thought slow and conservative. It is backing such enterprises with all she has that has put England where she is; and it was simply glorious to note in the Major's remarks the personal illustration of the English willingness to take every risk for a profound conviction, not less in business than in the political upbuilding of an empire. A little touch also that "brought down the house" was his statement that when up at Glace Bay he found that for thirty days Mr. Marconi and his assistants had none of them got to bed from their work before half-past three in the morning. Major Page is an old Edison man in England and the incident recalled painful episodes to some of Mr. Edison's associates, who, in the old days when the volcano of invention at Menlo Park was in full eruption, had not known what it was to go to bed for seventy-two hours at a stretch.

And so this memorable banquet came to its close, with a practical finale in an exhibit of Marconi apparatus set up in the two corners of the room, and over which in good old telegraphic style, Marconi sent Edison his "Seventy-Three."

Electricity at the World's Fair.

The Department of Mechanical and Electrical Engineering, at the St. Louis Fair is wiring the Education Building, formerly the Textiles Building. The wires are so carefully concealed that cursory inspection fails to find them. Chief Engineer Rustin has devised an attractive scheme of night decoration for this building. The upper and lower cornice lines of the building will be marked by 8-cp incandescent lights, 10 in. apart. The vertical lines of the corner pavilions are marked in the same way. The rest of the facade, which consists of a magnificent sweep of giant fluted columns, will be treated so that the columns will be silhouetted against the screen wall, which will be a blinding blaze of white light. This unique effect will be obtained by inserting in the rear fluting of the column a line of electric lamps, invisible from the front of the building.

Telephone Meeting of the American Institute of Electrical Engineers.

A VERY crowded and successful monthly meeting of the American Institute of Electrical Engineers was held in New York City at the house of the Mechanical Engineers, when once again the difficulty of accommodating and seating so large an audience in the present quarters was illustrated. As a general thing telephony is not supposed to have much attraction for an Institute gathering, but on Friday night last, January 23, the place was filled to suffocation, and the quality of the attendance was also strikingly high.

President Scott introduced the subject of the evening in an admirable address. He pointed out that telephony is not merely an invention, but that its great system of conductors and connections are more properly the work of the engineer, supplemented again by that of the mechanical designer. "The telephone switchboard," he said, "has not sprung into existence fully equipped for its requirements. It has been an evolution. The requirements themselves have been an evolution; an evolution in a field quite apart from that in which dynamos and motors and electric lighting and power transmission have held sway. The telephone evolution may have attracted less attention; it has been less heralded, and the details and methods less generally known; but the apparatus and methods used in the modern telephone system have not come as the result of inspiration or luck, but they have followed along the lines of scientific evolution. The advance has been by step, but the steps have followed rapidly, and in a score of years a system has been evolved almost perfect in its operation, of colossal extent and marvellous in detail. It has brought about in these few years changes in our social and commercial methods greater than have occurred throughout centuries in the past." Mr. Scott then introduced Mr. Thomas D. Lockwood, to whom he paid a deserved compliment as one who had been prominent in telephonic development for many years past.

Mr. Lockwood then presented a paper of some 27 pages in which he discussed in a masterly manner the evolution of the telephone switchboard. After discussing the earlier stages of the work and the importance of a good "busy test," he said:

"The subsequent development of the telephone switchboard depended upon the outcome of three apparently parallel and independent but really co-ordinate and gradually convergent lines of investigation, which were all about this time under consideration. These investigations were directed towards:

"*(a)* The further improvement of the switchboard apparatus proper, by abolishing the serially-connected jack contacts, which as indicated, were a prolific cause of imperfect service; and by substituting some form of construction wherein each subscriber's line when switched to another, would have a clear, continuous and highly conductive path through the switchboard for the voice currents; together with such other changes as each progressive advance might render necessary.

"*(b)* To do away, if possible, with the multitudinous transmitter batteries of the sub-station and operating room, and to substitute for them a common central source of transmitter current; for if this could be done, there would not only be effected a great reduction in the number of cells required, but such as were required might be kept at all times under the eye of skilled employees.

"*(c)* To arrange if possible for the gradual displacement of the sub-station call generator, and the necessity for its operation in the transmission of incoming call signals; to provide that call and disconnect signals should be automatically transmitted by the simple acts of taking the receiver from the hook switch, and restoring it thereto; and to devise suitable appliances at the central station for the appropriate display of these signals.

"These several directions of prospective advance seem superficially to have little necessary community with each other, but the closer they are viewed, the more apparent will it appear that the realization of all would inevitably involve the complete re-organization of the switchboard; and that the efforts thus far devoted to the subject must be regarded henceforth as having resulted mainly in the determination of the principles which should be followed; and of what features were and were not desirable in an ideal switchboard. This was a well-advanced position; and constituted a definitive foundation on which the completely organized superstructure of an efficient modern switchboard might be successfully reared."

Mr. Lockwood pointed out that the connection of multiple board jacks in parallel was not at that time a new idea; and he then outlined the steps by which "the 'how' of an efficient central and common battery system for telephone circuits and the central and sub-station transmitters, together with a system of incoming call signals and supervisory signals was as a whole devised and decided upon." His paper thereupon took up and illustrated in some respects the details of modern operation.

Mr. Lockwood concluded his excellent paper by saying: "It is, however, obvious that to realize this conservation and economization of time to the fullest extent, the possibilities of usefulness inherent in the telephone itself must be competently seconded by a central station switchboard through which all of the several operations and sub-operations requisite for the connection and disconnection of lines, can be carried out with accuracy and celerity. The standard relay switchboard—as the organization of apparatus and circuits whose development I have traced has been entitled—is such an instrumentality; and by it, notwithstanding the marvellous increase of late years in the number of lines entering large central stations, and in the number of calls received and connections made in pursuance of such calls, the speed and efficiency of operation has been not only well maintained, but has exhibited marked improvement.

"Here, then, at least for the present, we take leave of our theme. The efforts expended in producing the switchboard which for the time is standard, are amply justified by the general satisfactoriness of its work. True, its organization is complex, but so is that of every poly-functional machine; and why should we object to complexity if accompanied by corresponding efficiency; or unless it shall be proved that the same efficiency can be achieved by simpler means. This switchboard, though not yet a perfect product of evolution, is at least a complete and successful machine; but evolution still goes on. It may well be that the next step in its never-ceasing progress will be in the direction of simplifying the organization either in its concrete devices or in its circuit arrangements, without any sacrifice of efficiency."

Mr. John J. Carty, in calling attention to the fact that the inventor of the telephone was a member and past president of the Institute—Prof. A. G. Bell—mentioned also the name of Mr. Edison in the same connection. He said that Mr. Lockwood had given them the successes of the switchboard, but had touched very lightly on the failures. He alluded to Mr. Lockwood's official capacity of tea taster for his company, and characterized him as a lord high executioner, whose hands were red with the blood of inventions. Mr. Carty made the following statement of interest: "After looking over our statistics for the hundred thousand instruments in Manhattan, and looking at the trouble records, I find that using the system described the telephone station in New York is out of order for a period of one hour and twenty-seven minutes on an average during a given year. That means that on the average every station will be in good order during the entire year except for a period of one hour and twenty-seven minutes. These figures are taken directly from accurate records and speak volumes in favor of the new type of switchboard which Mr. Lockwood has so ably described; this absence of trouble being one of the principal features of the success which has accompanied the installation of the switchboard."

Mr. F. A. Pickernell remarked: "A switchboard engineer, if he designed a defective apparatus, might introduce losses in the service and impair the service to an extent which could not be counterbalanced by tons of copper in the circuit. Some of these electric magnets in service which Mr. Lockwood referred to might not only impair the transmission, but they might introduce sources of disturbance due to an unbalanced condition. All these things had to be taken up in designing this equipment. The effort has been made and successfully carried out to arrange the apparatus so that any particular station may be connected with any other particular station, within the range of a thousand miles, and the switchboard engineers have designed their apparatus so well that from the telephone station located in this building connection can probably be had with three-quarters of a million, if not a million, other stations in various parts of the country. None of these results could have been produced or attained if the switchboard work had not been of the highest possible type."

Mr. B. Gherardi, Jr., chief engineer of the New York & New Jersey Telephone Company, made an elaborate contrast between the functions of an electric light station and those of a telephone exchange, and Mr E F Sherwood, of the New York Telephone Company, took up a few questions of traffic He said:

"The first standard relay switchboard installed in New York was cut into service on November 13th, 1898, and the last one, which for Manhattan Island rounded out the conversion of the entire system of local switchboards to a relay basis, was cut into service November 2, 1901 The tests of service for the year preceding the installation of the first relay switchboard in New York and for the year 1902 show the following results:

	Avg time taken by operator to answer.	Avg. time taken to complete local connections.	Avg. time taken to complete trunk connections.	Avg. time taken to disconnect.
1897.	7.7	27.6	50.7	17.1
1902.	3.8	23.7	30.7	2.8

"The improvement made in the time of answering is chiefly due to two causes: First, unlike the arrangement of magneto equipment, the answering jacks in the relay board are immediately associated with the line lamps or calling signals, so that no time is lost by the operator in locating the answering jack corresponding with the calling signal; and second, with relay equipment subscribers' lines are promptly released after conversations are finished, and delays due to slow clearing out of previous connections do not occur as they did with magneto equipment, which required that operators should listen in and ask "Are you through?" in every case before disconnecting.

"Further evidence that the installation of relay switchboards has improved the service is furnished by the record of written complaints from subscribers. During the year 1897, when the average number of subscribers' lines in service in Manhattan was 17,066, a daily average of 3.2 written complaints were received, or one complaint a day for every 5,333 lines. During the year 1902, when the average number of subscribers' lines in service in Manhattan was 49,955, a daily average of 3.3 written complaints were received, or only one complaint a day for every 15,138 lines; or to put it another way, at the rate of one complaint for each line every 41 years.

"The relay switchboards in New York have been put to the most severe test, and have stood that test in a most satisfactory manner. Since the installation of the first relay board in New York, the number of lines in Manhattan has increased from 20,740 to 53,792, and the number of stations in Manhattan has increased from 25,516 to 91,945. During this time the daily average number of calls originated by subscribers has increased from 243,590 to 549,940, and the daily average number of connections handled by each subscriber operator has been increased from 750 to 1,070; and yet with this very large increase in lines, stations and traffic, and the material increase in the number of calls handled by each operator, the relay switchboards have enabled us to make a very substantial improvement in the service." Mr. Sherwood described then the method of instructing new operators.

Mr. G. C. Allen, the superintendent of construction of the New York Telephone Company, then spoke of features of construction. In regard to cables, he remarked: "The early practice of the telephone art was to employ for its cables gutta percha or rubber-covered wires. This was natural enough in view of the fact that telegraph men were, as Mr. Lockwood has pointed out, among the first telephonists, and in telegraph-cable practice rubber and gutta percha, particularly as applied to submarine cables, was then and is still a well-established usage. But in telephony the peculiar effects of capacity were particularly troublesome and drove us to the use of a dielectric having a low inductive capacity. In paper we have found a material which, up to the present time, has proved to be the best to use, notwithstanding its susceptibility to the influences of moisture. The maintenance of such a vast network of paper cables as is required for such a system as that of Manhattan Island is possible only by the exercise of eternal vigilance. The last central office converted from the magneto to the standard type of switchboard was the Cortlandt Street office, which was done a year ago. The work of establishing the new central office involved an additional story on the building, putting in new switchboard and a rearrangement of all cables. Some of the cables had to be handled two and three times, and there were over twenty thousand to be handled and reterminated in the new terminal room and connected to the switchboard. When the switchboard went into service on Monday morning—we generally do work of this character on Sunday—it was found that five or six of the circuits were misplaced and that connections on ten or twelve had not been properly made. These troubles were remedied, and the rest of the subscribers did not realize a change had been made in the system. At the present time on Manhattan Island there are installed as part of the telephone system, outside of the company's offices, 222,543 miles of telephone conductors. Of this vast mileage of wire, 98.08 per cent. is wholly underground. Substantially all of these wires are paper insulated and covered with lead pipes."

Mr. W. J. Hammer then read an elaborate paper on the Faller automatic system, which has already been very fully illustrated and described in these pages. It embodied an elaborate summary of the various features of advantage and disadvantage as between the manual and the automatic method of operating exchanges.

Mr. Lockwood said: "Mr. Gherardi's remark about the necessity for co-ordinating the stations in large cities, for example cities like New York and Boston, was highly interesting. That is a remarkable thing, but it is not a matter which is reached in a moment; and the necessity for co-ordination was not apparent until after the long-distance telephone rendered commercial service and rendered it well. I also was much instructed and interested in his statement which I perhaps may paraphrase, that the telephone engineer has to be more kinds of an electrical engineer than perhaps any other electrical engineer following a specialty. That may sound paradoxical and sophistical, but it is true, and I have been accustomed to congratulate young telephone engineers on the fact that having to deal with the weakest current which is employed in commercial work, they must also be prepared to deal with all other currents.

"Of course, neither I nor any one else at this hour of the evening could seriously think of making any discussion on the paper which Mr. Hammer brought before us, but I think all of you will agree with me that there is certainly one advantage in the mechanical operator of which he spoke—there will not be 700 resignations in a year of operators who desire to get married. (Laughter.) I think that advantage in one sense is a great deal. The mechanical operator has that advantage over a human operator, as I cannot imagine any subscriber in any possible contingency wanting to marry one of his mechanical operators." (Laughter.)

Mr. F. E. Kinsman: "Mr. Lockwood omitted reference to the first telephone exchange established in Boston. He said, if I recall, that it was a connection made by twisting a wire from one post to another. As a matter of fact, I was employed in Boston in August, 1877, and my recollection is that the first exchange was operated by transmitting the message through the operator.

Mr. Lockwood: "There is a brief reply needed to the last remark. The first exchange was established in Boston in May, 1877, through some burglar alarm wire."

Mr. Kinsman: "I will take the correction as to date; but I will say that the exchange was first introduced in Mr. Holmes's burglar alarm office, and it was made by the operator taking the message and turning about and talking through the telephone to the party to whom the message was to be given."

The meeting then adjourned.

Institute Annual Dinner.

The annual dinner of the American Institute of Electrical Engineers will be held at Sherry's, New York City, on Monday, February 9, and will be specifically a "Library" dinner, just as the brilliant affair of last year was a Marconi dinner. The presidency of Mr. Scott has witnessed a wonderful growth in the new library, based on the gift of the Latimer Clark collection by Dr. S. S. Wheeler and seconded by the generous gift of Mr. Andrew Carnegie, who duplicated in a money donation for general purposes the value of the Wheeler gift. Mr. Carnegie is to be the guest of honor upon this interesting occasion before his departure for the South, so that the members will have an opportunity of expressing directly to him their gratitude for his liberality and encouragement. The list of speakers will not be long, but will include some very well-known men, and will have throughout a literary flavor. The dinner is to be attended by ladies as well as gentlemen, and the dinner committee believes there will be an attendance in excess even of that enjoyed in 1902. Tickets will be $5 per cover, without wine, which will be served á la carte, and orders should be sent in at once to the secretary, at 95 Liberty Street. Only orders accompanied by check will receive attention. A novel and attractive menu design worthy of careful preservation has been prepared for the affair.

The Metric System and Export Trade.

Deputy Consul-General Dean B. Mason, of Berlin, Germany, in reporting to the State Department on "Metric Weights and Measures in Germany," says that an American commission agent residing at Berlin, who is constantly bringing American and German business men into connection with one another, and who is quite intimately acquainted with the import and export trade between the two countries, considers that the use of the awkward system at present employed in the United States is a very decided inconvenience and hindrance to trade between the two countries. He cited various instances where injury had been caused, and among others the misfortune of an American who had his goods seized at the German custom house and was involved in a lawsuit with the government, owing to a blunder caused by the use of the two systems. A Hamburg commission agent and a German citizen stated that he was firmly convinced that the use of different weights and measures in the two countries caused inconveniences that made themselves seriously felt in every export and commission house dealing in American goods; that the conversion into decimal units caused serious loss of time; that the system of bookkeeping in use in Germany could not be applied to American goods.

The report indicates that German houses which have adjusted their methods to the American system will not view with favor a change, since it would be likely to subject them to more general competition in the American trade. With firms buying only occasionally from America, however, the inconvenience of two systems is keenly felt. American firms unacquainted with exigencies of foreign trade and seeking to obtain connections or business abroad continue to send circulars in the English language, in which our weights and measures are used, the result being that they generally find their way to the waste paper basket without serious consideration. A consular officer has not infrequent opportunity to observe difficulties created by ignorance of the metric system on the part of Americans, who are placed at a disadvantage owing to their ignorance on this subject. Particularly in the export of machinery, in which complicated specifications are often requisite, the difficulties caused by the use of the two systems are especially apparent.

The German law adopting the metric system was promulgated August 17, 1868, and made the use of the system permissible after January 1, 1870, and obligatory after January 1, 1872. According to testimony obtained at the Berlin Chamber of Commerce and through other reliable sources of information, the general use of the metric system in wholesale business was introduced promptly without serious inconvenience or opposition and with very satisfactory results. In retail trade some of the old weights and measures are still in use, after having been modified in order to correspond with the metric system, the old names being still retained. The German pound, for instance, is exactly one-half a kilogram, and many articles are sold at retail by the pound, half pound, etc. Professor Fischer, who was in charge of the German Bureau of Weights and Measures at the time the metric system was adopted, and is probably better qualified to judge of the difficulties encountered in its introduction into Germany than anyone else, stated in a personal interview that no serious or concerted popular opposition to the innovation was encountered, and that owing to the period of time after the law was published before the metric system became obligatory, the public was well supplied with metric weights and measures and more or less familiar with their use. Professor Fischer is fully convinced as to the great benefit derived by the German nation from the change. As to the expense involved by the change, it is impossible to derive any very definite conclusion from the statistics and reports of the German government. Information was asked on this point both by the American and English governments some time ago, together with data, as to the difficulties and results of the introduction of the metric system into Germany, but a careful examination of the reports made by the German authorities failed to give any definite information on this point. Owing to the different economic conditions that prevailed in Germany thirty years ago, such information as could be obtained relative to the expense entailed by the introduction of the metric system would necessarily be of very limited value.

While German experience as to the difficulties incident to the introduction of the decimal system may be of limited value, there can be no question as to the great advantage derived from the change. On this point, public opinion is practically unanimous; whether it be the experts of the Bureau of Weights and Measures, business men, or manufacturers, only one opinion has been found, and when the radical advantages of the metric system over the weights and measures formerly in use are considered, this unanimity is almost a matter of course. It is only those who have used the metric system after having been accustomed to the use of other weights and measures who can realize fully its great superiority when calculating or computing. The only example of the advantages of the decimal system for purposes of calculation over other systems that can be readily observed by the American public is the far greater ease and rapidity with which it is possible to calculate in dollars and cents than in pounds, shillings and pence. While, owing to the great number of semi-independent states in Germany, the need of a single authorized system of weights and measures was still more imperative than in the United States, the advantages to be derived in America by the adoption of the metric system are practically the same as have already been attained in this country. Owing to its scientific character and greater simplicity, the German citizen has a far more complete comprehension of the weights and measures of his country than the American. He saves a great deal of time and labor both at school and in later life and numerous possibilities of error are avoided. Considering the inherent advantages of the metric system and the experience of Germany and other countries where it has been introduced, it is safe to predict that if it ever comes into general use in the United States there will be the same unanimous verdict both as to its satisfactory character and the wisdom of its adoption that is given in Germany to-day.

The metric system has spread with ever-increasing rapidity throughout the civilized world. It has been adopted by the European states, with the exception of England and Russia, and by most of the South American states, by Mexico, and even by Turkey and Egypt. Unless the American people are willing to see the civilized nations using one universal system of weights and measures and the United States and the more backward countries like China adhering to their old and clumsy weights and measures, it is likely the metric system will have to be adopted. Both in England and Russia the sentiment in favor of the metric system seems to be growing steadily, and it is likely that it may be adopted in these countries within the near future. It is probable that the agitation in favor of the adoption of the metric system in the United States will continue and that if it is not introduced now, it may be introduced later on when the change would involve far greater expense and inconvenience. With the population increasing 20 per cent. every ten years and a rapidly expanding industrial development, it is important that the metric system, if it be adopted at all, should be accepted as promptly as possible.

In considering the question of the adoption of the metric system in the United States, the one valid objection that can be raised is the difficulty of the change. Owing to different political and industrial conditions, the experience of European countries is of limited value to the United States; but their experience tends to show that the radical measure of rendering the metric system permissible for a certain period, after which it becomes the only system that is legal, is an effectual way of bringing it promptly into general use, and is far more economical and satisfactory than halfway measures. The experience of Germany also shows that an efficient bureau of weights and measures is one of the most potent and necessary factors in making such a change.

While the general introduction of the metric system into the United States will undoubtedly cause temporary expense and trouble, the benefits derived from its adoption will be permanent, and a far greater population than that of the United States at present will be materially benefited by the change.

Trusts in Germany.

Discussing the subject of trusts, the *New York Times*, in a recent issue said: Those who fancy that the trust is peculiarly an American institution, the mushroom product of prosperity, may be comforted to know that Germany has more than four hundred well-developed trusts, and that at last accounts they were multiplying rapidly. The greatest number of them in any one industry have been formed in the several branches of chemical manufacture. There are several in the electrical industries, and it is announced that these are about to be united in the Central European Electrical Trust, which is to control everything worth controlling.

Proceedings of the Northwestern Electrical Association Convention at Milwaukee.

THE regular annual meeting of the Northwestern Electrical Association was held as usual at Hotel Pfister, Milwaukee, Wisconsin, January 21, 22 and 23, 1903. The convention was called to order at 11:30 A. M., January 21, and President Irving P. Lord, of Waupaca, Wisconsin, read his address, which was in part as follows:

"It is with pleasure that I greet you, at this the tenth annual meeting of the Northwestern Electrical Association. The year just closed has been one of usual prosperity with all industries, and I do not think that the electrical business has been any exception. I can speak somewhat intelligently as to the prosperity of the central station men, as I have talked with a good many of them, and all seem to report a successful year. We find that we have been obliged to pay rather more for our new electrical machinery and supplies than we paid three or four years ago, but even with this pleasant little jolt our increased incomes have been such that our net profits at the close of the year have been somewhat in excess of previous years. Our labor account has also been larger, as it has cost our employees more to live, and necessarily they were entitled to an increase of wages. The merchants and people generally are finding that electricity produces the best light on the market, and while it costs more than other kinds it is worth more. I think that the people are being surely educated to the use of electric lights, and that even in the small cities plants which have in times past had a hard struggle will eventually be placed upon a paying basis, and will return at least a fair rate of interest on the investment.

"One thing that I wish especially to call the attention of central station men to is the tendency of State legislatures to place exorbitant taxes upon electric lighting plants. I do not think that this is really the intention of the members of the Legislature, but there seems to be a large demand from the people in general for increased taxation along certain lines, and especially upon corporate interests. It is probably unfortunate that most electric lighting plants are owned by corporations, for I really think that were the properties owned by individuals they would not be placed in the same classification with railway companies, express companies, street railway companies and the like, against which there now exists a manufactured prejudice. I do not think that there is a man interested in the electric lighting business but is willing that his property should bear an equal and just proportion of the taxes paid by the owners of other property, but the trouble seems to be in determining just what this equitable and fair proportion is. An electric lighting plant can hardly be likened to money in hand, secured notes or mortgages, or even a brick business block or farm, but occupies a field almost by itself. I am in hopes that the legislative committees from the various electrical associations throughout the country may be able to talk this matter of taxation over with the proper committees of the different legislatures, and that it will result in fair and equitable legislation in reference to the taxation of lighting plants. There are already hundreds of thousands of dollars invested in electric lighting plants in the State of Wisconsin, and every year witnesses the installation of new ones and the betterment of old ones. Unless the owners can receive a fair rate of interest upon their investment, progress in this line will be slow."

President Lord then cited a little personal experience in the use of meters. His company began the use of meters early in 1902. Since he put in the meters the load, especially after 11 o'clock P. M., has been reduced fully 60 per cent., and during the earlier part of the evening from 30 per cent. to 40 per cent., while the gross income of the company has been increased about 12½ per cent. He could not too urgently recommend to central station men the benefits that would accrue from the installation of meters or the doing away with the old contract method of selling electric current, so prevalent in smaller cities.

Secretary Thomas R. Mercein then read the secretary and treasurer's report, which included a financial statement and a brief review of the work of the past year. An acknowledgement was made of the debt of the association to Mr. James Wolff, who assumed the duties of secretary in connection with the summer convention at Waupaca, in the absence of Secretary Mercein in Europe.

WEDNESDAY AFTERNOON SESSION.

The first business Wednesday afternoon was the appointment of a nominating committee as follows: John H. Harding, of La Porte, Ind.; E. P. Maxwell, of Dixon, Ill.; H. F. Pearce, of Negaunee, Mich.

On the membership committee the chair appointed H. J. Gille, of St. Paul; O. B. Williams, of Whitewater, and P. H. Korst, of Janesville, Wis.

REPORT OF THE LEGISLATIVE COMMITTEE.

S. B. Livermore, of Winona, Minn., chairman of the Legislative Committee, was unable to be present but sent in a report which was read. This committee is a general committee with sub-committees in each State to look after proposed legislation on central station matters in each State. No legislation of importance was reported as having been enacted in any of the States. A special session of the Minnesota Legislature was held in January and February, 1902. A bill was introduced at this session, which would in effect levy a tax on the face value of the stock and bonds. The bill was defeated. At the present session of the Minnesota Legislature a bill has been introduced authorizing the tax of public service franchises either on the basis of property or gross earnings proportioned among the State, counties and municipalities where the franchise is exercised. There seems to be in Minnesota little objection to a gross earning tax, which a careful study of the matter has convinced Mr. Livermore is the fairest method of taxing public service corporations.

UNIFORMITY OF ADVERTISING.

At the last annual meeting a committee was appointed to report on uniformity of advertising matter. This committee, consisting of H. J. Gille, of St. Paul, chairman; F. J. Bowen, of Kenosha, Wis., and A. M. Barron, of South Bend, Ind., made a report which is given in full, since it is likely to be the beginning of a national movement among electrical interests, toward uniformity of advertising literature.

The primary object of advertising is to bring and keep a class of goods before the buying public. The question is, does the present method accomplish this result; that is, is the advertising matter in such form that it can be utilized for reference by the purchaser, and does the advertiser obtain the best results? There are large sums of money spent annually in advertising matter in journals, through circulars, catalogues, personal canvass, etc., a large portion of which we believe does not bring adequate returns. The reason for this is that it is not distributed in such form that it can be properly filed for reference. In order to keep goods or a concern making or selling them before the buying public it is necessary to have advertising matter in such form that it can be conveniently and accurately filed, and it must be borne in mind that advertising matter is filed by the purchaser, not only on account of advertising a certain brand of goods, but for the information it contains regarding that brand. It would, therefore, seem that the most effective advertising is literature which contains the most information and in such form that it can be utilized for the purpose intended.

The question of uniform advertising is, therefore, a very important matter. If, for illustration, a manufacturer who spends large sums of money annually for the purpose of familiarizing the trade with his goods, could feel that his advertising matter which gives full information covering his goods, was carefully filed away and will be referred to whenever a prospective customer is in the market for that particular class of goods, he would feel that he is getting value received, and would place his customer in a position where he would at all times have complete information covering the product. Such a system of advertising, therefore, would be very valuable to both parties concerned.

This question is not new by any means. It has been considered and discussed by other associations in years gone by. For an illustration, in 1894 the Master Car Builders' Association went so far as to adopt standard sizes for pamphlets, catalogues, specifications, etc., which were as follows: For postal card circulars, 3½ in. x 5½ in. For pamphlets and catalogues, 3½ in. x 6 in., 6 in. x 9 in. and 9 in. x 12 in. For specifications and letter paper 9¼ in. x 10¾ in.

In connection with these standards it was decided that a standard practice should be, to have the proper standard dimensions and the word "standard" printed on the upper left-hand corner of title paper or cover, whenever practicable. These standards, we understand, are still adhered to, and is certainly a step in the right direction. However, we believe that it could be carried considerably further to good advantage.

We also believe that some of the sizes should be changed to conform to the standard card index system, which is used very extensively at this time, and which was not used so extensively when the Master Car Builders' Association adopted its standards.

We do not know of any electrical society or association that has adopted or has made an attempt to standardize advertising matter, and feel that this association is in a position to adopt standards which we feel will meet with the hearty approval and co-operation of manufacturers and jobbers in the electrical business. We, therefore, recommend that this association adopt standards and suggest the following:

For postal card circulars, quotations, etc., 3 in. x 5 in.; catalogues, 4 in. x 6 in., 6 in. x 9 in. Letter paper, specifications, bulletins, circulars, etc., 8½ in. x 11 in.

All descriptive circulars are to be printed on paper similar in size and thickness to letter paper, and issued in bulletin form; numbered, dated and punched so that they can be bound in a binder. At least two holes to be punched on the left-hand side, 3 in. from the top and bottom, making the holes 5 in. between centers.

For an index to these bulletins we suggest the card index system with which can also be combined prices on material described in the bulletins. On these cards or paper (if cards are used they should be very thin) the index or title subject, to be printed on the top of the broad side with date on the right hand; bulletin number in which description of material can be found, on the left. On the next line to be the manufacturer or jobber's name and address; then following with prices similar to a form presented herewith. These cards to be 3 in. x 5 in. This size could also be used by punching holes on one side to bind in a cover, to be carried in a pocket.

We would also recommend that business cards be of this same size, gotten up in a similar way for filing purposes; for the reason that very often a representative of a company will present his card and if the customer contemplates purchasing any particular article, prices can be put on the card and conveniently filed. This matter has been suggested to several manufacturing and jobbing companies in Chicago and has already been introduced with very good results.

Your committee has taken this question of uniform advertising up with quite a number of manufacturers and jobbers, and are assured by them that they will welcome any suggestion or standard adopted by this association for the reason that it will give them some assurance that the money they are spending for advertising matter is increased in value and is appreciated by their customers, and is in such form that it can be utilized at their convenience.

We think it is not necessary to enter into the question of the form in which advertising matter is circulated at the present time. It is almost impossible to devise a system without considerable labor, that it can be utilized at all. The result is that we venture to say that a large amount of advertising matter finds its way to the waste basket; whereas, if there was a system of uniformity it would be a comparatively easy matter to keep it in some form where it is easily accessible. If the system suggested is adopted each manufacturer and jobber would have at all times a complete up-to-date catalogue of their product or goods in the hands of the customers without going to the great expense of issuing catalogues. H. J. Gille, chairman; F. W. Bowen, A. M. Barron.

Harold Almert, of Chicago, thought the committee's report a good start and that the work ought to be continued and certain matters gone into more in detail. He said the central station men felt very badly the need of uniformity in size in advertising, so that it could be filed according to some definite system.

George Cutter, of Chicago, said that this is an era of filing away information in a manner convenient to be reached; and he, for one, would like to know that his advertising matter and especially that part of it he would arrange for this purpose, would be filed away by the prospective purchaser in such a way that it could easily be found when wanted. Mr. Cutter said that he simply needed a suggestion from a prospective purchaser indicative of what they would like to have in print and what size they wished him to adopt and they could rest assured he would carry out their wishes. He might follow up standard size circulars with some circular of odd shape that the customer might throw into the waste basket if he desired, but which would remind the customer of the other circular that was filed away and still in existence. He did not propose to have his matter filed away and buried.

Mr. Gille: "I have, as you know, taken a great deal of interest in this matter for a long while, and have taken the matter up with various associations, notably the Master Car Builders' Association, who have had this plan in effect since 1894. The purchasing agents of railroad companies, I think, pretty generally, will throw all of their advertising matter into the waste basket that does not conform to standard sizes. It is needless to say here that a central station man will say, unless you do so and so I will throw your advertising matter into the waste basket, for the fact that it has gone on so for years and years makes the statement entirely unnecessary."

T. F. Grover, of Fond du Lac, recited some of his recent trials in locating price lists, which he had filed for future reference and heartily endorsed the movement.

F. W. Bowen, of Kenosha, Wis., said that while he and other central station men had systems which they had used for some time, for filing away information for reference, these systems did not accomplish the object so fully as they would if the association had a standard size for advertising matter which its numbers would receive from manufacturers or dealers. However, he did not think the association ought to act too hastily in adopting sizes, although he was aware of the fact that Mr. Gille had given the matter a great deal of attention for some time.

A. M. Barron, of South Bend, Ind., favored the adoption of the report at once, because any other action would practically sidetrack the matter for another year. He thought if the report were adopted, advertisers would fall in line as soon as its contents became known over the country.

Mr. Cutter thought the scheme should be worked up more fully and the report should not be considered as final. He would like to know, for instance, if he was to adopt any special style of headings on circulars, whether there would be some special classification of machinery, some special method of naming machinery and a number of questions of this sort, a settlement of which would make it possible to file away these things where they could be found.

Mr. Gille: "We have gone into the matter of size very carefully. The first size is United States standard postal card, 3 in. x 5 in.—that is the standard size adopted by the Globe-Wernicke Company and every other cabinet company in the country. Most of us use the card index system to some extent at least, for prices, etc., and we know that to be true. The next size is standard pocket size, a size adopted by every one of you, I think. The next larger is the volume size; that is the standard size in which the proceedings of the American Institute of Electrical Engineers, our own proceedings, the proceedings of the National Electric Light Association, and other associations, are printed. In regard to the letter head size, it is a standard letter paper size, and all patented binders are made that size. We have not favored any one in this matter, and, taking a general view of the matter, the sizes that we have selected cannot be improved on very much."

Further discussion and action on the report was postponed until the following day.

LETTER FROM MR. DOHERTY.

Henry L. Doherty, of Denver, Colo., who was unable to be present, sent a communication, urging that the association take some action tending to support the Louisiana Purchase Exposition, in St. Louis, in 1904. Since the National Electric Light Association has already fixed its place of meeting as St. Louis in 1904, he suggested that the Northwestern Electrical Association hold its summer meeting there, or join with the National Electric Light Association at its convention. The assurance that electrical men would attend the convention will greatly influence the decisions of possible exhibitors and will encourage those who have already decided to exhibit, to elaborate on their present plans. After some discussion it was voted that the association hold its summer meeting in 1904 at St. Louis, in connection with the National Electric Light Association.

NORTHWESTERN ASSOCIATION HISTORY.

Secretary Thomas R. Mercein presented in a very attractive form a brief history of the Northwestern Electrical Association. It was in Oshkosh, in 1892, that a handful of men of electrical interests organized the Northwestern Electric Light Association. The next meeting of these men, with others, was held at Milwaukee, in February, 1893, and the organization incorporated as the Northwestern Electrical Association. Since its first meeting the association has held two conventions annually, except in 1899, when no summer convention was held. The summer conventions were briefly reviewed by Mr. Mercein. The association has now some two hundred members, about equally divided between active and associate lists.

The rapid growth of the electric lighting industry in the West called into a new field of business many bright, progressive men, who had not the technical education now to be had in every college in the land. Manufacturers of electrical machinery turned out a product comparatively in the experimental or development stage. Modern economies of central station management were unknown. Design of central stations was not then, as now, the result of careful, conscientious work by experienced engineers. The ubiquitous legislator, elected often either as a dependable cog-wheel in the political machine, or because he is a "good fellow," and not on account of his brains, ability or judgment, preached municipal ownership as a peg to hang speech upon and as a medium of information for unthoughtful constituents that their representative in legislative halls was protecting their interests.

These and many other reasons led to the formation of the Northwestern Electrical Association, for mutual aid, information and protection, for social intercourse and good fellowship, for interchange of ideas, and standardization of apparatus, material, work and methods. The association has done much to help its members along all these lines.

While the association's proper territory is the Northwest, it has many members in States outside of that region. The association gives special attention to the interests of the smaller central stations in its territory, believing that the larger plants, theoretically, at least, are not so much in need of its services as are the smaller ones. The expense of membership is so light that no plant, however small, is debarred on that account. There has been no special or systematic effort to increase the membership.

After the reading of Mr. Mercein's paper, here abstracted, a vote of thanks was given him and a committee was appointed to act upon the suggestions contained in the paper.

The next paper was by Prof. A. H. Sabin, expert chemist for Edwards, Smith & Co., of New York, on the subject of

METAL PRESERVATION.

The paper, which was somewhat in the nature of an informal talk, reviewed some of his work on the coating of pipe to prevent corrosion, numerous instances being cited where water pipes and the like had been coated so as to successfully resist rust. It was explained why coatings applied cold, as paint, could never equal baked enamel coatings. A high baking temperature of 400° Fahr. during the process of oxidation of the linseed oil which forms part of the compound, prevents the slight porosity of the coating and drives off the film of air, which might exist between the applied compound and the metal to be coated. The fact that this coating, oxidized at a high temperature or in a fused condition, was not porous, was proved in a test made several years ago by an electrician of the General Electric Company, who found a film measuring .0025 inch in thickness to afford complete insulation against a direct current of 6,500 volts. If the coating had been porous it would have allowed the current to leak through the lower voltage.

The process for doing this work requires that the surface of the metal be made first clean, either by pickling or by the sand blast. The sections to be coated are then to be put for a few minutes into the hot oven, then into the hot compound. Two or three minutes is long enough in the dipping tank. It is then slowly drawn out and put into the oven, where it is baked for about two hours, when it is done.

At the close of the paper Mr. Pearce, of Negaunee, Mich., said that central station men had a great deal of trouble with smoke stacks, and inquired the best way of maintaining them.

Prof. Sabin said that the primary trouble with the smoke stack is that it gets so hot that no paint or varnish can be applied that will stand for any length of time, since all these coatings are organic substances. As an engineer, he might maintain that the temperature of the gases going into the smoke stack should be below 400° F., but at the same time this was not always the case, and in consequence the paint burned off the stack. He cited instances where steel stacks had stood five or six years without repainting and the paint was still in excellent condition.

Mr. Pearce said that his greatest trouble was in stacks burning out the fourth or fifth course from the top, the stacks being about 75 feet high.

Prof. Sabin said that this was due to sulphur in the coal, which formed sulphurous acid, which was very, very corrosive. This was not hard on the paint, because good paint would stand considerable acid; but none of the paints was entirely non-porous. The acid gets through the pores to the iron underneath, and heaves the paint off.

J. H. Harding, of La Porte, Ind., inquired as to the efficacy of coating the inside of hot water pipes. He said he was operating a central station heating plant, and had some trouble with the nipples in the radiators being eaten up. There was no trouble with the circulating pipes of the system. He wondered whether there was any preservative that would protect these nipples.

Prof. Sabin did not think there was. He did not know of anything that would withstand hot water for any length of time. Granite ware enamel will withstand hot water for a time, but not for months and years. Hot water will dissolve almost anything, if you give it time.

The president appointed as a committee to consider the relation of national and local organizations, mentioned in Mr. Mercein's paper, the following gentlemen: Thomas R. Mercein, P. H. Korst and E. L. Debell.

A committee was appointed to consider the proposed additional clauses to be inserted in the National Electrical Code, which had been sent for the consideration of the association by the council of the A. I. E. E., regarding precautions to be taken in connection with extra high voltage constant-potential circuits, and grounding of secondary circuits, this committee to report the following day. The committee appointed consisted of W. T. Putnam, R. N. Kimball and P. H. Korst.

THURSDAY MORNING SESSION—TAXES.

The meeting was opened with a call for questions and answers.

Mr. Pearce. "About the only question that I have is the subject of taxes. In Michigan during the last year we have had a tax commission visit all the railroad plants in the State, and our plants have increased in value about 200 per cent. Ours, for instance, has been in operation for about twelve years, and during the twelve years instead of depreciating in value, it has gone up 200 per cent. The plant when it was built cost $142,000, and they had an expert come around and look the thing over, and thought we ought to go down on the rolls for $200,000. We will sell them the plant for $80,000. Now, if anybody has any way to suggest to get out of paying this enormous amount of taxes, which amounts to about 4 per cent. of the capital stock, I should like to hear from them. They have placed our valuation on the basis of the gross receipts of both gas, electric light and street railway, so that if we earn $12,000 our assessed valuation is $200,000. There is another street railway in that part of the State which is a modern, up-to-date plant, recently built. It is one of the best plants in that part of the country. It cost in the neighborhood of a million and a half dollars, and the tax commissioners put it on the list at $577,000. So we have a plant that is a wonder."

Mr. Bowen expressed an opinion that taxation of institutions of this class should be upon a basis of the net results. A plant may cost a million dollars, and lose money; and the additional burden imposed upon it of taxation on the cost of the plant would mean a very considerable deficit in the balance sheet. Another plant might cost a hundred thousand dollars, only one-tenth of what the first plant cost, yet have made possibly 20 per cent. Now that fellow ought to pay an equitable tax, based upon the result of his business. The other fellow has got a non-paying proposition, and, on the theory of the taxing authorities, he really ought to pay no tax whatever. Taxation, in theory, is levied against taxable assets. If the plant is a money loser, it is not going to be a taxable asset for any continued length of time. Taxation of public service corporations ought to be a reasonable tax, based upon their profits, and not upon any arbitrary valuations.

The president thought that it would meet the desire of the public better if these corporations were taxed upon the percentage of their gross receipts, rather than upon their net profits, since the net profits might be disposed of by the company in one way or another. Mr. Bowen still maintained that a losing venture should not be taxed, because, theoretically, it had nothing with which to pay the tax.

President Lord.—Supposing a merchant had a stock of $100,000. He had it there in actual, tangible goods. He ran the business, and at the end of the year instead of making any money he lost $5,000; would you say for a moment that he ought not to pay any taxes on that stock of $100,000 because he lost money during the year?

Mr. Bowen thought the merchant received a certain amount of police and fire protection, which would cost the commonwealth something, and it should receive a return for its expenditure on his account. In other words, it is "ready to serve" him, according to Brother Doherty, and this ought to be paid for. He thought very few companies would run their books in such a way as to mislead themselves, if they could help it, and that there was at least a reasonable degree of honesty in the managers of corporations, as well as among private individuals, that would not permit them to willfully misrepresent to the taxation authorities the condition of their business. He thought in the matter of taxation of public service corporations, there was no question but that their methods of bookkeeping and their books should be open to the authorities, and this would be a sufficient check upon any condition of affairs which would be misleading as to the profits.

A. M. Barron thought the assessment of public utility property should be made on the physical value, rather than on the gross or net receipts, because bookkeeping is so susceptible of manipulation. In Indiana the material and physical value of the property is taken in making the assessment.

Mr. Pearce said that in Michigan the Board of Taxation Commissioners levy on tangible value, or property, and also on the intangible value, or franchise; so that they are taxed on franchise, as well as on physical property. He mentioned some cases of inequality of taxation in his State.

Mr. Gille: "We are being taxed now on the so-called physical properties of the plant, but we would very much prefer a gross earnings tax. We believe that everybody up in our country prefers a gross earnings tax, on the ground that it is a great deal better than to be placed in the hands of an assessor, who does not know very much about the property. At the same time a gas, electric or street railway property is such that it is pretty hard to tell what the value of it is, and I do not think there is any question but what in a very short time the entire country will place electric, gas and street railway properties in a parallel line with telephone and railway properties, and I think it ought to be done, and I think it is the only way to get at a fair valuation of the property."

NEW RULES FOR ELECTRICAL CODE ENDORSED.

The committee appointed the day before to consider the proposed additions to the National Electrical Code, submitted to the association by the council of the American Institute of Electrical Engineers (which is securing the views of electrical men on the rules before action is taken by the Underwriters' National Electrical Association), reported in favor of the rules as they stand. The proposed rules adopted by the joint committee are familiar to the readers of this journal.

The committee reported that it had conferred with a number of the members, who would be most interested in this matter, and that all seemed to think there was nothing against their interests in this joint report. The rules mainly take the form of suggestions.

Mr. Gille said that this report referred only to outside construction of constant-potential circuits of over 5,000 volts, and, therefore, affected only transmission lines. He thought the regulation proper, and recommended it to the American Institute of Electrical Engineers some time ago. He considered it perfectly proper that the association should endorse the proposition. After some discussion the report of the committee was adopted and accepted.

STANDARD ADVERTISING SIZES ADOPTED.

The report of the committee on standard sizes for advertising matter which was presented the day before, was the subject of a lengthy discussion. All seemed to agree that there was great need for such standards. The discussion was mainly on the best way to further the movement, in order that it might be made national, rather than purely local, among electrical organizations, and that headings and subjects might be formulated for convenience in filing. The discussion was taken part in principally by Messrs. Almert, Gille, Bowen and Barron. It was finally moved and carried to adopt the report of the committee, and to continue the committee, that it might push the work further and bring the matter before other electrical bodies.

J. W. Shuster, of the University of Wisconsin, then read a paper on the subject of

RATES AND METHODS OF CHARGING.

Six methods of charging were outlined. The flat rate, the meter rate, the Wright maximum demand, the Doherty rate, the four-C system and the double-rate meter. The only apology for mentioning the flat rate, is the fact of its existence. The fact that the station has no check on the length of time the lamps are in use makes it obvious that the flat rate is unjust and entirely devoid of business principle. The rate should be refused entirely or made so high that consumers would prefer some meter rate. In dealing with most commodities, a charge on the basis of product delivered is generally equitable. The plain meter rate does this, but the supplying of electric power deals with conditions of investment that are seldom if ever met with in other lines of business. These conditions require the working out of special systems of charging more equitable to company and consumer. The various methods of charging outlined at the opening of the paper were then described in detail, the Wright demand system as developed in England being first taken up.

Mr. Gille: "This is a very interesting paper to me and probably is to every one, and is a subject which will bear considerable study. I would like to take issue, however, with Mr. Shuster on one point. He says the only apology for mentioning the flat rate is that it is in existence. I differ with him there. I believe that there is a large amount of business in every central station, be it large or small, that can be gotten on a flat rate better than it can in any other way. I refer to sign lighting and window lighting. That is a class of important business which you cannot get on meter rates, but you can get satisfactory compensation out of that class of business on flat rates. In a big city that class of business is very important."

President Lord: "In reply to Mr. Gille, I will say that I have tried flat rates, and have tried meter rates; and I tried the flat rate on the window and design lighting, charging so much a month; but the trouble with our customers was that they would go home and leave the lamps burning all night, and I could not get an adequate rate. But I realized that they should have a lower rate for that window lighting, so I simply connected my window lights and side lights on a separate meter, and I said, I will make you a special rate for your window lighting; that was done, and the plan proved successful."

Mr. Gille: "In very large cities inspectors are employed for all night service, and any man that burns his lights longer than his contract permits pays extra for it."

Mr. Almert: "I think Mr. Gille's scheme works out all right in the congested districts of large cities, where they must have an inspector all the time, and it is a policy in most of the big cities to have such service connected with service boxes, and the lights are thrown on and off by an employee of the company; but I do not think it would work out in small cities."

Mr. Gille: "I neglected to say that there are quite a number of time switches on the market at the present time; we are using quite a number of them, and believe that the use of the time switch solves this question. The time switch throws the sign in and out whenever desired."

Mr. Shuster: "As to signs, that question has been discussed by very many authorities who have had a great deal of experience in station work, and they differ very much as to the advisability of giving a flat rate on sign work, or on giving a special meter rate, as has been suggested. In regard to the flat rates, one of the objections has been mentioned as being due to the fact that they burn the lights longer than is specified in the contract, and the other objection is that there is quite a considerable objection to giving a special rate in cases of that kind, from the fact that when you commence giving special rates for any particular kind of service, there is no end to the number of special rates that you can make."

Mr. Almert: "I have found that the great difficulty with many of the small store owners who would like to have electric signs is the first cost, and I have found it profitable to make a proposition similar to this, that the central station sells him an electric sign and makes him a rate of so much a month, by which he pays for that sign, and also for the current consumed. Included in this is the cost of an automatic switch on the premises, instead of a meter, which is taken care of by an inspector who winds it every 7 or 8 days, and changes the time of the clock as the dusk hour changes."

HOW SOME PLANTS COULD BE MADE TO PAY BETTER.

Prof. Geo. D. Shepardson, of the University of Minnesota, was on the programme for a paper on the subject, "The Economic Value of Testing." He said that there is a tradition abroad that some trusting superintendents believe everything that is told them or that they read or hear in regard to the claims made by manufacturers. Now, it is sometimes suspected that manufacturers and particularly their selling agents, wax enthusiastic as they continue to present the advantages of their particular apparatus, and their enthusiasm is always on the increase. Some things that they wish were so they soon believe are so. If the station man accepts everything that is claimed he sometimes awakens to the fact that he has been deceived. Not that the manufacturers intentionally deceive him, but still he finds things are not exactly as represented. Even if they are as represented at the outset it sometimes occurs that equipment is subject to deterioration, and its performance after a time—weeks, months or years—may be very different from what it is when equipment was new. So it seemed to Prof. Shepardson that the topic of this paper represented a matter of considerable importance. He believed that everything should be tested which enters into the cost of production and distribution, from the coal pile to the receiving cashier. So the subject of this paper might very well be, "How Some Plants Could Be Made to Pay Better." We hope to give an abstract of the paper next week.

In connection with the desirability of the 8-hour day, Prof. Shepardson supplemented his paper by saying that he was often invited to recommend men for going into central stations, and the new graduate from a technical course is attracted to station work. "There are opportunities there for a good man, but when they get out and find they have to work from 12 to 20 hours a day for 7 days in a week and no let-up at all, except in the summer time, they find it a pretty serious proposition, and unless the opportunities for advancement are unusual you will find that the better class of technical graduates are going over into the factories, in with the construction engineers, and that they are going into the station operation less and less frequently. Now, it seems to me that that is unfortunate for the central station people. My students have been going less and less frequently for several years into station work, and it is because of the long hours and the slow rate of promotion and low wages which they get as compared with the wages that they can get elsewhere. I am not here making a petition that you go after technical men, because the demand for college graduates exceeds the supply very greatly. I think in the last 12 months I have had fully six times as many applications for graduates as our last year's graduating class numbered, and there is no occasion whatever to beg for jobs; but looking at it from the standpoint of station operation, it seems to me that if the station men could make the conditions of the employees more like those obtaining in other lines of practice, they would secure a better class of men for operating in the stations, and these men would stay longer with one concern."

The Nominating Committee presented the following report: For president, F. W. Bowen, Kenosha, Wis., for first vice-president, H. J. Gille, St. Paul, Minn.; for second vice-president, A. M. Barron, South Bend, Ind.; for secretary and treasurer, Thomas R. Mercein, Milwaukee. For Board of Directors—S. B. Livermore, Winona, Minn.; T. F. Grover, Fond du Lac, Wis.; J. H. Harding, La Porte, Ind.

The report of the committee was adopted and the ballot of the association cast for the officers nominated. The new president was escorted to the chair, and responded to the honor conferred upon him in a few well-chosen words.

On motion of Mr. Ahnert, the Committee on Standardization of Advertising was authorized to appoint sub-committees in such territories as he sees fit, to work in connection with the committee.

Secretary Mercein said in behalf of the Committee on Consolidation of Electrical Associations, that he did not know whether he approved of the plan or not. He would like an expression as to whether or not it was advisable for the committee to take any action at present, with a view to the consolidation of electrical association interests. His personal feeling at the moment was that it would be best to have the committee discontinued.

President Lord said: "We do not care to syndicate the Northwestern Electrical Association. We have done well. We have a large and prosperous association; and it seems to me, really, that the committee which you appointed yesterday on motion should be discharged."

President Bowen called attention to the fact that there were a number of gas associations, but none of the State associations had in any wise drawn from the strength of the membership or the work of any larger associations. He thought that both the National Electric Light Association and the Northwestern Electrical Association would both continue to grow stronger as time goes on.

Mr. H. C. Wirt, of the General Electric Company, Schenectady, N. Y., was then introduced and read his paper on "Automatic Voltage Regulators." By way of introduction, he said that Prof. Shepardson's paper revealed a bad state of affairs in central station practice due to improper voltage regulation. The paper to be read would suggest methods to correct these troubles.

During the reading of his paper, Mr. Wirt said: "It is the custom of lamp manufacturers always to find out whether their customer has an alternating-current plant or a direct-current plant; that is, they know by practical experience that it would be useless to send a high-efficiency lamp to an alternating plant, although I think with the high pressure the reverse condition ought to occur; that is, you would expect with that high pressure that the alternating plant could run with less drop and therefore the alternating plant should use higher efficiency lamps than the direct-current plant. The tables issued by the incandescent lamp manufacturers are not taken as they should be by the central station men. Think of only one volt variation on a 100-volt circuit decreasing the life of your lamps 18 per cent. I think it is physically impossible for a station to-day under practical conditions, to keep good voltage (that is within a volt). A great many think they are doing it, but put a recording chart on and you will be surprised at the result. We are all studying methods to improve our condition, and I think it is a case where a little expense will do a wonderful lot of good. Most of you know cases where by spending a lot of money you can improve your conditions somewhat, but what you are looking after is where a few hundred dollars will do a great deal for you; and I think voltage regulation is the place to put your money."

Mr. Gille: "It seems to me that we have got a question before us now that there is not a plant in the country that is not vitally interested in. We are operating a water power plant similar to what Mr. Wirt has described, and we must keep a man at the switchboard and one at the water wheel governor, day and night. Has this system been worked out so that it will handle rotary converters at the end of a 30-mile transmission line?"

Mr. Wirt: "We are working on that line. We can do the work all right on a motor generator set. We are developing regulators to keep motors at absolutely constant speed, and I think we can do something with the rotary converter. Before the regulator was used the cases of trouble that we had from that source were such as to cause us to throw up our hands, and it was practically a question of taking our machinery back.

"It can be arranged so that it would maintain practically absolutely constant voltage at your point of distribution. That is exactly the condition that we had in Colorado, that the circuit was so long, where they had induction motor work, that whenever they started the motors, they would kill the machines—they could not operate in spite of the fact that they had men there to grab the rheostat. But they could not do it quickly enough. In other words, a man cannot catch the rheostat arm and jerk it around 800 times a minute, as the regulator does."

Prof. D. C. Jackson, of Madison: "We have found, as Mr. Wirt says, that to regulate quickly, the arm of the rheostat must be thrown clear around and brought back, which it is very difficult for a man to do quick enough. But this machine does the work. I wish to ask Mr. Wirt, and it is a point that I do not believe would really be troublesome in the regulator, but it seems to me with a very sensitive exciter there would be a tendency for a variation in the voltage passing through the generator field, and I would like to know whether any trouble of that sort has been noticed, from the heating of the fields from the use of this Tyrrell regulator.

"Another point which I think is of interest to all of us who are interested in transmission work, is whether the General Electric Company has taken up, in connection with this regulator, in the compounding of the regulator, the regulating for the inductive drop, which has been taken up to a certain extent I know, by some of the companies, and I doubt not the General Electric Company has done the same. I should be very glad to hear regarding these two points. I know one thing regarding the Tyrrell regulator, that in Burlington, Vt., Mr. Tyrrell put in such a regulator as this, and when I examined that regulator it was a great curiosity to me, but at the same time it seemed to do the work, and I am inclined to think that we have every reason to believe what Mr. Wirt has been telling us regarding the remarkable operation of this regulator."

Mr. Wirt: "As regards the exciter, we do not notice any flickering in the light. We did until very recently notice a flickering in the light of a direct-current machine, and we were up almost to the point of recommending an independent exciter for the direct-current machine where the flickering was objectionable; but we found that by greatly increasing the rapidity of the relay magnet, we could do away with all the flickering. We have not noticed any trouble with any of the generators operated, in connection with these regulators, in the way of heating fields or otherwise.

"We do not simply go down a little way, but go way down if we want to bring the voltage down. We apply so much energy to changing the voltage that it overcomes any reluctance of the fields, and for that reason we stipulate in the operation of the regulator that the exciter must be one where you have great range of voltage; where you can apply 125 down to 40 volts to get a 110-volt working result. As regards compounding for inductive loads, that is allowed for, and Mr. Tyrrell, who has made a special study of that, says that it compounds for the induction loads."

(Charts were exhibited by the speaker, showing the difference in constancy of voltage with and without the regulator, the charts where the regulator was used showing a constant voltage in every instance, while the voltage where the regulator was not used was quite variable.)

Mr. Almert: "There is one point not quite clear to me, and that is regarding the operation of a number of exciters from the same machine."

Mr. Wirt: "By putting the exciters in multiple you can control the voltage of the exciters; that is, you operate your generators and exciters both in multiple, with one regulator."

MODERN ILLUMINATION.

The lecture by W. D. Ryan, of the General Electric Company, Lynn, Mass., was the best attended of any feature of the convention, the room being crowded to listen to Mr. Ryan's remarks and to see his demonstrations. The lecture was illustrated with lantern slides and with some other optical apparatus. He said in introduction that the subject, properly speaking, should be treated in a series of four or five lectures, and it would be necessary for him to make some very abrupt turns, going from one subject to another, because of the limited time at his disposal.

His introductory remarks and demonstrations were on certain well-known scientific facts regarding light and color, and led up to the point where it was demonstrated that it is necessary to have a white light in order to properly match colors. For instance, if you have a light that has no violet in it, and attempt to look at a piece of material which would ordinarily reflect violet, it would not appear violet at all, but would go down as low as the bronze; so that a piece of violet material, purchased in a light which has not the proper amount of violet, will have a very different look in daylight from what it did under the circumstances mentioned. We must be careful in all lights to get it as nearly daylight balanced as possible. There is an average daylight effect which we can approach very closely with the arc light, but it has not been approached with any other form of artificial light.

He showed, projected on the screen, a photograph of an invention of his called the Ryan chromoscope, which is used for comparing the appearance of the same material under different kinds of light at the same time. This experiment, he explained, was useful in showing prospective station customers the effect that different kinds of light would have in a display of goods.

A diagram was exhibited showing the relative proportion of the different kinds of light waves in sunlight, arclight and gaslight, indicating not much difference between the sun and arclight, as to quality, but considerable difference between arc and gaslight.

The object to be secured in illumination is to get lighting even. Mr. Ryan here showed his new form of concentric light diffuser and also some special forms of diffusers. He called attention to a form of reflector lamp, used at a shipyard over very large ships, so that shipbuilding could be continued at night. The effect is like daylight. There are practically no shadows. This is the first time that ships have been so lighted that the men could work safely on them at night.

The superior quality, volume and unequaled economy of the electric arc is so well recognized that it has supplanted all other artificial lights for high-class mercantile illumination. The open arc, while giving an especially white light of high candle-power, concentrates the most powerful rays in a comparatively small circle within a few feet of the lamp. The circle encloses a dark zone directly under the lamp and beyond the ring of concentrated light, the illumination falls off rapidly and the general result is most disastrous to good lighting, particularly when the goods and surroundings are dark and not of a diffusive character. Not only is it impossible to show material satisfactorily where the light is weak, but merchandise displayed in the strong circle of light is so brilliantly illuminated that in the case of colored fabric the eye fatigues and the complimentary color introduces itself, which robs the original color of its purity. This in many cases causes the customer to become undecided and a lost sale results.

If there was any way of estimating lost business due to this consequential after-effect, the figures would undoubtedly be astounding.

In many stores, fatigue and subjective color effects are partly corrected by the use of dense globes. There still remains, however, equally serious inherent defects, namely, the distortion of the light distribution due to the wandering of the arc, and to the great change in the total volume of light at different increments of time between the so-called picking up and feeding points.

About 1893 several so-called incandescent arc lamps having the defects mentioned, considerably minimized, were introduced. These lamps were of the rack and pinion or clockwork type. The mechanism was of a somewhat delicate character and not sufficiently rugged to withstand rough handling. Further they were fed with high-grade cored carbons of a prohibitive price for general purposes, especially as a pair of carbons was consumed in about ten hours.

The enclosed lamp was placed on the market about 1895 and was soon recognized as having superior advantages of distribution, steadiness and maintenance economy over its predecessors and so rapidly is it replacing the open arc lamps that the latter will in a very short time be regarded as practically obsolete.

The enclosed arc while giving a superior distribution to the open arc is far from perfect and there still remains in a reduced degree the objectionable effect of the wandering arc.

The General Electric Company has been carefully studying this important problem and as a result the concentric light diffuser has been introduced. This apparatus while of an exceptionally simple character, not only cuts down sharp contrasts and diffuses the light equally in all directions, but the effect of the wandering of the arc has been reduced in a considerable degree, so that the light at any point is to a great extent independent of the position of the arc with respect to the carbon ends.

The apparatus consists of a metal diffuser attached to the lamp casing in the same manner as an ordinary reflector or shade. In place of the outer globe a screening shade is used which performs the double function of subduing the light directly under the lamp, while the upper portion of the shade is so shaped that much of the light strikes it beyond the critical angle and is then thrown to the diffuser and added to the direct rays, which naturally go upward. From the diffuser it is distributed, producing a white, even steady light, the general effect of which is most pleasing and the illumination is especially easy on the eyes, being particularly adapted to the matching of colors, which is of the utmost importance in a very large percentage of mercantile lighting. Furthermore, the diffuser makes the illuminating power of the lamp independent of the nature or color of the ceiling; that is to say, it is immaterial whether the ceiling is light or dark. The light will be about equally effective under all overhead conditions, as there will be practically no light lost by absorption, in the ceiling itself.

The semi-concealed arc lamp is especially recommended for use in cotton, silk or other mills where arc lighting is generally difficult owing to shadows cast by high looms and other light-intercepting objects. For printing, calendering, folding and other machines requiring concentrated light the adjustable diffuser has been designed. This diffuser is especially adapted to the lighting of mills with high-studded ceilings or saw tooth roofs. It is so arranged that the light can be "tuned" so as to change the distribution without moving the lamp. This makes it possible to throw more light on a given loom which may require a stronger illumination and this can be satisfactorily accomplished without disturbing the operators on other looms, which would naturally follow a change in the location of the lamp itself.

The arguments advanced in favor of the concentric diffuser may generally be applied to the adjustable diffuser, except that the latter throws the light only on three sides. The lamps are usually small units and are placed back to back, as shown in the accompanying cut. It will be found that in the majority of cases the concentric diffuser will be most satisfactory, particularly if the mill to be lighted has a low-studded roof or ceiling.

It must be recognized that to give definite data on the amount of light or power required to illuminate a given area is most difficult. Not only does there exist a wide difference of opinion as to volume of light which should be called satisfactory for a given set of conditions, but the conditions are so variable that it is practically impossible to lay down a set rule. For instance, the amount of light required varies with the physical dimensions of the building, the height and color of ceiling (when the concentric diffuser is not used) color of walls, also the number of obstructions in the center of the area illuminated as well as in the nature of the stock; that is, whether it is generally light or dark, etc. Therefore, each building illuminated practically calls for a separate piece of engineering based on the particular condition to be contended with.

Close attention to the matter of general lighting and the compilation of careful data has enabled us to suggest some general figures which will answer for average conditions. We have also added a maximum and a minimum to cover extremely good or particularly bad conditions of lighting. In any case the figures will serve as a general guide.

It will not be necessary to differentiate between alternating or direct current as one set of figures will in general answer for either, nor will it be necessary to consider the size of the unit. If the area illuminated has a high-studded ceiling of say 14 or 15 feet, it is better practice to use say 6-ampere lamps and take advantage of the higher efficiency of the larger units. If, on the contrary, the ceiling is low, say 8 or 10 feet, and there are a number of obstructions which would intercept the light from the various lamps, to get the best effect, it will be necessary to use small units of say 4 amperes. The better distribution of the small units in this particular case would offset the higher efficiency of the larger units. The amount of power consumed per square foot should figure up about the same in either case.

When laying out a lighting plan, if the question arises of a few watts more or less one way or the other it might be well to bear in mind that as an advertising feature, a strong illumination inside associates itself better with the building making the display, than a moderate light inside and an incandescent display on the front of the building. In many cases it would be better policy to add the power expended on the front of the building to the lighting of the interior. This is a point of considerable importance, and is well worthy of consideration, as it would not only act in many cases as a better advertising feature, but would undoubtedly result in increased sales due to the superior light.

WATTS* PER SQUARE FOOT FOR HIGH CLASS ARC LIGHTING.

Building.	Average Conditions.	Range of Variation.
Machine shops, high roofs, electrically driven machinery, no belts	.75	.5 to 1
Machine shops, low roofs, belts and other obstructions	1	.75 to 1.25
Hardware and shoe stores	.75	.5 to 1
Department stores, light material, bric-a-brac, etc.	1	.75 to 1.25
Department stores, colored material	1.25	1 to 1.5
Mill lighting, plain white goods	1.1	.9 to 1.3
Mill lighting, colored goods, high looms	1.3	1.1 to 1.5
General office, no incandescents	1.5	1.25 to 1.75
Drafting rooms	1.75	1.5 to 2

* Energy based on watts at lamp terminals.

Mr. Gille: "Why do you take the square feet for enclosed spaces for lighting instead of the cubic feet?"

Mr. Ryan: "If you use the square feet it gives you a constant that is very satisfactory, whereas if you use cubic feet it involves a continued change. You get a better diffusion at a greater height by the method I suggested. As far as incandescent lighting is concerned, you may perhaps use the cubic foot basis there. You have a different condition there. You are not trying to work at such great heights and are on a constant level all the time. But personally, for all kinds of lighting, I prefer the square foot basis, but a combination of the two may be desirable. With this diffuser you can get along with about 25 per cent. less lights, but we are not advocating that. We go to a man and say, you use a diffuser and you will get better light with the same amount of power. We are not increasing his bills, but he will get a better light out of the same number of arcs. In Wanamaker's store there were five arcs and 105 incandescents, and we took out 100 of the incandescents and replaced them with 5 arcs with diffusers, but no more power was used, although the light was much better and much better diffused. In some cases where a man is using a moderate amount of power, say from a watt to a watt and a half, with two sources of light, we put it all together and give him a fine light of one kind. Lights of different kinds do not mix very well. You cannot mix daylight and artificial light, or two artificial lights with much satisfaction.

"With regard to the apparatus used at the shipyard, I would say that it is the best I ever knew. The lights are 60 feet apart running lengthwise of the building and are up 150 feet high.

"With regard to the mirror reflector, I would say that it must be superseded by something better. We have a device now with a highly polished surface which is kept in good shape by the shade, that does very well indeed—better than the mirror reflector which is always getting dirty.

"With regard to the suggestion that the color of the walls as well as the ceilings be added to these data, I would say that all details were not attempted to be placed on the tabulated form, but it is a fact that with a concentric diffuser you are almost independent of your ceiling, and the side walls ordinarily are so far removed from the lamps in store lighting that it is not necessary to consider them. It would, however, be necessary in a small room, of course."

The attendance at the convention was about 25 central station men, and about 40 supply and manufacturing companies had from one to half a dozen representatives each.

Recent Electrochemical Developments.

By CLINTON PAUL TOWNSEND.

A NEW METALLURGICAL METHOD.

The incandescent electric furnace has never been applied with any signal success to the production of the non-volatile metals. On the other hand, its earliest development was connected with the production of such metals as zinc and sodium, and such metalloids as phosphorus, which are recoverable as products of distillation from a mixed charge. By the term "incandescent electric furnace" as here used, it is intended to include such furnaces as are actuated by the heat developed by the current in a conductor of the first class, as distinguished from the "electrolytic furnaces" or molten electrolytes which are maintained in fusion by the current.

The reason for this non-applicability of the incandescent furnace to the production of the fixed metals is to be found in the fact that these metals have in general a strong affinity for carbon, and that, therefore, the use of a carbon core usually determines the formation of a carbid. If carbon be present in the furnace in proportions not exceeding those absolutely necessary for the reduction, even silicon and aluminum may be produced in elemental form, but in the presence of the excess of carbon represented by the usual resistance core, corresponding carbids are formed.

Of the two suggested remedies, namely the use of a refractory core other than carbon, and the coating of the carbon core with an inert, refractory and heat-conducting sheath, the former is impracticable for commercial metallurgical work; and until the recent brilliant discovery of Mr. Acheson that the carbids themselves possess the essential qualities for the sheath, the latter could be used only for metals of relatively low-fusing point. The production of such elements as silicon and aluminum by this means, a result now accomplished by Mr. Acheson, has been heretofore impossible.

Mr. Acheson's furnace requires only a few words of description. A carbon core, preferably of granular coke, traverses the charge to be reduced, the terminals being electrically connected in the usual manner. Around this core and interposed between it and the body of the charge, is a sheath which may be formed of carborundum crystals, or of silica and carbon in proportions to form carborundum. In operation, this interposed protective material being subjected to the high temperature of the core, is fritted or agglomerated into a coherent layer or sheath which possesses sufficient strength to support the carbon core after the charge has fallen away from it by reason of the reduction of bulk consequent upon its reduction to metal, and which possesses the qualities fitting it for use as a refractory, non-fluxing, conductor of heat. The metal, as aluminum for instance, collects at the base of the cavity formed around the core.

RECOVERING TIN FROM SCRAP.

A patent issued to R. H. Gould, of Surbiton, England, derives its chief interest from a detailed statement of the e.m.f. which may be derived over long periods from the system; tin scrap—sodium chlorid solution—carbon, functioning as a galvanic cell. The process is simple and new and consists in partially detinning scrap in a chlorid solution by opposing the tin scrap as anode to a carbon cathode. Both tin and iron pass into solution and the current generated by a series of these cells is employed for completing the work of stripping the tin, being conducted for this purpose to supplemental vats wherein previously treated portions of the scrap are connected, again as anodes, in a solution of caustic alkali. The tin is precipitated in both sets of cells in a non-compact or spongy form.

The advantage of the method is that no current is supplied from an external source. Its obvious disadvantages are that it necessitates the double handling of a bulky and cheap material, that the first step involves the solution of iron as well as of tin, and that the tin is not directly recovered in commercially available form.

The Fritz Medal.

At a meeting of the Fritz Memorial Committee, held in New York on January 23, the announcement was made that the four national engineering societies have appointed the following as their representatives on the board of trustees of the Fritz Medal: American Society of Civil Engineers, J. James R. Coes, New York, one-year term; Robert Moore, two-year term; Alfred Noble, New York, three-year term; Charles Warren Hunt, New York, four-year term. American Institute of Mining Engineers, E. E. Olcott, New York, one-year term; E. G. Spilsbury, New York, two-year term; James Douglas, New York, three-year term; Charles Kirchhoff, New York, four-year term. American Society of Mechanical Engineers, Gaetano Lanza, Boston, Mass., one-year term; John E. Sweet, Syracuse, N. Y., two-year term; Robert W. Hunt, Chicago, Ill., three-year term; S. T. Wellman, Cleveland, Ohio, four-year term. American Institute of Electrical Engineers, Arthur E. Kennelly, Cambridge, Mass., one-year term; Carl Hering, Philadelphia, Pa.; two-year term; Charles P. Steinmetz, Schenectady, three-year term; Charles F. Scott, Pittsburgh, Pa., four-year term.

A preliminary organization of the board of trustees was effected and a committee was appointed to prepare the way for a permanent organization.

Water Power and High Voltage Transmission Plants as Investments.

The extent to which long-distance transmission plants are being built in California has been somewhat of a marvel to Eastern engineers, even considering the high price of fuel at the time some of these enterprises were started. While coal is very high in California, the extensive output of the various California oil fields and the cheapness of that fuel in some localities, would naturally lead to the belief that investment in very long high-voltage transmissions would in the future be very limited, because of the comparitively great investment required per kilowatt capacity in a large water power transmission, where expensive hydraulic work must be undertaken and where there must necessarily be a large investment in long high-tension lines. Nevertheless, the building of high-tension transmission lines and the employment of water power on a larger scale than ever before and at greater distance from the market than ever before, seems to have gone steadily on. Perhaps "steadily on" is too conservative a term to apply to the rapid growth that has recently taken place. Most noticeable is that in Southern California, which was the original home of high-tension transmission in America. Around Los Angeles oil is exceedingly cheap. In spite of this fact new and more important water power plants are being developed every year. In one case a range of mountains is to be crossed and power is to be brought a distance of 120 miles from the Kern River Cañon to Los Angeles. George H. Barker, of Pasadena, Cal., who was president of the Edison Electric Company, of Los Angeles, at the time the first 83-mile transmission of that company was started, has been in the East recently on business in connection with the recently formed American Conduit Company, of which he is vice-president. In conversation with Mr. Barker the writer expressed some curiosity to know how it was considered profitable in the Southern California territory to transmit power such great distances with the enormous investments involved, when plenty of fuel oil was available in the city limits of Los Angeles itself, at a very low cost. Mr. Barker's reply cannot fail to be of considerable interest to all who are in any way connected with high-tension transmission work, either in practice or in prospect. Mr. Barker is not now financially interested in the Southern California power transmission. His answer was, therefore, the more impressive. "These companies can prove to you," he said, "that they can transmit power from water power plants to the point of consumption and pay interest on the whole accompanying investment cheaper than they could generate it by steam power if fuel cost them absolutely nothing. While a water power plant is an expensive thing to install, the labor and maintenance required per kilowatt-hour, if the plant is a large one, is a very small item compared to what it is in a steam plant. Water power plants are now considered by investment houses as among the best classes of investment. The Edison Electric Company, of Los Angeles, is having no trouble in disposing of bond issues up to 75 per cent. of the cost of its extensive improvements. Its 5 per cent. bonds are selling at a premium."

Effect of Marconi's Work on Cable Quotations.

One is reminded a little by the decline in cable quotations of the drop in gas stocks some years ago when Edison's work in incandescent lighting was made public. The London *Economist* has the following to say on the subject:

That the progress made by Mr. Marconi has caused some apprehension among the interests concerned is indicated by the market quotations of the securities of the more important cable companies, which are, almost without exception, appreciably below the highest points touched last year. The following table illustrates the position:

	Highest, 1902.	Present price.	Fall.
African direct 4 per cent. mort. debs.	101	98	3
Anglo-American def. ord.	9¾	8¼	1½
Anglo-American pref. ord.	96¾	91	5¾
Commercial Cable 4 per cent. debs.	98½	94	4½
Direct Spanish ord.	3½	3	½
Direct United States ord.	10⅞	10	⅞
Eastern ord. stock	139	117½	21½
Eastern 4 per cent. mort. debs.	113½	106½	7
Eastern and South African 4 per cent. mort. debs.	101¾	100½	1¼
Eastern extension	13 15-6	11	2 15-16
Indo-European	42	40	2
West India and Panama 5 per cent. debs.	103	99½	3¾
Western Telegraph 4 per cent. debs.	102½	98½	4

Eminent authorities have questioned the commercial value of the Marconi efforts, and it is admitted that difficulties which seem to be of a very serious nature have still to be overcome. Yet, when confident predictions of failure are put forward, it is well to remember the opinions that were expressed when the submarine cable had yet to prove itself a success. But so far as the investor in cable companies is concerned, there seems at present no cause for undue pessimism. Mr. Marconi has shown that messages can be sent across the Atlantic by his system, but he has yet to demonstrate that his system can be worked on a paying commercial basis; indeed, before this can be done various difficulties, notably that relating to the tapping of messages, must be obviated. The policy of those financially interested in cable companies should be one of watchfulness, but not of panic.

In this connection it may be well to note that Prof. Willis L. Moore, chief of the Weather Bureau, while on a visit to Yale, delivered a lecture on the work of the government weather reporting system. He says with regard to the use of wireless telegraphy to report the weather and to warn vessels of the approach of severe storms: "Wireless telegraphy has been used experimentally by the Weather Bureau. We found that no system yet devised works with accuracy under varying atmospheric conditions. But wireless telegraphy is in the experimental stage yet. If it ever reaches that stage of perfection so that you can send several messages at the same time within the same magnetic field it will become very valuable to the meteorological service, for then we could flash our storm warnings from our coast stations out to vessels a long distance at sea. I do not think wireless telegraphy will interfere with submarine cables, for where permanent and rapid communication is needed the cable will be the better means. Many government officials, I think, are in favor of government control of wireless telegraph interests. Such control would prevent erection of interfering stations for one thing."

Combined Alternating and Direct-Current System.

By Eleazer Darrow.

In a great many of our cities we have combination power stations which supply street railway power 550 volts to 600 volts direct current and also furnish lighting service from 60-cycle alternators. It would be a great boon to many of these stations and a source of added economy could the alternating and direct-current systems be tied together electrically, so as to work the engines at points near their maximum efficiency. During the day the load of lighting station is usually only a fractional part of the evening and night load, and the peak loads of a railway plant occur between six and eight A. M. and five to seven P. M.

There is nothing radically new in the suggestion that rotaries or motor generator sets can link the two systems of a combined light and railway plant together, but I have been unable to find, after extensive correspondence with the engineering departments of our leading electrical manufacturing establishments that just the conditions stated below have been met and successfully worked out heretofore.

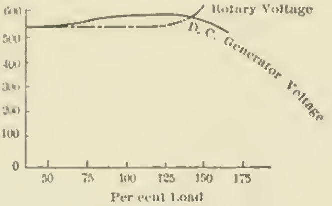


FIG. 1.—CHARACTERISTIC CURVES.

The main power station of the Cincinnati, Newport and Covington Light & Traction Company contains the following generating apparatus: One 1,000-kw, 550-volt generator; five 400-kw, 550-volt generator; one 1,000-kw, 3-phase, 60-cycle, 4,500-volt generator; two 400-kw, 3-phase, 60-cycle, 4,500-volt generators. The total nominal capacity is thus 5,000 kw, divided into nine units. Normal operation requires at peak loads the operation of five and sometimes six of these units. At minimum load times, viz., between 12:30 A. M. and 5:00 A. M., two engines are required.

We figured that if we could successfully connect the two systems electrically by intermediate rotaries, we could operate peak loads on three engines and minimum loads on one, and get the benefit of increased efficiencies due to full load conditions and fewer operating units.

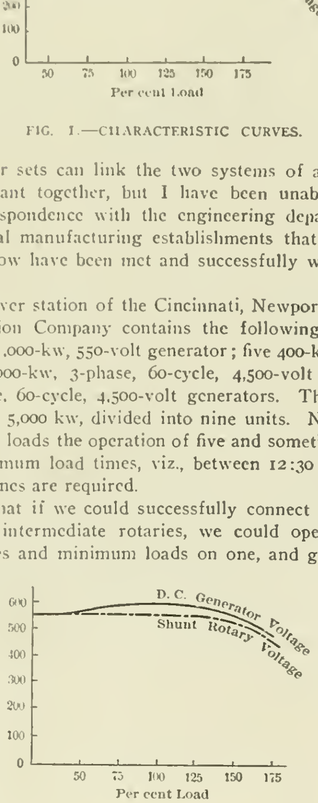


FIG. 2.—CHARACTERISTIC CURVES.

An installation was planned of two 60-cycle, 3-phase rotaries, each of 400 kw capacity, having usual overload ratings. I might say right here that our alternating voltage is kept absolutely constant by means of automatic voltage regulators, so that the alternating side of the converters is supplied by constant pressure and hence they deliver constant direct-current voltage when working alternating to direct. On the other hand, the 550-volt generators were over compounded 5 per cent., so that with increasing load the voltage on the street railway busbars reached 575 volts. But when the street railway generators passed the 125 per cent. load point, the engines dropped in speed sufficiently that at 150 per cent. load the voltage was only 560, and at 175 per cent. load 540 volts. The result was that there was a decided tendency for the compounded rotary fed by constant alternating voltage to take more than its share under maximum conditions.

The result obtained can be graphically illustrated by the curves shown in Figs. 1 and 2.

This was serious and was met by changing the compound rotary to a shunt machine. The characteristic curves then were modified to look like those in Fig. 2.

Two things were accomplished by this change: First, equalization under maximum load; second, at light and medium loads, the rotary maintained a practically constant output of amperes, the fluctuation being taken up by the compounded direct current generators.

Another thing to be very much desired in rotaries for this class of service is improvement of the commutation by the use of a large number of equalizing rings or cross-connecting of commutator bars.

A thing which we anticipated might give us serious trouble was that the fluctuating railway load would interfere with the lighting voltage. However, we have experienced no bad reactive effects at all on the lighting system and at times we have dropped as much as 75 per cent. or 1,000 kw off our lighting busbars and not had a variation of more than 2 per cent. in volts. We are accomplishing all we expected and more in the way of a more economical operation, saving steam, oil and attendance.

Automobile Manufacturers' Association.

On Friday evening the National Association of Automobile Manufacturers gave its annual dinner at the Waldorf, signalizing a most successful week. Every one was delighted with the success of the show, and Mr. Sanger, of Madison Square Garden, was quoted as authority for the statement that the gross profits would reach at least the sum of $40,000.

President Davis was in the chair and Mr. Scarritt officiated as toastmaster. Brief speeches, and to the point, were made by the following gentlemen on the topics named:

Hon. Jacob A. Cantor, President of Manhattan Borough, "The City of New York"; F. L. Smith, "How to Sell an Automobile"; T. C. Martin, "Electrical Matters Pertaining to Automobiles"; Hon. John S. Wise, "What Lawyers Hope for From Automobiles."

It is estimated that the total sales for the week, including agents' contracts, amounted to $4,000,000. One firm received orders for 3,600 light runabouts of a popular gasoline model, and 450 tonneau cars, which was said to be the largest total for any one maker. It is stated that at least two orders were placed for a total of 900 electrical vehicles. At the annual meeting of the National Association of Automobile Manufacturers held last week the question of the next show was thoroughly discussed and there was a tendency toward having it as early in January as possible. Windsor T. White, H. Ward Leonard, Lucius T. Gibbs and F. S. Fish were re-elected to vacancies on the Executive Committee, and I. A. Page was elected to replace W. C. Baker.

New Telephone Patents.

Two telephone patents were issued January 20. Of these one is for a "Telephone System," especially adapted to replace or supplement existing call-bell systems within a building; while the second describes a telephone wall set, designed to facilitate repairs. F. B. Wood, of New York, and K. B. Miller, of Chicago, being the respective inventors.

In Mr. Wood's telephone system a set of telephone instruments is provided for each call station of a hotel or other annunciator system and one special set is provided for the receiving or central station. These instruments are wired specially upon a common battery plan, so that the outlying ones may be inserted directly in the annunciator wiring, replacing the push button of the system. At the central station the wiring changes involve the insertion of a spring-jack in each calling line and some special wiring between the annunciator box and the central station. Of course with this system no intercommunication between outlying stations is contemplated, and the patent even states that the circuits are so arranged that when a connection is established no other station can interfere or overhear the conversation. A study of the circuit, however, shows that one side of the line is common to all stations, proving that this statement cannot be wholly correct, for interfering circuits can be traced for both the transmitter and receiver of any station desiring to overhear or interfere with an existing conversation. One novelty of this invention is a suggested method of calling, wherein an open space cut-out is so inserted in the circuits of the sub-station instruments that a high-potential, alternating current may jump the cut-out and pass through the receiver to produce therein a buzzing sound to serve as a calling signal. The novelty of this suggestion seems rather greater than its practicability.

The invention in Mr. Miller's wall set lies chiefly in the mounting of the hook switch upon the front of the backboard or condenser box in such a manner that both sides, top and front of the ordinary apparatus box may be removed entirely or swung aside on hinges, so that all wiring and apparatus becomes accessible from five directions. This will greatly aid in repairs, the facility of access to the parts being in marked contrast to that in such instruments as have only the top and front of the apparatus box removable. Mr. Miller has assigned his patent to the Kellogg Switchboard and Supply Company.

The Federal Telephone Company.

At a meeting of the directors of the Federal Telephone Company recently held in Cleveland, President Dickson presented a detailed report showing the condition of the company's affairs. It indicated that while there is no doubt as to the ultimate success of the various subsidiary companies controlled by the Federal, the affairs of the parent company are in a precarious condition, and there seems every probability that the stockholders will be called upon for an assessment to place the company on its feet. The company has a debt of $4,000,000, a very large portion of which is due to manufacturers for material furnished for construction purposes. The Federal owns bonds of subsidiary companies to the extent of about $1,800,000 and stock to a par value of $6,000,000. If these bonds could be sold, together with a certain percentage of the stock, allowing the company to still retain control of the subsidiary exchanges, the Federal Telephone Company would be able to pay its debts and retain enough stocks to pay a fair dividend on Federal Telephone stock. Incidentally the report showed that there are 25,244 telephones in the cities served by the Federal exchanges compared with 23,910 Bell telephones. It is reported that the officials of the company have under consideration two plans for the refinancing of the Federal Telephone Company. One involves the disposal of large blocks of the securities of the subsidiary companies under the collateral trust plan, while the other contemplates the formation of a new parent company to have a capital stock of $10,000,000 divided into $2,500,000 first preferred 6 per cent. cumulative stock; $2,500,000 second preferred non-cumulative stock and $5,000,000 common stock. This was noted in our columns last week. The entire scheme, if it is adopted, is to be underwritten by the Everett-Moore syndicate.

CURRENT NEWS AND NOTES.

FRENCH PATENT REGULATIONS.—According to a regulation which went into force January 1, any application for a French patent of which the specification and drawing are not in conformity with the rules, will be rejected without right of appeal, and if corrected, will be dated from the new and not former entry.

MUNICIPAL OWNERSHIP IN CHICAGO.—A telegram from Chicago of January 20 says: Mayor Harrison was defeated on municipal ownership in the city council on Monday night. The vote of 48 to 19 indicates early passage of the Union Traction franchise. The committee of capitalists formed to draw up a plan for complete regeneration of the local traction system includes Messrs. Marshall Field, J. J. Mitchell and Norman B. Ream.

ELECTRICALLY HEATED GLOVES AND SHOES FOR MOTORMEN.—A Dr. Alois Zeckendorf, of Cincinnati, has proposed an electrically heated glove and shoe for the use of motormen in cold weather. The heat is generated by fine resistance wires woven in the fabric of the articles. The shoes and gloves are detachable from the current-supply circuit, and are claimed not to interfere with the movements of the arms and feet. The press dispatch does not say if the motorman is connected direct in the trolley circuit.

WIRELESS TELEGRAPHY IN STORMS.—A dispatch from Sydney, C. B., states that Mr. Marconi took advantage of the recent storm to test the behavior of his wireless telegraph system under adverse weather conditions, and that messages were successfully transmitted. At the same time there was a severe storm along the English coast, but the messages, it appears, reached their destination without trouble.

CAR SPEED.—Governor Bates, of Massachusetts, in his inaugural address, has recommended that right of appeal to the railroad commission should be given from jurisdiction of local authorities over use of and speed on highways, especially by electric cars. It is said that the New York State Railroad Commission will ask the city to pass ordinances providing for such regulation of trucking all over the city as will give the trolley cars freer headway.

HIGHER WAGES WITH ELECTRICITY.—The Boston Elevated Railroad Company has issued an order to its employees granting an increase in wages amounting to nearly a quarter of a million dollars annually. The order provides for an increase according to the length of time a man has served, and in addition for a system of pensions after a certain term of years. Learners who, previously, have been paid nothing while under instruction, are to receive wages, and extra men will be paid while on waiting orders. Previously the Boston Elevated Company paid a higher scale than any other street railway company in the country, and the increase was a total surprise to the employees, and was unsolicited by them.

WATER PURIFICATION is occupying a good deal of attention just now at the hands of electro-chemical inventors. A patent issued last week to Mr. Joseph Johnson, of Minneapolis, Minn., deals with a system for purifying water and other liquids, in which a set of pipes arranged to admit the liquid and a certain amount of air are connected into the circuit from an electrical source, and the walls of the outlet pipe are associated with electrode surfaces. The disintegrating effect of air upon organic substances is well understood, and it is also well known that running water on account of its constant exposure to air is free from impurities. It is evident, therefore, that the water flowing past the suction air tubes will become impregnated with oxygen, and if the water has become tainted or impure by reason of the presence of animalculæ or organic matter it will to a certain degree be purified before reaching the electrodes. As soon as the water enters that part of the pipe between the electrodes the circuit will be closed and the stream subjected to a current of sufficiently high potential to destroy all animal or vegetable life that may have escaped the previous treatment by aeration, so that when the water is discharged from the apparatus it will be purified, safe and palatable for drinking purposes.

ELECTRIC ROADS IN ENGLAND.—A special cable dispatch to the *New York Sun*, of January 17, says: Taking heed of the events of the last session of Parliament, the British authorities are now talking of establishing a royal commission to deal with the whole subject of electric transit in the United Kingdom. The commission would be similar to the existing Railway Commission and would entirely supersede the Parliamentary committee to which the rival propositions were referred during the last session. Its duty would be to recommend the best projects without concerning itself as to whether they are American or English. One important scheme now before Parliament will probably be referred to the new commission. This is the Hammersmith-Piccadilly-Bank of England route, for which various groups have been competing. The prominent rivals now are the Central London Railway Company, which owns the "tuppenny tube," and includes Sir Ernest Cassell and Sir Henry Oakley, and the Yerkes-Speyer interests. The latter to-day offered at par two millions sterling of shares of their Great Northern, Piccadilly & Brompton Railway, which are to be allotted from 200,000 £10 ordinary shares, a dividend of 4 per cent. on which is guaranteed by the Yerkes Underground Electric Railway Company of London. Mr. Yerkes's control of the old Underground District Railway, which for a long time sought to amalgamate with the Metropolitan Railway, is now showing some signs of having practical effect. The scheme was futile two years ago, owing to the fact that the directors of the various companies could not agree on a system of electric equipment. At that time Mr. Yerkes was not sufficiently strong to effect his purpose. His association now with the Speyers and the trebling of the capital put him in a better position to dictate terms.

TROLLEY FARE FREE.—The Nottingham (England) electrical tramways afford such excellent facilities for rapid transit that some of the large shopkeepers in the center of the town are now advertising that they will pay the fares of customers from the outlying districts.

CHINESE TELEGRAPH FINANCE.—The Honolulu stockholders of the Chinese telegraph system have received news that the Empress Dowager intends to seize the telegraph system, giving decorations and orders in payment for stock. We don't understand this, but it is what the cables say about the matter.

ELECTRICAL CONTRACTORS' ASSOCIATION.—The Electrical Contractors' Association of New York State has elected the following-named officers for the ensuing year: President, S. Davis, of New York City; vice-president, G. Barnes, Albany; secretary, William J. Davis, Ithaca; treasurer, J. C. Stearns, Buffalo.

WIRELESS TELEGRAPHY FOR ITALY AND ARGENTINA.—The Minister of Posts and Telegraphs, Signor Galimberti, has announced that at the reopening of the Chamber of Deputies he will ask for an appropriation of $150,000 to erect wireless telegraph stations for a service between Italy and Argentina. The work will be directed by Signor Marconi.

LAW OF LIGHT AND ELECTRICITY.—A cable dispatch from Paris of January 21 says: At a meeting of the Academy of Science to-day Henri Poincaré announced that American and French scientists were co-operating in a series of experiments on the law of light and electricity. The Carnegie Institution of Washington, D. C., will defray the expenses of an American expert who will arrive here soon to take part in the experiments.

STATE ELECTRICAL LABORATORY.—The board of directors of the American Institute of Electrical Engineers, at a recent meeting, passed a resolution, by unanimous vote, disapproving of the establishment on the part of the State of a laboratory and standardization bureau. The recommendations of the State Electrical Commission, appointed by the last Legislature, that the State act as a technical arbitrator in disputes between lighting, railway or power companies, and municipalities or other consumers, was also generally opposed, on the ground that an amendment to the Constitution would be required to make such a law possible, and that in practice the plan would not be practicable.

FRENCH SUBMARINE BOAT.—A cable dispatch from Paris of January 24 says: It has just been announced that the construction is to be undertaken of a submersible boat, the dimensions of which will surpass those of all submarine boats built or building in France. The construction of the boat will be begun this year. Her displacement when submerged will be 350 tons, as compared with the 266 tons of the Gustave Zede, which heretofore has been the largest submarine boat. She will be 49 metres long, 4⅕ metres broad, and will have a draught of 2¾ metres. She will have a single screw and four torpedo tubes and will cost £50,000. The new boat will be able to attack an enemy's ports, and will also be able to cruise on commercial routes. It is expected that the new boat will be built in two years.

THE TISSOT SYSTEM.—The *New York American* sent abroad last week the first wireless press message to cross the Atlantic. In its reply the *Paris Temps* said: "Thanks to the *American* for its message and congratulations. From a humanitarian point of view, wireless telegraphy is worthy of all praise and Marconi has given great results. We have an analogous system in France; ours is the Tissot system. It is a great thing for journalism, especially when a property right in news can be established. One can have a special code by which to do this, and when certain obstacles have been surmounted it will be full of the richest results." The *Paris Figaro*, in its reply, remarked in a somewhat chauvinistic spirit: "Ducret, Tissot, Rochefort and Marconi are the heroes of wireless telegraphy." We are glad that it did not forget Marconi. What about Hertz?

THE AUTO SHOW, in New York last week, moves on to Chicago. It was a great and worthy success, with record-breaking sales and attendance. It is said that a firm building electric trucks of two or five tons capacity sold forty of them. At any rate, it put up on its stand the names of those who had ordered them. A few statistics of the show reveal what tendencies were manifested. Of 84 distinct makes of cars 69 had wood wheels, 11 wire wheels and 4 tubular wheels. Fifty had detachable tires, 23 hosepipe tires, and 9 had solid tires. Fifty-five had wheel steering devices and 27 lever steering. Of 65 different makes of gasoline cars shown, 39 had vertical motors and 26 horizontal; 35 had the motor in front and 30 had it in the rear; 20 had the motor in the back, but a hood in front. Forty-four used batteries for sparking purposes, 5 used a dynamo or magnets and 16 employed both. Just a dozen cars showed mechanical inlet valves, 34 had a single chain drive, 11 had double chain drive, 18 used bevel gears and 2 spur gears. The electrical exhibits were illustrated and described in these pages last week.

LETTERS TO THE EDITORS.

Improvement of Rapid Transit in New York.

To the Editors of Electrical World and Engineer:

Sirs: The idea recently occurred to me that if a "second story" were added to the present Manhattan Elevated system, the rapid transit problem of New York would be solved for a number of years at least. An uninterrupted express service could be established for all trains on the "second story," while a strictly local business could be maintained on the present or first floor.

Moving stairways could conduct the express passengers to the "second floor" from and to the street and at the express stations, which could be placed at three-mile intervals; communication could be had to the local trains on the first floor on the payment of another fare. By making the intervals between the express stations—say three miles—a very rapid transit could be obtained.

With the above idea in view, I examined recently the various portions of the Manhattan Elevated Railway of New York, which at first thought would present the most difficult engineering problems, if the following suggestions were carried out and adopted I find that a "second story" could be added to the Manhattan Elevated without difficulty.

Electric transit could be used on the present tracks and steam or electricity could be used on the second story. Steam would have none of its present objectionable features on the second floor, would be less costly than electricity and use could be made of the present engines. Electricity being used on the first floor tracks, the second story express passengers would not be inconvenienced by the smoke, dirt and steam.

I find that in many localities the present foundations for the supporting columns could be used for a new column supporting the girders for both sets of tracks and at the One Hundred and Sixteenth Street curve the present tracks could be lowered and the second story tracks need be but slightly higher than the present tracks, at that point. Of course at many parts of the line new foundations and independent supporting columns would be necessary for supporting the second floor track girders.

I doubt very much if the cost of superimposing a second floor on the present system would cost as much as the original cost of building the present system, omitting of course the obtaining of the original right of way, which in this case would be eliminated entirely.

From a financial standpoint, the difference in cost between this method of providing a double track from the Battery to One Hundred and Fifty-fifth Street with express service uninterrupted by local service, and the cost of the present tunnel, would probably build another elevated system, or another Brooklyn Bridge.

Baltimore, Md. James E. Hewes.

[This is quite interesting, but not at all new.—Eds. E. W. & E.]

The Sleet Problem.

To the Editors of Electrical World and Engineer:

Sirs: In a communication made by me some three years since to another journal, the device of R. H. Dalgleish, chief electrician of the

Chevy Chase division of the Capital Traction Company, of Washington, D. C., for the spreading of oil on the overhead trolleys of the Chevy Chase road was illustrated and the experiments with it described. The device was so successful in conquering sleet storms that its use, so far as I know, is continued up to the present. The principal point in the "trolley greaser" was that it applied the oil by rolling contact through a grooved wheel, exactly where it was needed to prevent ice coating on the trolley wire. All ice that formed was easily scattered by the trolley wheel of a passing car without any arc resulting. The oil spread itself around the wire, and two or three coatings a winter were all that were necessary to keep the road running when forty miles of competitive trolley road were tied up for days at a time. While oil accumulations made soldering operations more difficult, the breaks occurring along the line were so few that this objection became insignificant. The device described worked, kept the line open and cars ran on schedule time, which is the all-important thing in street railway operation. I would recommend a careful investigation of the economy and simplicity of the trolley greaser for fighting possible sleet storms.

PITTSBURG, PA. J. B. ALEXANDER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Tandem Connection of Induction Motors.—BRESLAUER.—A long article in which he discusses by means of diagrams the tandem connection of induction motors. He shows that there is a possibility of varying the speed within rather wide limits, but there are inherent disadvantages, especially a very poor power factor. He gives the theory of the case in which the two motors are connected together by means of a gearing, and shows that this method may be applied to traction. It has the advantage that both motors may have a small number of poles, and a relatively small diameter. In a special case in which the diameters of the gear wheels have the ratio 4 to 10, he shows that if the speed of the first motor alone is 100, then that of the first and second connected against one another is 66.7, that of the second motor alone is 40, and that of both connected in tandem is 28.5; hence, the variations of speed are within the limits of 1 to 3.5. Yet for practical application, it is necessary to compensate for the phase difference.—*Elek. Zeit.*, January 1.

Theory of the Gramme Ring.—K. R. JOHNSON.—An article pointing out that the laws regulating the generation of a current in a Gramme ring do not constitute a special case of the usual alternating current laws. The length of wire of the coil practically contains an artificial wave equal in length to the length of the wire, and generally shorter than the natural wave-length. In consequence of the compulsion exercised by the rotation, this wave is propagated along the wire with a velocity equal to the rate of rotation, but in the opposite sense, so that, as a matter of fact it is stationary. But if the Gramme ring is given such dimensions that the length of wire becomes equal to the wave length corresponding to the rates of propagation of the wire waves under the influence of the iron core, the current must reach a maximum and so must the potential, since the wave undergoes no compulsion by the length of the wire. In a case which is quoted, the rate of propagation of the wire waves under the influence of the iron core is 1,500,000 meters per second or more, and the length of wire required in the winding for proper resonance is 30,000 meters, or 667 kg of 1 mm diameter. This may not be practicable, but it would yield a higher efficiency if it were.—*Phys. Zeit.*, December 15; abstracted in Lond. *Elec.*, January 9.

REFERENCE.

Three-Phase Transformers.—KOENIG.—An illustrated description of a graphical method for predetermining the current and voltage values occurring in the external circuits of a three-phase transformer, when the load is not balanced.—*Elek. Zeit.*, January 8.

LIGHTS AND LIGHTING.

Incandescent Lamps.—SWINBURNE.—In the course of his presidential address to the (Brit.) Inst. Elec. Eng., he also discusses the problem of incandescent lamps. The limit of efficiency of ordinary incandescent lamps is chiefly due to the variations of supply pressure. The sensitiveness of the carbon lamp to pressure, limits the practical variation of pressure of supply, and thus costs heavily in mains. If we had incandescent lamps which did not mind 20 per cent. pressure variation, a great saving in mains would be possible. Recently the demand for "ballast" for the Nernst lamp has led to the introduction, for that purpose, of little bulbs containing fine iron wire heated to the critical point. This ballast may also be used in series with the incandescent lamp. Solomon found that a small resistance will allow a lamp to be run nearly at its maximum safe efficiency in spite of pressure variations, while a large resistance will enable lamps to be run from tramways and other varying pressure circuits with good overall efficiency. He makes some remarks on carbide filaments and on the Nernst lamp. He thinks that the whole subject of the Nernst lamp is very obscure. "We cannot say we have got anywhere near our limits of high temperature efficiency of running, low temperature in starting, or high pressure in the electrolytic lamp."—Lond. *Elec.*, December 26.

REFERENCE.

Photometry of Electric Lamps.—FLEMING.—The first part of an illustrated reprint of his paper, an abstract of which was recently noticed in the Digest.—Lond. *Elec.*, January 2.

POWER.

German Power Plant.—A description of the electric light and power transmission from the Berggeist central station, at Badorf, near Cologne. As there is no coal proper found in the neighborhood, but there is lignite, the company owning the lignite mines has installed a power plant at the pit's mouth. This is not the first example of lignite entering into direct competition with coal in the European continent, as the Dresden municipal electric plant burns lignite successfully. At Badorf, three engines of 110,475 and 900 hp respectively, are installed, and a 1,200-hp unit is soon to be added. The engines drive three-phase generators, the voltage being 5,700. The consumers are supplied through transformers with current for light at 110 or 220 volts, and power at 220 volts. The district is chiefly agricultural; the Catholic churches want light for the early masses, the farmers use motors for their machines, and small and large manufacturers claim a good deal of power. One firm of carpenters, for instance, has motors installed aggregating over 100 hp, but requires even in busy times rarely more than 32 hp at a time, so that it has so far been possible to put down installations for four times the actually available power. There are 13 factories with motors, aggregating 736 hp, joined to the central station. The maximum charge for light is 12 cents per kw-hour. Power is supplied at about a third of the light rate, the maximum charge being 4.32 cents per kw-hour.—Lond. *Eng'ing*, January 9.

Electric Power in a Printing Office.—REYVAL.—An illustrated description of the new electric installations of Draeger Brothers, a French printing firm. There was required the possibility of wide speed variation for the printing machines and at the same time good light. To meet both conditions a double distribution was adopted: The first, using the two-wire system at 120 volts, supplies all the lamps (100 incandescent lamps, 9 arc lamps and the photographers' lamps); the other, using the four-wire system, supplies the separately excited motors, the voltage being either 120 or 170 or 220. Fifteen motors are installed, 12 of which are driving the presses. The plant contains two generating sets of 30 kw at 120 volts and two boosters of 250 amp at 50 volts in order to raise the voltage from 120 to 170 and 220.—*L'Eclairage Elec.*, January 3.

TRACTION.

Localizing Faults on Tramway Systems.—JOHNSTON.—An illustrated description of the following method for finding the position of a fault with a fair degree of accuracy and rapidity, from the generating station of a tramway system. The connections in the station are shown in the adjoining diagram. The testing current should be comparatively great so as to get an appreciable reading on the voltmeter *V*, one terminal of which is permanently connected to the auxiliary bus bar, the other being put to the far end of the feeder to be tested by means of a pilot wire laid for the purpose. The cost of the pilot wires are the chief objection, and they should be put in at the same time as the other cables. One pilot wire is necessary for each terminus, at which place they are connected to the trolley wires, preferably through fuses. The diagram shows the connections for the case in which feeders go out from the central station in four different directions. All of the four feeders are brought to ammeters *A*, and these are connected to the hinges of single pole change-over switches. The ordinary working position of these switches is on the upper contacts; the feeders are then connected through circuit-breakers *C B* direct to the positive bus-bar; but if a switch is changed over to the bottom contact, that feeder will then be connected to the positive bus-bar through an auxiliary resistance, *A R*, which if there is a "short" on the feeder, will keep the current down to a reasonable figure. While this testing current should be large so as to get a distinct reading on the voltmeter, yet, if it is too large, it may burn through a trolley wire or destroy a length of cable; 50 to 100 amp should be safe. A large scale map is required, of the tramway lines and feeders, and the resistances of the latter are marked at all points where they change in sectional area and at junctions, such as feeder pillars, etc. When a fault occurs, the switch of that section is put on the bottom contact, the low-reading voltmeters, *V*, is put between the far end of the feeder and the auxiliary bus-bar by means of the small multiple way switch, *S*, thus showing the drop in volts along the feeder (and the trolley wires, if they are connected in parallel with the feeder) to the fault, this drop is divided by the value of the current shown on the feeder ammeter, and the map is then consulted to find the position of the fault. A similar method of testing is to take the drop in volts in the rails instead of on the feeders. A numerical example is added.—Lond. *Elec. Rev.*, January 9.

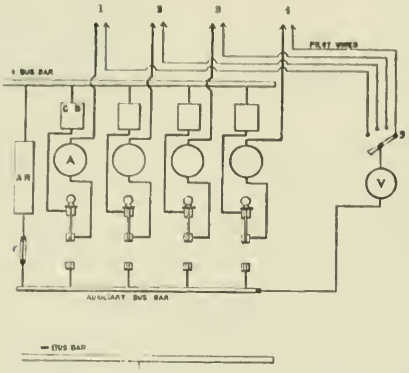


DIAGRAM OF CONNECTIONS.

English Conduit Tramways.—A well-illustrated description of the municipal Bournemouth tramway system, which, with the Blackpool, is the first public tramway on the slotted conduit system to be opened in England. Parts of the line are on the overhead trolley system, so that the cars are equipped with ploughs which can be lifted up out of the conduit when the car leaves the conduit portion of the track for the trolley sections. There is at present an equivalent in single track of 3 miles conduit line and 15 miles of trolley line. The slot is a side and not a center slot; otherwise the construction is very similar to that of the London County Council. The slot is 1 in. wide and serves as one of the running rails; it is formed of two rails, held in place by cast-iron yokes embedded in concrete. The plough consists of a steel neck holding a double board of walnut to which the spring contacts are fastened on either side by clips. They are connected by flexible cables to the top of the carrier and thence to a switch which is controlled from a small handle at the side of the car, and which is for switching either the trolley or the plough on to the controller. The plough slides in two sets of guides, one vertical set for raising and lowering it, the other horizontal, both enabling the plough, when lowered, to move freely in a horizontal direction at right angles to the length of the car. The traveling head on which the plough is suspended can move only up and down, but, as soon as this head is in its lowest position, the plough rests on the horizontal guides, and releases itself from the head, thus becoming free to move from the side to the center of the car. At each point on the line at which the slot construction stops and the overhead construction begins, the slot changes from the side to the center, and ends at a plough pit. The municipal generating station supplies both the tramways and public lighting, the private lighting being supplied by a company. The municipal station contains four 292 kw generating sets and a 77-kw motor-generator, the latter being provided in order that the conduit portion of the track (which is run from other bus bar than the overhead portion, both poles of the conduit line being insulated) may yet be run from the same dynamo.—Lond. *Elec.*, January 9.

REFERENCE.

Electrical Haulage on Canals. Marchant.—The first part of a full illustrated reprint of his paper, an abstract of which was recently noticed in the Digest.—Lond. *Elec.*, January 2.

Installations, Systems and Appliances.

British Central Station Statistics.—The annual tabulated statistics of British central stations issued as a supplement. They give concise information on all stations in operation (316 in number) and those in course of erection (41), and in addition to these full details on those projected and a list of undeveloped provisional orders. A general summary of the cost of operation in British central stations was noticed in the Digest last week. The following conclusions are drawn from the statistical table: The increase of the total number of connections is greater than in any previous year. The motor load in London is unmistakably growing, although it is still small. The connections in the provinces are still largely in excess of those in London, and the yearly increase of the former over the latter exhibits a decided tendency towards expansion. The increase in the total number of connections over last year, in both London and provinces, amounts to 103,000 kw, while the connections to date in the equivalent of 8-cp lamps is equal to 17 millions.—Lond. *Elec.*, January 9.

Wright System of Charging for Electrical Energy.—A note stating that while for several years the Belfast municipal electric plant has used the Wright system, yet certain influential consumers became dissatisfied with it, and the Electricity Committee asked the borough electrical engineer, M'Cowen, to report on the subject. His report was in favor of the Wright system and recommended its retention. But at the general meeting of the council which followed it appeared that the maximum demand system was by no means popular, and the report was referred back to the committee. A summary of M'Cowen's report is given in the same issue. He strongly recommends refraining from the contemplated change from the "demand indicator" to the "flat rate" system. He gives statistics which prove clearly that the long hour consumer at a low average price per unit brings far more profit to the undertaking than the short hour consumer at a high average price per unit; the former, therefore, ought to be encouraged by the retention of the demand system. He shows by diagrams that the same capital expenditure is required to supply 20 units at the peak load as to supply 2,400 units spread over the whole 24 hours, and that short hour consumers are an actual loss to the undertaking, while long hour users, paying the lowest price, are the most profitable. He is strongly against the introduction of a general flat rate, but thinks that such a movement for domestic purposes might be worth consideration, as the maximum demand of private houses occurs at a later hour than in the city.—Lond. *Elec.*, January 9.

Electro Physics and Magnetism.

Electrostriction of Glass.—Wuellner and Wien.—An account of an investigation in which they repeated Quincke's experiments on the change of volume of glass under electric stress, but he used as the variable the quantity of electricity in place of the potential. At the moment of charging and discharging the hollow glass condenser, they noted the change of volume by means of a fused-in capillary containing liquid, and the quantity of electricity was simultaneously read by means of a ballistic galvanometer. They found no difference of elasticity in the charged and the uncharged glass, and they were thus enabled to determine the modulus from its behavior under electrostriction. Here, however, they were confronted by a discrepancy between the value thus found and the modulus obtained by the acoustical or compression method. This discrepancy is greatest (50 per cent.) in flint glass and least in Thuringian glass, the electrostriction value being too high. The compression values are the lowest, and here, again, flint glass shows the greatest variation and Thuringian glass the least. The after effect found by Quincke and Cantone is due to Joulean heat.—*Ann. d. Phys.*, No. 13; abstracted in Lond. *Elec.*, January 2.

Spontaneous Deozonization.—Warburg.—An article on the phenomenon that if partly ozonized oxygen is left to itself, the proportion of ozone decreases with the time. This phenomenon is known under the name of spontaneous deozonization, and may be due to a variety of causes. The author points out that since the amount of ozone at 200° in a state of equilibrium is inappreciable, such equilibrium can only be attained at ordinary temperatures by complete dissociation of the ozone. The factors bringing about this dissociation may be external, such as contact with foreign bodies or with the walls of the vessel; or they may be internal and due to the collision of two molecules of ozone, or of a molecule of ozone with a molecule of oxygen. He formulates a mathematical theory of the process and finds by suitable experiments that the internal effects are almost altogether due to collisions between ozone molecules themselves. This internal disintegration rises much more rapidly with heating than the external process, and becomes the chief agent at high temperatures. He finds that moisture makes no difference to the stability of ozone at 100°.—*Ann. d. Phys.*, November 12; abstracted in Lond. *Elec.*, January 9.

Photo-electricity.—Wulf.—He first describes a new lamp for photo-electric work which gives a powerful light containing a great quantity of ultra-violet rays. It consists of carbon bisulphide in a Mariotte bottle, which enters the wick of an ordinary petroleum burner and is mixed with oxygen introduced into the center of the flame. With this he then studied the relations between chemical and photo-electric effects and found that platinum electrodes with occluded hydrogen are highly photo-electric, whereas in oxygen, chlorine and ozone they lose their sensitiveness. The effect of the medium surrounding the electrode is greater the greater the chemical difference of potential between the two. This matter is closely connected with the question as to whether the dissipation of electricity by light is connected with a chemical process. Lenard did not discover any appreciable decrease of the effect, even in the highest vacua, and this makes it probable that, if the gas plays any part at all, quite minute quantities suffice to produce the phenomenon.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 26.

References.

Electrons.—Oliver Lodge.—A reprint in full of a lecture given before the (Brit.) Inst. Elec. Eng., and giving a complete review of the development of the theory of electrons.—Lond. *Elec.*, December 12, 19, 26, January 2.

Alternating-Current Model.—White.—A description of a mechanical model for illustrating alternating current phenomena to students.—*Phys. Rev.*, November.

Oscillating Discharges.—Bartelli and Magri.—An account of their continued remarks on the oscillatory discharge of a condenser.—*Phys. Zeit.*, December 15; abstracted in Lond. *Elec.*, January 9.

Magnetic Effect of Electric Convection.—Pender.—An account of his continued researches on this subject, the results being in every way confirmatory of his former results and of Maxwell's theory, while they refute Cremieu's results.—*Phys. Rev.*, November.

Electro-Chemistry and Batteries.

Residual Currents.—Bigelow.—A long paper giving an account of experiments on what Helmholtz calls "Reststroeme" (residual currents). It is a generally accepted theory that there is a definite minimum e.m.f. required to decompose a certain electrolyte, yet it is a fact that with all electrolytes a current is found to pass with a low e.m.f.; this is what Helmholtz calls a Reststrom; but later experiments have shown that his explanation cannot represent the whole truth. The present author gives the results of a series of experiments which he has made with platinum electrodes. He offers the following new theory: A dissolved gas is assumed to be in a condition analogous to a rarefied gas, some of whose molecules Thomson has shown are capable of carrying positive electric charges, others negative ones. The process of solution is assumed to be sufficient to occasion this differentiation. When a charged gas molecule comes in contact with the metal of the electrode, it gives off its charge; the molecule may then be occluded or remain in solution; in the latter case it increases the concentration of the neutral molecules and thus induces a further differentiation into molecules with opposite charge. If the smallest external e.m.f. is applied there will be a tendency for one electrode to attract positively charged molecules and for the other to attract negatively charged molecules. This theory enables one to say that there is a real and definite decomposition point for each pair of ions under given conditions; any current observed before this value is reached being due to the charged molecules present.—*Jour. Phys. Chem.*, December.

Dry Cells.—Zacharias.—An article stating that the manufacture of dry cells has developed rapidly in the last two years, especially in the production of very small cells, which are very useful for pocket lamps for physicians, travelers, for use in the army, etc. Not one quarter of the depolarizer is utilized in the ordinary dry cell under the usual circumstances. He recommends that in installing electric bells, etc., in houses more attention should be paid to the proper dimensions of the wires, as much of the power of the dry cells is now wasted. Even the best of the small cells, when continually used to light a lamp, last only 15 minutes; they should, therefore, be used only momentarily, but are even then very useful for various purposes. He gives some notes on testing such small dry cells.—*Centralbl. f. Accum.*, December 1, 15.

Diminution of Cathodic Depolarization by Potassium Chromate.—Mueller.—An account of an investigation of the influence of potassium chromate upon cathodic depolarization, being a continuation of his researches on the effect of soluble chromates in the electrolysis of aqueous solution of the halogens.—*Zeit. f. Elektrochemie*, December 11.

References.

Stassano Process.—Goldschmidt.—A paper in which he reports on his examination of the manufacture of steel in the electric furnace by the Stassano process. He thinks the process is no longer in its first experimental stages and that it deserves consideration.—*Elek. Anz.*, December 25.

Electrolytic Oxidation of Organic Substances.—Salzer.—An account of preliminary experiments on the electrolysis of formic acid and oxalic acid, also of potassium carbonate. The results show the great difference in the reaction and especially in the anodic potential difference with a bright platinum or a platinized platinum anode.—*Zeit. f. Elektrochemie*, December 4.

Units, Measurements and Instruments.

Portable Capillary Electrometer.—Smith.—An abstract of a (Brit.) Phys. Soc'y paper in which he describes a modification of the form of capillary electrometer consisting of two wide tubes joined by a cylindrical capillary tube, which may be horizontal or inclined. Certain difficulties are overcome by using a key consisting of a U-tube closed at one end, communicating at the other with a pneumatic pressure ball and containing mercury in the bend; three platinum wires are fused into the tube, so that by squeezing the ball the same change of contacts is produced as by pressing the lever of an ordinary spring key. With the arrangement described, the sensitiveness of the instrument is doubled, and, by using a microscope magnifying 50 diameters, a P.D. of 1/10000th volt can be detected without difficulty. The instrument, used as a surface-tension galvanometer, is more convenient than an ordinary galvanometer with a magnetic system, because there is no suspension, no lamp and scale, and practically no levelling.—Lond. *Elec.*, December 26.

Telegraphy, Telephony and Signals.

Vacuum Tubes as Lightning Arresters for Telegraphy.—Kinsey.—An abstract of a paper read before the Dublin section of the (Brit.) Inst. Elec. Eng. He describes some observations made in connection with the testing of vacuum tubes when used as lightning arresters. The tubes used in the Telegraph Department of the Post Office are about 1¼ in. long with 1/32 in. air-gap, and they are tested by means of a Ruhmkorff coil, the resistance of the primary winding of which is from 0.1 ohm to 0.15 ohm and of the secondary 350 ohms, the condenser having a capacity of 0.02 microfarads. The coil is adjusted to a ⅛-in. spark-gap and is worked by a single Leclanche cell. Used as a lightning arrester, the tube is connected with one end to earth and with the other to the line; if in good order the colors of the glow at the two ends are blue and green respectively when they are being tested. He noticed that a good tube connected only at one terminal to the secondary of the induction coil, glowed when the glass was grasped by the fingers. When a bad tube, that is, one incapable of glowing under any ordinary circumstances, was connected between the terminals of the Ruhmkorff coil, and a good tube was brought near for connection in parallel with the first, it was observed that its approach to the bad tube caused the latter to glow fully. Subsequent investigation showed that the effect was due to the approach of the hand, and not to that of the good tube. The bad tube could not be induced to glow by any other means.—Lond. *Elec.*, December 26.

REFERENCES.

Wireless Telegraphy.—Reyval.—A long illustrated article on the recent long-distance wireless telegraphy achievements of Marconi, the Poldhu station, Marconi's magnetic detector, and the experience of the cruiser *Carlo Alberto.*—*L'Eclairage Elec.*, January 10.

Wireless Telegraphy.—Arco.—An article illustrated by many diagrams in which he describes how the multiplier may be used for tuning purposes in wireless telegraphy installations.—*Elek. Zeit.*, January 1.

Duesseldorf.—Kehr.—An illustrated description of the new telephone exchange at Duesseldorf.—*Elek. Zeit.*, January 8.

Miscellaneous.

Patents.—An editorial note on British patents which will expire during the coming year. Among them is one embodying the construction of an alternating-current generator, constructed with a single coil for exciting "imbricated pole" field-magnets. The armature is stationary and the field coil is fed from slip rings. The Hellesen cell patent will also expire; the electrolyte in this cell is dissolved in a phlegmy substance such as tragacanth, and the evolved gases are passed through plaster of paris; the outside of the cell consists of two concentric cylinders, the space between which is filled with sawdust or some other absorbent material; there are holes near the top of the inner cylinder and others near the bottom of the outer one; the top of the cell is sealed with pitch, and the gas, in passing through the sawdust, is robbed of its moisture, so that the cell does not get dry. Another patent that will expire is important as it involves some of the principles upon which the successful working of the ohmmeter depends. The method of obtaining the two magnetic fields at any angle, and the elimination of the effect of the earth's magnetic field by means of a permanent magnet free to move on a vertical axis, are the two most important points. The patent for the "Derkert" microphone will also expire.—Lond. *Elec.*, January 2.

Electric Production of Sleep.—Leduc.—An account of a continuation of his interesting researches on the anæsthetic use of an electric current. His experiments, which were recently noticed in the Digest, have now been extended to the human body, as he performed them upon himself. The voltage was 50 at a maximum, and the current was introduced through cotton electrodes moistened with salt solution, and placed, one on the forehead and another over the kidneys. The potential is reached gradually in the course of five minutes. The faculty of speech is first inhibited and then the rest of the motor system. There is a gradual inhibition of sensation, beginning with a numbing of the limbs. The only disagreeable sensation is the gradual loss of the faculties, which gives the sensation of a nightmare. The heart is entirely unaffected, but the breathing is somewhat obstructed, probably by the strength of the current through the neck, which should be shunted. On breaking the current the awakening is instantaneous and the feeling is one of invigoration. All danger to life may be avoided by switching off the current as soon as the breathing shows a sign of stopping.—*Arch. d'Elec. Med.*, December; abstracted in Lond. *Elec.*, January 2.

Radioscopy for Medical Purposes.—Grummach.—A report on the progress made in the diagnosis of diseases of internal organs by means of Röntgen rays. Contrary to the prevailing usage, he recommends the use of large induction coils giving sparks 50 cm or 60 cm long, as these alone furnish reliable results. He even goes further and uses a coil of 100 cm spark length operated with current from the Berlin electric light mains. Many applications of radioscopic methods have been made to the heart, and the author shows how the best radiograms may be obtained, and mentions that the subject should breathe naturally while they are taken. Gaseous and liquid gatherings, tumors and fibrous aggregations are easily discovered with the eye method. In one case described, the lung was seen to be pressed against the heart, and the liquid gathering was seen to break into waves with the movement of the patient. In another case an abscess in the brain was discovered owing to the calcareous infiltrations it contained.—*Arch. d'Elec. Med.*, November; abstracted in Lond. *Elec.*, December 26.

Electric Separation of Metals from their Ores.—Negreano.—A description of what might be called an electrostatic method of separating noble metals from their ores. It is based upon the following experiment: A central disc is cut out of a metallic plate, and the plate and disc are connected with the poles of a Wimshurst machine. If now a powdered mixture of sulphur and red lead is blown upon the metallic surface through a wooden sieve, the sulphur will be deposited upon the disc, and the minium upon the other plate, or vice versa. This is, of course, due to the frictional electrification of the two powders. The author has varied the powders by pounding up a silica rock with malachite, iron oxide and copper oxide. On using the powdered mineral in the same way he found that the metallic particles were separated from the silica. In the case of a quartz rock containing limonite the separation of the gangue on one side from the yellow limonite on the other was easily brought about. Another easy separation was that of pyrites from a matrix of lignite. The author proposes to employ this method for the separation of gold from gold dust.—*Comptes Rendus*, December 15; abstracted in Lond. *Elec.*, January 9.

REFERENCE.

Röntgen Rays for Medical Treatment.—Cleaves.—A paper on the Röntgen ray and ultra-violet light in the treatment of malignant diseases of the uterus, with a report of an inoperable case.—*Med. Record*, December 13.

New Books.

American Municipal Progress. By Prof. Charles Zueblin. New York: Macmillan Company. 1902. Cloth, 12mo. 380 pp. Price, $1.25.

This interesting volume is one in the Citizens' Library of Economics, Politics and Sociology issued under the editorship of Dr. Richard T. Ely. We cannot say we are greatly impressed with it as a calm and impartial survey of the progress made by cities in the United States, but it will probably find many readers among those who believe that all is well under municipal ownership and all is ill under the régime of private initiative and enterprise. "Public ownership promotes good citizenship" we are told, which goes easily in a city like New York, where the public ownership of important services has been and remains full of crying scandals; so that ceaseless inquiries and investigations are in order, while the struggle to spend revenues equal to those of five or six European monarchies combined, is of the most debauching character. As one might expect, Tom Johnson is held up for glorification, while of C. T. Yerkes it is recorded that when "a more rigid public control was threatened, he decamped." If there was any decamping, it has escaped our notice; although we have observed it in the case of boodle aldermen and gamblers who flourished with the connivance of city authorities.

While there is no chapter on public lighting in this book, and but few incidental references to it, there is a whole chapter devoted to transportation. Municipal telephony also escapes the treatment one might expect. The street railway companies get several sharp raps on the knuckles, some of which are doubtless deserved. We have ourselves taken occasion to condemn certain things; but to jump thence by inference to municipal street railways is a folly we have fortunately avoided, although Prof. Zueblin sees in it "the only way." While his remarks in regard to the Metropolitan Company and its overwork and poor pay for employees are worse than ridiculous, they are matched by his commendation of the fire alarm telegraphs —under municipal ownership—in New York and Boston. So far as New York is concerned, the system is beneath contempt from the electrical standpoint.

Municipal sociology is a valuable study, and this brochure is not bad as a compilation of some of its data, but we take decided exception to its want of philosophical spirit and its assumption that the plain American citizen at once becomes a bad man when he operates a public service corporation.

DIE GEWINNUNG DES ALUMINIUMS. By Adolphe Minet. Halle: Wilhelm Knapp. 130 pages, 57 illustrations, 15 tables. Price, 7 marks.

The book contains a historical summary of the methods employed for the production of aluminum. Chemical methods are first described, and then electrochemical methods. These various processes are described in some detail with the aid of illustrations.

The second part of the book deals with the uses of aluminum. It is shown that in the year 1885 the total world production of aluminum amounted to 14 tons, of which 10 were in Germany, and 1 in the United States. In 1900 there were nearly 4,700 tons produced, of which 500 were in Germany and 1,650 in the United States. Prices for the metal are given, also analyses and physical tests. The use of aluminum alloys is alluded to, and also the applications of such alloys in the arts.

The book is an excellent compendium of elementary facts concerning aluminum and is interesting and instructive to many classes of readers.

IMPROVEMENTS IN THE HUNGARIAN TELEGRAPH AND TELEPHONE INSTALLATIONS. Published by the Royal Hungarian Direction-General of Posts and Telegraphs. Budapest: Hornyanszky and Court. 56 pages, 72 illustrations.

This is a report of experiments made by the Hungarian Bureau of Telegraphs. There are four parts. First, experiments in operating telephone plants directly from a dynamo machine. Second, improvements in the Hughes system. Third, operating Morse sounders without relays. Fourth, duplex telephony. Many attempts have been made to operate telephone exchanges directly from a dynamo. The first 17 pages are devoted to tests in this direction. In common with other efforts, the experiments have proved successful so far as transmission is concerned, but the difficulty encountered lies more in the possibility of a sudden failure of the machine than from any other cause. On this point the report does not touch. The next 30 pages are occupied with tests of the Hughes printing telegraph, directed chiefly toward the selection of a better driving mechanism by the substitution of an electric motor for weights. Part 3 is a short note upon the operation of Morse sounder apparatus without a relay. Part 4 is devoted to experiments upon duplex telegraph and telephone systems. The greater portion of these trials relate to the perfection of telegraphic duplexing. A number of different circuits are worked out and tested with satisfactory results. Altogether the precautions shown to be necessary are so great as to render commercial adoption difficult and uncertain.

JAHRBUCH DER ELEKTROCHEMIE. Berichte uber die Fortschritte des Jahres 1900. By Dr. W. Nernst and Dr. W. Borchers. Halle a. s.: Wilhelm Knapp. 596 pages, 192 illustrations. Price, 24 marks.

Another volume of an excellent and creditable publication which has been appearing for some years. These volumes appear annually and cover the literature on electrochemistry for the year, the present one being for the year 1900. The previous volumes have already been reviewed in these columns, and it may be remembered that the reviewer has had nothing but favorable comment to make. It is certainly a publication which those interested in the progress of electrochemistry should not fail to be without. As was shown in previous reviews, it consists of a series of classified abstracts, many of them illustrated, of all the current electrochemical literature, the abstracts being in most cases sufficiently complete to give the most essential information in the original article, and they also give a very good idea of the nature of the articles themselves, so that if the information that one seeks is not in the abstracts, one will be enabled to see from the descriptions whether or not it is likely to be in the originals. The articles are well classified and intelligently abstracted by men well known to those familiar with the German literature on this subject. It is accompanied by two full alphabetical indexes, one of authors and the other of subject matter; it is, therefore, easy to find anything that one is looking for.

The scientific section is larger than in the former volumes, as it now occupies 313 pages. Nearly the whole of this department has been prepared by Dr. H. Danneel, including chapters on general electrochemical theories, methods, apparatus, constitution, conductivity, electrical energy, polarization and electrolysis, a rather long chapter on discharges in gases, Bacquerel rays, radiant energy, electrical energy, etc. This scientific section is concluded by a brief report on electric analyses by Prof. F. W. Kuester.

The second part, on applied chemistry, was edited by various authors. Prof. K. Elbs was in charge of the sections on galvanic cells, storage batteries and on organic chemistry; while Prof. W. Borchers was in charge of those on inorganic chemistry, electrometallurgy, alkalis, chlorine, and apparatus for electrochemical industries such as magnetic separators, furnaces, electrodes, diaphragm, etc. The volume furthermore contains many statistics, some of which are of considerable interest in such a young and rapidly growing science and industry as this is.

The reviewer is pleased to add that the editors and publishers, unlike some others in Germany, show that they are progressive, as they use the Latin or international type in this publication, thus making it much easier to read by foreigners, and less injurious to the eyes of the natives, than the old German type, which should long ago have been relegated to the melting pot, before it caused the ruin of the eyesight of so many natives and prevented German publications from being read as much by foreigners as the books generally warrant.

THE TELEPHONE GREEN BOOK FOR 1902. By H. H. Robinson. Cloth 12mo. 238 pp. Price, $2. The Telephone Green Book Publishing Company.

This is an excellent compilation of the statistics relative to the independent telephone companies in the States of Ohio, Indiana and Michigan. The directory part is in itself valuable, but is supplemented by three special papers, one on independent telephone work in Ohio by J. B. Hoge; one on Indiana by S. P. Sheerin, and one on Michigan by J. B. Ware. In giving the details of the various companies, Mr. Robinson has supplied information as to capitalization, etc., but we note an absence of data as to rates and as to the style of apparatus, manufacturers' name, etc. This will, it is to be hoped, be given in later editions. At the end is an alphabetical list of the exchanges in each State.

SUCCESSFUL ADVERTISING. By J. Angus McDonald. Cloth, 12mo. 400 pp. The Lincoln Publishing Company, Philadelphia. Price, $2.

This is an exceedingly interesting book on a subject to which the author has given his attention for some ten years. A great many of our readers are concerned to know how best to set forth the merits of their product and meet the keen competition of other manufacturers. Advertising has become a science in the same sense that political economy has, viz., there are many elements in it that can be reduced to definite data and formulæ, and Mr. McDonald traverses the whole field of trade for his facts and principles. The book deals not merely with the preparation of "ad" copy, but the attractive arrangement of a store and, in fact, every feature of the campaign to win the customer's dollars and continuing esteem.

MANUAL OF RURAL TELEPHONY. By J. A. Williams. Cleveland: Manual Publishing Company. 177 pages, 104 illustrations. Price, $1.00.

This is in many respects a remarkable little work. Within its pages the author has endeavored to condense instruction for organizing and financing telephone companies; directions for line construction, sub-station installation, central station outfits, estimates of cost, and a treatise on electricity in so far as it pertains to the telephone.

Considering space, rather a greater success is attained than is sometimes found in such digests, yet the intellectual aliment provided is so concentrated as to require dilution with other knowledge and experience. The book is intended as an aid to the rural electrician, who has been so successful in talking over a few miles of barbed wire fence that he imagines himself a full-fledged telephone promoter, and is trying to persuade his friends and acquaintances to form a company. Directions for this purpose are provided in Part I, Chapter II, containing forms for by-laws, articles of incorporation, stock certificates, etc., together with a few comments upon the advantages presented by various types of organizations. Chapter III gives estimates of the cost of rural installations, some of which would be of the greatest interest if they can be substantiated. For instance, the author estimates telephone poles at 50 cents delivered on the ground, ready for erection, setting poles at 15 cents each, and connecting subscribers' premises to the pole line at 25 cents each. It is to be feared that locations where such Utopian prices prevail are few and far between. Part II is devoted to directions for building telephone lines and here the author has been more successful in giving plain and simple directions sufficient for the "bean pole" type of telephone construction, commonly known under the name of the "Farmer's Line."

The remainder of the work, Part III, deals with the construction of sub-station apparatus and the simplest form of the switchboards, and in this the writer seems at home, giving clear and lucid descriptions which will be of value to those having telephone stations in isolated parts of the country to which the repair man never comes.

THE LOCOMOTIVE: SIMPLE, COMPOUND AND ELECTRIC. By H. C. Reagan. Fourth Edition, Revised and Enlarged. New York: John Wiley & Son, 1902. 565 pages, 300 illustrations. Price, $2.

This is a new edition of a treatise on locomotive engineering, bringing former editions to date. As a practical man, Mr. Reagan writes directly and successfully to his co-workers on the footboard in an endeavor to explain the principles of the locomotive, the diseases to which it is subject, and the remedies to be applied in the field. The plan of the work is catechismic, consisting of a description of each portion of the locomotive, followed by a series of Questions and Answers. On the whole the style is highly commendable; no useless space is occupied, each sentence is directly to the point, describing some vital portion in a way easily comprehensible by the practical man.

The first 86 pages are devoted to general description of the functional parts of the locomotive. The compound engine is then taken up and occupies the next 160 pages. Succeeding this auxiliary appliances are treated—injectors, steam gauges, air pumps, brakes, etc.—the chapters on brakes and brake appliances being particularly commendable. Next comes a short chapter on locomotive packings, completing the body of the work. An appendix is then added in which the electric locomotive is taken up. This seems to be rather the weakest portion of the work, as considerable space is devoted to the Baltimore tunnel locomotive and the Heilmann. The pages on the Baldwin locomotive are interesting but antiquated, and the Heilmann apparatus has not yet won a place in a description of practical traction engines.

Oil burning locomotives and a section on liquid fuel complete the book. The typography of the book is excellent and it is unusually well illustrated with carefully selected diagrams.

BOOKS RECEIVED.

DIES: THEIR CONSTRUCTION AND USE FOR THE MODERN WORKING OF SHEET METALS. By Joseph V. Woodworth. New York: Norman W. Henry & Co. Cloth. 384 pages, 505 illustrations, 9 x 6 inches. Price, $3.00.

HARDENING, TEMPERING, ANNEALING AND FORGING OF STEEL. By Joseph V. Woodworth. New York: Norman W. Henry & Co. 280 pages, 200 illustrations, 9 x 6 inches. Cloth. Price, $2.50.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE, Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION, Secretary, E. W. Pichardt, Huntingburg, Ind.

New Standard Dry Battery Tests.

In selecting dry batteries for engineering work of any kind, it often happens that the cells are selected by mere guesswork only. These circuits are duly designed, the voltage necessary to force the required current through them is computed, and enough primary cells are procured of presumably sufficient capacity to do the work, and if they prove deficient, more or larger cells are substituted.

In order to provide more comprehensive data for the benefit of the engineering profession, Mr. Wm. A. Roche, 42 Vesey Street, New York, has had numerous tests made upon some of his types of battery with the idea of displaying in a thoroughly concise form their energy producing qualities. Curves resulting from these tests are quite interesting, and some of them are submitted herewith. The cells whose tests are illustrated by the following curve sheets are known as the Roche new standard dry battery No. 5. The weight of these cells is 2 pounds. Their internal resistance averages about .12 ohms, their voltage is rated at 1.52, and on short circuit these cells will give from 15 to 18 amperes.

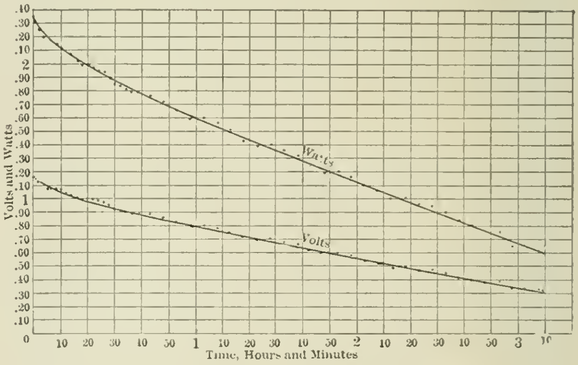


FIG. I.—CURVE OF DISCHARGE THROUGH VARIABLE RESISTANCE.

The curves of Fig. 1 indicate the performance of one of these cells discharging through a resistance which is varied so that the current will always be 2 amperes. It will be noted that the starting voltage with resistance in circuit was 1.18, and that it required nearly 3 hours and 10 minutes to reduce the voltage to .3, the voltage falling off almost uniformly with respect to time. On releasing the cell from the test, the voltage rapidly recovered, and in 12 hours the open circuit voltage had returned to 1.20.

Fig. 2 gives the discharge curves of the cell through .179 ohms.

The current started at 5 amperes and at the close of the test was slightly over 2 amperes, it requiring a little over 2 hours and 30 minutes to reduce it to this condition. The voltage of the cell on open circuit quickly recovered within 12 hours to 1.20 volts as in the former case. The watt hours per pound of cell on a 3-hour test was a little over 2.3.

The curves of Fig. 3 are interesting as showing the behavior of the cell on a heavy short circuit and its subsequent recovery. The cell was short-circuited through .056 ohms, and starting with 10 amperes, the current fell off until at 2 hours and 15 minutes it had reduced to a little below 2 amperes. On releasing the cell from its load, the open circuit voltage almost immediately jumped to .7 of a volt, and after that by slower increments it rose within 1 hour and 40 minutes to .965 volts. This curve should be of interest to those who employ dry cells for the purpose of bell and telephone work. It shows that such a cell could endure a very severe short circuit and almost immediately recover sufficient voltage to work any ordinary apparatus to which it might be connected.

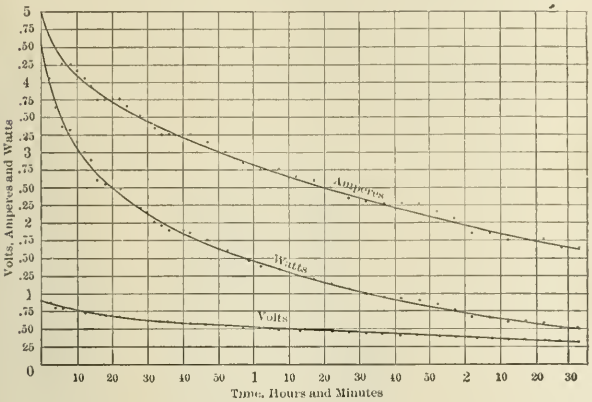


FIG. 2.—DISCHARGE CURVES.

In all three of these tests the voltage recovery is very prompt, and is very noticeable in view of the fact that these cells are intended for intermittent work. In a subsequent test made on these cells on interrupted circuit, conditions that would obtain in automobile work being duplicated, the results were very satisfactory. The cell was first tested with a commutator in circuit, which closed the circuit one-thirtieth of the time. The cell when operated under this interrupted load ran for 3 hours and 25 minutes with rests between each hour period. The current was taken with the commutator at rest both before and after the test, as was also the open-circuit voltage. It was found that the current fell almost uniformly from 6.2 amperes to 5.2 during the period of the test, the open circuit-voltage falling proportionately.

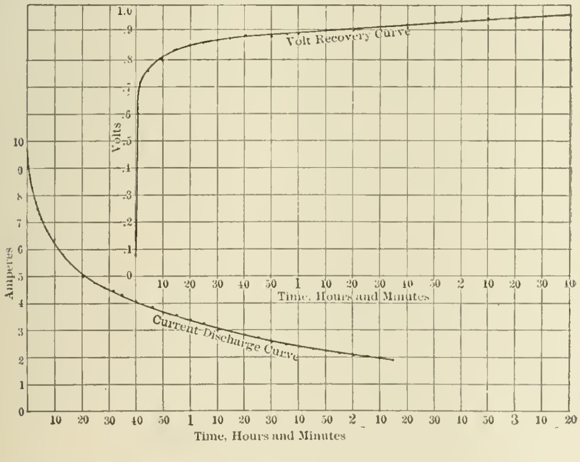


FIG. 3.—CURVES SHOWING DISCHARGE ON SHORT CIRCUIT AND SUBSEQUENT RECOVERY.

Finding that this arrangement would make the test unduly long, the commutator was changed and another was substituted closing the circuit one-quarter of the time. This subsequent test extended over a period of 28 hours of running and 69 hours 26 minutes in rests, these rests being divided up at approximate hour intervals, the aim being to duplicate automobile conditions as much as possible. On the start of this second test the battery was able to force 4.2 amperes through its circuit. At the close of the test it was able to force 1.2 amperes through the circuit, the capacity for delivering current falling off practically uniformly throughout the run. At the close of the test the cell showed a marked and substantial tendency to recover its voltage and current-producing capacity.

A Four-Ported Engine.

A new form of four-ported engine is being built by Mr. W. J. Francke, at New Brunswick, N. J., and is now illustrated and described, we believe, for the first time. It is shown in Figs. 1 and 2.

It has only one valve, designed to give a perfect four-valve steam distribution, and simple in construction. It will be observed that the valve is simply a cylinder with a steam port on one side and an exhaust port on the other, turned on the outside to fit a bushing containing the ports leading to the cylinders and on the inside to fit a tube containing the live steam ports, and is rotated by a pair of bevel gears from the shaft, running constantly in oil.

The valve is connected to the governor by means of a substantial spindle which drives the governor and makes the valve and governor practically one integral part, the valve rising and falling with the motion of the governor in a ratio determined by the relative length of the governor arms. The steam port in the valve, one edge of which determines the lead given to the engine, is cut longitudinally with the valve on its inside diameter, so that the up and down motion imparted to the valve by the governor does not change the position of the valve with relation to the position of the piston, and the lead is maintained constant and may be changed at will without interfering with cut-off, release or compression. On the outside diameter of the valve, the form of the port changes so that two ports are formed which have a slant corresponding to the slant of the ports cut in the bushing in which the valve rotates, consequently when the valve is raised by the action of the governor the cut-off takes place earlier and when the valve is lowered it takes place later, without in any way changing the lead, release or compression.

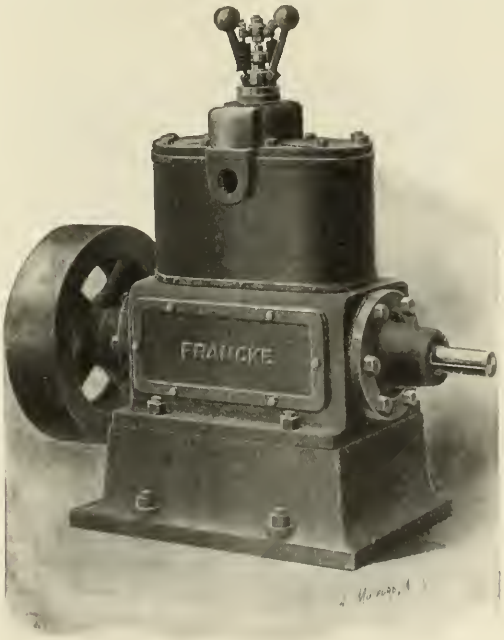


FIG. 1.—FOUR-PORTED ENGINE.

The exhaust port in the valve is simply a slot cut longitudinally with the valve, one edge of which opens the port and the other edge closes it. As the valve edge which opens the port does not close it, which is the case in every reciprocal valve motion, it follows that the position of the opening edge may be set in exactly that position which is determined by the indicator to be the best for the speed at which the engine is to run without interfering with lead, cut-off, or compression and the closing edge may be set in exactly that position which is determined by the indicator to be the best to get the compression necessary for the economical use of steam and that smooth running and freedom from shock, which is so essential to high speeds, without interfering with the lead, cut-off, or release.

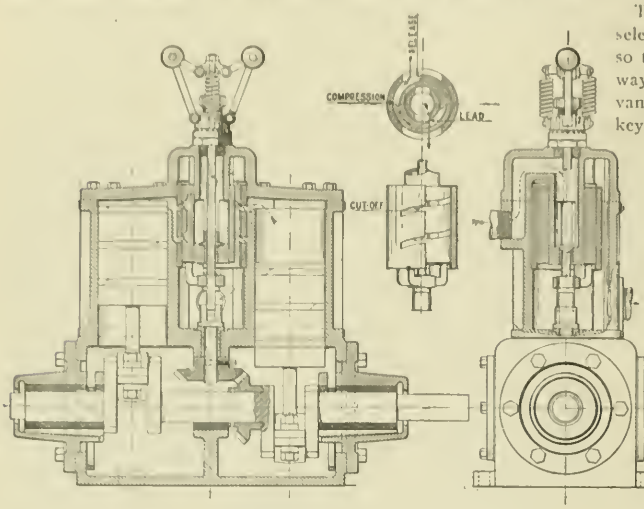


FIG. 2.—VIEW SHOWING INTERIOR OF ENGINE AND CONSTRUCTION OF VALVE PORTS.

By referring to the cut, it will be seen that the reciprocating parts of the conventional type of engine have been almost entirely eliminated, leaving only the two connecting rods and pistons, shorn of the usual weight of cross-head and piston rod. The governor is of the centrifugal type, but instead of having heavy, massive weights connected to an eccentric through which they must operate a heavy reciprocating valve mechanism, they are connected directly to the valve spindle itself, both the weight and the valve being driven by bevel gears from the main shaft, operating continually in oil. The governor's only function being to raise or lower a light balanced valve according to the load on the engine, a very close regulation is obtained with very light weights and springs and the simplest form of construction.

For lubrication ring oiling bearings are used for the shaft and an oil bath for the running gear in the crank case. A sight-feed lubricator takes care of the pistons and valves. The exhaust steam impinges on the flat surface of the exhaust valve port, forming an oil separator, which spreads the oil over the entire valve surface; the engine can be run at exceptionally high speed without undue wear or attention. Every engine is tested under steam at full working pressure at maximum speed and varying loads before leaving the works, and is shipped ready to start.

The Francke engine will be furnished when desired without sub-base, wheel or governor. The sales are controlled by Thomas C. Maxfield, sole sale agent, with general offices at 120 Liberty Street, New York. The Francke engine is furnished with either automatic or with throttling governor, for direct connection or belting to anything. Sizes now ready are 5 hp to 25 hp. The smaller engines run as high in speed as 1,000 r.p.m.

Monoplex Intercommunicating Telephones.

The Atwater-Kent Manufacturing Works, of Philadelphia, are bringing out intercommunicating instruments similar to their two-station monoplex telephones that have been on the market for the past year. The success of these instruments for a two-station line and the many demands that this company has had for an intercommunicating system that would give equal satisfaction, led the concern soon after these instruments came out to give the matter their attention, with the present result. They made a careful study of the requirements of systems for various uses and developed them by installing them in a large number of places that have given a severe test of their reliability and convenience. The "monoplex" instruments used on these systems are as simple as it is possible to make them.

The systems are designed so that they are simple to install, and the diagrams, as shown here, are plain and complete.

Their No. 2 system is an all-around intercommunicating and selective ringing system. The instruments are of the switchless type, so that they are perfectly automatic and need no adjustment in any way when the receiver is hung up. This instrument has many advantages, it is asserted, over the switch type. It saves consulting a key to find the number of the station that one wishes to call, then turning the switch to that point and pressing the button. Pressing the button beside the name of the station to be called is all that is necessary with the switchless type.

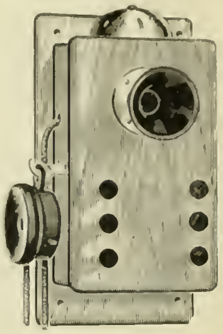


FIG. 1.—MONOPLEX TELEPHONE.

Another prominent feature is that it can be used for a finder to get a man immediately, no matter where he is in the building. This is done by a code of signals, which are rung on all of the bells at one time. The person then, on hearing his signal, goes to the nearest telephone. The number of wires required on this system are three, plus the number of instruments. Hence, a system of say five stations would require three plus five, or eight wires.

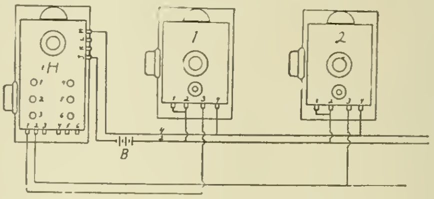


FIG. 2.—DIAGRAM OF CIRCUITS.

Only one central battery is needed for both ringing and talking circuit, and for the ordinary system, three dry cells or four wet cells are sufficient. The impedance coil necessary with this system is inexpensive, and is as easily connected to the wires as would be a single cell of battery.

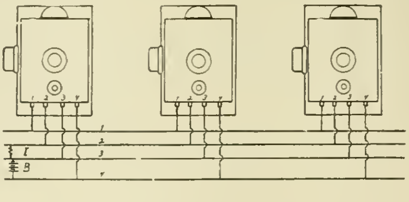


FIG. 3.—DIAGRAM OF CIRCUITS.

System No. 3 is their "Universal Intercommunicating" method.

It is non-selective, but thoroughly intercommunicating. It requires four wires and a single push button at each instrument rings all of the bells on the system. By a code of signals the different stations may be called, or for factory use it is much better for the signals to call the different men required. A central battery of two or three cells is all that is needed.

System No. 4 is a selective ringing non-intercommunicating system. This is to be used where there is a central with several outlying stations. The station can call up and talk with central and central can call them up individually, but they cannot call up and talk to each other. The number of wires needed is two, plus the number of outlying stations. Thus a system consisting of a central and four outlying instruments would need six wires. If the instruments lie in opposite directions, three wires go to each. The battery is centrally located and no impedance coil is used. The impedance coil used in Systems Nos. 2 and 3 is sealed in a wooden box with heavy leading wires for connecting.

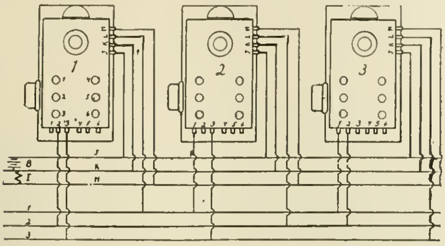


FIG. 4.—MONOPLEX TELEPHONE CIRCUITS.

Steam Turbines in the Rockland, N. Y., Central Station.

The Rockland Light & Power Company, of Nyack, N. Y., has for a number of years been engaged in furnishing light and power to the local territory surrounding the town of Orangeburg, N. Y., where the generating station is located. The system covers a territory of considerable extent, embracing the towns of Nyack, Grand View, Piermont, Sparkhill, Orangeburg, Tappan, Blauvelt, Nanuet, Spring Valley and Monsey. The territory will now be covered by five independent distributing systems, each fed by a separate transmission circuit from the power house at Orangeburg. The load consists mainly of incandescent lighting, but motors of considerable capacity are installed at a number of points. The present equipment of the station comprises a number of different types of boilers, engines and generators. The latter are belted outfits, and will be largely replaced by the new steam turbo-generator unit to be installed. The present system is a two-phase, 3,300-volt, alternating-current system, each generator operating independently upon a separate circuit. In the new arrangement provision has been made for operating the entire system from the turbo-generator unit, the remaining machinery being held in reserve for periods of heavy load. The turbine is of the standard single-cylinder, multiple-expansion type, built by the Westinghouse Machine Company, of Pittsburg, Pa., and is of the type that has been installed in other power plants, notably the Westinghouse Air Brake Company, Hartford Electric Light Company, and the Yale & Towne Manufacturing Company, Stamford, Conn. The turbine will be furnished with superheated steam at 125 pounds pressure, this being accomplished by an independent superheater, with which a superheat of 100° to 125° F. will be obtainable. The mechanical equipment includes also a Snow condenser, capable of maintaining a high vacuum, an Alberger cooling tower for cooling the circulating water, and a mechanical draft outfit. The turbo-generator will be of the type recently standardized by the Westinghouse Electric & Manufacturing Company, for this class of service, and will furnish two-phase, 60-cycle current at 3,300 volts, directly to the station bus, from which the several transmission circuits extend in various directions to the local centers of distribution.

Exhibits at the Northwestern Convention.

As usual, a number of parlor exhibits were made at Hotel Pfister during the convention of the Northwestern Electrical Association at Milwaukee, January 21 and 22.

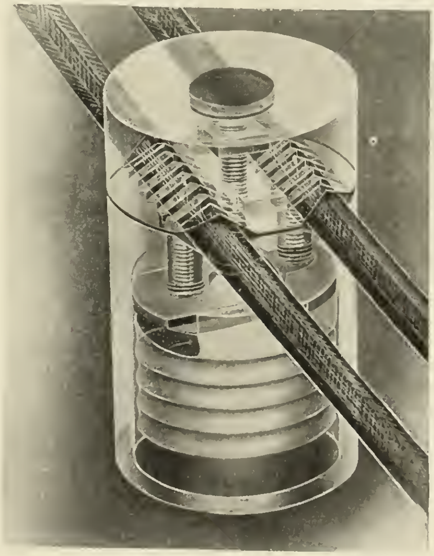
The General Electric Company made no attempt at extensive display, but had headquarters at one of the parlors, and that company's new concentric diffuser for store and factory lighting by arc lamps, which was taken up in Mr. Ryan's lecture on "Light and Illumination," was seen in practical use in the club rooms of the hotel, where the convention was held. These diffusers distribute the light equally over the room, giving a very superior kind of illumination. W. D. Ryan and Mr. Stickney, of Lynn, Mass., and H. C. Wirt, of Schenectady, were the factory contingent in attendance, while J. Scribner, F. N. Boyer, S. F. Dibble and Mr. Beardsley, of Chicago, with Thomas Ferris, of Milwaukee, represented the sales department.

The Westinghouse Electric & Manufacturing Company received visitors and distributed bulletins in one of the parlors and were represented by W. R. Pinckard, A. L. Millard and W. D. McDonald, of Chicago.

The Jandus Electric Company had some of its interchangeable arc lamps burning in the hall on a rack where all parts could be easily inspected. These lamps have parts interchangeable, so that the coils can be changed to adapt the same lamp to various circuits. W. R. Bonham, of Chicago, explained the points of the lamps to delegates and also represented the Buckeye Electric Company.

Mr. John A. Stewart, of Cincinnati, received visitors in Room 12 and represented his company, which is doing a fine business throughout the West in second-hand electrical machinery.

The Crouse-Hinds Electric Company, represented by F. F. Skeel, of Chicago, exhibited some of its switches and Norbitt porcelain specialties. The latter, which attracted special attention, consist of a line of wall and ceiling sockets that permit of remarkably safe, easy and rapid connection to the mains, and sockets also, adapted to rapid connection with stranded wires without cutting and scraping the insulation. The connection in the latter case is made with points forced into the conductor. It is specially intended for rapid stringing of festoons of lamps or other temporary decorative work.



TEMPORARY SOCKET FOR DECORATIVE PURPOSES.

The Electric Appliance Company made its presence in Parlor 10, known by numerous original and catching methods of advertising, most notable among which was the "Buttinsky," which was found hanging at frequent intervals around the corridors. Packard transformers, Gutmann wattmeters and Whitney instruments were among the principal exhibits of this company. The core and coils of a Packard transformer immersed in water were shown operating at 1,000 volts, and one of the salesmen was sufficiently devoted to his company's interests to demonstrate that the 1,000 volts was not a bluff, by putting his hand across the terminals. W P. Upham, I. A. Bennett and J. B. McMullen represented the Electric Appliance Company, I. Chadwick the New York & Ohio Company, Packard transformers, and C M. Nevins, the Whitney Electrical Instrument Company.

The Kuhlmann Electric Company, represented by Mr Kuhlmann, exhibited several sizes of Kuhlmann transformers, which are provided with sheet steel riveted cases in place of the usual cast iron.

The Fort Wayne Electric Works had a new electrostatic ground detector for high potential alternating-current circuits on exhibition. The revolving fan motor, which was shown last year for the first time, has enjoyed a great sale the past year, and was again on exhibition practically without modification. This fan is said to take but 16 watts. W S Goll, J. H. Raymond and I. S. Jackson were the company's representatives.

The Bryan Marsh Company had Geo. C. Keech, of Chicago; L. P. Sawyer and J. L. Barnard, of Minneapolis, receiving delegates at its headquarters.

The Illinois Electric Company exhibited a very neat combination socket and shade for incandescent sign and decorative lamps. When desired the tiny porcelain shade can be reversed to cover the socket, making a very neat appearance. A line of cheap service switches was shown. The Peirce bolt for fastening brackets and signs to brick walls with tools for doing the work was also shown. N. G. Harvey and C. W. Bacon were this company's representatives.

Van Rensselaer, Lansingh & Company, agents for the Holophane Glass Company, for Chicago territory, had an exhibit parlor, but the main exhibit was in the lobby of the hôtel, where a contract had just been filled for the equipment of all the lamps with holophane globes. The difference in illumination with the holophanes as compared with the old frosted globes was striking, and all the more so when it was learned that 10-cp lamps had replaced 16-cp in all the sockets. V. R. Lansingh was on hand and also C. A. Howe, vice-president of the Holophane Glass Company.

The Christensen Engineering Company, which so recently branched out into the extensive manufacture of electrical machinery, made an exhibit of course. Some of its smaller armatures and a generator were moved from the factory to the hotel for this purpose. S. W. Watkins, president; F. L. Hutchinson, sales manager; Charles D. Knight, engineer, and Mr. Richards, of Milwaukee, with Charles G. Burton, manager of the new Chicago agency, formed the company's representation.

Pass & Seymour.—Their switches, sockets and porcelain specialties were exhibited by John W. Brooks, the Chicago sales agent.

The Dearborn Drug & Chemical Works received visitors and gave out barometer cards at one of the parlors. They were represented by P. H. Early, of Milwaukee.

The Osborne-Morgan Company, of Cleveland, Ohio, is a new company in the arc lamp field. It makes an arc lamp which can be run on either direct or alternating circuits. The coils are the same for both circuits, and the only change when run on alternating circuits is the omission of the resistance coils, which are cut out by a switch on the lamp. P. J. Morgan and Joseph Melzer were in attendance exhibiting the lamp.

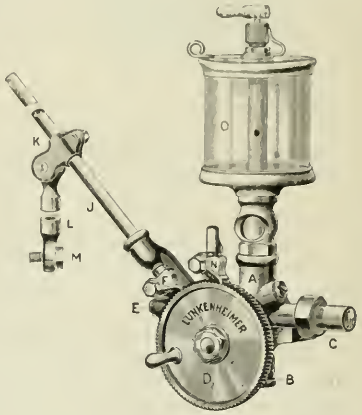
Andrae & Sons Company, of Milwaukee, made an exhibit of the various lines of goods handled by them, including Nernst lamps and other Westinghouse apparatus.

The Electric Storage Battery Company invited delegates to visit one of the largest batteries in the world, viz., 608 cells, recently installed by the Milwaukee Electric Railway & Light Company, used either for railway or lighting or both. G. H. Atkin and Otto E. Osthoff did the honors.

Other companies represented at the convention, but not making exhibits were M. B. Austin & Co., A. Meinema; American Circular Loom Company, Thomas G. Grier; Adams Bagnall Electric Company, J. G. Pomeroy; A. M. Barron, consulting engineer; Chicago Insulated Wire Company, William M. Smith; Curtiss-Crippen Engineering Company (De Laval turbine), L. F. Mahler; Columbia Incandescent Lamp Company, W. O. Garrison, James B. Coole; Crescent Soldering Compound, J. H. McGill; Gregory Electric Company, A. O. Kuehmstead and R. H. Watson; G. I. Company, Francis Raymond; Gould Storage Battery Company, E. L. Draffin; Guarantee Electric Company, Charles E. Gregory; Hart & Company; McRoy Clay Works, E. F. Kirkpatrick; Monarch Electric Wire Company, C. A Kuhlman; Mechanical Appliance Company, T. F. Whitfield; Mechanical Boiler Cleaner Company, W. R. Mason; Minneapolis Steel & Machinery Company, W. B. Kitt; Northern Electrical Manufacturing Company, T. F. Whitfield; New York Insulated Wire Company, James Wolff; Standard Underground Cable Company, J. R. Wiley and E. J. Pietzeker; Sprague Electric Company, Alexander Henderson; Wagner Electric Manufacturing Company, R J. Russell.

Mechanical Oil Cup.

An ingenious but simple form of mechanical oil cup, herewith illustrated, has been put upon the market by the Lunkenheimer Company, of Cincinnati, Ohio, as the result of the demand for a positive mechanically-operated lubricator, and as the result of considerable study and experimenting to produce a first-class lubricator of this kind. This method is said to be more reliable than that obtained by lubricators hydrostatically operated, and, when properly constructed, the oiling is absolutely positive, and all of the oil fed to the pump is bound to be forced to the steam chest or cylinder of the engine. Referring to the illustration it will be seen that the driving mechanism is of the ratchet type and is operated by the clutches *F* and *N* that work co-operatively by the motion of the rod *J*, which can be attached to the eccentric rod, or other moving parts of the engine, by the couplings, *K* and *M*. The motion thus obtained is transmitted to the piston, *E*, by the crank-pin mechanism, *H* and *G*. The ratchet wheel, *D*, is provided with a handle whereby it can be rotated by hand in case it is desirable to force a quantity of oil at any time, as, for example, when starting the engine.



MECHANICAL OIL CUP.

By moving the part *K* up or down the rod, the stroke of the pump can be lengthened or shortened, as desired, thus regulating the amount of oil fed by the pump independent of the feed from the oil cup. The joints of the cup are tight, the sight-feed glass being packed so as to prevent the access of air that would have a tendency to cause the cup to feed after the engine had ceased running. This construction and the use of check valves in the pump prevent the oil supply from flooding.

The outlet, *C*, is piped to the steam pipe or chest of the engine, and the spring check valve, *X*, should be placed as near the end of the pipe as possible, preferably into the steam pipe. The bottom of the pump body, *B*, is tapped ½-inch pipe thread to receive a stand so that it can be placed wherever desired. The pump is substantially constructed, the workmanship being first class, and, as the parts are made to jigs and templets, they can all be easily renewed, being perfectly interchangeable. The ratchet wheel, *D*, and pawls, *F* and *N*, are made of tool steel, tempered and hardened. All other metal parts about the pump are made of the very best hard bronze composition.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was easier throughout the week, closing at 4¾ for all dates up to six months on good mixed collateral. The stock market was dull and featureless, with a sagging tendency in prices, the easing of money having no apparent effect in stimulating interest in the market by outside speculators. The announcement of the decision of the Appellate Court against the validity of the franchise tax law affected temporarily the traction group and other stocks directly involved. The industrials were dull most of the week, although Amalgamated Copper had better support and was fairly active at between 65⅛ and 62¾, but afterwards shared in the general dullness. United States Steel stocks were steady and comparatively featureless. The tractions closed weak with net losses compared with the closing prices of the previous week amounting, in the case of Brooklyn Rapid Transit, to ⅞ point and in the Metropolitan Street Railway to 2¾. The former closed at 67⅜ after having reached 69⅛, and the latter 138¾, the highest price of the week being 142. Manhattan was featureless, closing at 150½, a net loss of 3⅜ points. The market for outside securities closed quiet, with, however, a steady tone. Fractional advances were recorded in Electric Vehicle common and Marconi Wireless of Canada. About 600 shares of the latter changed hands on Saturday at 5⅜ a 5½. De Forest Wireless Telegraph sold at 5¼ a 5⅜ for about 500 shares. In Boston, American Telephone & Telegraph declined 1½ points for the week. Following are the closing quotations of January 27 at New York:

NEW YORK.

	Jan. .20	Jan. 27		Jan. 20.	Jan. 27
American Tel. & Cable	85	86	General Electric	185	191
American Tel. & Tel	160	162	Hudson River Tel	..	..
American Dist. Tel	36	37	Metropolitan St. Ry	140½	138½
Brooklyn Rapid Transit	67¼	68	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel	161⅛	161
Electric Boat	22	23	N. Y. E. V. T. Co	10½	10
Electric Boat pfd	37	30	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3	Western Union Tel	90¼	90
Electric Vehicle	8⅛	7⅞	Westinghouse com	210	215½
Electric Vehicle pfd	13⅛	12½	Westinghouse pfd	210	220*

BOSTON.

	Jan. 20.	Jan. 27		Jan. 20.	Jan. 27
American Tel. & Tel	163¼	162	Western Tel. & Tel. pfd	101	99½*
Cumberland Telephone	..	..	Mexican Telephone	2⅛	2
Edison Elec. Illum	.	*277½	New England Telephone	137	135
General Electric	..	192½	Westinghouse	103	107
Western Tel. & Tel	26½	24	Westinghouse pfd	103	108

PHILADELPHIA.

	Jan. 20.	Jan. 27		Jan. 20.	Jan. 27
American Railways	..	..	Phila. Traction	98¼	98¼
Elec. Storage Battery	80*	80½	Phila. Electric	8⅜	8¼
Elec. Storage Battery pfd	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9½	9¼	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Jan. 20.	Jan. 27		Jan. .20	Jan. 27
Central Union Tel	..	..	National Carbon pfd	98	98
Chicago Edison	..	165	Northwest Elev. com		..
Chicago City Ry	230	228	Union Traction	16⅛	12
Chicago Tel. Co	.	..	Union Traction pfd	50	45
National Carbon	25	20			

*Asked.

TOLEDO RAILWAYS & LIGHT.—Mr. Albion E. Lang, chairman of the board of directors of the Toledo Railways & Light Co., in the annual report of the company, says: In view of the improvements in track and equipment made during the year 1902, and provided for 1903, and the enlarged facilities growing out of the construction of the new shops and car houses, it is my opinion that we will earn the current year not less than 3 per cent. on the capital stock of the company. We are now supplying the city with 1,167 street arc lamps, being an increase of 85 over the previous year, and are at present supplying current for 107,663 incandescent lamps and current for 3,271 hp in motors. During the year an extension to the engine room of the power house has been completed, and the large 3,000-5,000-hp engine purchased of Allis Company, and the 2,000-kw Westinghouse direct-connected generator has been installed. Some additions have been made of machines of smaller capacity to strengthen the electric light department. Two large Heine boilers were also installed during the year. The work of installing the McKenzie traveling grate has been continued during the year, and all boilers are now equipped with them except two, which will be installed during the coming summer. Five interurban roads now enter the city under contract with us over our tracks, and a sixth interurban road will enter during the year 1903. The following is a comparative statement of the gross earnings of the present properties owned by the Toledo Railways & Light Company for the years 1897 to 1902, inclusive. It is difficult to show the net earnings of the several properties, owing to the many mergers, consolidations and changes made during this period of the underlying electric light and railway properties:

1897	$897,361
1898	968,516
1899	1,069,279
1900	1,182,516
1901	1,311,084
1902	1,459,091

The increase in gross earnings over the preceding year is 11.29 per cent., as against 10.87 per cent. for 1901 over 1900. The net income for the year shows earnings of 2.27 per cent. on the capital stock of the company.

INTERNATIONAL STEAM PUMP.—The circular to shareholders of the International Steam Pump Company with reference to the issue of debenture bonds recently authorized says that the growth of the business has so far exceeded expectations that it has become necessary to greatly enlarge and concentrate its existing plant and to build new factories to meet the changed conditions and provide for further extensions. The volume of business for the year ended October 31, 1902, is about double the amount of business of the constituent concerns for the year ended at the formation of the company. On October 31, 1902, there were $5,686,067 of orders in hand. The net profits for the three years have averaged 6.95 per cent. on the common stock over and above all fixed charges and contributions to the sinking fund, and after allowing amply for depreciation. A tract of land has been purchased and work begun on a plant at Harrison, N. J., which will be by far the largest pump works in the world. The works of the Snow Company, at Buffalo, are being changed and enlarged with the view of concentrating a large part of the water works business at that point, and the capacity of the Blake factory is also being increased by the erection of a new factory and equipment. For these purposes, as well as to provide funds to pay for improvements already made, for which the company has temporarily borrowed about $700,000, the directors have authorized an issue of $3,500,000 debentures. It is intended to issue not exceeding $2,500,000 of these debentures at this time and then only from time to time as the money is needed. This amount of $2,500,000 has been underwritten at the price to the company of par and interest less one and one-half per cent. (1½ per cent.) commission, subject to the right of the stockholders to subscribe for their proportion of these debentures at par.

CHICAGO TRACTION DEALS.—It is stated from Chicago by one of the committee formed to negotiate terms with the city for a renewal of street car franchises that prior to the formation of that body "strong Eastern interests" in the Union Traction Company pledged themselves to raise $50,000,000, if needed, for improvements. It is understood that this pledge originated with J. Pierpont Morgan, and therefore it is not doubted that the pledge will be made valid when the time arrives for using the money. The same authority says that after the franchises shall have been granted a complete reorganization of the finances of the Union Traction Company will take place. This also would involve the raising of a large amount of new capital. It is proposed in a tentative way to retire most of the underlying securities with a general 4 per cent. bond. Nothing, however, will be done with the old Chicago West Division and North Chicago Railway stocks guaranteed at 35 and 30 per cent. respectively.

THE UNITED GAS & ELECTRIC COMPANY reports results of operations of their constituent companies for the year ending December 31, 1902, as compared with the previous year as follows:

	1902.	1901.	Changes.
Gross	$619,430	$541,844	Inc. $77,586
Expenses	470,892	437,699	Inc. 33,193
Net	$148,538	$104,145	Inc. $44,393

Expense include all cost of operation, insurance, taxes, maintenance and interest on all bonds of sub-companies. From the net earnings of $148,538, the company has paid preferred stock dividends amounting to $64,500. The balance, $84,038, is equal to more than 8 per cent. on the entire outstanding common stock, and is being expended on extensions and betterments.

CENTRAL UNION TELEPHONE.—The Central Union Telephone Company for the year ending December 31 showed gross earnings of $3,003,717; net profits, $180,345. W. S. Chapman replaces Colonel Clowry on the directorate.

AMERICAN DISTRICT TELEGRAPH.—The annual report of the American District Telegraph Company for the year ended December 31 shows a decrease in gross earnings of $14,149, a decrease in operating expenses of $22,368 and a consequent increase in net earnings of $8,219. The total surplus increased $9,981 and the outstanding capital stock remained unchanged at $3,844,700, of which $5,500 is in the treasury. In his annual report President Robert C Clowry says: The comparison is very favorable, especially in view of the fact that during the first half of the last year the records show a decrease of $17,887 in the net receipts, and that the conditions since have been distinctly unfavorable for a good business. The income account compares with 1901 as follows:

Rev., all sources	$610,043	Dec. $14,149
Ex., main. and const	513,176	Dec. 22,368
Net revenue	$96,867	Inc. $8,219
Dividends	76,886	Dec. 19,221
Surplus	$19,981	Inc. $27,440
Previous surplus	78,729	Dec. 7,459
Total surplus	$98,710	Inc. $9,981

NEW YORK CONSOLIDATED GAS.—At the annual meeting of this great concern, President Gawtry said: "The year just ended has been a trying one for the company, the works, both gas and electric, have been run up to their full capacity, and it is a source of congratulation that the company has been able to meet the demands made upon it. The scarcity of fuel caused much anxiety, as at times during the last two or three months the requirements ran up as high as 3,500 tons a day, for which, in most cases, high prices have had to be paid, as all contracts were suspended during the strike. There was imported early in the summer a quantity of Welsh coal, which helped out the situation to a great degree. It was a serious question at one time whether all the supply of gas required could be supplied, some days the consumption running very near 80,000,000 cubic feet." He added that the output of electric current during the year had been 88,500,040 kw, an increase of 18.36 per cent.

MARCONI WIRELESS TELEGRAPH.—The success of Mr. Marconi has renewed interest in the Marconi Wireless Telegraph Company, which controls the patents for the United States. The capital of the company is $6,500,000 and of this stock $1,200,000 was offered to the public at $65 per share. This stock is now $65 bid, and since Mr. Marconi's remarkable success there has been considerable inquiry for the stock. While estimates as to probable earnings of the company are necessarily vague at the present time it is considered within bounds, say the officials, to figure upon net earnings of about $350,000 annually from its transatlantic stations by sending messages at one-half the present rates. The Marconi and Postal companies will work together in the transmission of messages.

MEXICAN LIGHT & POWER.—The Canadian Bank of Commerce, through Senator Cox, of Toronto, and the Bank of Montreal, through Mr. James Ross, president of the Dominion Iron & Steel and Dominion Coal Companies, have subscribed the $12,000,000 worth of stock required for the carrying out of the project of the newly formed Mexican Light & Power Company, Limited. The new company, the entire capital for which has been subscribed in Canada, will supply electric power to the City of Mexico from the Uecaxa River, a distance of 85 miles. Mr. Hugh L. Cooper, of New York, the engineer of the San Paulo project in Brazil, will be engineer of the new Mexican company.

BRISTOL GAS & ELECTRIC COMPANY, of Bristol, Tenn., will receive bids for its 5 per cent first mortgage collateral twenty-year gold bonds at 95 and accrued interest. The total issue is $375,000, of which $220,000 is authorized to be sold. This company is now the owner of all the gas lighting, electric lighting and street railway service of both Bristol, Tenn., and Bristol, Va. Mr. M. F. Dobbins is business manager.

ASSIGNMENT.—The assignment of the Sargent Automatic Signal Company, of Rochester, N. Y., is announced. The company's capital was $1,000,000. Mr. H. C. Rutherford was appointed assignee. The company made electric automatic signals for railways. The reason for the assignment has not been learned, but it is reported that the company's assets consisted almost exclusively of patents.

DETROIT EDISON COMPANY.—The Detroit Edison Company, of New York City, was incorporated at Albany a few days ago with a capital stock of $6,000,000. The directors are Charles W. Wetmore, George R. Sheldon, Edwin M. Bulkley, Charles A. Coffin, William F. White, Alfred Jaretzki, Albert S. Ridley, Henry W. Clark and George H. Olney, of New York City.

DIVIDEND.—The Western Telegraph & Telephone Company has declared a regular semi-annual dividend of $2 a share on the preferred stock, payable February 2 to stock of record January 22. A dividend of $3 per share will be paid on the preferred stock of the Jacksonville Electric Company February 2, 1903, to stockholders of record January 20, 1903

WIRELESS TELEGRAPH STOCK.—Stocks of the American De Forest Wireless Telegraph Company and the Marconi Wireless Telegraph Company, of Canada, have been added to the list of marketable securities in New York financial circles.

Commercial Intelligence.

THE WEEK IN TRADE. The reports submitted to the mercantile agencies continue to be favorable, there being further expansion in spring trade, particularly in dry goods. Clothing, shoes, hardware and hardware lumber are active, says *Bradstreet's*, and the volume of shipments of spring goods to fill orders offers still another problem for the congested transportation companies to solve. There is some complaint of the interruption in manufacturing industry by the high price and scarcity of coal at the East; imports of foreign coal are increasing, however. Among manufactured products the strength of iron and steel is notable; and in finished products steel plates, bars and rails are especially strong and active. Numerous orders for cars are coming forward and this has created a large business for miscellaneous steel and for yellow pine. The strength of the building materials market is a notable feature; the outlook for new building operations during the year 1903 shows that there will be much activity. Specially good Western trade reports came from Chicago and in St. Louis spring business is fully equal to expectations. Favorable reports are also received from other widely separated sections of the country. Taking it altogether, the situation could hardly be more favorable to the industries in general. In the metal market copper showed little increase in activity and prices slowly fell off. Various glowing reports of a large copper business were circulated, but these had no apparent effect upon the market. The last quotations were as follows: Lake, 12.15 c. to 12.30c.; electrolytic, 12.5c. to 12.25c.; casting stock, 12c. to 12.12½c., and Standard, 11⅝c. During the week ending January 22 there were 253 business failures according to *Bradstreet's* reports, against 234 the week previous, and 292 the corresponding week last year.

ORDERS FOR TROLLEY APPARATUS.—President H. H. Vreeland, of the Interurban Street Railway Company, has placed an order for 200 large open cars for the Forty-second Street, Manhattanville & St. Nicholas Avenue branch of the Third Avenue line, to be delivered in the near future. Some time ago the company ordered 150 cars for this line, but when they arrived the roadbed was in such condition that they could not be used. Mr. Vreeland said that the Interurban Company will spend $5,000,000 in increasing the facilities in Manhattan by the installation of the sub-surface trolley system on its crosstown lines on Thirty-fourth Street. Fourteenth Street, Grand Street and Fourth Avenue. This work will begin early in March and will be rushed to completion. The rails and other materials for the conduits have been ordered, some of which have already been delivered.

TELEPHONE EXCHANGE CONTRACT.—The local telephone company, Bellevue, Ohio, will shortly close a contract for central office equipment for Norwalk, Ohio. The equipment will consist of multiple switchboard for party line service. Each cord circuit will be equipped with four party selective indicating keys. Equipment will be modern in every detail. The power plant will be operated from a gas engine installed by the company. Specifications for the plant were drawn by LeRoy W. Stanton, consulting telephone engineer, of Cleveland, Ohio.

WIRELESS TELEGRAPHY.—The American De Forest Wireless Telegraph Company has just received a dispatch from Mr. G. Harry Barbour, executive engineer, stating that the wireless tower at Cape Hatteras has been rapidly pushed to completion. A large force of men are at work and expect to open long-distance wireless communication with their station at Block Island, nearly 500 miles away, within 60 days.

INSULATORS FOR MEXICO.—Pass & Seymour, Incorporated, of Solvay, N. Y., through Mr. W. Brewster Hall, 34 Dey Street, has just secured a contract from the export commission house of William E. Peck & Co., 116 Broad Street, New York, for special porcelain insulators for shipment to the City of Mexico.

CATALOGUES, ETC., WANTED IN SPAIN.—La Industria Electrica, 57 Muntaner, Barcelona, Spain, desires to secure catalogues, price lists, with best discounts, of American electrical machinery. The concern is interested in everything pertaining to the equipment of electric plants.

STATUS OF THE COPPER MARKET.—The National Conduit & Cable Company, of New York, in their "Copper Gossip" circular of January 21, says: The copper market is a peculiar one and places us in a position where it is somewhat awkward to act as advisors. Our feelings are that the price of bars should go lower, and yet the various sellers of the same are holding their prices firm. It is hard to get information that is correct in regard to the production and amount of stock on hand of refined copper. The various producers have always either refused information or have given figures which suited their purposes, rather than those which were correct; but from the information that is obtainable, and from comparison with past figures, the stock on hand on January 1, 1903, is said to be over 250,000,000 pounds, being as large as any, if not the largest, ever in the hands of producers. There are also millions of pounds of copper bars which were sold last year to new enterprises, such as the New York Rapid Transit Subway, the Pennsylvania Railroad, the Underground Electric Railways of London, and others; also to the manufacturers of copper products, all of which must be consumed this year and next, before the enormous surplus stock can be called upon. In the meantime, the producers of copper are turning out each month an amount of copper which is largely in excess of the average amount of consumption, and either the consumption must increase, culminate or the production be curtailed, or the producers will have a load which will be impossible for them to carry. As there does not seem to be any uniformity of action among the producers we can only see one result, and that is a continued overproduction, and necessarily enormous interest charges to carry such a stock. If they put the price of copper bars at a figure which will allow it to be consumed in much larger quantities than heretofore, and used for new purposes, they will be able to take care of this overproduction; and by their placing the bars at such prices they will necessarily curtail production by cutting out such producers as are unable to sell at these figures. The record for last year was phenomenal, inasmuch as the copper consumed in this country, exports from this country, and imports into this country, are all record breakers; and yet, notwithstanding the fact that both the consumption and exports were the greatest ever known, the surplus stock was considerably increased. All indications for the year point to a large volume of business, which, we believe, will fully equal that of 1902, but this can only be accomplished by maintaining about the same basis of prices.

THE ST. JOSEPH & ELKHART POWER COMPANY, of Mishawaka, Ind., is installing a large hydraulic plant on the St. Joseph River near Mishawaka, including power house, dam and hydraulic and electric equipment for the generation and transmission of electric power to the cities of South Bend, Mishawaka and Elkhart, Ind., and adjacent territory. The energy will be used for general lighting and power purposes. The consulting engineers and general contractors for the complete development are Messrs. Sanderson & Porter, 31 Nassau Street, New York City, who have recently purchased from the Westinghouse Electric & Manufacturing Company four 1,000-kw, 13,200-volt, revolving-field alternators, and two 125-kw, direct-current exciters. The machines are all to be direct coupled to horizontal shaft water wheels. The engineers have also recently ordered a complete high-tension large capacity switchboard from the Westinghouse Company, including a complete equipment of the latest type of its electrically operated oil-brake switches for operation at 13,200 volts.

STROMBERG-CARLSON TELEPHONE CONTRACTS.—The Stromberg-Carlson Telephone Manufacturing Company, of Chicago, reports the following recent contracts: Shawhaw, Ky., with the Buckeye Construction Company, for a 100 capacity drop switchboard; Scottsville, Ky., with Mr. D. A. Oliver for a 100 capacity drop switchboard; Rudd, Iowa, with Mr. W. A. Eckels for a 50 capacity drop switchboard; Clarington, Iowa, with the Clarington Telephone Company for a 100 capacity drop switchboard; Montrose, Pa., with the Clarington Telephone Company for a 100 capacity drop switchboard, and with the Montrose Telephone Company for a 120 capacity drop switchboard; Havre, Mont., with Mr. E. V. Hauser for a 100 capacity board; Centreville, Ky., with the Buckeye Construction Company, for a 100 capacity drop switchboard; Pleasant Hill, Ill., with the Pike County Telephone Company for a 50 capacity drop switchboard; Elmo, Mo., with the State Line Telephone Company for a 100 capacity drop switchboard.

MORE MOVING STAIRWAYS.—The Manhattan Elevated Railway Company has drawn up plans to install escalators (moving stairways) at its stations at Thirty-third Street and Forty-second Street for both the uptown and the downtown platforms. It is believed that the Railroad Commission recently expressed to the "L" officials the desirability of a better handling of passengers between the stations and the street. The receipts of the uptown station at Sixth Avenue and Twenty-third Street have increased at a greater ratio than at any other station of the system since an escalator was installed there, about two years ago. The contract between the city and the Subway Construction Company provides that where the station platforms are more than thirty feet, either below or above the level of the street, mechanical means of conveyance between the platform and the street must be provided. The Subway Company has accordingly arranged to install similar moving stairways at several of its stations.

THE OHIO BRASS COMPANY has decided to substitute alternating-current power distribution for the direct-current system at present in use in its shops at Mansfield, Ohio, on account of the superior economy of the former. A recent purchase from the Westinghouse Electric & Manufacturing Company comprises a 180-kw, 7,200-alternation, two-phase alternator, a direct-current exciter, switchboard equipment and the following induction motors: Two of 40 hp, four of 30 hp, one of 20 hp, one of 15 hp, and one of 2 hp. This apparatus is to provide increased capacity and to replace the following direct-current machinery: One 75-kw, 125-volt generator, one 35-kw generator, three 40-hp motors, two 25-hp motors, and two 5-hp motors, also a three-panel, direct-current switchboard.

THE CINCINNATI ELECTRIC MOTOR COMPANY is starting the new year with a good business. It has just completed the installation of 31 motors in the *Commercial Tribune* Building, Cincinnati, also equipments for operating the large presses of the *Cincinnati Enquirer* and the *Cincinnati Post*, motors for the Baldwin Piano Company, the Premium Buggy Company, Decatur Ill., and the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. It has also made a large shipment of motors to New York City. A neat bulletin, describing its new Type C multi-polar motor is off the press ready for general distribution.

BALL ENGINE ORDERS.—The La Junta Electric Company, La Junta, Colo., has recently purchased a 250-hp tandem compound engine from the Ball Engine Company, Erie, Pa. The National Transit Company, of Oil City, Pa., has recently purchased a 350-hp direct-connected unit. The Ball Engine Company builds the engine. The Lewis Block, Pittsburg, Pa., will have a large and complete electric plant, consisting of three 350-hp vertical cross compound engines direct connected to Westinghouse generators. The Ball Engine Company, Erie, Pa., will also build these engines.

PROMETHEUS ELECTRIC COMPANY, manufacturing electric heaters, etc., elected the following officers at its annual meeting: President, D. T. Davis; vice-president, J. V. Cole; treasurer, W. B. Symmes, Jr.; secretary, Max Loewenthal. The first three are the directors, with Dr. S. S. Wheeler, Max Osterberg, William Ballin and Herbert Noble. The outlook for the apparatus is reported as excellent and the demand is growing rapidly.

THE ANACONDA COPPER MINING COMPANY is about to put in operation a new 5,000-ton-per-day reduction plant, which will be equipped with electrical apparatus for power distribution. A recent contract with the Westinghouse Electric & Manufacturing Company embraces seven motors of an aggregate of 185 hp, to be added to the present installation of about 30 Westinghouse motors of an aggregate of over 1,000 hp.

WHITEHEAD MACHINERY COMPANY, of Davenport, Iowa, has purchased the entire present power plant of Slater Cotton Company, Pawtucket, R. I. The equipment, which will remain in service four or five weeks, comprises 300, 400 and 750-hp Corliss engines, Babcock and Wilcox boilers, large tubular boilers and usual accessory machinery. The purchasers will, it is understood, offer the property for sale.

HEATING PLANT.—The Birmingham (Ala.) Railway, Light & Power Company has let contract to the American District Steam Company, of Lockport, N. Y., for the erection of a steam heating plant to cost $100,000. The same company has nearly completed its 25-mile electric car line loop, connecting Birmingham and Bessemer, and will soon have it in operation.

THE SUSQUEHANNA IRON & STEEL COMPANY, of Columbia, Pa., is about to install an electric power distribution plant in its mills and has purchased from the Westinghouse Electric & Manufacturing Company a 400-kw, alternating-current generator, one 200-hp induction motor and 300 to 400 horse-power in motors, ranging in size from 50 hp to 20 hp.

ELECTRIC FREIGHT TERMINAL.—A new electric terminal freight railway for the convenience of warehouse concerns between the Pennsylvania terminal, Sixty-fifth Street and the Brooklyn Rapid Transit terminal, Thirty-ninth Street, Brooklyn, will be built at once.

WIRELESS TELEGRAPH FOR CUBA.—At Havana on January 21 the council of secretaries decided to authorize the Marconi Wireless Telegraph Company to establish communication between Cuba and the United States.

General News.

THE TELEPHONE.

SAN FRANCISCO, CAL.—An employer of the Ralston Mining Company in Placer County was fined for shooting deer in the close season, by a judge thirty miles away, who inflicted the sentence over the telephone.

DENVER, COL.—The Rocky Mountain Bell Telephone Company has begun line building in the Big Horn Country in Wyoming. Lines will be built from Rock Springs to Lander, and from Lost Cabin to Basin City. An exchange is being established at Thermopolis. The company contemplates the extension of its Montana lines through to Denver.

ATLANTA, GA.—The long distance line of the Bell Telephone and Telegraph Company, which is being built from Atlanta to Chattanooga, Tenn., has been completed to a point within 17 miles of Chattanooga.

CARROLLTON, GA.—The Gainesboro Long Distance Telephone Company, of Carrollton, has bought out the local exchange at Cedartown, Ga. An 18-mile connection was recently built to Cedartown.

MACON, GA.—A Daus, of Macon and others have bought the interest of J. E. Smith in the Macon and Dublin Telephone Company. A charter has been applied for, the company to have $6,000 capital. The company owns lines from Dublin to Macon and to Sandersville.

ATLANTA, GA.—The entire plant of the Atlanta Standard Telephone Company will be sold at public auction in that city on February 5, under foreclosure proceedings. No bids under $200,000 will be received. This price, it is stated, is about one-third the actual value of the plant. The conduit system and the line construction are of the best character. This sale offers an excellent opportunity in the telephone field, Atlanta being the representative city of the South and capable of supporting 8,000 telephones.

POCATELLO, IDAHO.—The Bell Telephone Company recently increased its rates 70 per cent. which action has caused a storm of indignation among its subscribers. There is talk of starting an independent system.

YATES CITY, ILL.—The Ideal Telephone Company has increased its capital stock from $2,000 to $3,000.

BUNKER HILL, ILL.—The Bunker Hill Farmers' Mutual Telephone Company has been incorporated; capital, $2,500. The incorporators are J. N. Barnes, H. M. Chaffee and M. M. Brown.

CHICAGO, ILL.—Work of installing its first exchange in Chicago is now under way by the Illinois Telephone and Telegraph Company. The exchange building is located at No. 181 Fifth Avenue. On January 1st, 5,000 automatic switches had been mounted and an additional 5,000 are now going in.

INDIANAPOLIS, IND.—The New Telephone Company has declared 1½ per cent. quarterly dividend payable February 1.

FRANCESVILLE, IND.—The Francesville Telephone Company has again changed ownership and is now under the control of J. T. Graves, of Monon.

AURORA, IND.—The People's Telephone Association, of Indiana, has incorporated with a capital stock of $10,000. The principal office and exchange will be in Aurora. B. L. Kilgore, E. W. Swarthout and G. M. Roberts are the directors.

BEDFORD, IND.—The Bedford Home Telephone Company has been organized and incorporated with a capital stock of $75,000. This company absorbs the local company. Charles Lanz is president.

WABASH, IND.—In order to make extensions and pay up the current debt incurred through the destruction of the plant by fire, the Home Telephone Company, of this city, will issue $20,000 of bonds of which $10,000 will be sold at once.

GREENFIELD, IND.—The Sugar Creek & Warrington Telephone Company, of Hancock County, has been incorporated for the purpose of constructing and operating a rural telephone system. B. F. Reeves, S. E. Shube and others organized the company.

EVANSVILLE, IND.—The Cumberland Telephone Company is reported to have announced to investors in its stock that the company is about to withdraw the service in Evansville. The franchise has expired and the city has brought an injunction suit to force the company to get out of the streets. This announcement, however, is not taken seriously.

TILDEN, IND.—This part of Hendricks County is well provided with farmers' free telephone lines. There is an exchange here, one each at Lizton, Clayton, Hazlewood, Stilesville, Amo, Coatsville and other points, and the farmers of this county do an immense amount of talking over their lines. The tendency is to unite these company lines and seek an entrance into the larger cities. It is predicted that there will be much strife over this ambition of the farmers' lines in the spring.

EVANSVILLE, IND.—If the plans of the city administration are successfully carried out, it will be less than a year before a municipal telephone plant is in operation and every wire of every kind within the fire limits is placed in conduits. The mayor and city attorney spent a week in Chicago recently to complete the arrangements for disposing of stock necessary to insure the success of the scheme. They say they were successful beyond expectation. Supply and construction companies have agreed to help out by taking the remaining required amount of stock. The citizens of Evansville will take $125,000 of the stock and when this is subscribed a franchise will be asked for and then it will only be a question of time until the plant is constructed and installed.

INDIANAPOLIS, IND.—Two bills have been introduced in the Indiana Legislature calculated to interest telephone men to the point of lobbying against their passage. The Senate bill provides that where there is more than one telephone exchange in a town or city, the exchanges shall maintain a trunk line, by which, a subscriber of one exchange may talk to a subscriber on another exchange. A rate of 1 cent a minute is provided for in the bill, three cents being the minimum charge. The House bill is designed to regulate the rates telephone companies may charge for service. Under the bill no company can charge more than $1 a month for a residence telephone or $1 50 a month for a business telephone. The author of the bill says that companies are now discriminating against patrons in certain cities and his bill is designed to correct it.

FAIRFIELD, IA.—The Libertyville Telephone Company, with a capital of $7,000, has been incorporated. Ed. Glotfelty is president.

CLARION, IA.—The Clarion & Northwestern Telephone Company will increase its capital stock from $10,000 to $20,000, to extend its service.

DUNKERTON, IA.—The Farmers' Telephone Company and the Jesup Telephone Company have been consolidated. The line will be extended to Waterloo.

HARLAN, IA.—The Marne & Elkhorn Telephone Company has been incorporated by Walter E. Potts and Alfred Long, of Clay Township, and H. J. Ensden, of Marne, Ia. The capital stock is $100,000.

LOUISBURG, KAN.—The City Council has granted a franchise to the Effingham Telephone Company to put in an exchange here.

CLAY CENTER, KAN.—G. M. Stratton has been granted a telephone franchise at this place. His company will be known as the Home Telephone Company.

LEWISTON, ME.—A telephone company has been organized to establish local telephone service at Swan's Island and to extend a cable to the mainland via Mt. Desert.

BAY CITY, MICH.—The present officers of the Valley Telephone Company were re-elected at the recent annual meeting in Saginaw.

CADILLAC, MICH.—The Citizens' Telephone Company of this city, which recently purchased the Sill exchange, is improving the system. A new switchboard is being installed and the circuits will be changed to metallic. The service numbers 300 now and orders are booked for 200 more telephones. All will be completed April 1.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, of Grand Rapids, will change its system in that city from the manual to the automatic, and has given the Automatic Electric Company, of Chicago, an order for 5,000 telephones and switches, to be delivered during the spring, as soon as the Citizens' Company has completed its new building. The ultimate capacity of the exchange will be 19,000 stations.

WASECA, MINN.—The stockholders of the Waseca Telephone Company have re-elected the present officers of the company for the ensuing year.

JOPLIN, MO.—A general boycott was declared January 10 against the Home Telephone Company by the Central Labor Union. The boycott is the outcome of the telephone girls' strike, which has been renewed with marked strength. Over 500 telephones are reported to have been ordered out, and many have been disabled by cutting of wires in all parts of the city. The strike is not for higher wages, but is claimed to be an "honor" movement.

BUTTE, MONT.—The operators of the Bell Telephone Company in this city have been granted an increase in wages. The company states that it may be necessary to raise the rates because it thinks that the demand of the operators was unreasonable and that it was forced to grant them owing to the peculiar conditions existing in labor union matters.

LINCOLN, NEB.—The Plattsmouth Telephone Company will ask the Council for a franchise to enter Lincoln.

LINCOLN, NEB.—The Ord Independent Telephone Company, capital $10,000, has been incorporated by Fred Bell, S. E. Bell, H. M. Davis and others.

NORFOLK, NEB.—The Elkhorn Valley Telephone Company has incorporated, with a capital stock of $100,000. The incorporators are G. A. Luikhart, W. K. Bowne, O. O'Neill and I. S. Maha.

HOOPER, NEB.—The stockholders of the Hooper Telephone Company have elected the following officers and directors for the coming year: President, E. O. Spielberg; vice-president, Herman Meyer; secretary, J. Howard Heine; treasurer, T. W. Lyman; manager, M. E. Shipley; directors, Bernard Monnich and M. A. Uehling. The reports show that the company has made a wonderful growth during the past year.

ASHEVILLE, N. C.—The linemen of the Asheville, N. C., Telephone Company, who recently went on a strike, have returned to work.

ELMIRA, N. Y.—The Elmira Telephone Company will soon commence the construction of a telephone line from Elmira to Williamsport.

ALBANY, N. Y.—The Ontario Telephone Company, of Onondaga and Oswego counties, has increased its capital stock from $20,000 to $40,000.

BINGHAMTON, N. Y.—The property of the Binghamton Telephone Company has been transferred to the York State Telephone Company for a consideration of $210,000.

SOUTH CAMBRIDGE, N. Y.—The Easton & South Cambridge Telephone Company, with a capital of $3,000, has been incorporated. Directors: S. Allen, E. H. Borden, and P. D. Ives, of South Easton, N. Y.

BAINBRIDGE, N. Y.—The Bainbridge Telephone Company, of Bainbridge, Chenango County, has incorporated, with a capital of $2,000. The directors are: G. L. Douglass, Christopher Toby and Frank L. Smith, of Bainbridge.

ELMIRA, N. Y.—The Elmira Telephone Company's system has been transferred to the York State Telephone Company, the consideration being $142,000 in capital stock and $72,000 in bonds of the York State Company.

MECHANICSBURG, OHIO.—The Mechanicsburg Telephone Company has increased its capital stock from $25,000 to $35,000.

CHATTANOOGA, TENN.—The independent telephone ordinance has passed the city council and the matter is now with the board of aldermen.

SALT LAKE CITY, UTAH.—The Bell Telephone Company will extend its lines from Beaver to St. George, Utah.

LOGAN, UTAH.—Mr. S. F. Fenton is trying to get a franchise in this place for a local telephone company. The Bell interests are opposing the effort.

ELECTRIC LIGHT AND POWER.

WILLIMANTIC, CONN.—The Willimantic Gas & Electric Light Company has practically completed its new coal gas plant, and is now making extensive improvements in the electrical plant. The additions represent about $130,000 of expenditure.

VALDOSTA, GA.—The city of Valdosta has rescinded its action to establish a municipal light plant and has accepted a bid of $75 per light per year from the Valdosta Light and Manufacturing Company. The contract is for five years.

BEDFORD, IA.—The electric lighting business at Bedford, conducted under the name of the Bedford Electric Light & Power Company, C. Wilbur Wiley, proprietor, has been sold and will henceforth be conducted by the Bedford Light, Heat & Power Company, which is a stock company with $20,000 capital.

EAST ST. LOUIS, ILL.—The Citizens' Electric Light and Power Company, of East St. Louis, has increased its capital stock from $25,000 to $250,000.

INDIANAPOLIS, IND.—Returns are beginning to come in from towns which invested in municipal plants built to be traded off. A number of Indiana towns have received hard bumps. The bonds are held by investors and the plants need new engines and dynamos before illumination can be renewed. On top of all this many of these towns have an empty treasury. There is a fear that many Indiana towns will have similiar trouble with these cheaply constructed plants.

LEBANON, KY.—The new city lighting plant at Lebanon has been put in operation.

DELTA, MISS.—The Delta Electric Light & Power Company has increased its capital stock from $50,000 to $100,000.

GRAND RAPIDS, MICH.—The Thornapple Electric Company has elected the following officers: S. D. Kopf, president and manager; Howard A. Thornton, vice-president; Wesley W. Hyde, secretary and treasurer. These officers constitute the board of trustees.

CADILLAC, MICH.—The Cummer Electric Light Company is installing a large generator in its plant and will furnish electricity for power. Six large manufacturing institutions are installing motors to run their plants.

SPRINGFIELD, MASS.—Additional equipment for the municipal electric light plant is being advertised for. The equipment will include two 350-kw generators, two or three-phase; 400 enclosed arc lamps and 150 alternating current arcs.

DULUTH, MINN.—The Great Northern Power Company, of Duluth, has been incorporated with a capital of $100,000. The company proposes to develop hydraulic power. The incorporators are F. A. Cokefair, E. C. Bacot, C. C. Kritzer, E. P. Duffies and Wm. Harrison.

MOUNTAIN GROVE, MO.—A proposition to grant an electric light franchise to the Ozark Cold Storage Company, which proposes to light the city of Mountain Grove with electric lights, will be voted on here.

NEW YORK, N. Y.—The Lehigh Light & Power Company, with a capital stock of $200,000, has been incorporated under the laws of New Jersey. The company will engage in the manufacture of electricity for light, heat, etc. The incorporators are William F. Eidell, Joseph F. Cotter and John A. McPeak, Camden, N. J.

BINGHAMTON, N. Y.—The stockholders of the Binghamton Light, Heat & Power Company have elected the following-named directors; George W. Dunn, Thomas L. Waters, F. W. Jenkins, C. F. Hotchkiss, George F. O'Neil, Chauncey Eldridge, George F. Johnson, T. M. R. Meiklcham and W. B. Dinsmore, Jr. The board of directors elected the following officers: President, George W. Dunn; vice-president, Thomas L. Waters; treasurer, W. B. Dinsmore, Jr.; secretary and attorney, F. W. Jenkins. The company is pushing the work at the station as fast as possible. It will be some time yet before the machinery is installed, but when it is finished it will be one of the most complete plants in the country.

COLUMBUS, OHIO.—The Council Committee on Finance has approved the ordinance authorizing an issue of $122,000 bonds with which to erect and maintain a municipal electric lighting plant. The ordinance will undoubtedly pass and bids for the construction of the plant will be called for as soon as possible thereafter.

YORK, PA.—The Ambridge Light, Heat & Power Company, of Ambridge, Beaver County, has been incorporated with a capital of $1,000.

YORK, PA.—The Merchants' Electric Light, Heat and Power Company has elected the following named directors: Charles H. Bear, George C. Campbell, Harry Wasbers, W. L. Bear, Albert Faulk, Thomas B. Loucks, J. A. Walker. The board organized by electing Charles H. Bear, president; George C. Campbell, vice-president; Thomas B. Loucks, secretary; Harry Wasbers, treasurer; Harry Reichard, superintendent.

LEWISBURG, TENN.—The town of Lewisburg has contracted with the Braid Electric Light Company for $5,000 electric light plant. Lighting bonds were issued.

SPRINGVILLE, UTAH.—The city authorities are considering a proposition to bond the city for an electric light plant.

SALT LAKE CITY, UTAH.—The Kennebec Mining Company, of this city, will install an electric power plant this spring. Mr. W. J. Craige is manager.

ATLANTIC CITY, WYO.—The Dexter Mining & Development Company at this place is arranging to put in an electric light and power plant.

THE ELECTRIC RAILWAY.

DOVER, DEL.—The Keystone Electric Railway Company, of Wilmington, has been incorporated with a capital stock of $10,000.

NEW CASTLE, IND.—Estimates are being made for the construction of the Muncie-Newcastle electric railway. Coulter Bros., of Chicago, will finance and build the road.

NEW CASTLE, IND.—A second election is to be held in Harrison Township to vote on a subsidy for the New Castle-Pendleton line. The amount asked has been reduced from $16,500 to $10,000. In the previous election the subsidy was defeated by a small margin.

LAPORTE, IND.—A company is being organized to be known as the Logansport & Laporte Electric Railway Company, to construct a line from this city to Logansport by way of Winona, Twenty Knox, Logansport and Laporte.

KOKOMO, IND.—A company has been organized here to construct an electric railway to connect the cities of Kokomo, Marion and Wabash. Applications for franchises have been filed with the commissioners of the three counties. The promoters are G. W. Dukes, O. V. Darby, and T. C. McReynolds.

MARION, IND.—The Union Traction Company has bought ground in this city and will begin at once the erection of a modern freight depot. The County Commissioners have granted a franchise to the Bundy-Clark Electric Company, of this city, to build an electric line through the county from this city to Kokomo.

PLAINFIELD, IND.—The owners of the Indianapolis and Plainfield Traction line are asking the tax-payers of Center Township, Hendricks County to vote a two per cent. subsidy for an extenison of the line from Plainfield to Danville. The subsidy would amount to $48,000. The company is already under $5,000 bond to have the line completed by December, 1903, and this, it is thought, will encourage opposition to the subsidy.

LOUISVILLE, KY.—The Louisville & Interurban Railway Company, with a capital of $500,000, has been organized to build interurban railways. The Louisville Railway is the owner.

NEW ORLEANS, LA.—The New Orleans Railway Company has filed a mortgage in favor of the New York Security and Trust Company pledging the properties of the various street railways to secure a $40,000,000 gold 4½ per cent. bond issue. The trust company will issue bonds to the extent of $7,154,000 whenever they are needed for improvements.

LANSING, MICH.—Right of way has been secured for the electric railway to be built from Lansing to Pine Lake by the Hawks-Angus syndicate.

OTSEGO, MICH.—The Chicago & Grand Rapids Railway Company has secured a franchise through Otsego. W. H. Patterson is president.

NORTON, MASS.—The Norton & Taunton Street Railway Company will, as soon as the weather will permit, begin building a line through East Norton to connect with the Mansfield & Easton line, now operated by this company.

BOSTON, MASS.—It is stated that a plan is on foot to connect Boston and New York by trolley. The route will be completed, it is thought, in about three years. A high-speed line is contemplated, and the ride from Boston to New York will take ten hours. Dining and sleeping cars will be introduced. Fares will be reduced less than one-half of steam rate. The project is but the first step in the ambitious interurban trolley system down the coast to Washington. Rights of way have been secured for the lines from Worcester to Hartford and Providence, and charters will be sought from the Connecticut and Rhode Island legislatures this winter.

DURHAM, N. C.—The Durham Traction Company has given notice of application to be made for a charter to build an electric railway to Chapel Hill, 15 miles distant.

ALBANY, N. Y.—The Fonda, Johnstown & Gloversville Railroad Company has received the approval of the State Board of Railroad Commissioners for a proposed issue of $7,000,000 first mortgage and an increase in its capital stock from $1,950,000 to $2,500,000.

ALBANY, N. Y.—The Bush Terminal Railroad Company of Brooklyn has been incorporated, with a capital of $15,000, to construct and operate a street surface railway a distance of 1¼ miles in Brooklyn. The directors are Irving T. Bush, Frederick B. Studwell, Herbert Boughton, Henry Greene, Thomas C. Horton, Arthur Carter, A. Brodie, R. Gould Simonds and Joseph Nash, of New York City.

LEECHBURG, PA.—The Pittsburg & Allegheny Valley Railroad Company has closed the purchase of four big electric light plants of this district and the franchise of the Leechburg & Apollo Street Railway Company. The plants of the Parnassus Electric Light & Power Company, the Leechburg Electric Light & Power Company, the New Kensington Electric Light & Heat Company, and the Apollo Light, Heat & Power Company have been purchased. The street railway will be built from Apollo to Vandergrift, to Leechburg, to Braeburn, to Arnold, New Kensington and Parnassus, a distance of 20 miles, and will connect with the Pittsburg Railways Company. The company has a capital of $1,500,000 and is organized by John Q. Cochrane, Pittsburg, president; Dr. J. D. Orr, Leechburg, vice-president; J. J. Burke, Pittsburg, secretary. Leechburg and Vandergrift bankers, with Hon. T. J. Ford and W. T. Marshall and J. R. Cavanaugh, of Pittsburg, make up the directory.

ROANOKE, VA.—The Roanoke Railroad & Electric Company, capitalized at $690,000, has been sold to Philadelphia capitalists. Twenty miles of track are included in the purchase. The new officers are: President, A. R. Apperson, Lynchburg, Va.; vice-president, Charles R. Miller, Philadelphia; secretary-treasurer, F. H. Shelton, Philadelphia; general manager, J. W. Hancock, Roanoke, Va.

CLARKESBURG, W. VA.—H. B. McKinley has organized a company to build an electric railway from Salem to Adamsville. The capital stock will be $300,000.

PORTLAND, ME.—The New England Street Car Transportation Company has been organized at Portland, to carry on a general transportation business. The capital stock is $100,000. The promoters are John L. Warren, Lyman C. Fowler, Thomas M. Foley, all of Portland. Lyman C. Fowler is president and John L. Warren is treasurer.

EAST ORANGE, N. J.—The Mansfield & Eastern Traction Company has been incorporated here, capital $500,000. Incorporators: Charles Mealy, James J. Maguire, James W. Galbraith and William J. Pentz.

JERSEY CITY, N. J.—State Senator E. W. Wakelee, of Bergen County, has been appointed Receiver of the Newark & Hackensack Railroad Company, which operates a trolley line between the two points named. The receiver was appointed on the petition of bondholders because the company has failed to pay interest due.

NEW BRUNSWICK, N. J.—The Elizabethport, Amboy & Long Branch Railway Company has been incorporated here, with $500,000 capital stock. It proposes to build a trolley line connecting the three towns. The incorporators are: Edwin Furman, of Savville; W. Parker Runyon, of Perth Amboy, and Andrew Kirkpatrick, of Newark.

SPRINGFIELD, OHIO.—The Springfield Railway Company is installing in its power house a 450 hp engine and a 300 kw generator, which about doubles the capacity of the plant.

COLUMBUS, OHIO.—The contract for building the extension of the Columbus, Buckeye Lake & Newark Traction Company's line from Newark to Zanesville, has been placed with A. E. Appleyard, of Boston.

MONTPELIER, OHIO.—F. E. Seagrave, of the Toledo & Western Railway, is securing right of way for an extension from the present terminus at Fayette, to West Union, Montpelier, Edgerton, Butler and on into Indiana.

COLUMBUS, OHIO.—The Kenton & Southern Railway Company has been incorporated with a capital stock of $600,000. The incorporators are Richard Emory, Emmett Thompkins, Frank W. Merrick, E. E. Bartman and J. A. Godown. The company proposes to build from Kenton to Bellefontaine and the road will be an extension of the Urbana, Bellefontaine & Northern Railway. Eventually the system is to reach Toledo.

CLEVELAND, OHIO.—The directors of the Lake Shore Electric Railway met with the representatives of the American Trust Bankers' Syndicate, which had contracted to buy part of the new 5 per cent. bonds to be issued, and the plan submitted by the bankers was formally approved. A meeting of stockholders has been called for February 12 to approve the financing plan.

CINCINNATI, OHIO.—The Miami & Erie Terminal Railway Company has been incorporated with a nominal capital of $10,000. T. N. Fordyce, one of the prime movers of the canal project, is one of the incorporators. The ostensible purpose is to afford a means of hauling freight from the Ohio River to the terminus of the canal, a distance of about a mile. Coal and freight will be transferred to barges on the canal and hauled up the valley by means of electric towing motors.

COLUMBUS, OHIO.—At the recent annual meeting of the Columbus Railway Company the stockholders authorized a number of important improvements to the property. The power facilities will be largely increased, a new barn will be built, extensions to several of the lines will be built and the system will be brought up to the highest standard of efficiency. To secure funds for this work the directors were authorized to issue 5,000 shares of preferred stock now held in the treasury, and the proceeds will be used for the improvements.

BOWLING GREEN, OHIO.—The Lake Erie, Bowling Green & Napoleon Railway Company has increased its capital stock from $500,000 to $1,000,000. Officers were elected as follows at the recent meeting: W. M. Tuller, president; F. W. Rogers, vice-president; E. M. McKnight, general manager. The above with R. A. Beatty, M. L. Case, A. Forney, B. F. James, Morris Reese, L. Black, C. R. Painter, J. H. Whitehead and D. B. Whipple are directors. The company has decided to commence work at once on an extension from Pemberville to Port Clinton and from Bowling Green to Defiance.

STEUBENVILLE, OHIO.—The power plant of the Steubenville Traction & Light Company was destroyed by fire recently. The roof fell in and all of the equipment was badly damaged. The loss to machinery and building is estimated at $65,000. The company supplied lights as well as electric railway service and both utilities were tied up for a time. Arrangements were made with the Steubenville, Mingo & Ohio Valley Traction Company for power sufficient to operate the city cars.

COLUMBUS, OHIO.—The Bellaire, Zanesville & Cincinnati Railroad, a narrow gauge steam road operating from Zanesville to Bellaire, has passed into the hands of the Appleyard syndicate. The name of the road has been changed to the Ohio River & Western. New officers were elected as follows: A. E. Appleyard, Boston, president; Richard Emory, Columbus, vice-president and general manager, W. R. Pomerene, Coshocton, secretary, W. R. Mitchell, Boston, treasurer. The above with C. A. Alderman, Springfield, W. V. Baker, Columbus, H. E. Montgomery, Boston, F. S. Hambleton, Baltimore, W. C. Mooney, Woodsfield, and Frank Brandon, Lebanon, are directors. Receiver J. K. Geddes will remain in charge of the property for the present and will be retained in some official capacity. The headquarters will be removed from Woodsfield to Zanesville. The road will be changed to standard gauge and will be operated by electric power, probably with the third rail system. The capital stock of the company was increased from $1,300,000 to $2,700,000.

CHATTANOOGA, TENN.—Franchises have been introduced in the city council for right of way for the proposed Cleveland and Ducktown Electric Railway, projected by S. W. Divine and others. The company proposes to get its power from a waterfall on Coosa River.

MONTPELIER, VT.—The strike which has hampered the Montpelier and Barre Traction Company since the new year came in has been settled. The employes who have been with the company longer than six months are to receive 16 cents per hour and the new men $10.50 per week, the working day to be ten hours.

THE AUTOMOBILE.

BRAZIL, IND.—Capitalists of this city and of Poland are negotiating with a Chicago automobile manufacturer for the purchase of a twelve passenger motor car and an express motor car to put in service between this city and Poland, fourteen miles. The Terre Haute Electric Company promised to build an electric railway between the two cities but it has failed to materialize, hence the movement to establish an automobile line.

NEW INDUSTRIAL COMPANIES.

THE CHICAGO BATTERY COMPANY has been incorporated at Chicago, Ill., with a capital stock of $50,000, by W. R. Gibbs, Wm. Buckley and T. J. Behen.

THE CALHOUN FALLS INVESTMENT COMPANY has been formed at Anderson S. C., by W. F. Cox and others to develop Calhoun Falls. The capital is $30,000.

THE MECHANICAL ELECTRIC COMPANY, New York, has been incorporated with a capital stock of $10,000. The directors are: Francis Lewis, P. M. Randall and Gaetano Damato, of New York.

THE PERFECT TELEPHONE DISINFECTOR COMPANY has been incorporated at Buffalo, N. Y., with a capital of $4,000. The directors are: H. D. Tatem, Lillie H. Tatem, of Buffalo, and Wm. Brennan, of Sloan.

THE MULTIPLE SPEED AND TRACTION COMPANY has been formed in New York City to operate a moving sidewalk in a subway from Hanover Square to the Brooklyn terminus of the new Williamsburg bridge.

THE HOLLAND PALACE CAR COMPANY, of Indianapolis, Ind., has incorporated with a capital stock of $1,000,000. The company will establish a plant in Indianapolis and manufacture cars for steam and electric railways. The incorporators are: H. F. Holland, W. R. Myer, J. W. Selvage and A. L. Wheeler.

LEGAL.

FRANCHISE TAX.—The New York State franchise tax has been found unconstitutional by the Court of Appeals. This relieves lighting, trolley, telegraph and telephone companies from a heavy burden on top of all their other taxes.

THE NAME OF EDISON.—In the federal district court at Wilmington Thomas A. Edison has filed a bill in equity against the Thomas A. Edison, Jr., Chemical Co., of 14 Stone Street, New York. The bill prays for injunction to restrain the defendants from using the name Edison in connection with part of the corporate title, and the word "Wizard" used in the manufacture of ink tablets sold by the defendant company.

LAMP SOCKET LITIGATION.—A decision has just been handed down by Judge Ray in the suit brought by the General Electric Company, against J. B. Wise, of Watertown, N. Y., on the Tournier patent, No. 559,232, April 28th, 1896, for an incandescent lamp socket, declaring that the patent is valid and infringed by the defendant's device which is an Edison-type lamp socket. An order for an injunction has been issued restraining the defendant from manufacturing any more such sockets.

RIGHTS OF STOCKHOLDERS.—On Feb. 2 in Atlanta a case will be heard to determine the rights of stockholders in a bill of intervention ancillary to an original petition in the case of the City Trust and Safe Deposit Company, of Philadelphia, vs. the Atlanta Standard Telephone Company. A decree of foreclosure was granted some weeks ago ordering the property of the Standard Telephone Company sold at an upset price of $200,000, subject to the rights of the stockholders. The present hearing is to determine these rights.

PERSONAL.

MR. CHARLES T. YERKES has sailed for England again in connection with work on his London transportation enterprises.

MR. JOHN LEO LIVERS, electrical engineer of Martinsburg, W. Va., was married on January 20, in that city, to Miss Olive Mae, daughter of Mr. and Mrs. W. W. Logan.

MR. F. D. LAWRENCE, president of the Standard Electrical Manufacturing Company, of Cincinnati, O., visited New York this week. He reports business in very satisfactory condition.

MR. WILFRID BLAYDES, private secretary to Mr. Marconi, has been slightly indisposed since his arrival in New York City from Cape Cod, but recovered sufficiently during the week to sail for Italy.

MR. LEROY W. STANTON, consulting telephone engineer, of Cleveland, O., has been with the representatives of three or four telephone companies in Chicago during the present week, selecting telephone apparatus for their exchanges.

MR. ANDREW CARNEGIE.—Dispatches from Edinburgh announce that in furtherance of his educational scheme for Scotland Andrew Carnegie has decided to endow a trust for scientific research. The sum of $5,000,000 will be expended on the scheme.

MR. CARL L. DE MURALT has arrived at New York on another visit of several months to the United States. On a previous visit Mr. de Muralt read an interesting paper before the American Institute of Electrical Engineers on the polyphase railways of Europe.

MR. W. A. VAIL, special representative of the American Bell Telephone Company, with headquarters in Indianapolis, Ind., and well known in the East, has been made general manager of the Northwestern Telephone Company, controlling Minnesota and two Dakotas' lines. Mr. Vail's headquarters will be in Minneapolis.

MR. B. C. WASHINGTON, JR., for many years the efficient Washington correspondent of ELECTRICAL WORLD AND ENGINEER was in New York last week attending the automobile show. He has made a great success of the kindred show at the National Capital and has found a profitable field of new effort in connection with automobilism.

MR. JOSEPH B. BAKER, of Boston, who as a consulting electrical engineer has for some time past given his attention to telephony and particularly to automatic systems, visited New York last week to participate in the Institute telephone meeting and to renew many old acquaintanceships. Mr. Baker is an occasional contributor to these columns.

MR. A. J. CORRIVEAU, of Montreal, well known on account of his electric lighting and electric railway interests, has been visiting New York City in order to attend the annual Automobile Show. He is now engaged also in automobile work and is desirous of having a good show held in Montreal, with the object of stimulating interest in the subject generally in Canada.

MR. LOUIS J. MAGEE, the well known electrical engineer, who has now been some thirteen years in Germany at the head of the technical staff of the Union Elektricitats Gesellschaft, has a most interesting article in the February *World's Work*, on "German Business Methods." It abounds in shrewd observation, kindly appreciative comment, and instructive deduction.

MR. W. H. CUMMINGS, of London, formerly European manager of the American Vitrified Conduit Company, 170 Broadway, New York, and who has also acted as manager of the British electrical engineering and contracting firm of Maguire & Baucus, is now on a visit to the United States. Mr. Cummings represents various American electrical interests in Europe. He is a guest at the Hotel Imperial, New York.

MR. SELIM CHAKER, of Cairo, Egypt, who has been in the United States for the past six months, sailed for Europe last Saturday. While here he made arrangements to represent various American concerns in Egypt, Soudan, Syria and Palestine, and shortly after his arrival in Egypt he expects to send over some substantial contracts for electrical goods. Mr. Chaker, according to present arrangements, will return here December next.

SIR HIRAM MAXIM, the American inventor, so long domiciled in England, has postponed his visit to St. Louis and the Louisiana Purchase Exposition Commission until next summer. He has written to the Commission, expressing his interest in the proposed aeronautical exhibition, and offering to send to it his light steam engine constructed for aeronautical purposes, which, he says, however, has been supplanted by the petroleum motors. He does not think that the flying-machine problem has been solved, and does not know whether he will himself attack the question again.

MR. F. T. F. LOVEJOY, the young Pittsburg millionaire, whose interest in automobiling was the outgrowth of the purchase of over twenty expensive automobiles within four years is constructing in Pittsburg the finest automobile stable in the country at an expense of $175,000. It will be 180 feet by 75 feet and two stories in height, fitted with large storage rooms, a billiard-room, swimming bath and a gymnasium for the young sons of the millionaire. A tunnel will lead from the stable to the residence now being constructed. An electric plant in the stable will generate the power for lighting the stable and house. Mr. Lovejoy is thirty-five years of age, modest and quiet in his manner, and in appearance hardly the man of $25,000,000, which is the estimate of his wealth—gathered as a member of the Carnegie Steel Company.

Trade Notes.

PHOSPHOR-BRONZE.—The Phosphor-Bronze & Smelting Company, 2200 Washington Avenue, Philadelphia, Pa., has issued a circular letter and revised price-list No. 21 of its "Elephant Brand" phosphor-bronze.

RIEDLER ENGINES.—Catalogue No. 104 of the Allis-Chalmers Company, Chicago, Ill., which contains 180 pages, is devoted entirely to a partial list of users of Riedler pumping, compressing and blowing engines, manufactured by this company.

THE BURT MANUFACTURING COMPANY, of Akron, O., reports that the Pittsburg Reduction Company has just placed an order with it for a 90-gallon oil filter; also an 18-inch exhaust head, to be used in its new works at East St. Louis, Ill.

THE STANDARD TOOL COMPANY, Cleveland, Ohio, has issued a neat calendar for 1903. The figures are plain and distinct, and no weariness is imposed upon the eye in looking up dates. On the back are given several tables useful to machinists.

FUEL OIL.—The increasing use of oil as fuel for steam generation gives interest to the handsome pamphlet issued recently by the Petroleum Iron Works Company, Washington, Pa. Much information on this interesting subject is published, together with illustrations of boilers equipped with oil-burning apparatus, and of details.

WATER-TUBE BOILERS.—Almy sectional water-tube boilers constitute the subject of a well-illustrated catalogue issued by the Almy Water-Tube Boiler Company, Providence, R. I. The merits of the boiler are clearly pointed out and various illustrations show the constructional details of this type of steam generator, which is adapted to all kinds of stationary work and marine work.

NOXEM RECEIVERS.—In Duluth a short time ago a patron who was using a telephone received a shock through the exposed metal parts of the receiver, which resulted fatally. The Electric Appliance Company, Chicago, claims that its Noxem receiver is an absolute safeguard against an accident of this kind, as it has no exposed metal parts. Its Noxem circular fully describes this new receiver.

DIXON'S GRAPHITE.—"A Toot for Dixon's Graphite" is given in a neatly designed booklet just brought out by the Joseph Dixon Crucible Company, Jersey City, N. J. Graphite as a lubricant is used in many forms and for many purposes, and the advantages in each case are duly "tooted." The cover of the booklet is a light blue which matches very well with the bright red margins of the white pages—the national colors.

RICHARDSON AUTOMATIC SCALE.—The Richardson Scale Company, Park Row Building, New York, has just issued a neat catalogue illustrative and descriptive of its line of automatic weighing machinery. It shows several of the different styles of scale made by this company and includes a number of illustrations made from photographs of the scales in actual use. An illustrated description of an automatic scale for coal was printed in our last issue.

AYER CALENDAR.—Messrs. N. W. Ayer & Son, Philadelphia, Pa., have gotten out a handsome calendar for 1903. This firm marks each new year by getting up a calendar that surpasses all its predecessors for artistic merit and beauty. The firm charges 25 cents each for the calendar, because it cannot undertake to supply the demand that would follow free distribution. A little pamphlet just issued by the firm tells briefly about its newspaper advertising business.

BOOSTER SYSTEMS.—The Gould Storage Battery Company, 25 West 33rd Street, New York City, recently issued a bulletin devoted to the subject of "Boosters." Shunt, constant-current and differential boosters are illustrated, together with views of Gould storage battery plants. The various features of Gould boosters and battery plants and their wide application are pointed out in the text. Everyone interested in storage battery applications will find this bulletin interesting.

TURRET LATHES.—The Pratt & Whitney Company, Hartford, Conn., has just issued an interesting pamphlet on its new model turret lathes. Improvements incorporated in these machines make possible greater accuracy, capacity, convenience and durability in the production of work. Two sizes are illustrated and many views of details are shown, together with diagrams. The text is printed in two colors, black and red, the red being used for the subject headings of the various descriptions.

CRESCENT SOLDERING SPIRITS.—The Crescent Electric Company, Chicago, Ill., has brought out a useful article for electric wiremen in a form which is very convenient. It is called soldering spirits, and consists of a solution of gums and extracts in alcohol. It is stated to be especially adapted for fine instrument work, telephones, switchboards and magnet coils. It contains no metal or salts and will not corrode the finest magnet wire. It is useful as an insulation, as well as a flux.

THE YOST ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, whose incorporation with a capital of $75,000 was recently noted in these columns, is manufacturing the "Yost" key socket, which possesses several commendable features. The mechanism is entirely enclosed in a porcelain casing, giving the necessary insulation by thickness of the porcelain between the mechanical parts, and making it as nearly dust-proof as possible, besides being impervious to dampness. The company succeeded the Yost-Miller Company. Besides the key socket, it manufactures electrical and mechanical appliances and novelties.

A REMINDER OF THE BOSTON TEA-PARTY.—The Pettingell-Andrews Company, in a neat folding card, calls attention to the interesting fact that its new building stands on the site of the Boston Tea Party. On the building is a bronze tablet illustrating and commemorating this great historical event. An illustration of this tablet, together with one of the building, is given in the folder. The new building, according to this source of information, contains 70,000 square feet, and the stock of electrical goods it contains is claimed to be the largest of any electrical supply house in the United States. The company has a modern equipment and every facility for the execution of orders with dispatch.

A FREIGHT TRAIN EVERY SIX MINUTES.—The passenger travel on the New York Central has been exceedingly heavy of late, most through trains being run in sections; and a large amount of extra power has been required to keep mail and passenger trains going. The extreme weather conditions resulted in some congestion of freight traffic, but within five days the New York Central recovered itself and reached normal condition in freight operation. There have been moved recently 7,000 cars per day on the Western Division; and in one day recently out of the Dewitt yard the freight trains averaged one every six minutes. There are moved every day on the New York Central over 980 passenger trains, and from 22,000 to 25,000 freight cars, the daily freight movement being close to 550 frieght trains. When the weather conditions are good, this enormous traffic is readily handled by a perfect and well organized system of management; but during severe storms attended by zero weather the full energy of the thousands of officials and employees must be devoted to keeping the road open for traffic.

MARIS CRANES.—Under the title "Cranes," Messrs. Maris Brothers, Philadelphia, Pa., have issued a very handsome booklet, which tells briefly what this firm is doing in the interest of economical operation of manufacturing plants. It manufactures hand and electric traveling cranes, the principal advantage of which is the small amount of head room necessary for operation; another very important advantage is the ease and precision with which they are controlled by one man, from the floor. The firm claims that by installing one of their cranes ahead of other machinery and equipment it pays for itself before the plant is in operation, and is run practically without expense after that time. The booklet is of unique design, the cover having three folds. The cover is of dark slate color, on which the firm name, fancy designs, views of plants, etc., are printed in bright green and red colors, the chromatic combination being a very attractive and pleasing one. The booklet contains illustrations showing actual installations of these cranes. Cranes are quite indispensable to a modern electrical plant and the managers of such will be interested in the information contained in this booklet, a copy of which the firm will gladly furnish to anyone interested.

THE SURGERY OF LIGHT.—Four writers in the February McClure's Magazine, under the general title "The Surgery of Light," have joined to contribute a welcome discussion of an interesting subject. It was as long ago as 1895 that Dr. Niels Finsen, of Copenhagen, by his light treatment, effected the first absolute cure of that terrible disease, lupus. Yet even to-day, little has been heard of the cure in this country, though its efficiency is said to be established all over Europe. Of the four contributors to the McClure symposium, Jacob A. Riis, Finsen's countryman, gives a fine sketch of the discoverer—Finsen himself is a hopeless invalid; Cleveland Moffet interestingly and fully explains the cure; Alfred Harmsworth tells of the progress of the cure in England; and Dr. George C. Hopkins what has been done in this country. Dr. Hopkins adds the most important item of all—his belief that, in the Finsen ray, in combination with the X-ray, may be found a cure for cancer as certain as the Finsen ray alone has already proved for lupus. This idea has already been put forward and worked on by the well-known American electro-therapeutist, Dr. W. J. Morton.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 20, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

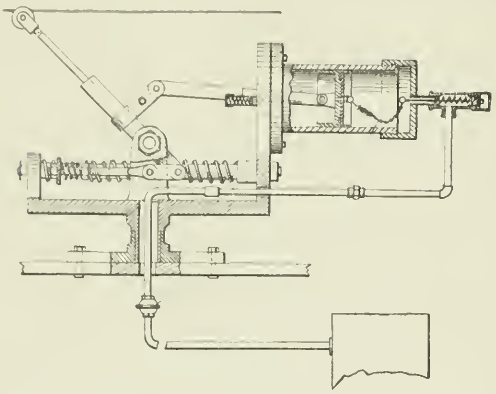
718,610. ELECTRIC CLOCK; W. J. Dudley, Bangor, Me. App. filed Aug. 20, 1902. Details.

718,610. ELECTRIC HEATING SYSTEM. E. E. Gold, New York, N. Y. App. filed Jan. 10, 1900. Heaters having main and auxiliary coils are arranged along a car in series and by means of suitable shunt circuits any of the main and auxiliary coils can be thrown into service.

718,632. ELECTRICAL FUSE OR JUNCTION BOX; M. H. Johnson, Utica, N. Y. App. filed May 31, 1902. A tablet carrying the distributing devices is arranged in the box in a manner to be readily removed and replaced when necessary.

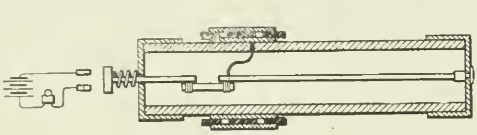
718,637. SECONDARY BATTERY. I. Kitsee, Philadelphia, Pa. App. filed April 28, 1900. A conducting grid having recesses in which are placed blocks built up of active material and conducting supports; any block can be removed and replaced at will.

718,660. THERMAL ELECTRIC CUT OUT; T. E. Scantlin, LaFayette, Ind. App. filed Sept. 5, 1901. A fusible portion of a circuit is arranged adjacent to an imperfect contact heating resistance.



718,678—Trolley.

718,678. TROLLEY; G. R. Tomb, Lorain, Ohio. App. filed May 21, 1902. The base of the pole is connected with a piston in a cylinder; air is admitted to the cylinder when the trolley jumps the wire and moves the piston to lower the pole.



718,797—Safety Fuse.

718,686. TELEPHONE SYSTEM; F. B. Wood, New York, N. Y. App. filed August 29, 1901. (See page 200.)

718,697. INDUCTION MOTOR; C. C. Chesney, Pittsfield, Mass. App. filed July 30, 1902. Separately formed conducting U-shaped pieces, the ends of which are connected to a conducting ring, are fixed upon the armature core.

718,774. ACCUMULATOR PLATE; W. Kraushaar, Neumuhl, Germany. App. filed June 20, 1902. The webs of the grid are provided with notches on opposite sides in staggered relation.

718,775. QUICK BREAK ELECTRICAL SWITCH; F. A. La Roche, New York, N. Y. App. filed Dec. 14, 1901. The switch bar, when closed, holds a spring under compression; a latch which locks the parts in this condition, can be released by a slight blow allowing the spring to act to quickly open the circuit.

718,797. SAFETY FUSE; J. Sachs, Hartford, Conn. App. filed Sept. 30, 1901. One of the fuse terminals is movable and under the tension of a spring, so that destruction of the fuse will be indicated by the displacement of the movable terminal.

718,828. PROCESS OF MAKING TAP-POLE PLUGS; A. Dickey, Niagara Falls, N. Y. App. filed December 2, 1901. (See Current News & Notes.)

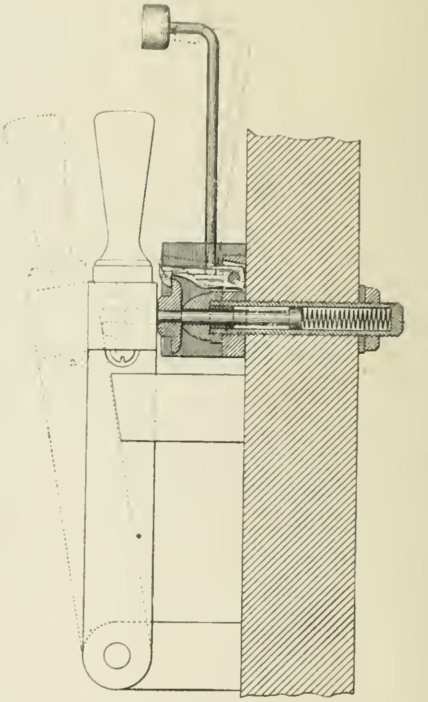
718,846. BATTERY CONNECTION; W. W. Keirstead, Grand Rapids, Mich. App. filed May 10, 1902. Details.

718,855. TELEPHONE SET; K. B. Miller, Chicago, Ill. App. filed August 23, 1901. (See page 200.)

718,891. METHOD OF REDUCING METALLIC OXIDS; E. G. Acheson, Niagara Falls, N. Y. App. filed December 4, 1900. (See page 198.)

718,892. ELECTRIC FURNACE; E. G. Acheson, Niagara Falls, N. Y. App. filed December 20, 1900. (See page 198.)

718,896. ELECTROTHERAPEUTIC APPARATUS; W. H. Ames, St. Louis, Mo. App. filed June 14, 1902. A blanket or sweat robe for man and animals having a heating resistance threaded through it and arranged in combination with suitable switching apparatus and resistances.



718,775—Quick Break Electrical Switch.

718,910. PROCESS OF CONTROLLING ELECTRIC MOTORS; W. H. Chapman, Portland Me. App. filed Oct. 22, 1902. Consists in connecting each armature terminal with each pole of the line through suitable resistance and simultaneously and equally increasing the resistance between one of said terminals and the positive pole of the line and decreasing the the resistance between said terminal and the negative pole of the line and decreasing the resistance between the other terminal and the positive pole and increasing the resistance between the latter terminal and the negative.

718,925. BLOCK SYSTEM FOR RAILWAYS; H. J. Fuller, Winchester, Mass. App. filed Mar. 5, 1901. The system comprises a single track railway divided into blocks by turn-outs and automatic mechanism for cutting the supply of current from a car when it reaches a turn-out until the arrival of another car at the turn-out.

718,927. RECOVERING TIN FROM TIN-SCRAP; R. H. Gould, Subiton, Eng. App. filed August 27, 1900. (See page 198.)

718,935. WATER-PURIFIER; J. Johnson, Minneapolis, Minn. App. filed September 23, 1902. (See Current News & Notes.)

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THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

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CONTENTS.

Editorial 221
The Niagara Break-Down 224
Preparations for the Institute Annual Dinner 224
Bournemouth, Eng., Slot Conduit Electric Railway 225
Bull System of Selective Wireless Telegraphy 227
Electrical Resistance of Bearings. By A. E. Kennelly and C. A. Adams 231
The Industrial Efficiency of Germany 231
Banquet to Marconi in Canada 231
Economic Value of Testing. By Prof. Geo. D. Shepardson 232
New Canadian Niagara Power Enterprise 234
Vicarino Car Lighting System in France 235
Voltage Regulation 236
Work of the Carnegie Institution 237
George Westinghouse in London 238
Wireless Telegraphy Lecture Apparatus 240
Points in the New German Tariff 240
United States Navy Tests of Wireless Telegraphy 241
Sound Condition of General Electric Finances 241
New York Electrical Society at Edison Station 242
A Lecture on Business Automobiles 242
To Develop Trolley Systems in Holland 242
New Telephone Patents 243
Electric Power and Floods 243
Municipal Ownership at Hagerstown, Md. 243
Sale of Richmond, Va., Independent Telephone Company 244
Current News and Notes 244
LETTER TO THE EDITORS:
  Water Power vs. Steam Plants. By Jas. L. Thorne 245
Digest of Current Electrical Literature 246
Lundell Fan Motors 251
Moskowitz System of Electrically Lighting Steam Railway Cars from the Axle 250
Walkins Inverted Third-Rail System 252
The New Woodward Water Wheel Governor 252
Double Spiral Filament Lamps 253
Universal Ohmmeter and Faradmeter 253
Improvements in Insulator Brackets and Fastenings 254
The International Telephone Transmitter 255
"Provo" Insulator 255
Combined Fan Guard and Deflector 256
A New Electrolytic Generator 256
Telephone Extension Closer 256
News of the Week 257

FAN MOTOR DEVELOPMENT.

We are glad to learn that fan motor manufacturers consider the prospects excellent for their product this year. There is no cause for surprise in a steady demand for such an article, as it cannot be classed with fads or luxuries. On the contrary, it has made its way into general use by its merits as a purveyor of comfort. Not only does it serve to mitigate the heat of summer, but in a great many instances it answers the purposes of sanitation and ventilation, so economically and efficiently that few other appliances can compare with it. We hardly imagine, however, that the early designers and makers expected to see so large a market for it spring up. The production in 1899-1900 was just about 100,000, and while last year was cool in this country to an abnormal degree, we doubt whether the demand fell off much on that account, although probably some effect was felt. Meantime, a large foreign market has grown up, and the handy little American fan motor can now be seen in a great many parts of the world. The field for its utility, indeed, in southern regions toward and below the equator, we suspect to be capable of indefinite extension, depending, of course, upon the degree to which electrical circuits are introduced or a day load is carried by those already in existence.

Technically considered, the fan motor has rapidly attained perfection in various respects, and has become a remarkably efficient appliance in a very short time. While susceptible of further refinements, keeping pace with the general advance of the electrical arts, it remains pretty much the organism with which we started; in the same manner as the telephone or the incandescent lamp. But even here the ingenious varieties for distributing the breeze engendered, or for projecting warm air—and the like—are evidences of American ingenuity in playing admirable variations upon a well-worn mechanical device. We do not find, however, many indications of important new "models" for 1903. Perhaps that is not a bad sign. When the bicycle fell from its high estate as an athletic craze, one portentous sign was that the manufacturers ceased suddenly producing swarms of new models, and had all they could do to dispose of old stock; and it may be shrewdly suspected that in some instances towards the end the new model was simply a device with which to maintain fictitious prices in face of a dwindling demand. This is not the case with the fan motor. It ranks rather as a necessity than as a luxury, and is a worthy compeer of other electrical appliances that change little, if at all, from year to year, depending upon their qualities as a staple article in the trade. Radical mechanical improvements might come, though we scarcely look for them; and in the meanwhile, it is cheering to note the confidence with which the well established concerns in this branch are preparing to deliver anywhere from 125,000 to 150,000 fans for use this summer at home and abroad.

◆

THE ECONOMIC VALUE OF TESTING.

Prof. Shepardson's strong plea for more extensive testing, in connection with central station lighting, will doubtless meet with general approbation. The necessity for testing and careful inspection increases with the size of the plant operated. In a small house installation, operated say by a gas engine of a few horse-power, and supplying incandescent lamps in the building, the necessities for careful measurement or testing are few. The whole expense of the system is small, and the economical value of improvements in the mode of operation is also small. But as the size of the plant increases, so does the cost of operation, and so also does the waste due to any error in operation. The economic value of improvement is correspondingly great. Finally, in the very largest central station systems, it pays to employ the best intelligence in all departments of operation. The intelligent control of the engineering department can only be carried on by the possession of accurate knowledge of every significant factor in the system. The possession of such knowledge immediately indicates the direction in which improvements may be secured or economies effected. In order to secure this knowledge, careful measurements and tests must be conducted and continued as a routine. The measuring instrument is the tool of the operating engineer. Without measuring apparatus and the facts deduced therewith, the value of the operating engineer is very greatly reduced. The observations and suggestions of the lineman or dynamo tender, may be as valuable economically as the best he can offer under such conditions.

It is in this way that the application of physics and physical measurements react upon the industrial world. The more highly specialized and the more concentrated the activity of the product, the more precise must be the knowledge, and the more keen the intelligence that must be brought to bear upon the process of production. The more thorough the scientific knowledge in that department, and the more complete the testing facilities of the time in that direction, the more useful can technical intelligence become to the needs of the community. The saving of money in any department of industrial service, consistent with the maintenance of quality, is not only a direct gain to the producer; but also an indirect gain to the whole community.

MOTOR DRIVEN MACHINE TOOLS.

The paper on this topic by Mr. Day, before the New York Electrical Society, which we presented in our columns recently, is one of the most suggestive which we have seen in many a day. Labor saving is the genius of American manufacturing, and the skillful and economical use of tools is the path to industrial supremacy. The American idea is to reach the desired standard of work with the minimum amount of human labor, and as quickly as possible. The first specification cuts down the labor cost, the second tends to keep down the fixed charges. Foreign manufacturers often turn up the nose of scorn at American machine-made products, but they quail before the competition. Now the fact is that while the last refinements of manufacture require skilled hand labor and infinite patience, these very refinements are for ordinary products and purposes both needless and wasteful. It is not necessary or desirable that the frame of a steel building should be fitted to the thousandth of an inch, or that every watch should be capable of a rate of half a second per day. Even in scientific investigation, the mind quickly grasps the points in method and apparatus which require extreme refinement, and those in which lesser pains will not injuriously affect the result. Mr. Day's paper was directed at the economical results to be attained by applying the same principles to machine shop practice. He took up, in the first place, the effect of modern air hardening tool steel on the rapidity and economy of machining. Using this material it becomes desirable greatly to increase the old standard speeds of cutting, and each material and process has its own most economical speed, just as in spinning machinery each frame must have its spindles drawn up to a certain speed to get stable running without endangering the thread.

From this standpoint, the great saving to be effected by motor drives is in the labor rather than in the fuel. All the old cone pulley devices for speed regulation are cumbersome and wasting in delicacy, so that the workman will generally run at an improper speed rather than go to the trouble of changing to one only a little nearer right, for a short period of operation. With an electrically driven tool the speed control can be made so convenient and sensitive that the workman will instinctively regulate his cutting speed to the needs of the work, and so turn out his job more quickly and with better economy in the use of tools. As to method of regulation, Mr. Day inclines strongly to multiple-voltage systems using direct current as being on the whole the most useful and convenient. He is by no means an extremist in advising motors for separate machines, looking at results rather than the principles of construction. It should be noted that electric driving from this standpoint is a very different affair from electric driving in textile mills and similar cases. Here the fundamental idea is to obtain facile control of the speeds of certain machines irrespective of the general character of the drive. There, no special provisions for very precise speed control are used, the drive being for the fundamental purpose of wor'cing the machines at a very nearly uniform high speed with the smallest possible waste of power. The one use is a labor saving scheme, the other a refinement of power saving, each being adapted to meet the peculiar requirements of a special branch of manufacture. Motor driving in factories and workshops is not, therefore, a single problem, but a group of problems, each requiring its own solution. An engineer in dealing with these cannot follow freely his preconceived notions, but must get down to the details of the particular manufacture undertaken, and must grasp the distribution of the manufacturing expense before he can properly design the electric drive required. We are glad to note that the paper has been printed by the Society for general distribution.

FATAL SHOCK IN PUBLIC BATHS.

A sad accident is reported from Fulham, London, in recent technical journals. It appears that the Public Baths in Fulham are lighted electrically. The baths are of glazed earthenware of cubical form, with wooden rims. A waste-pipe of gun metal drains each bath. Consequently a man standing in the bath would make a good ground connection at his feet, either by treading directly on the waste-pipe opening, or, through the water in the bath, to the outlet. The bath chambers are separated by enamelled slate partitions, 6½ feet high, rising from a concrete floor. The upper edges of these partitions are supported and united in flanged capping of galvanized iron. The electric lamps lighting the place were supported on metal saddles straddling the partitions. The wires connected to the lamps ran through iron tubes resting in certain places, on the iron capping. The iron tubing holding the wires may have been continuous as far as the switchboard in the bath house. It had not been connected to ground. Owing either to water or to a direct contact with one of the lighting wires, the iron tube became "live." Resting upon the continuous cappings of the bath partitions, these also became "live," and were supported on slate like a regular third-rail system, 6½ feet in the air. The electric supply was at 200 volts pressure of alternating current. It is not stated whether this was derived from a local transformer, or from a secondary system of street mains. It is clear, however, that while one side of the system was connected in some way with the "third-rail" running around the tops of the partitions, the other side of the system was somehow connected to ground. All that a bather had to do, therefore, to get a 200-volt shock, was to stand in the bath and lay his hand up on the iron partition capping. With wet hands, and his feet in water, he would be in a condition to receive a relatively strong current. If it had been a direct current the shock would probably have been severe, but momentary, because the man's arm would be muscularly thrown off the rail, or the man would collapse into the bath. The danger of fatality would be reduced to that of a momentary nervous shock. With an alternating current, however, a muscular paralysis is produced in which the victim is apt to be violently held grasping the conductor, and the current is kept on, with many shocks per second, until someone can disconnect the conductor.

It happened so in this case. The bath attendant heard a scream from a certain chamber, and, opening the door thereof, found the occupant standing in the bath and clutching the top of the partition with both hands, unable to let go. The scream caused other bathers to lay hold of their partitions in order to try and look over. Several reported having received shocks; and one was found dead in his compartment an hour later. As soon as the current was cut off the attendant found the original victim unconscious in the bath, and efforts to resuscitate him were unavailing. Two men, thus, died from an alternating-current shock at a pressure that was testified to, at the inquest, as having been 200 volts or less.

It seems to have been the unanimous opinion of those who were competent to judge, and examined into the matter, that had the iron tubes holding the wires been permanently grounded the accident would not, and could not, have occurred. Of course the dangerous conditions were here very special; and the ordinary dwelling house or office, wired at 200 volts pressure for alternating currents, presents no such likelihood of danger. But the fact that a pressure of 200 volts is declared to have brought about the death of two men, of ages 38 and 23 years respectively, shows the possible dangers of the alternating current; since it is in the highest degree improbable that the men would have been killed by 200 volts of direct current. It also shows that although such a danger in the ordinary house is quite negligible with 200 volts alternating, the danger in such a house becomes appreciable if there is a chance for an accidental cross between the primary and secondary circuits in or near a transformer; and it emphasizes the importance of permanently grounding secondary distributing circuits.

THE ELECTRIC FURNACE AS A MEANS OF RESEARCH.

Engineers are very familiar with the commercial applications of the electric furnace, and have come to appreciate it as a most powerful means of producing various reactions otherwise unattainable; but in spite of all that has been done it has hardly yet taken its place as an instrument of pure research. Even the brilliant work of Moissan and others in the artificial production of gems squints at commerce rather than mineralogy, and the fact is that this most powerful engine of investigation is much less used in this function than it deserves. The reasons for such a state of things are somewhat complicated. In the first place for the past quarter century inorganic chemistry has fallen into disrepute, and the attention of nearly every first-class chemist has been turned to the wonderfully futile field of organic compounds. These are vastly more manageable in the laboratory, are more amenable to comprehensible theory, and have yielded commercial results of truly immense importance. In inorganic chemistry, on the other hand, the list of fundamental working reactions is a short one and the products tend either to great stability which is inconvenient or too extraordinary instability which is equally bad. Nor has there been evolved any general theory of inorganic compounds that can serve as a guide to research. Inorganic chemistry has, therefore, remained comparatively undeveloped and has largely fallen into the hands of technologists able in their respective lines, but not with time or taste for purely scientific study.

There is, too, a very natural tendency on the part of experienced chemists to shun the so-called "dry" reactions, i. e., those produced without solution of the substances, as uncertain in their results and as giving more copious by-products than the corresponding "wet" reactions. Nevertheless, it is a well-known fact that the products of "wet" and "dry" reactions, nominally the same in effect, are often widely different in fact. To mention a single instance, the phosphorescent sulphides of calcium can be easily made by the latter process while the former fails to produce them. We commonly dodge the issue by ascribing the difference to the realm of physical chemistry, but this is only a convenient way of concealing ignorance. The present interest in radio-active substances has stimulated investigation in inorganic lines, but not yet to edification. Now the electric furnace with its tremendous temperature is capable of enormously increasing the possible range of inorganic reactions, and for this purpose it should form a part of the apparatus of the expert theoretical chemist instead of being as at present mostly in the hands of the technical chemist. We would not in the least depreciate the work of the latter, but it is directed at results rather than at the exact causes of results. Now chemistry, especially physical chemistry, is at a point where extensions of theory are greatly needed. The data are fast accumulating for some tremendous generalizations, and every powerful means of research at hand ought to be worked to the very utmost to furnish additional facts.

Perhaps the very greatest problem of the present in theoretical chemistry is the splitting up of the so-called elements. The indivisible atom has long been discredited, and the recent work on electrons has dispelled the last remnants of its old-time sanctity. Prout and Mendeleef long ago began the attack, but very little has yet been done in actually breaking down the defenses. By splitting up the elements we do not mean the mere isolation of minute traces of hitherto unknown components as in the cases of argon, krypton and their allies, which are akin to the finding of theophene in benzene by Meyer years ago; but the actual breaking down of an element as now known into its definite components. Not a few of the elements have been long open to suspicion. Zinc, cadmium and magnesium, for instance, form a trio conspicuously open to attack. In fact, one noted scientist thought a score of years since that he had broken up cadmium and communicated the result to the French Academy. Iron is another element which is very likely dissociated at very high temperatures, as it probably is in the sun, and who knows what strange properties its components might have if they could be isolated? Perhaps calcium is in the most exposed position of all to successful attack, for it is well-nigh certain that when vaporized at the temperature of the electric furnace it splits off a gaseous component, or passes into a new condition, comparatively simple, nearly as tenuous as hydrogen and well known in the solar atmosphere. If the elements could be split up into their primal components, there is at least a chance that these could be recombined in what marvelous ways no man would now dare to predict. Problems such as these lie at the very foundation of science, and are deserving of the best efforts of the best investigators. It is to this colossal theoretical work that we hope to see engines like the electric furnace successfully applied. And it should be remembered that no great advance in theory has ever failed of producing great advances in practice, sooner or later. The result of an investigation may seem at first remote and lacking in human interest, but it is likely at any time to loom into practical and commercial importance. To look at the matter from the most mean and venal standpoint, it pays to work to its limit every new means of investigation, for no man can foresee when even scholastic and visionary theories may suddenly be coined into hard dollars.

The Niagara Break-down.

At 10:45 o'clock on the night of Thursday, January 29, lightning struck the bridge connecting power house No. 1 of the Niagara Falls Power Company, at Niagara Falls, N. Y., with the transformer station, causing short circuits on the cables carried through the bridge and starting a fire, which, before it was extinguished, caused the greatest ruin ever known in connection with the Niagara power development, and developed conditions that were widespread in their effect. It was, indeed, a truly remarkable occurrence, and while its effects were very extended, it is gratifying to record that it also aided in showing the truly wonderful recuperative powers at command of the Niagara Falls Power Company.

The bridge where the fire started extends over the inlet canal. It is a handsome stone structure with three piers and four arches, and has a slate roof. Running through it from the generating station to the transformer station at the time of the fire were all the cables carrying current intended for Buffalo and various tenants on the company's lands. Approximately there was 50,000 hp passing over 52 cables of 1,000,000 cm capacity. These cables were installed in tiers on each side of the bridge interior and supported on arms or brackets. In each layer, so to speak, there were several cables side by side. The great power station was in operation with the usual load when the lightning shaft fell. The fire was discovered immediately, and the company employees started to fight it. All the generators in the big power house were stopped. An alarm was at once sent in for the city fire department, and this met with quick response. Considering the construction of the bridge interior, it was surprising that the fire should get such a hold, but the insulation on the many cables served as fuel. The flames extended into the transformer station, and there and on the bridge the firemen fought them. A large amount of water was thrown into the transformer station and on the bridge before the fire was conquered. Finally, when it was out, it was found that all of the cables on the bridge had been totally destroyed. The transformer room was badly damaged inside and on the roof, and the interior and roof of the bridge was burned.

The destruction of the 52 cables cut off every customer of the Niagara Falls Power Company, who had been receiving current that passed over the bridge. This included Buffalo and its trolley and lighting plants, numerous industrial establishments, grain elevators, large stores, and, in fact, every one of the patrons of the Cataract Power & Conduit Company, which company is the distributing agent for Niagara power in Buffalo. It also included the Tonawandas and the factories there operated by Niagara power. Also the Lockport plants using the energy of the Falls. The International Railway and all its lines in Buffalo and the suburban places. The majority of the electro-chemical plants in Niagara Falls, on the lands of the Power Company, had their current cut off. While the fire prevailed the big installations of the two power houses were completely shut down. The Niagara Falls trolley cars were without power, as was also the Buffalo & Niagara Falls Electric Light & Power Company, which company operates the lighting system at the Falls. In the suburb of Echota all lights went out, they being a part of the Niagara Falls Power Company's installation. Trolley cars midway between the cities mentioned came to a standstill.

Within an hour after the fire was out current was again supplied for the operation of the trolleys and arc lights of Niagara Falls, this service being fed through the rotaries in power house No. 1, which were all right. But everything that depended upon the cables that had passed through the bridge had to await repairs. Superintendent P. P. Barton and his assistants were equal to the emergency. Before the fire had finished its work of destruction, arrangements were being made to repair the damage. In spite of the fact that it was midnight, every available man was summoned to the task of reconstruction. The Niagara Falls Power Company had a quantity of cable on hand, and other cable designed for the construction work in power house No. 2 was available, as was also a quantity of cable the General Electric Company had on the ground. Temporary repairs were made to the roof of the bridge and to the transformer station. The debris of the fire was cleared. Temporary cables were run and connections made. While the water thrown into the transformer station had wet some of the machines there, all were not rendered useless, and it was possible to connect some of them up. This made it possible to give Buffalo a service as soon as connections were made Every effort was bent to get current over the transmission line by Friday noon. However, as the current was about to be turned on a short circuit occurred and this retarded matters until 4:30 P. M., at which hour the Buffalo transmission was resumed with 10,000 hp. This was sufficient for the lighting system and for the full operation of the cars of the International Railway Company On Saturday Buffalo was receiving its usual amount of Niagara power. Other customers were taken on as rapidly as possible, and by nightfall Saturday the majority of patrons of the Niagara Falls Power Company were receiving power.

There are comparatively few places that have 50,000 available horse-power, and to shut off this amount of energy from an industrial section like that about Niagara Falls was to cause idleness in many plants. The incident proved the value of the International Railway Company's storage battery, for this helped out on the lessened service of Thursday night. On Friday the steam plant was put in operation, but even with these sources of power supply it was necessary for the company to greatly reduce the number of cars operated on its lines. It was impossible to keep up the regular trolley service between Buffalo, Niagara Falls and Lockport, but when the transmission was resumed the people more than ever realized the value of Niagara power.

The concern that received their power supply from power house No. 2 were able to run Friday. All these are on the lands of the Power Company.

In reviewing the extent of the damage caused by the fire and the rapid manner in which connections were made and power again sent to Buffalo, it is evident that Buffalo has great cause to be thankful. To a majority of the electrical installations of the world, the destruction of 52 cables like those used at Niagara would simply mean a shut down for many days, possibly weeks. On the contrary, Buffalo received power in less than 24 hours after the Niagara loss. This was only made possible because the Niagara Falls Power Company, realizing the importance of its service and the necessity of prompt work in case of accident, always keeps a full reserve supply of all parts of its machinery and cables liable to injury by accident. Without the cable of the construction work of power station No. 2 and of the General Electric Company, all of which cable belonged to the Niagara Falls Power Company, this company had more than enough cable on hand to repair the damage. It was this splendid supply of reserve cable, and the quick, prompt work of the company's employees that made possible a wonderful feat that is a credit to the electrical profession.

Preparations for the Institute Annual Dinner.

Arrangements for the annual dinner of the American Institute of Electrical Engineers at Sherry's on Monday, February 9, are being pushed rapidly, and there is every prospect of a great success. The speakers will include Mr. Andrew Carnegie, on "Libraries"; Dr. S. S. Wheeler, on "The Latimer Clark Collection"; Dr. J. S. Billings, director of the New York Library, on "The Technical Library"; Mr. R. R. Bowker, editor of the *Publishers' Weekly*, on "The Unity of Science"; Theodore L. De Vinne, the bibliophile and great American printer, on "The Debt of Mechanics to Science," and Dr. J. C. Bayles, technical editor of the *New York Times*, on "Electricity and the Daily Press." President Scott will also deliver an address of welcome. Mr. and Mrs. T. A. Edison have expressed great interest in the affair and signified their intention to be present, and Mrs. Carnegie will also accompany her husband. The city will be represented by the Hon. R. G. Monroe, Commissioner of Gas and Electricity. Several of the past presidents of the Institute will also be in attendance and very cordial letters have been received from them, including Prof. Elihu Thomson and Dr. Louis Duncan, who are both coming over specially from Boston. In order to provide properly for subscribers to the dinner and their friends, the dinner committee requests most earnestly that orders for tickets ($5 each) be sent in immediately to R. W. Pope, 95 Liberty Street, accompanied by a notification as to the persons with whom it is desired to sit. The room will be arranged in tables of eight throughout. The menu cover prepared is a fac-simile in three colors of one of the larger volumes dated 1494, presented by Dr. Wheeler, in the Latimer Clark collection, and shows the volume as it now stands in the Institute Library, label and all. Two of the annotated pages are also reproduced.

Bournemouth, England, Slot Conduit Electric Railway.

THE first electric railway in Great Britain employing the slot conduit was recently opened at Bournemouth, England, the plant having been installed by J. G. White & Co. Only part of the Bournemouth system is thus equipped, the ordinary overhead trolley collector being used on portions of the road, provision being made whereby the shoe can be lifted out of the conduit when the car passes to a trolley section.

As will be seen in Fig. 2 a side and not a center slot is used. The slot, which is 1 in. wide, and serves as one of the running rails, is formed of two rails, held in place by cast-iron yokes at 3 ft. 9 in. centers and embedded in concrete, forming a continuous conduit. As is seen in the figure, the flanges of the rails fit on to the tops of the yokes, and are held up by adjustable tie-bolts. Halfway between every four yokes, and therefore at 15 ft. centers, are the insulators, seen clearly in one of the sections and in the photographic view, Fig. 4. Above is the cast-iron flange, which is bolted to the flange of the slot rail and the drip cap. Within the latter, set in Portland cement, is the insulator itself, which is single-lipped, and set within the insulator, also in Portland cement, is the iron bolt or pin. The surface of the insulator, which is within the cap, as also the surface of the bolt within the insulator, is corrugated so that the cement obtains a good firm grip. Attached to the bolt are the two iron pieces in which the one side of the contact T-rail is inserted, and the distance of the latter from the center of the bolt can be nicely adjusted by an eccentric washer which turns freely on the bolt and acts as a cam, and which can be gripped with a spanner. The T-rails are simply fastened by a pin, and the lengths are bonded. The track is paved with wood, and what may prove to be a disadvantage is that the insulators are not accessible without removing the paving blocks. At points and crossings, one or both conductors are interrupted for 12 ft. to 15 ft. The plough and its carrier are shown in Figs. 3, 4 and 5. Fig. 5 is the plough itself, which consists of a steel neck holding a double board of walnut to which the spring contacts are fastened on either side by clips. They are connected by flexible cables to the top of the carrier and thence to a switch—which is controlled from a small handle at the side of the car—for switching either the trolley or the plough on to the controller. The plough slides in two sets of guides, one set vertical for raising and lowering it, and the other set horizontal, thus enabling the plough, when lowered, to move freely in a horizontal direction at right angles to the length of the car. The traveling head on which the plough is suspended can only move up and down, but, as soon as this head is in its lowest position, the plough rests on the horizontal guides, and releases itself from the head, thus becoming free to move from the side to the center of the car. At each point on the line at which the slot construction stops and the overhead construction begins, the slot changes from side to center slot, and the slot ends at a plough pit (Fig. 6). The two covers of the pit normally leave a space 1 in. wide between them, but they are attached by a single series of links to a lever outside the track in such a way that when the lever is pulled over the covers are slightly raised and pulled back so as to widen the slot considerably, as seen in Fig. 6. Two guides within this pit and sloping down towards the contact rails, help to guide the plough down as it is lowered. The raising and lowering of the plough is effected by a chain roller mechanism seen in Figs 3 and 6 and the plough when in its upper position is held by a catch. The whole arrangement embodies many parts, but it is practically designed and works very smoothly. To wind the plough up and down, the crank of the controller is removed from the latter and used on the spindle of the chain gear above referred to.

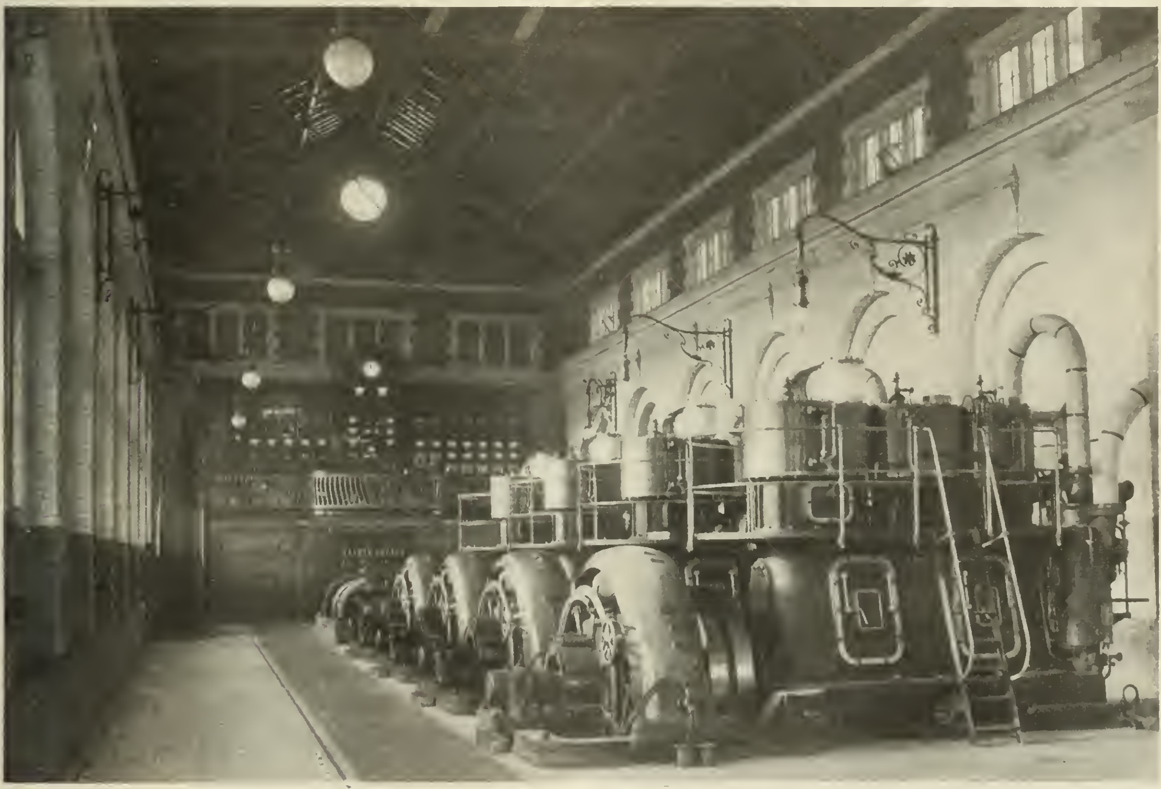

Fig. 1.—General View of Interior of Bournemouth Generating Station.

The conduit track is divided up into ½-mile sections, and there are two feeder pillars at the end of each section. One of these contains throw-over switches arranged so that the polarity of the contact rails on either side can be reversed; in the other are fuses connecting the feeders to the reversing switch pillar.

There are at present an equivalent in single track of 3 miles conduit line and 15 miles of trolley line. Most of the line is double track, single track being employed chiefly in those cases in which it is necessary to return by side streets on account of the narrowness of the roads, although the gauge is only 3 ft. 6 in. The work was commenced in March last year and completed just before Christmas. The greater part of the lines were then put in operation, although the government inspection has not been made. The overhead construction is chiefly with single bracket poles, but in some parts either double bracket poles or span wires are employed. In several roads the arc lamps for street lighting are placed on the center poles.

The cars are partly single truck and partly double truck; in the former case the plough carrier is held in between the framework of the truck and in the latter case it is held by two plates fixed to the axle boxes of the pony wheels of one of the bogies. The single-truck cars have Peckham underframes, and the double-truck cars Brill underframes. The motors and controller equipment are by the British Westinghouse Company, and the ploughs by Messrs. J. G. White & Co., the latter firm having been responsible for the whole of the conduit, track and overhead work. At present only hand and electric brakes are provided, but either air brakes or track brakes will be added, as there are one or two very sharp gradients, one of these being nearly 1 in 9 and with a sharp curve at the bottom. The electrical car equipment comprises two Westinghouse tramway motors, two controllers, one at each end of the car, with combined automatic cut-out and main switch, and diverters, etc., for electric "service" braking. "Nose" suspension is used for the motors. One of the principal features of the controller is that in it the number of contact pieces has been much reduced, without any reduction in the number of speed stops. The control is of the usual series-parallel type, there being three steps for the series, and two steps for the parallel arrangement of the motors; in the braking position there are four resistance steps. The "diverters" through which the current from the motors acting as generators is passed, are iron-framed, fire proof resistance coils, with large external surfaces.

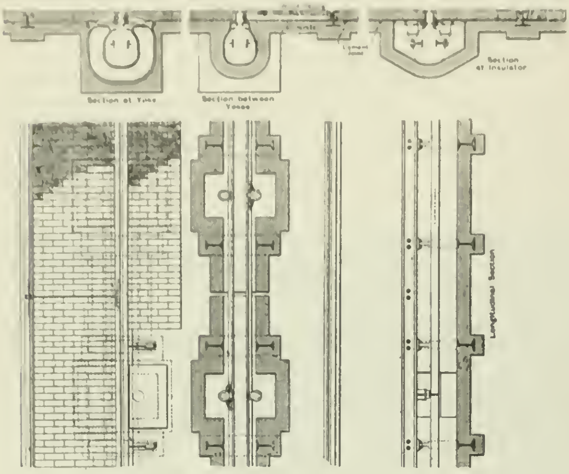

FIG. 2.—SECTIONS AND PLANS OF CONDUITS.

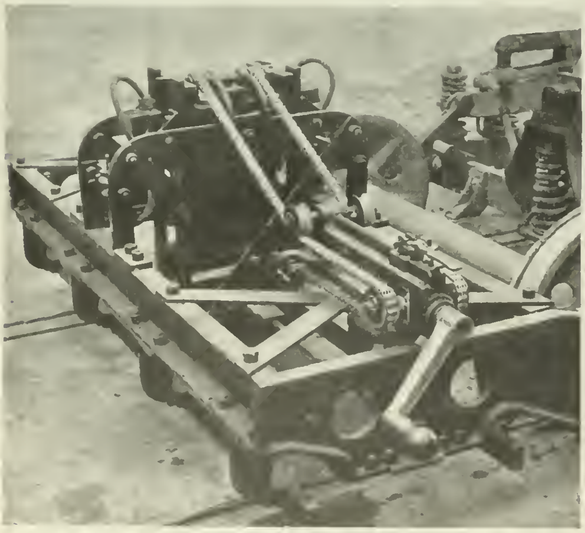

FIG. 3.—APPARATUS FOR RAISING SHOE.

The generating station of the Bournemouth Corporation supplies both the tramways and public lighting, the private lighting in Bournemouth being provided for by a company. In the station are four 292-kw sets running at 360 r.p.m., Fig. 1. The Belliss engines are three-crank, triple-expansion, with cylinders 12 in., 18½ in. and 28 in. diameter by 12-in. stroke, and there is on each a 66-in. flywheel weighing 9,000 pounds. They govern on the throttle, and there is a by-pass, in connection with the governor, which lets live steam into the intermediate cylinder when the throttle is full open and the speed still below the normal, to deal with overloads. The dynamos are eight-polar, of the usual traction type. Their fields are compound-wound for a constant pressure of 550 volts, when giving any current between 50 and 662 amperes, the series winding being ar-

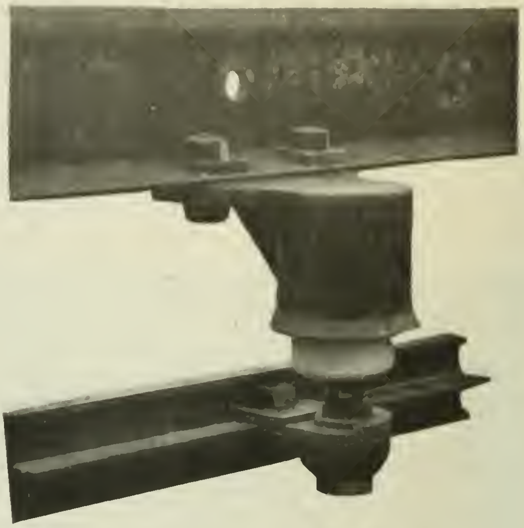

FIG. 4.—CONDUCTING RAIL AND INSULATOR.

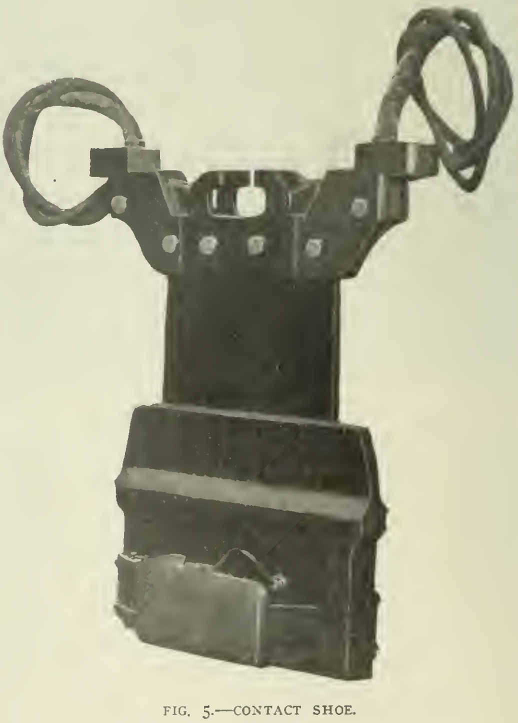

FIG. 5.—CONTACT SHOE.

ranged on the negative side of the machine—that is to say, between the negative brush and the negative terminals. The field rheostat for each generator is connected to a 30-way multiple-contact switch on the switchboard, and is capable of reducing the voltage from 550 to 500 volts. These machines are specified to take 25 per cent. overload if necessary, and between no load and this overload the brushes are to run practically sparkless without being shifted. The specified temperature, after a six hours' run at an output of 530 amperes and 550 volts, is not to exceed 60° F. at any part of the machine. Two Belliss surface condensers are provided, each capable of condensing 15,000 pounds of steam per hour, and giving a vacuum of 29 inches.

In addition to the generators already mentioned, the engine room contains a motor-generator in order that the conduit portion of the track, which is run off different bus-bars to the overhead portion, both poles of the conduit line being insulated, may yet be run from the same dynamo. This machine has a capacity of 77 kw.; its motor is shunt-wound and its generator compound-wound, and the speed is 550 r.p.m. The normal output of the generator is 140 amperes at 550 volts, but the machine is capable of giving an output of 140 amperes at 600 volts when running at about 600 r.p.m., and as an emergency load an output of 170 amperes at 550 volts for 10 minutes at a time. The motor works at an e.m.f. of 550 volts, the rise in speed to enable the generator to give its higher output being obtained by inserting resistance in the motor field. Both motor and generator are of the four-pole type, the field rings being deeply set in a common bedplate in order to bring the center of rotation as low as possible. Each armature is mounted on a separate shaft, provided with a half coupling for bolting to the central shaft carrying a cast-iron flywheel weighing about 1½ tons, the arrangement permitting either armature to be removed without disturbing the flywheel.

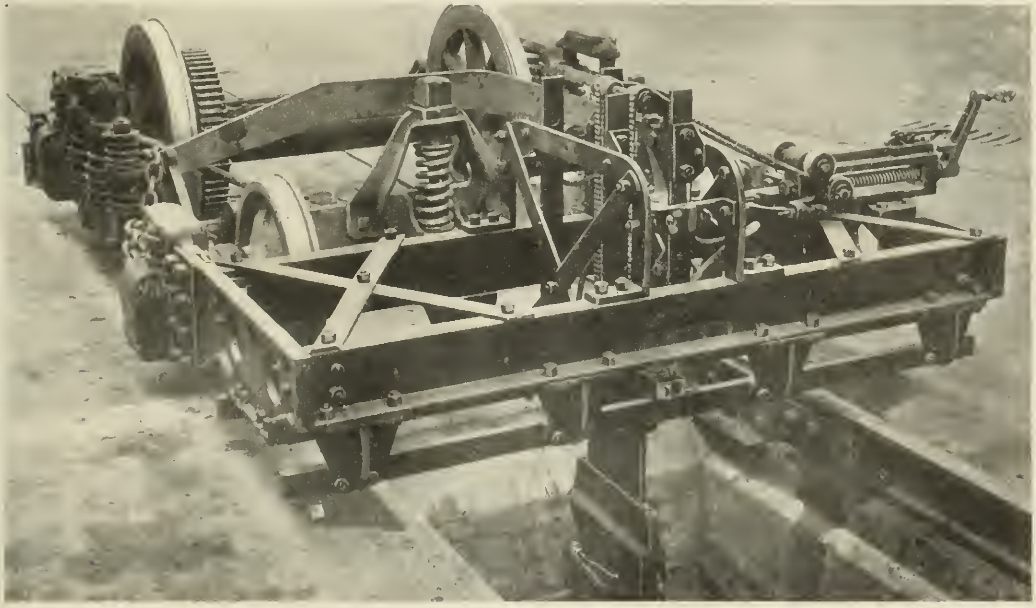

Fig. 6.—View of Truck Showing Shoe-Raising Mechanism.

The switchboard has to supply three sets of feeders which are more or less independent, viz., those for the conduit line, the trolley line and the public lighting. The conduit line is run, as already stated, with both poles insulated, and the trolley line utilizes a rail return as usual, while the public lighting is by 132 arc lamps, in circuits of 11 off the traction dynamos. Each dynamo panel has a throw-over switch which can connect it either to the trolley bus-bars at the top or the conduit bus-bars at the bottom. There is also a reversing switch by means of which the polarity of the conduit rails may be reversed. A water resistance is provided for testing purposes and burning out faults, and it can be adjusted from a handle on the switchboard.

The feeders are lead-covered and paper-insulated, laid in conduits embedded in cement, the ducts being in 2-ft. 6-in. lengths, with 3-in. ways. The traction feeders are single cables, and the public lighting feeders concentric. From the feeding points the cables to the arc posts are single lead-covered, rubber-covered cable being used from the base of the pole to lamp. At the works all the lead-covered cables terminate below the floor level, where they are connected to rubber-covered cables rising to the switchboard.

Bull System of Selective Wireless Telegraphy.

In an article contributed to the *London Electrician*, Mr. Andres Bull describes a system of wireless telegraphy of his invention in which, instead of using simple wave impulses in transmitting signals as by other systems of wireless telegraphy, a series consisting of a fixed number of wave impulses, succeeding each other at prearranged short intervals of time is used, and thus it is possible to give the signals from each separate transmitter a distinctive feature of their own. For instance, suppose each series to consist of five impulses, the intervals of time between them being a, b, c and d, then by giving these intervals different values it is easy to produce a great variety of series.

If a dot in the Morse code is to be transferred from a station, A, to another station, B, a series of, say, five wave impulses at intervals a', b', c' and d' is dispatched. The receiver at B, tuned for these intervals, collects the five impulses and registers them as a dot on the tape of a Morse apparatus; in transmitting a dash, a sequence of series is dispatched from A, and the receiver at B will register a row of dots (a dash) on the tape. If A wants to communicate with another station, C, a second series is used, the intervals being a'', b'', c'' and d''. This series will not be recognized by the receiver at B, as the intervals do not correspond with the adjustment of the latter. The receiver at C will, however, receive and record the signal. In this way, by using series of different forms, one can telegraph selectively from a transmitting station to any number of receivers.

The conversion of the Morse signs into series at the transmitting station as well as the reconversion of the series into dots at the receiving station is accomplished automatically by two instruments, the disperser and the collector, respectively. Sending is carried out in the usual way by pressing down a Morse key for short or long periods.

Fig. 1 shows diagrammatically the connections at the transmitting station. By pressing the key, *1*, a current will flow from the battery, *2*, through the windings of the electromagnet, *3*, the armature of which is fitted with a hook, *4*, to grasp the stop, *5*, on the disc, *6*. The latter is loose on the pivot, *7*, which rotates with a velocity of about five r. p. m., the friction being sufficient, however, to confer on the disc a tendency to rotate with the pivot. When, therefore, the armature is attracted, the disc, *6*, is released and starts rotating, the stop, *5*, in passing the contact springs, *8*, will close a circuit, including the battery, *9*, and the electromagnet, *10*, mounted on the frame of the disperser. If the key is pressed only for a short time (in order to send a dot) the hook, having released the disc, resumes its normal position, and the disc is stopped after one revolution. Only one impulse is then sent through the windings of the magnet, *10*. If, however, the key is pressed long enough to allow the disc to make several revolutions a number of impulses at regular intervals of one-fifth of a second are sent around the magnet.

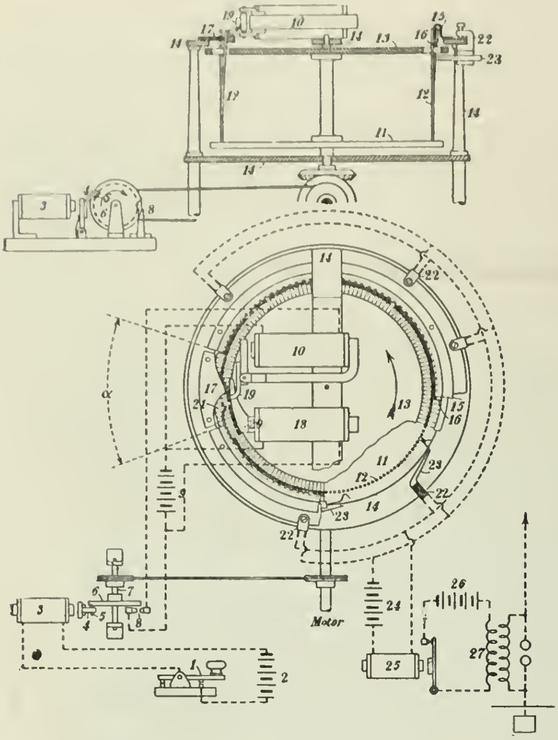

FIG. I.—CONNECTIONS AT TRANSMITTING STATION.

The disperser consists of a disc, *11*, to which is fixed a large number of concentrically arranged vertical steel springs, *12*. The upper ends of the springs are free, and are passed through radial slots in a second disc, *13*; their ends are thus allowed freedom in a radial direction only. The two discs are mounted on the same spindle and revolve within the frame, *14*, to which is fixed a ring, *15*, serving as a guide for the points, so that during a revolution they are caused to glide either within the ring, or in the U-shaped groove, *16*, formed by the latter. A piece of the ring corresponding to the angle *a* (Fig. 1), is cut off, and in its place is fitted a piece of bronze, *17*, which bends the ends of the springs towards the pole of the magnet, *18*. This magnet is constantly excited by current from the battery, *9*, and the steel springs are attracted by it. Their elasticity being overcome by the strength of the magnet, and the bronze finger, *19*, being in its normal position, the springs will slide along the pole of the magnet, *18*, and will not be released until they have reached the edge, *20*. On further revolving, they will glide within the ring, *15*. If, on the contrary, the magnet, *10*, is excited, the finger, *19*, fixed to the armature, will be pushed over the pole of the magnet, *18*, and protrude slightly in front of it. Then when the springs pass by this finger, they will be forced from the pole of the magnet, *18*, and on account of their elasticity will resume their vertical position. They will, therefore, enter the U-shaped groove at *21*, and remain in the latter for one complete revolution.

Around the circumference of the disperser a number of contact devices, *22*, are fitted, consisting of two contact springs, *23*, insulated from each other; by the aid of screws these devices may be fastened around the frame at any desired angular intervals. The contact springs are arranged in such a way as to allow the steel springs moving within the ring, *15*, to just clear them, while the steel springs in the groove, *16*, protrude, and therefore in passing will establish contact. When the disperser is working, provided the magnet, *10*, has not been excited, all the steel springs will glide within the ring, *15*, and consequently all the contact devices, *22*, will be open. If, however, a short current impulse is sent through the windings of the magnet, *10*, a steel spring is brought into the groove, *16*, and establishes contact successively at every one of the contact devices. The contact springs are electrically connected, as shown in Fig. 1, and, accordingly, each time a contact is made current from the battery, *24*, will excite the interrupter magnet, *25*, the armature of which will be attracted, causing a current from the battery, *26*, to flow through the induction coil, *27*. On the subsequent opening of the circuit a spark discharge takes place between the secondary terminals of the coil, and a wave impulse emanates from the transmitting station. Consequently, for each current impulse that is sent through the windings of the disperser's magnet, *10*, a number of wave impulses corresponding to the number of the contact devices, *22*, are dispatched. The discs revolving at approximately constant speed, the time intervals between the impulses of such a series will be proportional to the angular distances between the contact devices, and by putting these in different positions around the frame of the disperser, one can vary the form of the dispatched series at will.

At the receiving station the wave impulses strike the mast wire, *28* (Fig. 2), lowering the resistance of the coherer, *29*, and causing the relay, *30*, to become excited. The latter closes the circuit for the tapper, *31*, by which the initial resistance of the coherer is restored, and at the same time a current impulse is sent through the windings of the collector magnet, *32*, which is shunted with the tapper. As the collector is constructed in the same way as the disperser, a steel spring for each arriving wave impulse is brought into the groove of the ring, *33*. The disc to which the steel springs are fastened, like that of the disperser, revolves at approximately isochronous speed, and consequently the angular distances between the springs brought into the groove will be proportional to the intervals of time between the impulses that have impinged upon the mast wire, *28*. A series of, say, five impulses will, therefore, cause five springs to be brought into the groove at angular intervals corresponding to the intervals of time between the impulses. Around the frame of the collector are fitted the same number of contact devices, *34*, as are on the disperser, and, similarly, only the springs moving in the groove will be able to establish contact. The contact devices of the collector are, however, connected in series (Fig. 2), so that a current cannot flow through the Morse apparatus, *35*, until contact is established simultaneously at all the points. If now these points are adjusted to the same mutual angular distances as the steel springs, which, on the arrival of a certain series of impulses, are brought into the groove, then such a group of steel springs will, during the revolution of the disc, cause a momentary simultaneous contact at all the points; a current impulse then flows through the Morse apparatus, and is registered as a dot on the tape. Consequently, a continuous succession of series, dispatched by the trans-

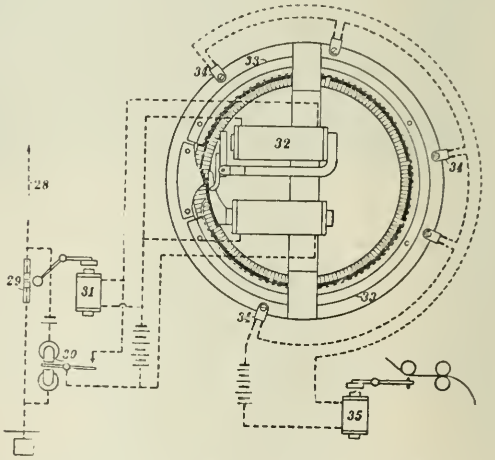

FIG. 2.—CONNECTIONS AT RECEIVING STATION.

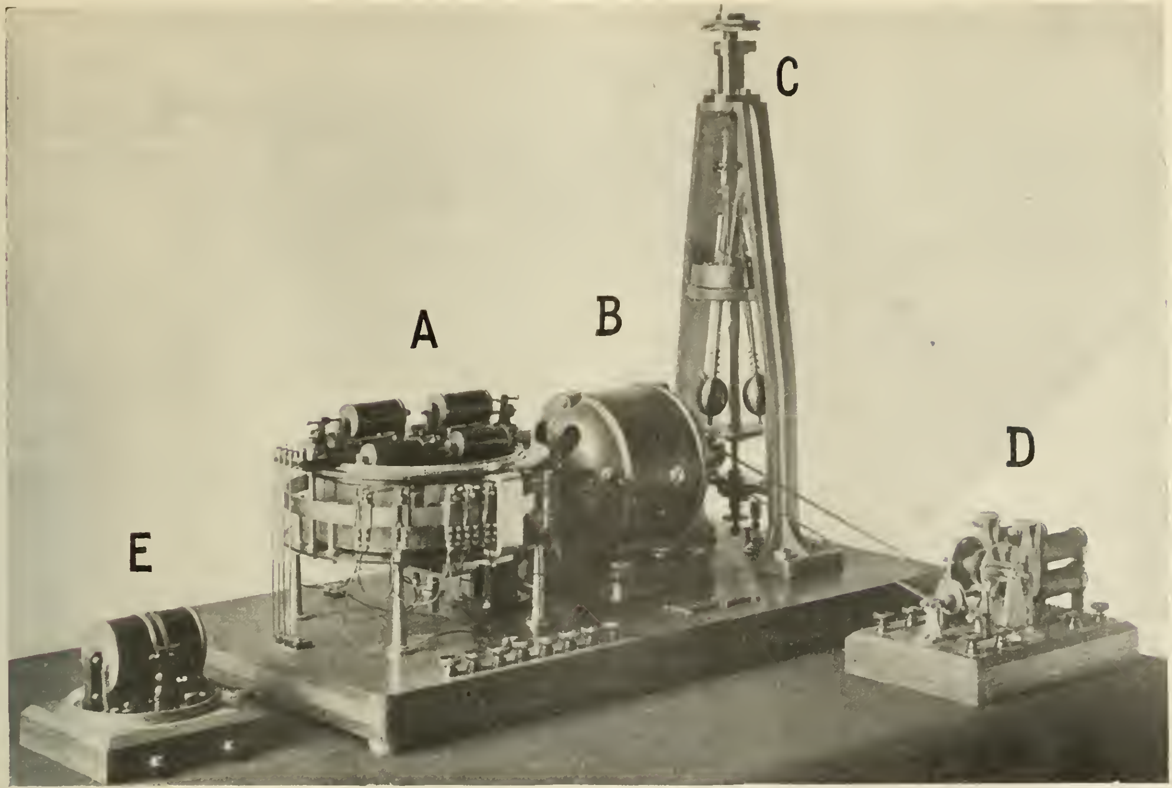

Fig. 3.—Instruments Used in the Experiments.

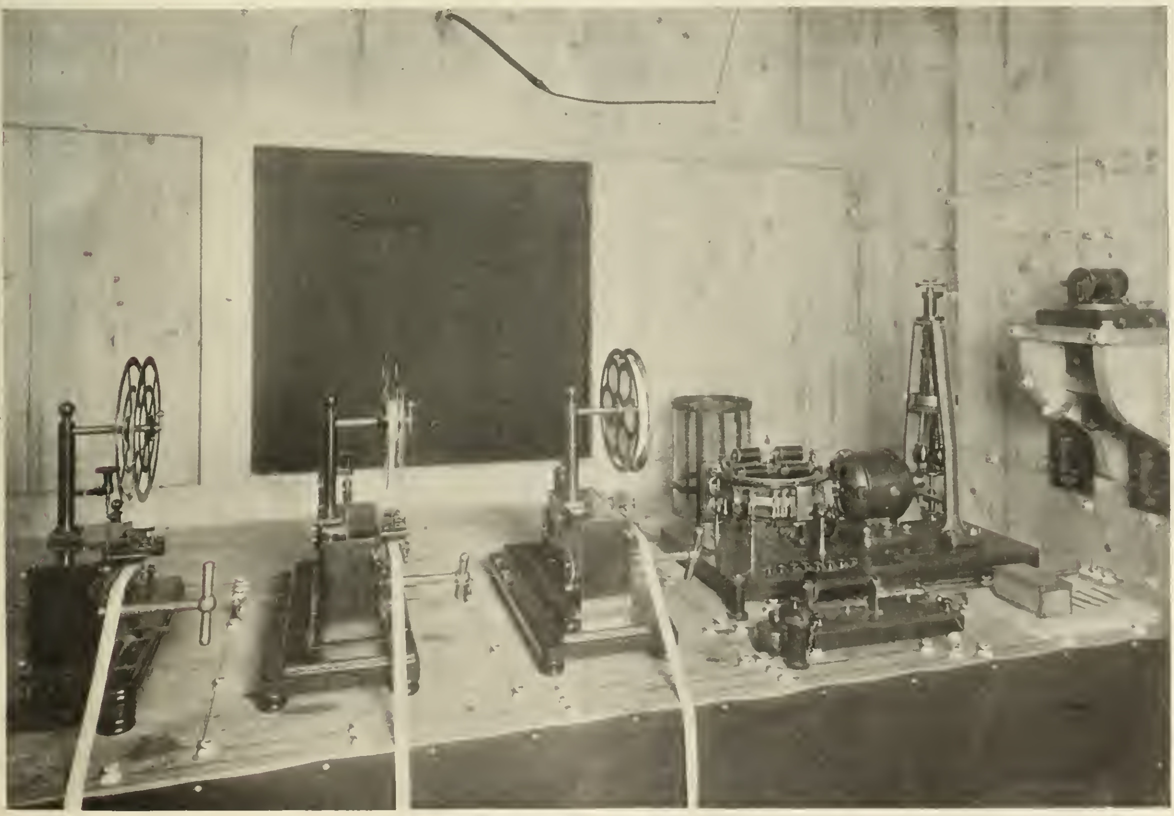

Fig. 4.—Complete Receiving Station.

BULL SYSTEM OF SELECTIVE WIRELESS TELEGRAPHY.

mitter when a dash is to be transferred, is registered as a continuous row of dots. Series of any other form than the one to which the collector is adjusted, cannot cause a simultaneous contact of the devices, *34*, and, therefore, they will not be registered by the Morse apparatus.

Fig. 3 shows the instruments used in the experiments. The disperser and collector are here combined in one apparatus, *A*, one half serving for dispatching and the other for receiving messages. The apparatus is geared to a small motor, *B*, the speed of which is regulated by a brake regulator of the Siemens & Halske type, *C*. The disc carrying the steel springs is rotated at a speed of about one revolution per second, and the number of the springs is 400. *D* is the automatic device above indicated by *3—8* in Figs. 1 and 2, and is worked from the shaft of the motor. *E* is a relay, designed for rapid acting, the armature being very slight and the iron core laminated. It works well with 0.1 of a milliampere.

In experiments made, only one transmitting and one receiving station were mounted, but the disperser was provided with three sets of contact devices, *34*, any one of which may be put in connection with the interrupter of the induction coil by means of a switch. The same key can be used to dispatch series of three different forms, and at the receiving station the collector is provided with three sets of contact devices, each of which is connected to a Morse apparatus; these are adjusted in such a way as to correspond with the three forms of series to be dispatched from the transmitting station. Fig. 4 shows the complete receiving station.

The number of impulses in each series is only three, and S_1, S_2 and S_3 at the upper left-hand part of Fig. 5 show diagrammatically the three forms used. Time is represented by the length of the horizontal line, and the impulses by heavy cross strokes. The distance between two of the fine cross strokes represents 0.05 of a second. At the upper part of Fig. 5, to the right, is shown how the series succeed each other when the key is pressed for a long time. By aid of these three series one could telegraph selectively to any of the three Morse machines at the receiving station. The messages arrived very distinct and precise, and appeared exclusively on the tape of the machine for which they were intended. I to III at the lower part of Fig. 5 show three pieces of tape simultaneously unwound from the three Morse machines, when words were sent by the transmitter, in each of the three series, S_1, S_2 and S_3 successively. The tapes show that when one machine was working no signal was registered by either of the other two.

Mr. Bull states that so far as he knows this is the greatest number of receivers that, up to the present, have been worked selectively by wireless telegraphy, but it is evident, however, that they may be increased by varying the forms of the series. The different transmitters and receivers will work equally well if mounted at different stations, and it is quite immaterial whether the distance to be covered is great or short; in these respects the present system possesses a great advantage over those based on electric syntony. The working distance over which these experimnts were carried out was about 100 yards, the energy of the transmitter being small in proportion. Several dispatches can be simultaneously transmitted by this system without interference, but owing to the lack of apparatus this has not yet been done.

It might be thought that the speed of working must be very limited, a dot requiring a series of at least three impulses; but this objection is justified only to a certain extent, as the dashes hardly require more impulses than by other systems. The dashes may without fear of confusion consist of only two dots, and two series are, therefore, sufficient, making six impulses a minimum for the transference of a dash. Although no arrangements for great speed were made in these experimnts, 50 letters a minute were easily transmitted, and this speed could be considerably increased. The system may also be, with little difficulty, adapted to the Hughes type printing apparatus. The greatest advantage, however, lies in the fact that it is impossible for an outsider to "overhear" or "tap" a message. The lack of secrecy has always been one of the most serious disadvantages of wireless telegraphy and an argument against its commercial adoption, but the inventor thinks that his system presents a solution of the difficulty.

Mr. Bull states he has discovered two ways of rendering messages unintelligible to those unconcerned; one is to make the intervals of time between the impulses in the series so long that the latter become somewhat longer than the intervals between each of the series, which are dispatched in continuous succession when the key is pressed for a dash. This is the case with the series S_3 in Fig. 5. When telegraphing, the series will then overlap each other in a way which makes the message unintelligible if recorded in the usual manner. This is plain from tapes IV and V (Fig. 5), which were simultaneously unwound from two Morse machines, one being tuned and the other connected to the coherer in the ordinary way. The latter machine, of course, registers each impulse in the order of arrival, and the message appears as on tape V. Tape IV is the identical message recorded by the tuned receiver, and it should be observed that the series in this case only consisted of three impulses. When a greater number is chosen the messages recorded by an ordinary receiver will be still more confused. The other way of keeping the messages secret is to use short series, as S_1 and S_2, in Fig. 5, and to send out in the spaces between the individual dots and dashes of the message a series of a form not affecting the receiver telegraphed to, but nevertheless resembling the series to which the receiver is tuned; this can be done by a very simple automatic device. In such a case an ordinary wireless telegraph receiver would give an unbroken row of dots, quite impossible to decipher, as the two forms of series could not be separated.

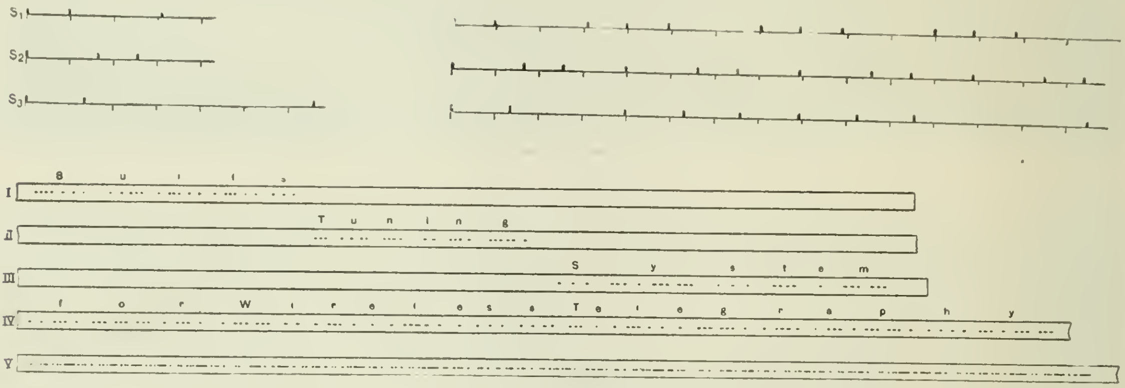

Fig. 5.—Diagram Showing Impulses of Series and Specimens of Tape.

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Exports of American Manufactures.

Exports of American manufactures show a marked increase in the calendar year 1902 as compared with 1901. The total value of the 1902 exports of manufactures, as shown by the figures of the Treasury Bureau of Statistics, is $410,650,967, against $395,104,030 in 1901, an increase of 15½ million dollars. Nearly all the important manufactures entering into export trade show an increase, the chief exceptions being iron and steel and refined mineral oil. Iron and steel manufactures show a decrease of over 4½ million dollars and mineral oils a reduction of 4 millions. Copper manufactures showed the largest gain, 12 millions.

The Electrical Resistance of Bearings.

By A. E. Kennelly and C. A. Adams.

It is generally known that a film of oil envelops a shaft rotating in a well-lubricated oil bearing. It is not, however, generally known that a shaft may be highly insulated electrically from the bearing by this film of oil, and that the oil film is capable of withstanding a comparatively high electric pressure.

We have found that in small sizes of dynamo machines there is frequently a very considerable resistance between the shaft and the pedestals or base of the machine, while the shaft is in rotation. When the bearings are in good mechanical condition, it seems that this resistance amounts to electric insulation. Also that this insulation is maintained throughout a wide range of speed. In other words, the insulation appears to break at speeds that are very low by comparison with the normal.

We have made some measurements upon the resistance in the bearings of an Edison bipolar 125-volt, 6-kw machine, having a normal speed of about 1,800 r.p.m. This machine has been in regular testing-room service for about ten years. When the armature is at rest, the resistance in the bearings is practically nil, the shaft resting in good electrical contact with the bearing metal. Above a speed of about 100 r.p.m. this short-circuit in the bearings disappears, and the resistance between shaft and pedestals, i. e., the resistance of both bearings in parallel, amounts to about 4.4 megohms, as measured by the insertion of a direct-current, 125-volt voltmeter, according to the series-voltmeter method, and using a direct-current pressure of about 120 volts. This represents a resistance of 8.8 megohms, on the average, in each of the two bearings, and since the bearings are approximately 5 in. long (12.7 cm), with an internal diameter of 1⅛ in. (2.86 cm), the surface in each bearing is about 114 sq cms, representing an average insulation of about 1,000 megohms per sq cm of oil surface. The bearings are of the usual self-oiling type, with two revolving brass oil rings in each.

This insulation is maintained under very considerable lateral pressures on the shaft. An altogether abnormal lateral pressure has to be exerted on the rotating shaft in order to break the insulation.

The insulation, as measured in this way, was found to break down periodically, owing to the accidental contacts between the brass oil-rings and the sides of the bearing slots in which they travel. When the rings were lifted, to remove this source of disturbance, it was found that the insulation entirely disappeared. The insulation of the shaft was not restored until all of the four rings had been released again and set in motion. In this manner the importance of the oil-rings, in maintaining an adequate flow of oil through the bearings, is readily demonstrated.

Similar experiments with new dynamo machines, in which the bearings had not had sufficient time to wear down to the normal condition of shape and surface, showed only a more limited degree of this insulation.

After the brass oil-rings had been replaced with insulating oil-rings of fibre having the same dimensions, the insulation of the shaft during rotation remained steady and permanent. The insulation does not break down under the influence of 500 volts direct-current pressure, as applied through a 600-volt voltmeter. The insulation resistance as measured in this way is no less than when the pressure of 120 volts is employed.

When a pressure of 1,670 volts alternating was similarly applied, the insulation in the bearings did not appear to break down, but the apparent resistance in the bearings was markedly reduced. It is not at present clear whether this is an actual diminution of resistance in the oil under the alternating-current pressure, or whether it is an effect due to capacity or polarization.

The sudden change with speed of such a dynamo shaft, from complete grounding to relatively high insulation, would make an effective lecture experiment.

The electrical resistance of a bearing, as studied in this way, may also be of considerable use in analyzing the mechanical condition of the bearing.

We are indebted to the assistance of Mr. S. E. Whiting in the course of these experiments.

The Industrial Efficiency of Germany.

In an article in the *World's Work* for February, on German business methods, Mr. Louis J. Magee, an American electrical engineer well known in this country, who has been prominently associated for some thirteen years with the Union Elektricitäts Gesellschaft, of Berlin, says:

I think the Germans possess pre-eminently the following traits:

First, thoroughness—the mastery of facts in the preparation of a basis for action; elaborate study precedes decision in most financial and technical work; high standard of education.

Secondly, unquestioning obedience to the existing laws—willingness to follow rules; a subordination of personal will to the established method. This is the good side of their lack of independence.

Thirdly, honesty throughout business life is the general rule. Comparatively little business depends upon the use of questionable methods.

In technical progress as well as in general business methods the Germans are keen for progress. All branches of business have their trade journals, which are eagerly watched, and scores of clever observers are traveling about the world learning much from their neighbors. Only thirty hours after the American astronomer, Perrine, had informed the world-central astronomical office of the discovery of a new comet, a French astronomer telegraphed his news of the same celestial visitor. This faint light of only the ninth magnitude found searching eyes on both sides of the Atlantic. How much more must the great worlds of business and industry on either side of the ocean be waiting for new hints of progress.

An American professor, after visiting a large technological institute in Germany, told me that the school and its equipment was ahead of anything at home. When this compliment was repeated afterward to a prominent instructor in the institute, he replied: "Why, that is exactly what I said of your technical schools after my trip to America, and that is the only way I could get the money to make ours what it is to-day."

That Germany's technical army is marching forward in good form is a generally accepted fact. The American terror is before their eyes, but they have elements of strength which may keep them up against all competitors in certain lines.

Banquet to Marconi in Canada.

A banquet was given to Mr. Marconi at Montreal last week by the directors of the Canadian Marconi Company on Thursday night. Sir William Mulock, responding to the toast, "The Canadian Government," gave voice to the strong prevailing sentiment in favor of a liberal subsidy for the Marconi system of wireless telegraphy.

Mr. Hugh A. Allan, of the Allan Steamship Line, urged the necessity of some system in aid of navigation on the St. Lawrence route and outlined the means whereby the safety of vessels would be assured. F. W. Morse, of the Grand Trunk system, asserted that the practical use of wireless telegraphy trains working at the rate of 60 miles an hour had been demonstrated on the Grand Trunk and that Marconi's system would prove more useful to the railways than even the telegraph or telephone.

Representatives of the government and all the most prominent interests in the Dominion were present at the banquet to do honor to the inventor. Mr. Marconi acknowledged the great debt he owed to Canada for its timely assistance and said that it was only reasonable to expect that the coast commercial messages by his system would be greatly reduced over the contract price named on the government franchises of his company, viz., 10 cents per word.

The Canadian Marconi Company is capitalized at $5,000,000. The parent company retains control in this case also. The company owns the Glace Bay transatlantic station and is preparing to install a number of other stations. It also owns the Canadian rights to Marconi's inventions, including the equipment of ships having Canadian registry. It has under consideration plans for the introduction of its system along the Pacific coast and to the Canadian Yukon. It will establish works for the manufacture of instruments either at Montreal or Toronto, including a school for the instruction of operators. Negotiations are in progress with the government for a system of subsidized stations on the eastern coast.

The Economic Value of Testing.*

By Prof. Geo. D. Shepardson.

The aim is to show that it would be a capital investment to put more money into buying accurate instruments and to have men competent to use them. It goes without saying that the manager of a manufacturing plant should know how much product he manufactures, how much it costs per unit, how many units he sells, how many are lost somewhere between the raw materials and the finished product, how many are lost or stolen between the factory and the customer.

Applying this to the operation of a central station for the manufacture and marketing of electrical energy, it is desirable and economical to keep systematic record of the amount of raw material used, namely the amount of fuel, water, oil, carbons, lamps and other supplies; the output of the factory, namely, the kilowatt-hours produced; the amount sold. The relation between amount of raw material and the station output furnishes a basis of comparison with the performance of other factories, and shows whether the cost of manufacture is reasonable.

The shrewd manufacturer desires to know not only whether he is conducting his operations about as economically as do others, but he wishes to know whether he is working as efficiently and as economically as possible. He is not satisfied to earn a ten per cent. dividend because that may be the average performance of his neighbors, but he wants to know whether he can raise that ten to fifteen or to thirty per cent. In order to accomplish this he must have detailed information about the actual working of his plant.

The portion of the income which every wise company sets aside for betterments can be expended most advantageously when the manager knows the condition and efficiency of every part of his system, so that he may be confident that $100 spent in one place will effect greater economy or other improvement than the same amount spent otherwise.

Information can be obtained only by testing. Every station does such testing to a less or greater extent. Where one man is superintendent, engineer, fireman, operator, lineman, trimmer, wireman, meter man, collector and general trouble man, the amount and quality of testing is necessarily limited. In larger stations where the responsibilities are differentiated, greater attention can be paid to details, and a larger amount of testing is practicable. The larger companies find it practicable and economical to maintain an elaborate testing department with one or more experts who devote their chief energies to systematic examination of all the parts of the business, seeing that everything is kept in the best possible condition. The syndicates which are operating central stations in different parts of the country find it pays well to maintain a competent and well equipped testing department. Many of the smaller independent companies are finding it profitable to engage the services of consulting engineers to make periodical examinations of their properties for the purpose of indicating leaks and economies. It is possible to err on the side of too much testing and superintendence, but actual cases of this sort are very rare indeed.

In most stations, the testing can be done with reasonable satisfaction by the regular employees without seriously adding to their duties or responsibilities, and without imposing an alarming expenditure for equipment. When the necessary apparatus is installed ready for regular use, the ordinary employees can take the readings after a small amount of instruction and with proper care. The instruments should be checked at intervals not more than a year apart, by comparing them with other instruments known to be correct. This can be done by sending them to the maker or to a laboratory of good reputation. Most of the technical schools now have sets of standards which are correct within very close limits and with which other instruments may be compared at small cost.

A considerable part of the testing can be carried on without any instruments other than a good eye directed with judgment and a knowledge of what is correct modern practice. Too much importance cannot be given to frequent and thorough inspection of the entire system by the superintendent or by some other person whose eye will notice apparent defects. An example may be noted where a 220-volt plant was so heavily overloaded that the owners were about to install larger machines. A young man who had not yet completed his technical course at the state university was sent to look over the situation; by careful inspection he was able to locate poor insulation After overhauling the lines he increased the number of lights installed by about one third, and even then the load was one-fifth less than before his arrival. In the same plant, by the careful use of a portable voltmeter, he was able to locate a number of bad splices and to show where the circuits should be strengthened with greatest profit. It is not necessary to send away for an expert in order to locate poor work where the lineman has made a "temporary" job in an emergency with the temperature below zero and a Dakota zephyr gently playing about his ears; nor is it difficult to detect lines crossed and lying on the cross arms, resting against trees and iron roofs and similar violations of insurance rules.

Every engineer recognizes the prime importance of feeling his bearings to detect any signs of undue heating. The electrician can also detect poor electrical bearings in similar manner. Dynamo operators make a practice of feeling various parts of their machines to see that the brushes, holders, studs, switches and other contacts make good connection and keep cool. The same vigilance should extend to the switchboard. Poor service due to excessive drop in the lines may frequently be traced to loose and poor contacts in switches and fuse blocks. Unless the fuses have hard terminals, they expand and squeeze out from under the screws and then become loose. The insurance rules call attention to this point, but fail to note that the screws in the switches as well as on fuse blocks work loose and often introduce so much resistance as to lower the voltage quite appreciably. In such cases local heating always occurs unless the circuit becomes opened entirely.

Flexible cables often heat excessively when soldered into terminal lugs, due to the fact that the individual wires were not properly cleaned and tinned before soldering, so that only the outside layer of wires are connected and these have to carry the whole current.

An occasional inspection of fittings and conductors at time of full load will often locate unsuspected sources of trouble.

In order to illustrate the actual value of testing, a few instances will be quoted from a collection of data gathered from central stations and isolated plants in various parts of the country, showing conditions that actually exist where there is little or no systematic testing.

One of the first sources of loss may be found in the boiler room, where the fuel may have been exposed to the weather and is in poor condition for use. The appearance of the smoke will indicate something of the quality of the firing. In one case the correction of leaky boiler settings and insufficient stack, which had affected complete combustion, effected a saving of twenty per cent. of the fuel bill.

In another case, proper cleaning of the feed water heater and of the boiler cut down the fuel consumption by thirty per cent. Grates not suited to the fuel, poorly proportioned grate area, poor boiler setting, poor draught, poor water, cold feed water and dirty flues are as a rule discoverable by the skilled eye without many instruments. Periodical cleaning and inspection of the boiler will increase efficiency and diminish accidents. Steam gauges are not uncommonly inaccurate. Track scales for weighing fuel and ashes, thermometers for checking temperature of feed water are of great importance, and the meters or tanks for measuring the amount of water evaporated will generally pay for themselves. Insufficient covering of steam pipes may be detected by the eye and hand. Excessive drop in steam pressure between boiler and cylinder will appear from the indicator card or from the difference between pressure gauges at boiler and at engine. A calorimeter for determining quality of steam is neither expensive nor very complicated in operation. The intelligent use of the indicator will detect improper setting or worn condition of valves. In one instance poor valve setting increased the fuel consumption forty per cent.; the engineer had an indicator, but did not know how to interpret the cards nor how to apply the remedy.

Tests of several stations operated by one of the largest corporations in the West showed that the inefficient heaters in two stations were costing more than $2,400 and $2,500 respectively each year of operation, and the saving effected by changes paid a good interest on the investment and went far toward the maintenance of the testing department.

Improper condition of the engine governor or uneven belt will appear in the unsteadiness of the lights. Dirty condition of the dynamo and improper setting of brushes, which are liable to induce trouble, will be detected by visual inspection. Poor regulation of voltage, one of the most frequent sources of trouble and loss, may be caused by speed variation, by improper compounding of generator, by inattention to the regulator and voltmeter, by overloading or poor design and construction of the circuits.

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* Abstract of paper read before the Northwestern Electrical Association.

On the switchboard the most common sources of loss are the integrating wattmeters and the voltmeters. In a surprisingly large number of stations the switchboard wattmeters are like snakes in Ireland; there are none. Correct integrating wattmeters are of the greatest importance for registering the output of the factory. By comparing the fuel consumption with the kilowatt-hour output the superintendent has at once a means of determining the efficiency of his station operation. It gives him records for comparing his work from week to week and thus for detecting serious changes in the efficiency of the station as a whole; it gives him the data for comparing the performance of his station with that of other stations and indicates how much improvement he may reasonably expect from his equipment; it gives him a means of noting any excessive discrepancy between station output and the energy registered by the consumers' meters; it gives him a means of comparing lamp breakage with service rendered, and so gives a check on poor lamps and on poor regulation; it gives him a record of the changes in daily, monthly and yearly load.

An interesting illustration of the value of station wattmeters was that quoted by Mr. Wirt before this Association last January: During the year ending June 30, 1900, the station wattmeter showed 729,923 kilowatt-hours delivered to the commercial circuits, while the consumers' meters read in the aggregate only 309,001 kw-hours, or 42 per cent. of the station output. This must have opened the eyes of the superintendent, for the next year the station wattmeter showed 671,006 kw-hours, while the consumers' meters registered 393,223 kw-hours, or 58½ per cent.; thus the paying load was increased while the station output was diminished. Another station reported a line efficiency of 75 to 90 per cent., showing a still better performance.

Care needs to be taken that the station wattmeters are properly installed and are properly calibrated. Station wattmeters are sometimes affected by the magnetic fields due to bus-bars or other sources; sometimes the jar makes them run fast. Direct-current instruments may be checked by ammeter and voltmeter without difficulty. With alternating currents, it is necessary to get a non-inductive load, such as a bank of incandescent lamps, or else to have a correct wattmeter for checking purposes.

When the station is not supplied with wattmeters, the lack may be partially offset by readings taken every half hour from the switchboard ammeters and voltmeters. From these the output of a direct-current station may be computed from hour to hour and for the whole run. It is desirable to supplement the daily or hourly wattmeter readings by the voltmeter and ammeter readings. In an alternating-current station the product of volts and amperes will generally be greater than the true watts delivered. In any station it is desirable to preserve a record of voltage, either by readings every half hour, or, better yet, by a continuously recording voltmeter.

The consumers' wattmeters naturally come in for consideration at this point. It is now generally recognized that all customers should be on meters. Flat-rate customers almost invariably have the best of the company. The rates are generally lower than meter rates; customers have little incentive to economical use of current. One notable case maintained for seven years a flat rate of one dollar per month for each residence, irrespective of number of lights. That was a municipal plant. In one case the load was reduced fifty per cent. by compelling the use of meters, thus allowing the taking on of additional load without increase of equipment other than meters. Experience shows that the reduction of load by changing to meters does not involve a corresponding decrease in revenue.

Wattmeters need to be purchased with some discretion, and need to be tested for accuracy at least once a year. They should in every case be tested before being placed in service and when changed from one location to another.

One superintendent reports that when he took charge several years ago it was quite common to find monthly meter charges of only a few cents, even in winter time; since cleaning and correcting meters, and establishing a minimum monthly charge, the improved financial showing has earned his salary several times over.

It seems not uncommon to find meters running from 10 to 40 per cent. slow on full load, and requiring considerable load before starting. Most stations would increase their income by using meters with greater accuracy at small load. In many cases this can be accomplished by using smaller meters. By using induction meters on alternating-current circuits, the light load registration has been greatly improved. It is desirable to have all meters of the same kind, especially in smaller stations, which cannot afford to keep a meter specialist. Cases are reported where customers buy their own meters, and where every different kind of meter on the market adds to the trials of the superintendent; it is needless to say that choice of meter, and preferably the ownership of same, should rest with the company.

Meters should be cleaned and tested at least once a year. This should be done during the summer, both because the station men have more time, and because the lighting bills are so small that consumers do not notice the change. No sane meter man would choose December as a proper time to clean a meter that was found to be 40 per cent. slow.

Good voltmeters are even more essential than station wattmeters. The ammeters may be only current indicators and their accuracy is of only secondary importance. But a good voltmeter, properly used, is vital to the satisfactory operation of the plant, and it should be accurate within at most one per cent. The voltmeter is the gauge by which the pressure is regulated, and proper regulation is the measure of satisfactory service. The voltmeter should not only be accurate in itself, but it should indicate the voltage at the main center of distribution, or at the point of important consumption. This may be accomplished by bringing pressure wires back to the station, or by using some sort of compensating device which will correct for drop in the lines. Good station instruments should be supplemented by accurate portable instruments, by which to test conditions prevailing on the circuits. Good portable instruments are as essential as those in the station if close regulation is to be attained.

The importance of close and correct regulation of voltage is not sufficiently appreciated. Lamp makers have insisted for years that the life of a lamp is greatly shortened by excessive pressure; that an increase of three per cent. above normal voltage cuts off the life of an incandescent lamp by one-third, and that an increase of six per cent. in voltage takes away about seven-tenths of the life of the lamps. High pressure not only shortens the life of the lamps, but it educates consumers to expect 30 to 50 cp from a 16-cp lamp, so that much dissatisfaction follows the correction of the voltage. Moreover, high pressure increases consumers' bills out of all proportion, an increase of 10 per cent. in the pressure causing an increase of more than 20 per cent. in the watts taken by the lamps, while the cost of lamp renewals is appalling. Low pressure is almost as bad as high pressure, for while the lamps last much longer they give so poor light that the people resort to oil lamps, candles and anathemas.

Excessive high or low pressure is often experienced in various parts of the system when the station operator believes that the pressure is normal. The station voltmeters frequently read low, so that the pressure is actually higher than indicated. Reports at hand show station voltmeters reading from 1 to 20 per cent. low, only a very few reading too high. The general tendency is for ammeters and voltmeters to read low as they age. Comparatively few stations seem to be provided with portable voltmeters. These are essential for checking line losses and distribution of load. No matter how skillfully the circuits may have been designed, the load is sure to change from the conditions assumed, some circuits will be overloaded while others are light. The result is the drop varies in different parts of town and at different hours in the day. Poor service means dissatisfied customers and slow increase of business. The use of a portable voltmeter will show what lines have too high voltage, what ones are too low; by a systematic study of the situation the causes may be located. A few cases may be cited to illustrate. One company was renewing about 1,000 lamps per month, about one-tenth of the entire number installed, on account of poor regulation caused by improper balancing of load on the different feeders, and by not tying secondaries in the business district. Another case of poor lights was located by a portable voltmeter showing 128 volts where 110 was intended, the trouble being traced to some intelligent wireman who connected service wires to the pressure wires running back to the station. Poor service on a secondary four blocks long, with a transformer at each end, was found to be due to the blowing of the primary fuses of one transformer. Other cases of poor service were traced to poor splices not soldered, but carefully taped, to small mains, to improper interior wiring. In two adjacent stores connected to the same transformer the full load voltages were found to be 93 and 102 respectively. In a three-phase plant with power house five miles from town a voltage variation of 15 per cent. in different parts of the town on moderate load was corrected by transferring part of the load to other legs of the circuit, by installing heavier transformers and heavy secondary circuits in the crowded district and by moving the smaller transformers to the thinly lighted districts. When my informant took charge of this plant there was no portable voltmeter in the county, and the only station voltmeter was five miles from the load. The purchase and intelligent use of a portable voltmeter quickly indicated the causes of dissatisfaction and the remedies became plain.

A supply man reports a case where the incandescent lamps were not giving satisfactory life; queries about the regulation were always answered that the regulation was first class and that the lamps gave good light. A personal visit developed that the engineer had no voltmeter at all and did not wish any, for he could tell by his eye when the lamps were at proper voltage. As a corroboration of his judgment, the supply man tried his voltmeter and found that the 104-volt lamps were operating at 116 volts.

One superintendent reports his success in determining the distribution of his load by putting a maximum demand meter into the primary circuit of transformers or into branches of secondaries. By moving this instrument from place to place, cutting it in at the fuses or wherever convenient, he is able to locate the causes of dim lights.

Since many conflicting statements are made by lamp agents, each of whom has positively the best lamp on the market, and, in fact, the only one that an up-to-date station can afford to use, the only wise thing to do is to make tests, or to secure the results of impartial tests made by others. Many central station men are suspicious of photometers, feeling that only experts can use them correctly. As a matter of fact, it is far simpler than an engine indicator, and with a good voltmeter and careful operation will easily give results reliable within two per cent. It is also an open secret that lamp makers are apt to furnish a more uniform selection of lamps at the same rate to stations known to have photometers for testing, and that they dispose of irregular stock to stations which do not know whether they get what they want or not. (This is not saying anything against the lamp men, for if they do not dispose of irregular products profitably, the cost of good lamps must increase accordingly.) As an example, a recent test of 35 lamps furnished to a station without a photometer showed only 6 out of 35 which came between 13½ and 17 cp, the others ranging all the way from 9 to 20 cp. Remarkable tales are told of the performance of bargain lamps sold by drug and department stores where the stations do not furnish renewals free or at a cost below competition.

The importance of close regulation of voltage is emphasized at almost every electrical convention, yet poor regulation is one of the most common faults in station practice. A recording voltmeter on an important feeder from one of the largest stations in the northwest, and operated by one of the large syndicates, shows a pressure fluctuating from 112 to 140 volts on a secondary supposed to give 110 volts. The effect on the lamps and on the cost of lamp renewals may be imagined. Photometric tests of 45 lamps from one building served by this feeder showed a range from 4.1 to 15.7 cp, with efficiencies running from 3.27 to 7.7 watts per candle, the lamps having been bought for 16-cp at 3.1 and 3.5 watts per candle.

In securing equipment for methodical testing, it is well to keep in mind that satisfactory service is more important than efficiency, for "the better the service, the more customers; and the more customers, the cheaper the cost of production." The most important testing instrument, therefore, is a portable voltmeter known to be accurate within one per cent. With this the station voltmeter can be tested and then be retained, corrected or replaced. The engine indicator is of next importance, for it is most likely to locate causes of poor economy. With this should come a tachometer or a speed indicator. Then should come scales for weighing fuel, switchboard wattmeters for each class of circuits. Then a portable ammeter accurate within about one per cent.: for measuring direct currents, this may be a "round-pattern" instrument provided with a number of shunts from one ampere up so as to obtain a variety of ranges; for alternating currents an ammeter about 15 amperes capacity and one about 50 or 100 amperes capacity will generally answer; then add water meters and thermometers and calorimeter and pump register; then add photometer, recording voltmeter; then for an alternating current station add two or more wattmeters, one for testing watt consumption of incandescent lamps, and one for testing meters, motors and arc lamps. There is a difference about the relative importance of the instruments, and the order in which they should be secured, but the above order will be about right.

The question of the extent to which a station of moderate size should afford to maintain regular testing is an open one. A consulting engineer of excellent reputation, who has been helping better the performance of central stations, says: "My procedure is to get the owner to mail me daily an hourly record of coal consumption, feed water consumption and kilowatt-hour output as measured by the integrating wattmeter; also kind of coal, temperature of water, steam pressure, and any readings of ammeters, voltmeters, indicating wattmeters, steam indicator diagrams, etc., which would affect the economy of operation; also a daily record of load factor as measured by wattmeter; that is, the ratio of average load to maximum load for one hour. By preparing an hourly record, operators get down to business and educate themselves on the subject of pounds of coal per kilowatt-hour. I will not take charge of a station using old style or 133-cycle transformers or any decidedly inefficient apparatus, nor unless there is provided a Weston voltmeter in reserve, an indicating wattmeter, thermometers, a cold water meter, coal scales, an engine indicator, a counter on pump, and keep these instruments calibrated. The monthly financial statements must also be furnished. Some of the results now obtained are excellent and the improvements most satisfactory. Systematic cleaning, inspections, tests and hourly records are to my mind necessary to pay maximum dividends."

New Canadian Niagara Power Enterprise.

The Ontario Government has granted a franchise to the Toronto Niagara Power Company which gives this company the right to develop 125,000 horse power in Victoria Free Park. The Government was governed in its action by a recommendation of the Park Commissioners. The franchise permits the construction of an intake, a wheel-pit and a tunnel. It is thus clear that the development of the Toronto Niagara Power Company will be along plans very similar to those of the Canadian Niagara Power Company.

The intake of the Toronto Niagara Power Company will be located between the forebay of the Ontario Power Company and the inlet of the Canadian Niagara Power Company. As it will be further up the river than the works of the latter company, it will necessitate the construction of a longer tunnel. This tunnel will extend under the riverbed, and the portal will be practically behind the sheet of water of the Canadian Falls. For the development of 125,000 hp the section of the tunnel is likely to be slightly larger than the tunnel of the Canadian Niagara Power Company, while the wheel-pit will probably be a little longer. From $3,000,000 to $5,000,000 will be expended on the work, which will take about three years in building. For this reason it will be a very long time, probably five years, before the scenic features of the Canadian park are restored.

When the Toronto Niagara Power Company applied for its franchise, the engineers of the Canadian Niagara Power Company pointed out that the construction of an intake above their inlet would effect serious injury to their installation by lessening the supply of water. The Government had expert engineers make a full investigation of the probability of such an occurrence, the result being that in granting the franchise the Ontario Government makes it compulsory on the Toronto Niagara Power Company to erect weir dams for the protection of the Canadian Niagara Power Company, bonding it in the sum of $25,000.

It is understood that the Toronto Niagara Power Company will commence work this spring. The principal promoters of the new company are Frederic Nicholls, Lieut.-Col. H. M. Pellat and William McKenzie, of Toronto. One of their principal arguments to secure the franchise was that Canadian power should be developed by Canadians for Canadians, and it is stated that the company will be all Canadian.

Vicarino Car Lighting System in France.

The accompanying illustrations refer to a French system of car lighting known as the Vicarino system, which is being exploited by the Compagnie Generale Electrique of Nancy, France. One of the main features of the system is the employment of two sets of storage batteries, one of which is being charged while the other is on the lighting circuit. This system is now installed on a number of cars of the Chemin de Fer de l'Est.

The apparatus consists of a dynamo suspended under the floor of the car connected with the axle by means of a belt; two storage batteries of 16 cells each grouped in two boxes; and a switchboard carrying the circuit switches and the automatic regulating apparatus. There is also an arrangement of switches whereby when the train is in motion the dynamo may also be thrown on the lighting circuit, at the same time continuing to charge the batteries. The batteries are automatically thrown into the dynamo circuit when the voltage of the latter reaches a given figure. The dynamo also furnishes to the battery on the lamp circuit a portion of the current which it generates, the amount depending upon the output of the machine and the state of charge of the first battery, this current passing through a regulating resistance by means of which the voltage of the battery discharging is maintained constant.

When the train stops, the circuit-breaker throws the two batteries in parallel and introduces into circuit a portion of the regulating resistance mentioned above. By this means there is avoided the fluctuation in voltage which would otherwise result through introducing into circuit the second battery. By means of a switch one battery can be cut out of the lighting circuit and the other cut in, or all of the lights extinguished, or the two batteries thrown in parallel on the dynamo. There is also an automatic arrangement whereby when the voltage of the dynamo passes a certain limit, a resistance is thrown into the exciting circuit, thus avoiding an abnormal charging current.

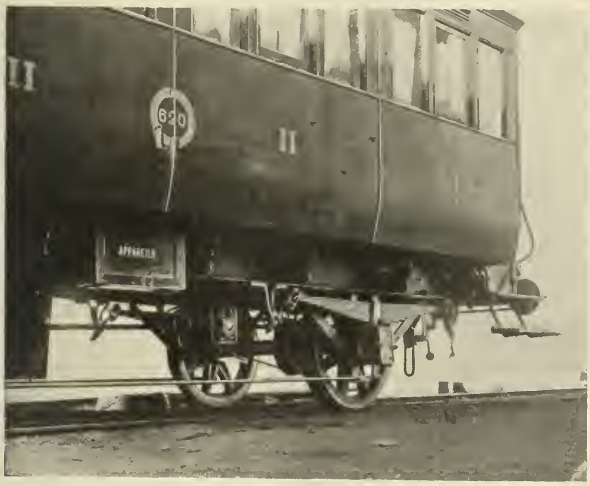


FIG. 1.—ELECTRICAL APPARATUS UNDER CAR.

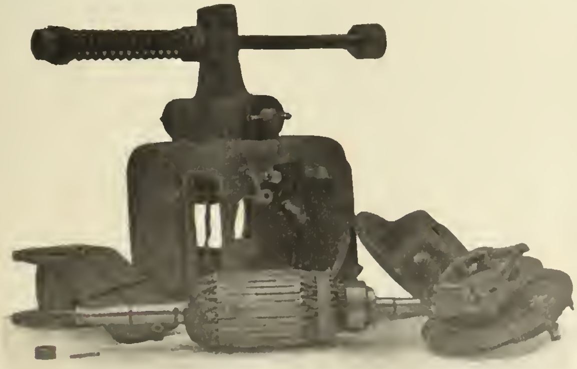


FIG. 2.—GENERATOR DISSEMBLED.

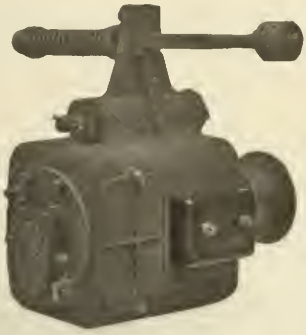


FIG. 3.—VIEW OF GENERATOR.

The dynamo brushes are automatically displaced by 180° when the motion of the train is reversed. The brushes are of carbon and are secured to a cast-iron disc; this disc is movable about its axis and is held in a normal position by a stop. When the direction of motion of the armature is reversed, the friction of the brushes causes the disc to take a new position at an angle of 180°, where it again brings up against a stop. The dynamo cut-out, which acts

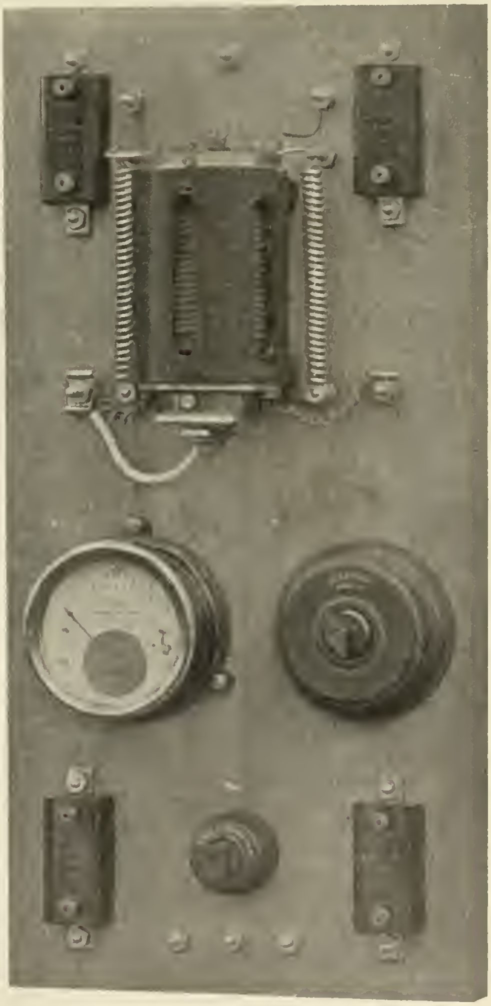


FIG. 4.—VIEW OF SWITCHBOARD.

when the voltage of the dynamo falls below a given point, has two windings, one being a fine wire shunt winding connected to the terminals of the dynamo, and the other a large wire winding through which the armature current passes. The windings act normally together, but in opposition should current pass from the batteries to the dynamo.

Voltage Regulation.

In a paper read at the recent convention of the Northwestern Electrical Association, Mr. H. C. Wirt considered the subject of voltage regulation of direct-current circuits. In the early days of electric lighting, a rheostat was used in the field of shunt machines, but this system is not a success on modern machines.

In order to vary the voltage quickly the rheostat arm would have to move a considerable distance instantly and regulators of this type have failed to control the voltage as the service demanded. Nor does the compound-wound generator give proper voltage when its speed is changed, and the compound winding does not correct for temperature effects.

Mr. Wirt then proceeded to describe a generator regulator recently invented by Mr. A. A. Tyrrell. Two types have been designed, one of them to be used with direct-current generators and the other for alternating-current generators. These regulators control the voltage of the generators by closing and opening a short circuit around the field rheostat, thus cutting in and out resistance in the field circuit of the generator, the voltage being varied by the length of time the resistance is included in circuit and out of circuit. This operation is made at a high rate of speed, varying from 50 to 800 times per minute. The movement of the contacts which switches in and out the resistance is accomplished by a relay, the motion of the contacts being about 1-16 of an inch.

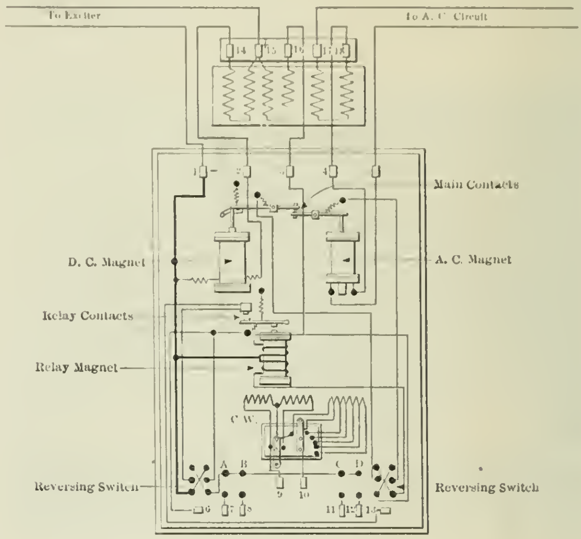
Fig. 1 shows the connections of the direct-current regulator. The magnet on the left is the control magnet, which is connected across the circuit, the voltage of which is to be regulated. A relay is located at the middle of the board. The movement of the contacts of the control magnet causes the relay contacts to open and close. The relay contacts are connected to the terminals of the field rheostat of the generator. When the relay contacts are closed the field rheostat is short-circuited, which cuts out the resistance and so causes the generator to give its highest voltage. When the relay contacts are open, all the resistance of the field rheostat is inserted in the field circuit of the generator and so causes it to give the lowest voltage; thus by rapidly closing and opening the relay contacts the voltage of the generator is maintained at a constant value. This operation is done at about 800 times per minute. A condenser is connected to the relay contacts to prevent injurious sparking. The control magnet is connected by means of pressure wires to the center of distribution. It is stated that a curve drawing voltmeter when connected to a circuit of which the voltage is controlled by one of these regulators, will show a record as straight as if ruled with a straight edge.

The regulator for alternating-current generators controls the voltage by varying the resistance in the field of the exciter. The regulator for the alternating-current generator is similar to the direct-current regulator with the addition of another magnet, which is connected across the exciter circuit. A magnet is connected across the exciter circuit and another magnet is connected across the circuit to be regulated. The alternating-control magnet has two windings, one of which is connected across the circuit to be regulated, and the other is connected to a series transformer. The function of the second winding is to build up the generator voltage in direct proportion to the current in the line and thus compensate for the loss in the line. The compounding effect can be varied by means of two levers swinging over contact points, which cut in or out various turns on the magnet. Once the regulator is adjusted, it will maintain constant potential at a center of distribution without any hand adjustment irrespective of the character of the load. The regulation is not affected by speed changes unless the speed is so low that the voltage could not possibly be maintained. The alternating and direct-current control magnets together operate a pair of contacts known as floating contacts which operate a relay magnet which opens or closes the shunt circuit across the exciter field rheostat as in the direct-current regulator described above. The function of the floating contacts is so to actuate the relay magnet that the voltage is maintained under all conditions of exciter and alternator voltages. These contacts bring together the alternate and direct-current portion of the regulator and control the voltage of both simultaneously. The contacts will usually raise from no load to full load about 3/32 of an inch, while the exciter voltage may vary from 10 to 130 volts in order to maintain the desired alternating voltage.

One regulator will regulate any number of generators of any kilowatt capacity providing they are all running in parallel and the exciters are also in parallel.

The voltage regulators described above are designed to control the voltage of the generators. These regulators may be controlled by pressure wires brought back from a center of distribution, but as the distribution system from a central station is usually laid out for several centers, it is necessary to have means of automatically adjusting the voltage for additional centers of distribution.

For this purpose an automatic feeder regulator for alternating-current generators has been developed. It is usually customary to allow considerable drop in pressure from the central station generator to the incandescent lamp or other translating device. Frequently this drop amounts to 10 per cent. of the initial voltage. With such a drop, which varies according to the load, it is manifestly necessary to adjust frequently the voltage at the central station in order to keep it at a uniform voltage at the center of distribution. At the present time this is generally accomplished by means of hand regulators and therefore it is only imperfectly done. An automatic feeder regulator will do the work much more accurately and more cheaply than an operator with a hand rheostat.



VOLTAGE REGULATION.

The alternating-current feeder regulators have been made in two types, one a booster transformer or the induction type, which is similar to the well-known constant transformer used with series arc lamps, the movement of the coils being accomplished by compressed air operating on a piston and cylinder, the movement of the coil being controlled by a voltmeter. This type of regulator has the advantage of having no contacts, and the voltage can be very gradually varied.

Where a transformer is used in connection with a transmission plant stepping down the voltage from, say, 10,000 to 2,000, a dial switch can be placed upon the transformer. The contacts can be arranged so that a portion of the winding can be cut out; thus the secondary voltage can be varied at will. The movement of the switch arm is controlled by a voltmeter, a motor furnishing the power necessary to move the switch. The voltmeter operates magnetic clutches which apply the power to the switch. The advantage of this type of regulator over the induction type is somewhat lower first cost. The disadvantage is that the voltage has to be varied by different steps depending upon the number of contacts employed. Usually a difference between steps of one volt is used and unless a large number of contacts are provided, which would make the apparatus probably too expensive. A variation of a volt is a little too great for the best work, therefore the induction type regulator has advantages over the dial switch type.

Regulators of the above types have been used in connection with water power transmission plants, as in such cases the drop of pressure in lines is frequently very great and the variation in voltage considerable. There seems to be a large field for the use of such regulators. In some water power transmission plants the variation in voltage at times has been as much as 20 per cent., which gives very unsatisfactory service to the consumers. An installation of these automatic feeder regulators has corrected the trouble and maintained almost constant voltage, so that the service is satisfactory.

Heretofore in trying to overcome troubles from bad voltage regulation attention has been given almost wholly to the question of making water wheels operate within proper speed limits, but such means cannot be made to compensate for line losses, so that it would seem desirable to use automatic feeder regulators rather than to depend wholly on water wheel governors.

At the present time it is almost the universal practice to use separate circuits for lighting and motor work, necessitating large expenditure on the part of the central station management. It has been considered almost impossible to give good lighting service and have an extensive motor service operated from the same mains. With automatic voltage generator regulators and automatic feeder regulators, very satisfactory service can be obtained where lights and motors are operated from the same circuit and several installations have been made where these results have been obtained. This new practice will undoubtedly reduce the cost of outside construction by reducing the number of feeders.

Work of the Carnegie Institution.

The current issue of *Science* contains an official account of the organization of the Carnegie Institution and of its plans to date. Eighteen advisory committees have been appointed, those for engineering and physics being as follows:

Engineering—R. H. Thurston, Director of Sibley College, Cornell University, Ithaca, N. Y., chairman; William H. Burr, Professor of Civil Engineering, Columbia University, New York, N. Y.; George Gibbs, Consulting Engineer, Baldwin Locomotive Works, Philadelphia, Pa.; George S. Morison, Civil Engineer, 49 Wall Street, New York, N. Y.; Charles P. Steinmetz, Electrician, General Electric Company, Schenectady, N. Y.

Physics—R. S. Woodward, Dean of School of Pure Science and Professor of Mechanics and Mathematical Physics, Columbia University, New York, N. Y., chairman; Carl Barus, Professor of Physics, Brown University, Providence, R. I.; A. A. Michelson, Head Professor of Physics, University of Chicago, Chicago, Ill.

After quoting the trust deed, the report says that it is the judgment of the executive committee that the aims enumerated can be best carried into effect under the following principles, which are to be departed from only in very exceptional cases.

The Institution proposes to undertake,

(*A*) To promote original research by systematically sustaining,

(*a*) Projects of broad scope that may lead to the discovery and utilization of new forces for the benefit of man, pursuing each with the greatest possible thoroughness.

(*b*) Projects of minor scope that may fill in gaps in knowledge of particular things or restricted fields of research.

(*c*) Administration of a definite or stated research under a single direction by competent individuals.

(*d*) Appointment of research assistants.

(*B*) To increase facilities for higher education by promoting,

(*a*) Original research in universities and institutions of learning by such means as may be practicable and advisable.

(*b*) The use by advanced students of the opportunities offered for special study and research by the Government Bureaus in Washington.

The Institution does not propose to undertake,

(*a*) To do anything that is being well done by other agencies.

(*b*) To do that which can be better done by other agencies.

(*c*) To enter the field of existing organizations that are properly equipped or are likely to be so equipped.

(*d*) To give aid to individuals or other organizations in order to relieve them of financial responsibilities which they are able to carry, or in order that they may divert funds to other purposes.

(*e*) To enter the field of applied science except in unusual cases.

(*f*) To purchase land or erect buildings for any organization.

(*g*) To aid institutions when it is practicable to accomplish the same result by aiding individuals who may or may not be connected with institutions.

(*h*) To provide for a general or liberal course of education.

The executive committee, keenly realizing the importance of thoroughly investigating and fully considering every proposed action before recommending it to the trustees, have given much time and thought to the subject of organization, and at the several meetings have discussed the suggestions received from individuals and from the advisory committees. It is hoped and expected that the Institution will set a high standard for research. This the committee believes can be best attained and maintained by establishing such laboratories and facilities, not found elsewhere, as are necessary when dealing with problems.

The committee is of the opinion that organization in Washington should be provided for by:

(*a*) Purchasing in the northwestern suburb of the city a tract of ground suitable for present and future needs.

(*b*) Erecting thereon a central administration building, to serve as the administrative headquarters of research work conducted, directed, or aided by the Carnegie Institution.

(*c*) Establishing such laboratories from time to time as may be deemed advisable.

(*d*) Employing the best qualified men that can be secured for carrying on such research work as it may be decided to undertake in Washington.

(*e*) Continuing and developing the present office organization as the Executive Committee may find it necessary to do in order to properly conduct the work of the Institution.

The only organization outside of Washington to be provided for at present should be such advisers and advisory committees as may from time to time be found necessary in connection with the development of the research work of the Institution. It is the opinion of the committee that such persons and committees should be largely advisory and not executive in their function. Executive work should be in charge of paid employees of the Institution. These may be officers, research associates and special employees.

Soon after the Executive Committee began its investigations it became evident that two lines of policy were open, namely:

(*a*) To sustain broad researches and extended explorations that will greatly add to knowledge.

(*b*) To make small grants.

Research may be defined as original investigation in any field, whether in science, literature or art. Its limits coincide with the limits of the knowable. In the field of research the function of the Institution should be organization, the substitution of organized for unorganized effort wherever such combination of effort promises the best results; and the prevention, as far as possible, of needless duplication of work. Hitherto, with few exceptions, research has been a matter of individual enterprise, each worker taking up the special problem which chance or taste led him to and treating it in his own way. No investigator, working single-handed, can at present approach the largest problems in the broadest way thoroughly and systematically.

With an income large enough to enter upon some large projects and a number of minor ones, it appears to be wiser, at the beginning, to make a number of small grants and to thoroughly prepare to take up some of the larger projects. With this in view the Executive Committee recommended to the trustees that there be placed at its disposal for the fiscal year 1902-3, two hundred thousand dollars for aid to special researches in various branches of science, and $40,000 for the publication of the results achieved. During the year plans will be perfected, data secured and experience gained that will be of great service in formulating recommendations for the ensuing year.

In the opinion of the committee, the most effective way to discover and develop the exceptional man is to put promising men upon research work under proper guidance and supervision. Those who do not fulfil their promise will soon drop out, and by the survival of the fittest the exceptionally capable man will appear and be given opportunity to accomplish the best that is in him. When the genius is discovered, provide him with the best equipment that can be obtained.

In making grants the wisest policy appears to be to make them to individuals for a specific purpose rather than to institutions for general purposes.

Under the authority conferred upon it by the trustees at their first meeting, the Executive Committee made three grants, as follows:

March 25, 1902. To the Marine Biological Laboratory, Woods Hole, Mass., for general support	$4,000
April 15, 1902. To Dr. J. McK. Cattell, Columbia University, New York, for preparing a list of the scientific men of the United States.	1,000
April 15, 1902. To Dr. Hideyo Noguchi and Professor Simon Flexner, Philadelphia, Pa., for continuation of their studies of the toxicological actions of snake venom and allied poisons	1,000
Total	$6,000

Since the second meeting of the trustees, on November 25, 1902, the Executive Committee has made the following grants in the several departments of science mentioned. Anthropology, mathematics and other branches will be acted upon later:

Astronomy	$21,000
Bibliography	15,000
Botany	11,700
Chemistry	3,000
Economics	15,000
Engineering	4,500
Exploration	5,000
Geology	12,000
Geophysics	8,500
History	5,000
Investigation of project for southern and solar observatory	5,000
Investigation of project for physical and geophysical laboratories	5,000
Investigation of natural history projects	5,000
Marine biological research	12,500
Paleontology	1,900
Physics	4,000
Physiology	5,000
Psychology	1,600
Publications	5,500
Research assistants	25,000
Student research work in Washington	10,000
Zoology	4,000
Total	$185,200

As a convenient summary of the plans and methods thus far agreed upon the following minute was approved:

The methods of administration of the Carnegie Institution thus far developed are general rather than specific.

The encouragement of any branch of science comes within the possible scope of this foundation, but as the fund, munificent as it is, is inadequate to meet the requests for aid already presented, not to mention others which are foreseen though not yet formulated, attention has been concentrated upon a selection of those objects which, at this time and in our country, seem to require immediate assistance.

Efforts have been and will be made to secure co-operation with other agencies established for the advancement of knowledge, while care will be exercised to refrain from interference or rivalry with them. Accordingly, ground already occupied will be avoided. For example, if medical research is provided for by other agencies, as it appears to be, the Carnegie Institution will not enter that field. Systematic education, abundantly provided for in this country by universities, colleges, professional schools, and schools of technology, will not be undertaken. Nor will the assistance of meritorious students in the early stages of their studies come within the scope of this foundation. Sites or buildings for other institutions will not be provided.

Specific grants have been and will be made, for definite purposes, to individual investigators, young or old, of marked ability, and for assistance, books, instruments, apparatus and materials. It is understood that such purchases are the property of the Carnegie Institution and subject to its control. The persons thus aided will be expected to report upon the methods followed and the results obtained. In the publication of results it is expected that the writer will say that he was aided by the Carnegie Institution of Washington, unless it be requested that this fact be not made known.

In order to carry out the founder's instructions in respect to bringing to Washington highly qualified persons who wish to profit by the opportunities for observation and research afforded by the various scientific bureaus of the United States Government, a certain sum is set apart for this purpose.

In addition, the Carnegie Institution will appoint from time to time a number of persons to be known as research assistants, who may or may not reside in Washington, and who shall undertake to carry on such special investigation as may be entrusted to them by the Institution. The appointments will be made for a year, and may be renewed in any case where it seems desirable. Permission may be given to go abroad, if special advantages not accessible in this country can thus be secured.

Publication is regarded by the founder as of special importance. Accordingly, appropriations will be made for this purpose, especially for the printing of papers of acknowledged importance, so abstruse, so extended or so costly that without the aid of this fund they may not see the light.

With respect to certain large undertakings involving much expense, which have been or may be suggested, careful preliminary inquiries have been and will be made.

In order to secure the counsel of experts in various departments of knowledge, special advisers have been and will be invited from time to time for consultation. Valuable suggestions and counsel have already been received from such advisers.

George Westinghouse in London.

At Claridge's Hotel in London, one night last month, Mr. George Westinghouse entertained at dinner a large company of British railway managers, financiers and scientists. Two speeches were made of unique interest. One of these was by Lord Kelvin, the other by the host of the occasion.

Lord Kelvin said: "At this dinner of friends I would like to express a common sentiment which all must feel, our appreciation of the qualities of our charming and beloved host, Mr. Westinghouse. I am sure that Mr. Westinghouse's coming to England reminds us all of the advantages that England has derived from his genius and perseverance and grand skill in bringing out for the public good so many of the results of science and inventiveness. There are many railway men present at this table, and many passengers by railways—which means that every inhabitant of our country is represented here. When people belonging to these two classes—the railway men and the traveling public of Great Britain are gathered together as now, we can scarcely see Mr. Westinghouse without feeling how much we owe to him for the Westinghouse brake. (Applause.) But Mr. Westinghouse has not stopped with his brake; he has gone on and on and on, in America, flashing over again on this side of the Atlantic, and bringing his energies here. The present development of the electric industry in the United Kingdom owes its growth largely to him. 'Largely' is a small word to express how much we owe to him. I do not wish to enter into any comparisons or superlatives, but I do not think any man in the world of engineering could be named to whom more is due than to Mr. Westinghouse for his work in electric engineering.

"Other things besides mechanical engineering and electrical engineering we owe to Mr. Westinghouse. We owe to him the bringing to England and causing to be appreciated in England, American methods—American methods in a certain way, which I may refer to without invidious comparison; American methods of industry, and resolution and determination—which are also English methods, because they have been inherited from England. (Applause.) Here it comes back to us, with compound interest, in the shape of Mr. Westinghouse, and I am sure that we all feel that we are largely indebted to him for what he has done for us, what he is doing for us, and in advance, for what he is planning to do for us in the future. We appreciate all this, and we appreciate him as a kind friend, a genial host and entertainer. I ask you to join me in drinking the health of Mr. George Westinghouse."

The toast having been honored with enthusiasm, Mr. Westinghouse rose to respond. He said: "I wish to thank our distinguished scientific friend, Lord Kelvin, for the complimentary language he has used about me. And I would like to say to all you railway men here present, that my life has been very much associated with your calling. I invented the brake, of which Lord Kelvin has spoken, when I was scarcely twenty-one years old, and thus became acquainted with railway men when the railway industry was rather a poor one compared with what it is to-day. Since then I have closely followed railway operations, becoming acquainted with almost everything that is being done in them, and it is particularly my friendship with railway men which has prompted me to go forward in my work with an interest and keenness that probably would not have resulted from ordinary commercial motives.

"Lord Kelvin has been good enough to refer to my coming to this country. I came here thirty years ago, and for ten years or so I was here about half the time. At that time it was very difficult to get any new thing done in England. I often wanted to sit down and cry, because I could not get anyone to believe in anything. (Laughter.) I wanted in those early days to try an iron brake shoe, because, on account of rapid wear we couldn't keep the wooden one adjusted. I had to beg and beg to be permitted to put a set of metal brake shoes on one tender on the Caledonian Railway. Finally I succeeded. You all know that nowadays all the railway shoes or blocks are made of cast iron or other metal and are used upon all the wheels of the train.

"Lord Kelvin has alluded to 'American methods.' May I say that one of your English difficulties is inherent, I think, in an old-world, highly-developed country. After a man (or a nation) has worked prosperously for a long time, he opposes improvement or suggestion, thinking, 'What I have is good enough—I won't try a new thing.' In America, however, the necessities have produced different results. Lord Kelvin speaks of England having sent many men to America. It has also sent to us many ideas. If you take up the American patent records and follow the cases in litigation especially you will find that among the references cited many are of English origin, some of them containing ideas so complete, the wonder is that the inventions disclosed were not established fully and completely in your own land. These records seem to show that Americans and Englishmen have invented the same thing many times.

Mr. George Westinghouse. Lord Kelvin. Mr. Chas. Merz.

WATCHING A TEST OF HEWITT CONVERTER.

(Taken by Light of a Hewitt Mercury Vapor Tube.)

"In America, however, we have always been short-handed with regard to labor. We have been obliged to find methods whereby one man may accomplish the work of two or three men as compared with your practice here. We have had the best men from Europe—Englishmen, Germans, French, everybody—skilled men, highly trained men, as well as laboring men; we have combined their experience with our own, coupled it with our necessities, and have thus accomplished results unattainable in a country like this, where you have more labor than you can well keep employed.

"As an illustration of what has been accomplished by the use of electricity in a great industry, I may cite the Homestead Mills of the Carnegie Company. Mr. Schwab, whose name is well known to you, is a genius in his way, particularly in the management of men; he is a master in organizing and directing men. Mr. Carnegie believed in him, and if Mr. Schwab made a suggestion in regard to the use of new appliances, even if it involved the tearing down of an old mill and putting up a new one, the new one was ordered. What Mr. Schwab thought should be done was done. As a result of such progressiveness we may see the splendid mills at Homestead, where they produce with about 4,000 men three times as much steel as the Krupp works produce with 15,000 men. The results are simply wonderful. You can start there to-day, in a building containing steel-melting furnaces, and you will there see three men mounted on a car with the charging apparatus which is moved and operated by electricity. With a few movements of this ingenious contrivance three men charge twenty furnaces, which, prior to the use of electricity, would have required the labor of over 200 men.

"You may go into the yards of the Homestead mills where they pile the metal in stock. This yard is covered by a system of overhead cranes, and the result is that not only here, but in the mill, and in every other place, you may see great weights lifted and many undertakings going on without a single man exerting himself a bit—working not half as hard as I am working now. (Laughter.)

"I took some English friends to Homestead. Mr. Schwab, after guiding us through several departments, said: 'I will now show you where we turn out 750 tons of plate girders per day.' The mill was in the shape of an L. We went into the short end of the L, where the furnaces were fed by natural gas, of course requiring no stokers. The end at which we entered had a rather low roof, and there was in sight a contrivance like a battering ram in front of the furnaces; two workmen were sitting down eating their dinners near by; no one else was present. I thought: 'Mr. Schwab has made a mistake; he has asked us to see a mill that is not in operation.' But we went through this mill, which was about 200 feet long, and suddenly we heard a rattle and then saw a truck approaching loaded with a big ingot. No one touched the truck or the ingot. The load came to a platform, the crane overhead dropped a pair of tongs and quickly put the ingot on the roller table, and as it moved along to the great rolls, it was automatically kept in place. The adjusting screws of the rolls were turned by little electric motors, and not a man in that house did a bit of work. It was just as easy as what you are doing now—looking on! (Laughter.) We went back to the furnaces. There was a fifteen-year-old boy seated in a little place called the 'pulpit.' He was able, merely by the movement of levers, to open at will any of the furnace doors, and move the car along. And we saw this car come in front of a furnace and the charging machine approach and take out of the open furnace a hot ingot, which was dropped on the car and moved off to its work. There was this boy doing absolutely no hard work, and his mill was turning out 750 tons of steel plate each day. My English friends said: 'England has no chance in competition with such methods.'

"Now, all this sort of thing came about in America because of our necessities. We hadn't men enough to do our work. There was a premium in favor of those who could invent machines to work and thus supply the deficiency.

"At the Carnegie mills we went to see three blast furnaces. They were making 1,800 tons of pig-iron in twenty-four hours. We saw only two or three men on a truck, which was moved automatically. These men were letting the ore run from shoots and mixing it in the required quantity, and when they had filled a truck, it was carried up and its contents dumped into a furnace whence it returned for another load. They were running the metal into an immense receptacle into which the metal from all three furnaces was mixed. From this place the metal was taken as required, put into a special tank, mounted on a car and taken to Homestead, two or three miles away, to be poured into the furnaces; one heating only was required.

"I refer to all this simply to illustrate the immense advantages we have had in America, and the kind of experience I have been able to bring to this country, and to which Lord Kelvin so generously alluded, and which I hope will be not only useful and profitable, but will establish for the company I represent a name and a position which you will all regard as most satisfactory. (Applause.)

"I want to thank you very sincerely for the kind expressions with which you have greeted me, and especially for your acceptance of my invitation to inspect this evening a couple of inventions, one of which—the Hewitt mercury vapor lamp—is a complete and accomplished thing. The rays of this light are not very pleasant as yet, but the light is likely, however, to be of great value. The other invention—the Hewitt static converter—is quite new, and its object is to convert alternating currents into direct current at so low a cost in comparison with the sums which have heretofore been expended for equivalent results, that it is likely, when fully perfected, to cause an immense stimulus in regard to the use of electricity in all parts of England, and particularly in the agricultural parts of the country, for farm work, and for moving all kinds of vehicles.

"I have taken advantage of these inventions to invite you to see them as my guests, and I thank you for having honored me with your presence to-night."

Wireless Telegraphy Lecture Apparatus.

We illustrate herewith the apparatus used by Mr A. Frederick Collins in his lectures on wireless telegraphy During the present season Mr. Collins has delivered about twenty lectures, including one before the New York Electrical Society and one before the Brooklyn Institute of Arts and Sciences.

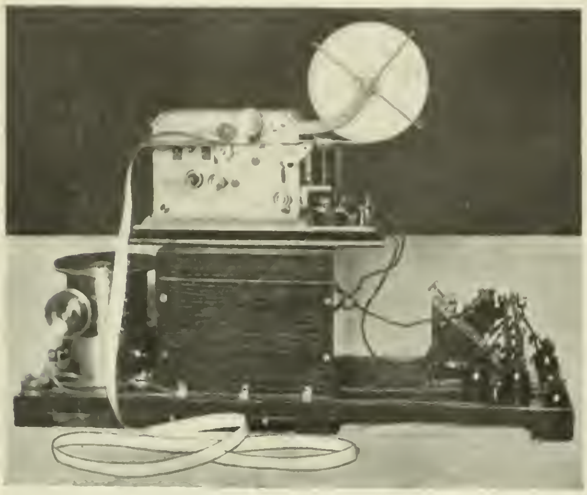


FIG. 1.—WIRELESS TELEGRAPH RECEIVER.

The receiver (Fig. 1), which was presented to Mr Collins by the Marconi Wireless Telegraph Company of America, is of the same type as that regularly employed by Mr. Marconi for his long-distance tests. The relay is so sensitive that by closing the circuit through the medium of the body it will respond, whilst the sensitiveness of the coherer is so great that for experimental demonstrations the slightest sparks of a direct current is more than sufficient to operate it, and the antennæ and artificial earths must be cut out entirely to avoid jamming.

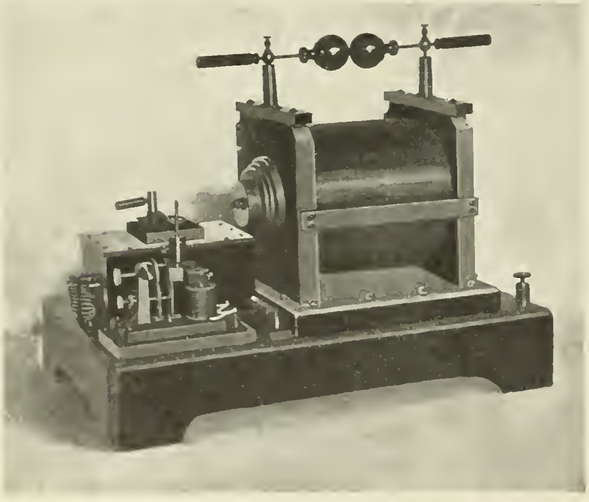


FIG. 2.—WIRELESS TELEGRAPH TRANSMITTER.

The coil shown in Fig. 2 has all the latest improvements, including an interlocking switch, an adjustable condenser and an independent vibrator.

The complete equipment is capable of sending and receiving messages a distance of fifty miles in actual practice, whilst the receiver in connection with a transmitter of greater power will respond to a correspondingly greater distance.

Points in the New German Tariff.

Mr Frank H. Mason, the energetic and efficient U. S. Consul-General at Berlin, has forwarded the State Department an interesting digest of the new German tariff act, in regard to which he says: The tariff act which, after the longest and most momentous struggle in German legislative annals, passed the Reichstag during an all-night session on December 13-14, was immediately thereafter confirmed by the Bundesrath and became a law of the Empire. The imperial decree followed, announcing its enactment, defining the classes of articles that are to be duty free, and declaring that the date at which the new tariff law would become operative will be announced hereafter. When this will be will depend mainly upon the time that will be necessarily occupied in negotiating new commercial treaties with the several nations with which Germany has had such treaties during the past ten years, which conventions must now be revised and agreed to on the wholly novel basis which will be established by the new tariff. How long this will require is as yet a matter of conjecture, but it is generally thought that the treaty negotiations will occupy from twelve to eighteen months, which would bring the tariff law of December, 1902, into force somewhere between January and July, 1904. The law as finally enacted was, with a few more or less important changes, practically identical with the bill originally proposed by the Imperial Government and first officially published on July 26, 1901. It is essentially of "agrarian" character, i. e., the agricultural classes or interests are favored with duties highly protective of the products of the farm and field.

Subjoined is data in regard to electrical and allied apparatus that is affected:

		Marks.
Electrical machinery, viz., dynamos, electric motors, converters, transformers, etc., for machines:		
Under 500 kilograms (1,102 pounds)	per 100 kilograms	9.00=$2.14
500 to 3,000 kilograms (1,102 to 6,614 pounds)	do..	7.00= 1.66
More than 3,000 kilograms (6,614 pounds) in weight	do..	6.00= 1.42
Machine tools for working metals, wood, or stone, steam and hydraulic presses, welding machines, mechanical hammers:		
250 kilograms (551 pounds) in weight	per 100 kilograms	20.00= 4.76
250 to 1,000 kilograms (551 to 2,205 pounds)	do..	12.00= 2.85
1,000 to 3,000 kilograms (2,205 to 6,614 pounds)	do..	8.00= 1.90
3,000 to 10,000 kilograms (6,614 to 22,046 pounds)	do..	6.00= 1.42
Over 10,000 kilograms (22,046 pounds)	do..	4.00= .97

Steam engines, turbines, gas and caloric engines, blowing machinery, pumps, portable cranes, pile drivers and power hammers, ice machinery, etc., range from a rate of $23.80 per 100 kilograms (220.4 pounds) for machines weighing less than 40 kilograms (88 pounds) each to $4.28 for machines between one and two tons in weight, and so on down to 83 cents per 100 kilograms for machinery weighing more than 100 tons each. Under the same interpretation, the following items appear, but not very clearly:

	Marks.
Telegraphic instruments, telephones, electrical lighting and power transmission apparatus, electrical measuring instruments, etc.	60.00=$14.28
Motor, railway, and street cars	10.00= 2.38
Freight cars, open and covered	5.00= 1.19
Passenger cars:	
Not upholstered	7.50= 1.78
Upholstered	12.00= 2.85

Under the new tariff most raw materials, including copper, lead and aluminum, remain free of duty.

The general subject now enters upon its final and, in some respects, most complicated phase—that of the negotiation of a new set of commercial treaties based on the revised tariff. During the final debate on the bill of the Reichstag, it was promised that the Government would undertake, before making new conventions, a thorough revision of all existing treaties which contain the most-favored-nation clause. As a reason for this, it was stated that the United States has introduced in practice a modified interpretation of that clause which renders it inadvisable for Germany to concede most-favored-nation privileges to any countries except those with whom new and special arrangements will be made.

United States Navy Tests of Wireless Telegraphy.

Official tests by the United States Naval Board of Wireless Telegraph examiners of the De Forest system between the Naval Academy, Annapolis, and the Washington Navy Yard, were recently concluded.

These two stations are separated by thirty-six miles entirely overland, consisting of rough, hilly country heavily wooded. German and French wireless telegraph engineers who have essayed to cover this distance have pronounced it equal to 180 or 200 miles over salt water. The Slaby-Arco and Braun German systems and the Ducretet and Rochefort systems from France have all been tried over this range. Though exhaustive experiments were made, the Slaby-Arco system was, it is said, the only foreign system which was able to transmit intelligible messages, and this only after careful tuning of the two sets of instruments. The De Forest apparatus was in use by the Naval Board three weeks, and no difficulty whatever was experienced in covering the distance from the start. No tuning whatever was required. This results from the extreme sensitiveness of the De Forest receiver and the positive and powerful action of the transmitter employed.

The De Forest anti-coherer, being a current-operated device, is best placed at a current loop or static node, that is, at the base of the antenna, which, it is said, accounts for its operating where the coherer, or potential-operative device, is uninfluenced. Inasmuch as the attaching of an earth connection to one side of the receiver compels a static node there, it was found that signals continued to be received, even when a length of wire, inductive or non-inductive, was inserted between it and the base of the antenna, even when this length amounted to that of the antenna, or more.

U. S. NAVAL WIRELESS TELEGRAPH STATION.

At Annapolis and Washington the Navy Department has masts 180 feet in height. From these hung a fan of five wires, of an average length of 200 feet. The ground connections consisted of two copper plates, 2 x 6 feet each, buried 6 feet below the surface. During the tests an officially recorded speed of 35 words the minute was maintained, and many of the test dispatches were in the Navy Code. Press dispatches were continually exchanged, and the value of "wireless" as a news transmitting medium was interestingly demonstrated when, after the runaway accident to Secretary of the Navy, Moody, at Annapolis, the De Forest operators at Washington had the news to the press and the Navy Department full thirty minutes before it was known by telephone or telegraph.

As a result of the tests the Navy Department has placed a contract for twelve sets with the American De Forest Wireless Telegraph Company. Sea tests of the system will be undertaken in March, upon the arrival of the cruiser *Prairie* from the Caribbean. The De Forest Company is now erecting at Cape Hatteras a 175-foot tower and a 5-hp outfit for communicating with vessels, and with Block Island, 300 miles distant. At the latter point a similar plant is under construction by the *Providence Journal* for commercial purposes. Other stations are now under way by the De Forest Company in Porto Rico. Orders have been placed by the De Forest Company, representing a total of 180 kw for four stations for trans-Pacific communication, to be located in Lower California, Hawaii, Philippines and China; and during the recent naval tests Dr. De Forest sent the following dispatch from Annapolis to President Roosevelt: "I have the honor to send you the first greetings by an American wireless telegraph system from Annapolis Naval Academy to Washington, with the conviction that within eighteen months we shall do the same from Manila, via Hawaii to California."

Sound Condition of General Electric Finances.

What seems to be a very close forecast of the General Electric annual figures, or what is at least an excellent analysis of the company's condition appears through financial channels, and is well worthy of note.

An indication of the growth of the company's business may be found in the following statement of sales and orders:

	Amounts billed.	Orders rec'd.
1898	$12,396,093	$14,382,342
1899	15,679,430	17,431,327
1900	22,379,463	26,323,626
1901	28,783,275	27,969,541
1902	32,338,036	34,350,840

As compared with five years ago, therefore, the company's business has risen $20,000,000 a year. It is worth noting, moreover, that on a similar basis of accounting, the amounts billed in 1902 would have been over $34,000,000, or almost $22,000,000 more than in 1898.

Excluding strictly capital items, assets and liabilities compare as follows as of January 31, 1897, and January 31, 1902:

Assets:	1897.	1902.
Stocks and bonds	$8,545,795	$9,825,120
Cash	703,483	4,058,448
Receivables	4,578,600	11,364,345
Work in progress	517,866	1,338,258
Inventories	4,034,753	8,876,883
Total current assets	$18,380,497	$35,463,055
Less various liabilities	468,931	1,357,211
Net working capital	$17,911,566	$34,105,844

In the five years there has been, therefore, a net gain of over $16,000,000 in the working capital. Every dollar of this has come from earnings, as nothing has been raised by the sale of capital stock or bonds. The working capital test is regarded as extremely satisfactory in the case of General Electric.

It is further to be noted that on January 31, 1902, the company's plants, patents, etc., were carried in its balance sheet at a total valuation of $6,000,000. In addition it had real estate amounting to $464,195. On January 31, 1897, the company's patents, plants, franchises, etc., and real estate were carried at $12,043,018. Thus, in the five years, the company has written $6,000,000 off the value of its plants, patents etc., as they stand on the books. But, in addition to this, it has also written off all improvements, enlargements, etc., made during that time. These have amounted to the following sums:

1899	$1,167,179
1900	1,683,762
1901	2,531,838
1902	1,583,655
Total four years	$6,966,434

These amounts are in addition to the ordinary expenditures for repairs, renewals, replacements, and maintenance of all kinds.

The General Electric Company has now outstanding $42,031,600 of stock and about $2,000,000 of debentures issued for the purchase of Sprague Electric stocks. It is reckoned that the earnings for the year ended January 31 will be equal to at least 20 per cent. on the company's stock.

New York Electrical Society at the Edison Station.

The members of the New York Electrical Society mustered 250 strong at the 231st meeting of the society, held January 29, to inspect the magnificent new Waterside Station of the New York Edison Company. The arrangements for the disposal of the guests were so admirably made that each of the visitors, placed in charge of a special guide, was able to cover all the salient points of the station. The building, which covers the block between Thirty-eighth and Thirty-ninth Streets, First Avenue and East River, is approximately 272 ft. long by 197 ft. in width. The plant has been very fully illustrated and described in these pages. The boiler room on the north side of the building is 70 ft. wide, the operating room occupying the remainder of the building. The boilers, of which there are 56, are arranged in two tiers. They are of the B. & W. water tube type, rated at 650 hp. Each boiler contains 294 four-in. tubes, and has a heating surface of 6,500 sq. ft. The feed water passes first through primary heaters, of the induction type, located on the engines, which raises the temperature to about 120°, and thence it runs into storage tanks, into which also empty the drips from the live steam piping, engine re-heaters, etc. The feed pumps draw from this tank and force the water through the secondary heaters into the boilers.

The plans call for sixteen generating units in the operating room; eight of these are now installed complete. The engines were built by the Westinghouse Machine Company, and are of the three-cylinder, compound, marine type, having a nominal capacity of about 8,000 hp each. The fly wheel is 23 ft. in diameter and weighs 60 tons. The three cranks are set at angles of 101°, 133° and 126° in order to give as near uniform angular velocity as is possible. Each engine is provided with an individual surface condenser, containing 9,200 sq. ft. of cooling surface. The air and circulating pumps are operated by a 16 x 24 Corliss steam cylinder with positively driven valves, the speed being controlled by a throttle governor. The eight generators already installed are of General Electric make, 3-phase, 25-cycle, 40-pole, 6,600 volts, and have a capacity of 3,500 kw, normal or will carry 4,700 kw for three hours. The revolving field has a diameter of 16 ft. 8 in. and weighs 13,000 pounds. The armature is built up of laminated steel, the coils being secured in the slots by dove-tailed wedges. There are 240 slots, that is, 2 per phase per pole. The field current is supplied by three motor generator sets. The motors are 225 hp, 6,600 volts, of the induction type, with squirrel-cage armatures and are directly connected to 150-kw, 150-volt, direct-current generators, the unit running at 500 r.p.m. In addition to these exciters, a storage battery capable of supplying current to the fields of sixteen generators for one hour is always connected to the field-charging bus. The energy required by the field of each generator at normal load is about 120 amperes at 175 volts.

The three main cables (500,000 cm) from each generator, together with the field cables and controlling wire cables, are run on brackets in the run-way to the basement of the switch galleries; from there they run up through individual ducts to the main generator switches, and from thence through the selector switches to the two buses. All switches are of the oil break compartment type operated by electric motors. The switches controlling these motors and all other instruments and apparatus used in connection with the generators, are mounted on the pedestals and panels on the third gallery. As each generator has a separate pedestal, it minimizes the chances of errors. Directly back of the generator pedestals are the panels containing the controlling switches and instruments for the feeders, of which there will be 40. Twenty-six of these are now installed. Each feeder has two oil switches in series, one of which is controlled by an automatic overload and time-limit relay. These switches are located in the lower galleries. There are two sets of high-tension bus-bars, to either of which any generator or any feeder can be connected. These are located in the bus chamber back of operating gallery.

At the close of the inspection, superintended by Messrs. John Lieb and Arthur Williams, a supper was given to the members of the society, and a vote of thanks was tendered to the company for its courtesy and hospitality. The evening was one of great enjoyment and success.

Telephony in Brazil.

The Brazilian Government has authorized the construction of a telephone line between Rio Janeiro and Santos.

A Lecture on Business Automobiles.

An extremely able and forcible lecture was delivered at the Automobile Club of America on Tuesday, January 27, by Mr. Hayden Eames, of the Westinghouse automobile department, on progress in the introduction of business automobiles. Mr. Eames has been in closest contact with the art for several years past and his utterances have an authority of no slight weight. The electric vehicle was considered almost exclusively and the statement was made that almost the only obstacle to the progress of the electric business vehicle is that many business men will not subject a motor vehicle to a test under the same conditions of operation as their horse-drawn vehicles work, but will insist upon impractical requirements regarding mileage, etc. It was stated that careful experiments by a leading firm of makers of electrical vehicles which were made in this city and vicinity showed the most difficult route in the entire city, which, as operated by a local express company, required three wagons and twenty one horses, to be eleven miles in extent, extending from the Grand Central Station to a point in Brooklyn. This route could be covered by a single motor vehicle at much less expense, the annual saving being sufficient to pay for a charging plant at both ends.

Another interesting comparison was made from actual results of a year's trial of an electric vehicle for express work in Pittsburg, where the annual expense was $1,998, as against $3,469.40 for horse service, showing an annual difference of $1,471.40. This data has already been very fully discussed in our columns by Mr. Eames. Mr. Eames also said he knew of two cases where orders for 900 electric vehicles had been given, one for 700, and the other for 200, neither of which could be filled.

In moving a vote of thanks on behalf of the club, Mr. T. C. Martin expressed the conviction that the topic under consideration was one of the most important that automobilists could discuss. The bicycle had ceased altogether to be a luxury or a fad. It had shrunk to the proportions of necessity, and was more or less a beast of burden. To-day saw the boom of the "auto," but he believed that while there was a larger future for the pleasure automobile than for the bicycle, the boom and the profits would shrink; and then, in time, automobile builders would find their largest opportunity in business vehicles. Of this class he considered that the electric in cities had the brightest prospects, and as supplementing Mr. Eames' figures he pointed out that the cost of electric service was always and steadily diminishing. In fact, about the only two things in the last two years that were cheaper in New York City were electric current from the Edison mains and telephone service. As for gasoline, there was little reason to expect that to get cheaper; and he hardly thought steam was in the race at all.

To Develop Trolley Systems in Holland.

At a meeting of the Netherlands Tramways Corporation, recently organized under the laws of the State of Connecticut for the purpose of acquiring and building electric railways in Holland, the following directors were elected: Henry J. Pierce, W. Caryl Ely, Charles W. Goodyear and Pendennis White, of Buffalo; William B. Rankine, of Niagara Falls; G. L. Boissevain, F. S. Smithers, N. W. Halsey, J. G. White, and James M. Edwards, of New York, and M. J. Boissevain, of Amsterdam, Holland. Officers elected were: President, Henry J. Pierce; vice-president, G. L. Boissevain; secretary, W. Paxton Little; treasurer, Edwin Henderson.

The Netherlands Tramways Corporation, capital $3,500,000, has been formed to purchase street railroads and to build electric lines. It has purchased all the street railroads in the city of Haarlem, consisting of part horse and part electric lines, and will equip the former with electricity. It has also purchased a road running from Haarlem five and one-half miles to Zandwort, on the North Sea, the second largest Dutch seaside resort. Franchises have been obtained, through F. Anderheggen, Jr., and L. J. Neumeyer, of Amsterdam, and contracts let to J. G. White & Co. for the building of a double-track electric railroad to run from the center of the city of Amsterdam to Haarlem, a distance of twelve miles. This road, which will be known as the Electrische Spoorweg Maatschappy, will probably be completed early in 1904.

New Telephone Patents.

Two patents of the issue of January 20, of interest to the telephone field remain for consideration. These both relate to protective devices and with the two telephone patents of the Patent Office issue of January 27, form the basis of the present notice.

Of the protective devices, the first is described in a patent granted to T. E. Scantlin, of Lafayette, Ind. This protector is of the "sneak-current" type, which is to say that the mass of material in it is made so large that the time element becomes a considerable factor in determining the operation. In this protector, as was the case with a somewhat similar device noted in these columns a few weeks since, a high resistance medium, such as carbon, is inserted in the circuit so that any excessive current will evolve sufficient heat to melt a fusible cement normally holding the parts together. The essential novelty of the present device lies in the use of the high resistance material in granular form, the granules being either in a closed chamber having terminals soldered on with fusible metal, or held together in a block by cement having a low melting point. Fig. 1 shows sectional views of three designs for this arrester.

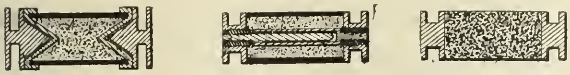


FIG. 1.—SCANTLIN THERMAL CUT-OUT.

The second protective device is the invention of Mr. Joseph Sachs. This device is a combination safety fuse, "sneak-current" fuse, and lightning arrester, all disposed in and around a shell of fiber giving the general appearance of the regular enclosed fuse of to-day. Fig. 2 shows a sectional view of the arrester. At the right the fuse proper appears extending about two-thirds through the enclosing tube. In practice this portion of the tube receives the usual asbestos packing. At the left, a sliding terminal controlled by a spiral spring is arranged. Between these two units, a high-resistance carbon rod is placed. This carries metal terminals and is held in position by easily fusible solder. The main circuit passes from end terminal to end terminal, a "tell-tale" circuit being arranged as shown. The lightning arrester is formed about the outside of the tube by concentric-metallic rings, the one connected to line as shown, and the other to ground, these rings being separated by a perforated mica space ring.

Of the two patents of the January 27 issue, both are the work of German inventors. The first is called a line tapper and consists of a telescoping, hollow, metallic rod having a hook at the upper end and a self-winding reel at the lower end. Within the rod an insulated flexible conductor is placed, held taut by the tension of the spring in the reel, about which the conductor is wound. The flexible conductor carries a hook and by proper manipulation the hooks of this and that of the rod may be caught about the wires of a line which is to be tapped, that line thereby being extended to within convenient reach at the base of the rod. When the rod is closed, the reel winds up the slack and draws the hook of the flexible conductor into a socket. Christian Dietz, of Munich, is the inventor.

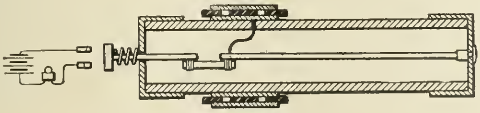


FIG. 2.—SACHS COMBINATION FUSE AND LIGHTNING ARRESTER.

The second patent is granted to W. Höhne, and provides for a "speaking-tube" telephone system wherein the wiring is so arranged that if, after a call, any subscriber fails to bring his switching mechanism to the normal position, no interference with the service will result. This is accomplished by interposing a self restoring switch between the regular switching mechanism at each station and the telephone instruments, which switch at any station must be manually depressed during all conversations originated at that station. Thus, the labor of holding the switch falls upon the station making the call and not upon the one receiving it. It is hardly probable that such an arrangement will appeal to Americans, and if tried here it would be interesting to note how long it would be before ingenious users would hold the switch by pegs of wood or other "labor-saving" devices in a manner to defeat the especial object of the system.

Electric Power and Floods.

The conservation of forests and water supply is coming to attract more and more attention. In its first annual report the New York State Water Storage Commission says the damage resulting from floods in New York State during 1902 aggregated more than $3,000,000. The commission is of the opinion that most of the important streams can be regulated by storing their flood waters in reservoirs on the streams themselves or their tributaries at moderate cost. This work, it thinks, should be intrusted to a permanent commission, with power to assess upon beneficiaries costs of remedial work.

"The time has arrived in the State," the commission says, "when the continued denudation of forests has intensified freshet conditions, when electrical progress has rendered power in small units economically available long distances from interior sources of generation by water power, and when the sanitary requirements of increasing urban population, the demand for draining marshes and the increased development of internal water communication render mill acts in use in other States inadequate, and demand that we take an advanced position in this matter of river regulation."

At the St. Louis Exposition, the government officials will show a miniature irrigation system, and they have selected that of the San Antonio Company, of California, which carries on both power and irrigation work from the San Antonio River. The river has that characteristic of mountain torrents, a heavy fall, and it was necessary to conduct the water but a comparatively little distance in a ditch around the foothills to a point where it would have a drop of 700 feet to the power house. The volume of water is such that, estimating on the lowest flow of water ever known, the minimum of power to be developed is estimated at 400 hp, while the maximum is estimated at about 1,200 hp. Even the smaller amount is sufficient to pump all the wells, light the houses and streets of the colony and meet such demands for power as now exist.

The fact that the electric plant, as well as the irrigation system, is owned by the land owners of the colony gives to the entire system what is practically public ownership. It is the electric plant which differentiates the Ontario system from other irrigation systems of the West, and which has led the government officials to select it as a model which should be followed wherever it is practicable to work on the same lines.

Municipal Ownership at Hagerstown, Md.

We find the following gloomy view of the local municipal situation in the *Hagerstown Morning Herald*: "The deplorable condition of the city finances is a matter of extreme regret to every citizen and taxpayer. The municipal lighting plant shows a condition bordering on bankruptcy. It is difficult to imagine what has brought matters to such a pass when the recent statement of the Street Commissioners places the cost of street lighting at $56 per lamp. The balance of unpaid bills amounts to the startling sum of $3,900. The levy for street lighting was 9 cents on the $100, but at the time the levy was made Mayor Holzapfel insisted that it was insufficient to meet the needs, as a number of bills for the previous year were pigeon-holed and had to be paid out of this year's levy. He took the view that the street lights were costing considerably more than the commissioners contended. His statement placed their cost at $104 each. The trifle of taxes yet to be collected gives no hope of relief from this distressing condition and the taxpayers and property owners might just as well make up their minds to pay a decidedly higher tax rate next year. The deficit will have to be met and the rates placed sufficiently high to meet the current needs as well. As the increase will be entirely for electric lighting, the cost of the investment to the town will be no trifle. The city authorities have a grave problem to face, and it will tax their brains and ingenuity to cope with the situation. They will, it is hoped, confer and act wisely. They must find some method by which the city plant can be made less expensive, but, of course, with an eye to the well-being of the works and system, so that when the annual report is made conditions will be brighter and more encouraging."

Sale of Richmond, Va., Independent Telephone Company.

The property of the Richmond Telephone Company has been sold to Warner Moore & Co., who are said to be acting for the Bell Telephone Company. In its petition to the common council for permission to transfer its property to the Southern Bell Telephone Company, and to be released from its obligations to the city under its ordinance, the Richmond Company stated that it had ascertained that public opinion was emphatically in favor of only one telephone system, and that as it is now required to put its wires under ground, to continue its system at its present rates would entail upon it an increased loss. President Maupin, of the Richmond Company, said that the loss suffered by the proposed sale would amount to $60,000. Mr Warner Moore, the principal holder of the company's stock and bonds, addressing the common council, said that every resource had been exhausted in the hope of interesting additional capital, but he did not think the company could be made to pay, and that the concern, notwithstanding the use of the most up-to-date equipment, had lost all but 750 of its subscribers, and that a number of these had given orders for the removal of their telephones.

Telephone News Service.

The *Philadelphia North American* announces that it has through an arrangement with the Bell Telephone Company, commenced a daily telephone service of about 100 words which will be distributed by the telephone lines about 6 o'clock in the evening to a large number of points in Pennsylvania, New Jersey, Delaware and Maryland.

CURRENT NEWS AND NOTES.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The annual meeting of the American Electro-Chemical Society will be held in New York City, April 16 to 18.

THANKS FROM CONGRESS.—Senator Hoar has introduced a concurrent resolution tendering the thanks of Congress to Signor Marconi for the great benefit he has done to mankind by the invention of the wireless telegraph. Morse had to go through a good deal of this sort of thing in his time.

AMERICAN CHAMBER OF BERLIN.—At Berlin on January 29, the long-projected American Chamber of Commerce was formally founded at a meeting of the organizers under the chairmanship of Mr. Frank H. Mason, the active and efficient American Consul-General. Mr. Hermann Kreismann, an American ex-Consul, who was appointed by President Lincoln, was nominated as the first president. A hundred members were enrolled.

NEW YORK CENTRAL ELECTRICAL COMMISSION.—The New York Central Railway Company has announced that the matter of the electrical equipment of its lines in New York City and vicinity will be in charge of a commission consisting of Messrs. B. J. Arnold, Frank J. Sprague, George Gibbs and W. J. Wilgus, fifth vice-president of the New York Central Company. The electrical and mechanical force which will carry out the work under the direction of the commission will be in charge of Mr. Edwin B. Katte as electrical engineer.

ITALIAN HONORS FOR MARCONI.—A cable dispatch from Rome of January 29 says: In the Chamber of Deputies to-day Signor Frascara moved the order of the day eulogizing Signor Marconi, whose achievements were described as conferring fresh glory on Italy. Signor Batolli, in supporting the motion, moved that the order should mention Marconi in connection with the names of Galileo, Ferraris and Pacinotti. This evoked cheers. In the Chamber of Deputies on January 30, Signor Galimberti, Minister of Posts and Telegraphs, announced a bill providing for a wireless telegraph station to connect Rome and America.

ALTERNATING CURRENT RAILWAY RETURN CIRCUIT.—A patent issued January 27 to W. M. Mordey, of London, England, relates to a means of reducing the drop of the return circuit by the employment therein of a transformer. The outgoing current is passed through one winding of a transformer and the return current in opposite direction through a second winding. It is stated that by this means fall of pressure in the return main or feeder is reduced without practically affecting the pressure of the motors or of the circuit as a whole. By suitably arranged windings any desired transfer of pressure to the return main may be obtained, and the transformer may be located where most convenient.

SYNTONIC WIRELESS TELEGRAPHY.—A patent issued January 27 to Lieut.-Commander W. S. Hogg, United States Navy, describes a tuning device for use in wireless telegraphy. It consists of a combined inductance and capacity, both of which can be regulated. An outer cylinder is cut in the form of a helix, within which is a similar cylinder, the two being separated by a dielectric such as a glass tube. The inner cylinder may be moved up and down, thus varying the capacity of the device; and the sections of the spirals of the outer cylinder may be short-circuited by plugs, thereby varying the inductance. The capacity and self-induction are made so large with respect to the period of oscillation that only like instruments with large period will respond sympathetically.

FOREIGN INVENTORS AT ST. LOUIS.—A bill now pending in Congress for the amendment of the patent laws provides for extending the caveat privilege to foreign inventors. It might have been allowed to die with the present session, through the inertia of everybody concerned, but for the fact that foreign inventors of mechanisms not yet protected by patent in the United States have objected to exhibiting them at the St. Louis World's Fair next year unless they can be assured against the theft of their ideas. The Exposition management, therefore, appealed to Mr. Allen, Commissioner of Patents, to give such exhibitors a certificate of protection; but Mr. Allen responded that this would be in contravention of the fundamental theory of our patent system, and suggests that the passage of the bill referred to would accomplish the purpose desired without any straining of the existing law by construction.

WIRELESS TELEGRAPH NEWS SERVICE.—A special cable dispatch from London of January 30 says: The first attempt to supply incoming steamers with a news service was made to-day, when Reuter's Telegram Company filed with the Marconi Wireless Telegraph Company 100 words of news for the Cunard Line steamer *Lucania,* which left New York last Saturday, and which is due to arrive at Queenstown to-day or to-morrow. The wireless company, thus far, will only engage to attempt to transmit messages twenty to thirty miles from Brow Head, so the news will reach the steamer only a few hours before her arrival at Queenstown. The company will have a better chance with the Atlantic Transport Line steamer *Minnetonka,* which also left New York Saturday, to which a news message will be transmitted to-morrow. The *Minnetonka* passes twenty miles from the Scilly Islands, reaching London forty-eight hours later.

A. I. E. E. CHAPTER IN ST. LOUIS.—Electrical experts in the Louisiana Purchase Exposition took a prominent part recently in the organization of a St. Louis Chapter of the American Institute of Electrical Engineers. The meeting was held at the rooms of the St. Louis Engineers' Club in the Holland Building Annex. W. E. Goldsborough, chief of the Department of Electrical Exhibits, was chosen chairman of the St. Louis Chapter, and Girard Swope, St. Louis manager of the Western Electric Company, was elected secretary. The Exposition workers present at the meeting besides Prof. Goldsborough were Henry Rustin, chief electrical and mechanical engineer; Robert Moore, his assistant; Frank Welz, technical clerk of the Department of Electrical Exhibits, and P. E. Fansler, chief clerk of the same department. A large number of other electrical engineers were present, among them H. H. Humphrey, consulting electrical engineer; George Hessenbruch, assistant engineer to the Superintendent of Structure, Union Station; Prof. A. S. Langsdorf, Washington University, Ferdinand Schwedtmann, General Superintendent, Wagner Electric Manufacturing Company, and R. H. Klauder, consulting electrical engineer.

WATER POWER IN NORWAY.—It is announced from Christiania that the Rjukanfoss, in Telemar, known as the Norwegian Niagara, has been sold to a Swedish industrial trust, which will harness and utilize its power.

GERMAN GAS ENGINE COMBINATION.—According to a dispatch to the *Sun*, the Allgemeine Electricitäts Gesellschaft, representing the German electrical manufacturing interests, has bought a controlling interest in the Koerting Gas Engine Works at Hanover, and that the new combination will have a capital of $75,000,000.

MARCONI RELIEVED FROM MILITARY DUTY.—The King of Italy has intervened to stop the proceedings instituted by the military authorities against Signor Marconi in regard to his military service. The King has ordered that he be placed on the navy list instead of the army in such a way as will make it unnecessary for him to cease his scientific work or to return now to Italy.

FRENCH WIRELESS TELEGRAPH ENTERPRISE.—A French company has petitioned the postal authorities at Paris for permission to establish a wireless telegraph station at St. Pierre, near Newfoundland, with the object of establishing a service between there and Cape La Hague (near Cherbourg, France). It will be remembered that recently the French authorities arrested the construction of a private wireless station at Cherbourg.

"BIG BEN" LIGHTED.—A cable dispatch from London of January 24 says: "Big Ben," the famous clock in the tower of the Houses of Parliament, is being lit at last by electricity, so that its time may be read occasionally at night. It is still wound by hand, taking two men twelve hours weekly to complete the operation. It is fifteen years since the clock has been cleaned, and recently it had begun to lose time.

GOLD MEDAL FOR PROF. J. J. THOMSON.—At the recent annual meeting of Smithsonian Institute, Secretary Langley reported that during the year a number of researches under the Hodgkins fund were aided by grants to scholars in this country and abroad and that upon the recommendation of a committee a gold medal was awarded to Prof. J. J. Thomson, of Trinity College, England, "for his investigations on the conductivity of gases, especially the gases that compose the atmospheric air."

ENGLAND'S AUTO SHOW.—A cable dispatch from London of January 30 says: The automobile show opened at the Crystal Palace to-day is by far the largest held in this country. Between 500 and 600 cars are exhibited, besides 120 circulating on the grounds for the use of prospective purchasers. The car which won the James Gordon Bennett Cup in 1902 is among those on view. Although pleasure cars predominate, many heavy transport vehicles are exhibited. Altogether it is a record display, demonstrating the rapid advance made by the automobile industry in Great Britain.

NAVY LEAGUE OF THE UNITED STATES.—An organization has been incorporated with Hon. Benj. F. Tracy as president and Hon. William McAdoo as secretary, having for its object the increase of the United States Navy. The League is modeled after corresponding bodies in Great Britain and Germany, which have exercised a great influence in securing appropriations for the navies of those countries. Every man, woman and child is eligible for membership. A certificate of mmebership will be sent to any applicant upon receipt of $1.00, and the *Navy League Journal* for one year will be sent to all members. The secretary is George B. Satterlee, 52 Broadway, New York, to whom all communications should be addressed.

PACIFIC CABLE.—According to a press dispatch, the Pacific cable is proving an expensive luxury for Hawaii, and though it is being extensively used, the novelty is beginning to wear off. The newspapers complain most. The press rate is twenty cents a word and all the newspapers have been compelled to increase their subscription price, but they continue to run behind. Aside from the newspapers the cable is little used. Stock quotations are received daily from San Francisco, and the sugar men are kept informed of the state of the market. It is stated that the cable company does not expect the local office to pay, and the cable will probably be a losing proposition until it is completed through to Manila. Work on the next section of the cable has already been begun in England, and laying will probably begin from Honolulu about June.

PROJECTING ENERGY THROUGH SPACE.—A special cable dispatch from Berlin, Germany, of January 24 says: Professor Ferdinand Braun, of Strasburg University, whose application of Leyden jars in propagating electric waves is said to have enabled Signor Marconi to telegraph without wires across the Atlantic, announced before the Strasburg Scientific Society yesterday that he had discovered a method of producing electric energy of unlimited volume and projecting it into space, in the form of electric waves, to any desired distance. Professor Braun's new method secures greater accuracy of transmission through a more perfect attunement of the transmitting and receiving instruments. He thinks he has substantially reached a method of transmitting exclusively to one point of the compass, thus avoiding interference by other waves. The method, it is claimed, will work economically and simply.

NATIONAL ELECTRIC CODE.—A meeting of the National Electric Code Committee of the American Institute of Electrical Engineers, Dr. A. E. Kennelly, chairman, will be held on Friday, February 13, 1903, at 3 o'clock, in Room 57, the office of the New England Cotton Manufacturers' Association, 45 Milk Street, Boston, Mass. This will be a joint conference with a corresponding committee representing the Underwriters' National Electric Association, and representatives of the following associations are also invited to attend: National Electric Light Association, Association of Edison Illuminating Companies, American Institute of Architects, Northwest Electrical Association, Pacific Coast Electric Transmission Association. At 8 o'clock P. M., on the above date, there will be a meeting of the Boston members of the American Institute of Electrical Engineers, in conjunction with the Engineering Society of the Massachusetts Institute of Technology. Members of the above committee and representatives of the various associations are invited to attend.

MUNICIPALISM IN BOSTON.—In his annual address to the Chamber of Commerce, President Lincoln had the following to say of the Boston city government: "Men who would not be appointed to any responsible office in any financial or business organization are elected by our citizens to positions of influence and responsibility where they can vote away millions of the money of the people. Recent events have revealed to us the character and disposition of our present city government. Politicians, bankrupt in morals as well as in pocket, obtain control, and by dishonorable and corrupt methods are enabled to carry out their schemes for their personal benefit at the expense of the taxpayers. The first meeting of our common council this year surprised every one by the large amount of loan orders, amounting to $670,000. The Mayor has said that the burden per capita exceeds that of any other great city in the country. The amount which the city has the right to borrow was $3,782,000. Nearly all the amount has been authorized, and the net debt of the city has reached the sum of $52,000,000. Fraudulent purchases of land, padded pay rolls, bills for carriage hire and entertainments, reckless appropriations, and the enormous loan bills are matters that demand the earnest consideration of every patriotic citizen."

LETTER TO THE EDITORS.

Water Power vs Steam Plants.

To the Editors of the Electrical World and Engineer:

SIRS: In your issue of last week Mr. George H. Barker, formerly president of a Pacific Slope transmission plant, is reported as having expressed the opinion that while water power plants are expensive to install, yet experience on the Slope has shown that they can generate electrical power cheaper than a steam plant, even if the latter be supplied with fuel absolutely free of cost. While this statement is undoubtedly correct if the steam plant with which a comparison is made is of the kind usually employed in electrical generation, and operating under central station conditions as to load curve, the writer doubts very much if it can be substantiated in a comparison with a steam plant such as would be erected and operated for generating power in large quantities for transmission and delivery for all purposes.

It has been said that careful calculations made previous to the introduction into Buffalo of Niagara power showed that a steam plant could have been installed in that city for generating current in large quantities for all purposes at a total cost about equal to the price at which Niagara current was offered for delivery in Buffalo. In a paper read several years ago before the American Society of Mechanical Engineers, Mr. F. W. Dean, basing his figures on New England mill practice, estimated that steam power can be generated in 1,000 hp units at a total cost of $17.54 per annual hp of 10 hours daily, coal being taken at $3.85 per ton, and 5 per cent. allowed for interest, 3½ per cent. for depreciation, 2 per cent for repairs and 1 per cent. in insurance and taxes. With fuel oil available on the slope at a cost equivalent to $2.50 per ton for coal, and with a reduction in labor account incident to its handling and less depreciation of plant attending its use, it would appear that some of the uncertain water powers of California are not so secure against competition from steam as Mr. Barker would believe.

Chicago, Ill. Jas. L. Thorne.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Motor with External Armature.—An illustrated description of a direct-current motor with external armature, designed by Mavor, especially for driving a propeller fan. The armature disc stampings are similar in form to the stampings of the stator of a polyphase motor, the windings being inserted radially from within. The magnet is a cross-shaped steel casting, with wire wound on two limbs, and with two consequent poles, the wire being held in position by pole-shoes attached to the magnet after the coils are in place. This magnet is mounted on a hollow stationary shaft, which carries the conductors from the outside to the magnet winding. On this stationary shaft is hung the external armature with a running bushed bearing at each end. The running bush is supported on the end plate carrying the armature discs and winding, and is formed at the inner end with a groove and projection, the groove communicating by openings with the outside of the running bush, over which is placed an oil-catching vessel. At the outer end of the running bush is fixed a flange, dipping below into the oil in the catcher reservoir. From this running disc the oil is thrown on to a stationary disc, forming part of and communicating by grooves on its inner face with channels in a fixed bush attached to the stationary shaft. The oil thus circulates from the catcher reservoir by the running disc, the stationary disc and grooves in the stationary bush to the running bush being thrown off again at both ends of the running bush into the oil catcher reservoir. The advantages are reduced weight and good ventilation of the armature.—Lond. *Elec. Rev.,* January 16.

References.

Design of Small Dynamos.—A full report of the discussion which followed Mavor's recent paper on this subject. The matter is also discussed editorially at some length. Mavor emphasizes that it is especially necessary in small machines to consider the speed at which the machine has to be run and the depth of the slot, with special reference to the iron losses; heating, he maintains, is the only limitation; for, in these small machines, commutation and efficiency may generally be left to take care of themselves.—Lond. *Elec.,* January 16.

Single-Phase Motor.—Girault.—An illustrated description of a single-phase alternating-current motor, patented about ten years ago by the Oerlikon Company. It has a fixed commutator and revolving brushes and starts under load. It is interesting in view of the recent proof (Heyland, Latour) of the peculiar properties of the use of armature windings with commutator for alternating-current motors.—*L'Ind. Elec.,* January 10.

Power.

Power Distribution in Great Britain.—A statistical table giving particulars concerning the large electric power distribution companies in Great Britain, working under Parliamentary powers. The only one of these companies which is really in active operation is the Newcastle-on-Tyne Electric Supply Company, which supplies electric light to a large part of Newcastle and power to a number of large manufacturing works, as well as to a line of tramways. The second company on the list, the Midland Electric Corporation for Power Distribution, has a finely equipped plant and an extensive distribution system, and as it is also in a most favorable position, it may be expected to soon be working with economy on a heavy load. The remaining power companies are either working under more or less temporary arrangements or are still in the earlier stages of their development.—Lond. *Elec.,* January 16.

Reference.

Steam Turbine.—Reyval.—The first part of a detailed and well-illustrated description of Parsons' steam turbines.—*L'Eclairoge Elec.,* January 17.

Traction.

New York.—Wheatly.—An article on passenger traffic problems in Greater New York. A table gives the increase in population in New York City during the last five decades, and it is shown that with contiguous territory the population of the New York district amounts to about 4,500,000 people. The traffic on Manhattan Island amounted in 1900 to an average of 388 rides per inhabitant, and in 1903 it is estimated at 415 rides per inhabitant per year. Statistics are also given of the passengers carried for a number of years back and also for recent days and weeks. The total travel into and out of the business district during the busiest hour is estimated at 250,000. The writer points out that no additional surface or elevated lines have been built in the business district during the past twenty years, although the traffic has quadrupled. A summary is given of the delays over five minutes in length in the street railway traffic in New York City for 18 days in December due to causes beyond the power of the company. Another table gives the number of vehicles crossing the tracks at different hours of a day selected for making the count; and a third gives the miles of track, car miles, gross receipts, population and gross receipts per mile of track, etc., for seven leading cities in the United States. The writer believes that the trains in the Subway, if run at 30 miles per hour, cannot be operated on a shorter interval than from 2 to 2½ minutes, and estimates the number of cars which can be passed through the tunnel at 540 per hour, giving a total seating capacity for 28,000 passengers and a total carrying capacity per hour in each direction of 43,000 people. He does not believe that this will have much effect on the total traffic of New York, which at present, in the busiest hours, amounts to 142,000 people per hour. Diagrams are also given to show the obstructions to the streets now caused by the excavations in building the Subway.—*St. R'y Jour.,* January 10, 17.

Reference.

Accumulator Traction.—Izart.—An article in which he gives some formulas for calculating the storage batteries required for use on street cars. He starts, however, with the sweeping statement that an economic solution of the traction problem prevents the use of batteries in cars.—*L'Ind. Elec.,* December 10.

Installations, Systems and Appliances.

Behavior of Synchronous Converters in Traction Installations with Stationary Accumulators.—Banti.—An article on a singular phenomenon which he has observed with rotary converters when set to charge a battery of storage batteries. The charging current was found to be highly pulsatory, though the same converter, working at the same actual power on the same supply, at the same voltage, but delivering its output on a plain non-inductive resistance, gives a perfectly smooth continuous current. The experiments were made at a traction station in Rome, and the converter was a single-phase apparatus, rated at 60 kw. The slightly pulsating current generated by the converter acquires a notably greater pulsation when working upon a battery, because the battery, by offering a counter e.m.f., produces on the current a greater pulsation than that due to the converter itself. He then examined whether an ordinary continuous-current dynamo also presented, or at least indicated, the same phenomenon; this might have been expected, as a direct-current dynamo furnishes of itself a more or less undulating current; however, the result was negative, as no pulsations were found in the dynamo current when charging the battery. His conclusions are summed up as follows: When a synchronous converter operates upon a non-induction resistance, it furnishes a continuous current with slight pulsations; it would be an error to calculate the power generated from the product of voltage and current if these are measured by hot wire instruments; the effective power measured by a wattmeter is found to be less than the apparent power, and in the case considered about 5 per cent. When the converter operates on a battery of accumulators, the said pulsations increase in amplitude and the continuous current becomes markedly pulsatory; the effective power generated by the machine is much less than the apparent power obtained as the product of volts and amperes measured by hot wire instruments, being, in the case considered, about 15 per cent. less. To obviate this inconvenience, or, rather, to cause the converter to operate in an identical manner whether on accumulators or on ohmic resistances, it suffices to insert into the circuit a suitable inductance capable of being regulated step by step; this inductance absorbs in itself a very small amount of energy.—Lond. *Elec.*, January 16.

British Three-Phase Plant.—A well-illustrated description of the Erith Electric Works, which is one of the first plants in Great Britain using the three-phase system for distribution. On account of the scattered nature of the district three-phase currents are transmitted at 3,000 volts. The secondary distribution is on the four-wire, three-phase system, the secondaries of the transformers being joined up in star connection and the fourth wire being run from the middle point. As 200 volts is the declared pressure at the consumers' terminals, the pressure between any two outers is 346 volts; the middle point of the star will probably be earthed. In addition to private lighting there will be a considerable amount of public lighting with Nernst lamps. About 580 Nernst lamps, partly ¼ and party ½ amp, will displace the present oil lamps. They will be connected as in private lighting, between the outers and the centers of the transformer secondaries. In addition to this there are 18 arc lamps of 15 amp. The plant, and especially the switchboard, are described in detail and are well illustrated.—Lond. *Elec.*, January 16.

London Supply Station.—An illustrated description of the electricity works of the Central Electric Supply Company, which is now being completed and is to support other existing stations in congested areas of London. The Central works generate 6,000 volts, three-phase current, this pressure being delivered at the terminals of the dynamos and without the assistance of step-up transformers. The current is led by three-core underground cables to existing stations, where it is converted into direct current at the voltage of the distributing network, which is in one case a 440-volt, three-wire system, and in the others 220 volt, two-wire. The conversion into direct current is also effected without the intermediary of transformers; induction motors are used, taking three-phase currents at 6,000 volts, and these motors are directly coupled to the direct-current generators.—Lond. *Elec.*, January 9.

Wires, Wiring and Conduits.

REFERENCE.

Transmission Wires.—Otto.—A mathematical article in which he gives formulas for calculating the sag of an overhead wire, as a function of the distance between two poles, the temperature, the wind pressure, and the tension.—*Elek. Zeit.*, January 15.

Electro-Physics and Magnetism

Excited Radio-Activity.—Rutherford.—An article in which he shows that the production of excited radio-activity is one of the properties of the emanation from thorium and radium. It is due to the deposition of radio-active matter which is derived from the emanation given out by these bodies. Excited radio-activity is transmitted by positively charged carriers produced from the emanation, which travel in an electric field with about the same velocity as the positive ions produced in air by Röntgen rays. This velocity is about 1.3 cm per second for a drop of 1 volt per cm. These positively charged carriers are due to the expulsion of a negatively charged body from the molecule of the emanation. The emanations and the matter which gives rise to excited activity are the result of a succession of chemical changes occurring in radio-active matter. In thorium there is evidence of at least four distinct chemical changes.—*Phil. Mag.*, January; abstracted in Lond. *Elec.*, January 16.

Optic Resonance.—Kossonogoff.—A description of experiments on resonance. A selective reflection of electromagnetic waves may be obtained by means of a mirror composed of resonators of a certain length. The present author shows that it is possible to produce a similar resonance for wave lengths belonging to the visible spectrum. For this purpose the components of the "mirror" must be exceedingly minute. He describes two good methods of producing the resonant mirrors, one of them involving the projection of a spray of very dilute solution of a salt or metal upon a hot surface, and the other consisting in cathode disintegration. The color of the films varies according to the size of the grains and their distribution; it also varies with the temperature, and with immersion in other dielectrics. Gold, silver and copper mirrors may be obtained of any color. The grains of platinum are too small to reflect any visible light. But the author has obtained at least one platinum mirror which has a deep blue color, and has also discovered optical resonance in lepidoptera.—*Phys. Zeit.*, January 1; abstracted in Lond. *Elec.*, January 16.

Effect of Temperature on Hysteresis Loss.—Mills.—An account of some experiments on the effect of temperature upon the hysteresis in an iron and in a tungsten alloy, the method being that devised by Searle, in which the energy dissipated in hysteresis is determined by observing the throw produced in the movable coil of a sensitive electrodynamometer. He found that the curves representing the hysteresis loss in iron as a function of the temperature, are practically straight lines until the critical temperature is reached, except that for the higher inductions the loss is slightly larger in proportion near the critical temperature. The rate of change in the permeability of iron as the temperature approaches very near to the critical temperature, is so great that, throughout a range of several degrees in this region only approximate values of the hysteresis could be obtained. Moreover, at such high temperatures the iron is in such a critical state that it was found that the process of demagnetizing by reversals does not entirely wipe out all the effects of previous magnetism, although the residual effect is only noticeable in extremely weak fields. In the case of a specimen containing 4.5 per cent. of tungsten, the passage from the magnetic to the non-magnetic condition is much more gradual, and the demagnetizing process, even at the highest temperatures, removes all traces of residual magnetism. The variation of hysteresis loss with temperature in the neighborhood of the critical temperature can, therefore, be much more satisfactorily examined with this alloy than with iron. As the temperature is raised the rate of fall of hysteresis increases, reaching a maximum at about 350° C.; then, as the temperature is increased, the hysteresis decreases less rapidly.—*Phil. Mag.*, January; abstracted in Lond. *Elec.*, January 16.

A Thermomagnetic Phenomenon in Gases.—Aschkinass.—A paper on a curious phenomenon described some 15 years ago by Nernst. When a heated metallic bar is introduced between the poles of an electromagnet, the temperature gradient in the air about the hot body is profoundly modified by exciting or demagnetizing the magnet. If a thermometer is placed beside the hot body, but not in the lines of force which pass through it, the mercury falls by 2 or 3° on exciting the magnet. No effect is observed, however, if the lines of force penetrating the hot body also penetrate the thermometer. The present author attempts an explanation of this curious phenomenon. He uses a copper rod 25 cm long and 6 mm wide, and places the axis of the electromagnet vertically. He finds that there is, indeed, a decrease of temperature near the rod, but an increase further away, and thence concludes that the hot air is diverted by the magnetic field. The phenomenon is connected with that described by Faraday, in which a current of hot air is driven through a tube into a magnetic field. It is due to the fact that hot oxygen is strongly diamagnetic with respect to the cold gases. The experiment fails with nitrogen or carbonic acid.—*Phys. Zeit.*, January 1; abstracted in Lond. *Elec.*, January 16.

Electro-Chemistry and Batteries.

The Storage Battery as an Electrolytic Cell.—Reed.—A theoretical article. All galvanic batteries, whether primary or secondary, are electrolytic cells, although electrolytic cells are not all galvanic batteries. The fundamental characteristic of electrochemical action is change of chemical valency; at the cathode the change of valence always tends to liberate an electropositive body from combination, and always tends to cause an electronegative body to enter into combination; at the anode the change of valency always tends to liberate an electronegative body from combination, and always tends to cause an electropositive body to enter into combination. This is the distinguishing characteristic of all electrolytic action, and the only one. Changes in chemical valencies may also occur in thermochemical action. The essential and universal difference between thermochemical and electrochemical reactions is that, in thermochemical reactions these two opposing changes of valency take place in two individual atoms or atomic groups which are at the same place and in contact, the energy change being from chemical energy to heat, and from heat to chemical energy; while in electrochemical reactions the two opposite changes in valence take place in atoms or molecules which are not in molecular contact, but are physically separated by an intervening compound-conducting body, the energy change being from chemical energy into electrical or from electrical into chemical energy. In an electrochemical action the transformation of energy always occurs at the electrodes, and a corresponding e.m.f. is either developed or absorbed at each electrode. If the total e.m.f. is positive, that is, if the electrolytic cell is capable of generating electrical energy at the expense of its chemical energy, it is called a galvanic battery. Every electrolytic cell which generates electric energy when a current passes in one direction will generate chemical energy, when the current passes in the opposite direction. There is no essential difference between a primary and a secondary or storage battery, but a difference only in the manner of using the cells and in their origin. If a battery is manufactured without the aid of an electric current, and is thrown away after its chemical energy is once dissipated, it is called a primary battery. If the cell has its chemical energy restored after discharge by passing a current in the opposite direction, it is called a storage battery. An apparatus may, however, generate chemical energy without actually storing it, on account of the accidental circumstance that the chemical products formed are mechanically lost in the process of generation; if any of the products of the electrochemical reaction formed in charging or discharging a battery are allowed to escape as a gas, or to precipitate as an insoluble product, they cease to be a part of the electrochemical system and cannot be available in that system for a subsequent action. But the author claims that this is more an accidental than an essential feature and no classification of electrochemical cells into reversible and non-reversible should be founded upon it. The author discusses at some length the action in the gas battery.—*Electrochem. Ind.*, December.

Table of Electrochemical Equivalents.—Hering.—A large table of the electrochemical equivalents and nine columns of their derivatives, which include such quantities as grams and pounds per ampere and watt-hour, kilograms and pounds per horse-power-hour, and in each case their reciprocals, so that all long divisions are avoided. It includes all but the very unusual elements, and in many cases two and three valencies which still further saves calculations. It also contains general formulas by means of which any other equivalents or derivatives not given may be calculated. The whole table has been carefully calculated and is based on the atomic weights adopted by the American Chemical Society and on the electrochemical equivalent of silver as adopted by the international congress. An auxiliary table gives the valencies which the elements have in their compounds, which latter are enumerated. There is also a set of typical examples showing how to calculate the amounts of any materials, either elements or compounds, corresponding to a given current or energy; these examples include many of the more unusual and complicated cases not generally explained in text-books. The basis of the method is that, knowing the change of valency, the required constant is found directly from the table. The older, indirect method, is also described. It is based on calculating some one convenient quantity in a complicated reaction and then by means of the complete equation calculating the desired quantity; this involves a quantitative knowledge of the complete reaction, while the other method does not, but gives the result directly. These examples are of the nature of a key to the solution of the more complicated calculations involving Faraday's law.—*Electrochem. Ind.*, January.

Electrolytic Refining of Gold.—Tuttle.—An illustrated description of the Wohlwill process of gold refining, used at the Philadelphia United States Mint. The feature of the process is the electrolyte, which is composed of a gold trichloride solution, rather strongly impregnated with free hydrochloric acid; the latter addition is necessary, because if a gold anode be placed in a neutral or only slightly acid solution of gold chloride, gold will be deposited on the cathode, but little or no gold will be dissolved from the anode, free chlorine being given off instead. The temperature of operation is 50 to 55° C., this increased temperature serving to reduce the voltage required, and at the same time to diminish the amount of free acid necessary to suppress evolution of chlorine at the anodes. Circulation of the electrolyte is also necessary. The cost of the hydrochloric acid required in the bath is 20 cents per 1,000 ounces of deposited gold. Any platinum present in the bullion can be recovered; it dissolves, but is not deposited with the gold. When the electrolyte becomes sufficiently charged with platinum, the gold is first precipitated by sulphur dioxide and reserved; then the platinum remaining in solution is separated as ammonium platinum chloride; lastly the copper is recovered by passing the wash waters over iron scrap. He does not treat by this process bullion having a fineness of less than 940 gold.—*Electrochem. Ind.*, January.

The Present Metallurgy of Aluminum.—J. W. Richards.—An article giving historical notes on the development of the aluminum industry and a discussion of the scientific principles of the only process by which aluminum is now made, i. e., the process of Hall and Heroult. The principle is that the melted double fluorides of aluminum and more electropositive metals can dissolve a considerable proportion of their weight of the relatively infusible alumina; when such a solution is electrolyzed, aluminum and oxygen appear at the two electrodes until the dissolved alumina has been almost entirely eliminated; by the addition of fresh alumina the process can be made continuous, while the solvent bath material remains unaffected by the operation. The way by which Hall and Heroult arrived at this process is sketched, together with the actual method of operation in use at present. To obtain pure aluminum it is necessary to use pure alumina; this requirement has led to considerable improvement in the manufacture of aluminum. The author finally discusses in detail the reactions taking place in the Hall process from a scientific point of view.—*Electrochem. Ind.*, January.

Canadian Nickel Industry.—A statistical review of the present situation of the Canadian nickel industry. The Canadian and Orford Copper Companies, which have been consolidated with the International Nickel Company, are still the most important producing concerns in the Dominion. The principal works of the Canadian Company are at Copper Cliff; the surface plant is producing from 500 to 600 tons of ore daily for shipment to the roast yards at Copper Cliff. Extensive smelting works have recently been completed for re-treating the low-grade mattes, with the result that their metal contents have been raised from 30 to about 70 per cent. For the final separation of the copper and nickel this material is treated by a series of smeltings with various alkalis, followed by an electrolytic treatment for the purpose of producing pure nickel. One of the companies outside of the combination is the Mond Nickel Company, whose mines at Victoria have been very considerably developed during the past year, the Bessemer process having been put down for turning out matte. The product is a high-grade article, carrying about 80 per cent. metallic contents in equal proportions of nickel and copper, the iron in the one being at the same time entirely eliminated. This matte is refined in England by Mond's own process. During the past ten years 1,306,722 tons of nickel, copper and copper ore, producing 26,606 tons of metallic nickel and 28,070 tons of metallic copper, have been produced in Ontario, the value of the nickel being over $20,000,000 and the value of the copper nearly $6,250,000. The rate of development has been very much greater during the last five years than in the first half of the decade. The most striking development has been in the production of high-grade matte, which in 1897 only amounted to 328 tons, whereas last year it was 15,546 tons.—Lond. *Eng'ing*, January 9.

Electrolytic Rectifier.—Hospitalier.—An account of the results of tests made with the Nodon "electrolytic valve" (aluminum rectifier) at the School of Industrial Physics and Chemistry of the City of Paris. Four cells were used, according to the arrangement of the

Wheatstone bridge, which was first used by Graetz for this purpose; the one diagonal line is supplied with the alternating current to be rectified; the other contains the apparatus in which the rectified current is to be used. As well known, this arrangement enables one to utilize both half curves of the alternating current to be rectified. The frequency of the alternating current used in the experiments was 42, and an electrolytic valve of the 5-amp type was employed. The rectified current was used to charge a storage battery of 42 cells in series. The wave forms of the currents and e.m.f.'s were determined by means of the ondograph and are reproduced in diagram. The efficiency of the rectifier was found to be about 70 per cent., and the wasted energy appears in the form of heat, so that the temperature of the electrolyte increases. This is said to have no other inconvenience than to cause an evaporation of the liquid so that water must be filled in at intervals. The electrolytic rectifier behaves like a condenser, the current being about one-quarter period in advance of the e.m.f.; the deformations of the current wave are the same as are obtained with a condenser and are due to the presence of higher harmonics.—*L'Ind. Elec.*, December 10.

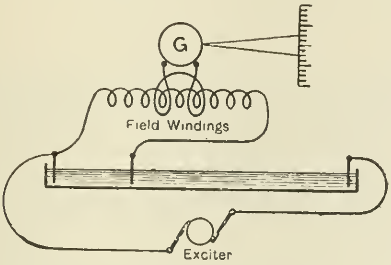
REFERENCES.

Calcium Carbide and Acetylene.—A review of the present conditions of this industry in the United States, with a brief outline of the chemistry of the subject.—*Electrochem. Ind.*, December.

Electrometallurgy.—Beadle.—In a continuation of his series on electrometallurgical problems the author discusses the manufacture of aluminum, magnesium and sodium.—Lond. *Elec. Rev.*, January 9.

Units, Measurements and Instruments.

Measurement of Magnetic Flux.—Thornton.—A communication referring to Beattie's description of the quantometer, recently abstracted in the Digest. He points out that to measure the flux in any part of a large dynamo field magnet it is not necessary to use any special instrument other than a dead-beat, moving-coil galvanometer. The arrangement is shown in the adjoining diagram. By increasing or decreasing the field current slowly by a liquid rheostat, the current induced in an exploring coil of one or two turns may be kept so steady that the galvanometer deflection can be noted every few seconds, and the mean deflection can be obtained over the total time of operation with an accuracy within 2 per cent. of a photographic or automatic recording method. The product of the mean reading and the total time is a measure of the electrical quantity or of the magnetic flux, according as the galvanometer reading is calibrated for current or voltage. Stoney first suggested taking the readings in this way, and the present author has found it in practice to work very well, the most important point being to move the slide in the liquid rheostat at a constant rate, starting and stopping slowly.—Lond. *Elec.*, January 9.



MEASUREMENT OF MAGNETIC FLUX.

Universal Permeameter.—Picou.—An illustrated description of a permeameter which is called "universal," because it is adapted as well to tests of iron sheets as of wires. The inherent difficulty in the ordinary permeameter is due to the joints between the piece under test and the other parts of the apparatus; an air-gap is thereby introduced, which may be very small, but may cause appreciable errors. In the author's method these errors are eliminated. In the adjoining diagram, B_1 and B_2 are two iron horse shoes and b is the piece under test. Each of these three parts is provided with a magnetizing coil. If at first current is supplied to the coil of B_1 and B_2 only, but in such a sense that the fluxes in these both parts have the same direction, nothing will happen in the piece under test, the two ends of which are at the same magnetic potential; but the flux passes through all the joints. If then the current of the coil of B_2 only is reversed, then the fluxes due to the magnetizing coils of B_1 and B_2 are opposed to each other and close themselves entirely through b. The magnetic flux is thus diminished by the introduction of the reluctance of b into the circuit. To bring the magnetic flux back to its original value, it is only necessary to send a current in the proper direction through the magnetizing coil of b. This current is measured by the ammeter, A, and this gives the corresponding magnetomotive force. Now this corresponds exactly to the magnetizing of the piece b under test alone, the influence of the other parts of the apparatus and of any joint being eliminated.—*Bull. Soc. Int. des Elec.*, December; *L'Ind. Elec.*, January 10.

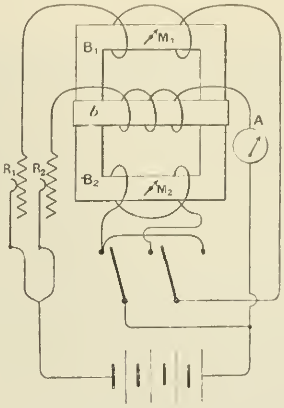


DIAGRAM OF CONNECTIONS OF PERMEAMETER.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—Wilke.—An illustrated description of portable stations for wireless telegraphy of the system of Braun and Siemens & Halske, and their application in the German army.—*Elek. Zeit.*, January 15.

Indicators at a Distance.—Hentze.—A brief illustrated description of an electro-hydraulic instrument for indicating at a distance the speed of axles, machines, motors, etc.—*Elec. Zeit.*, December 18.

MISCELLANEOUS.

Success of Municipal Ownership in Great Britain.—Donald.—A continuation of his article. The writer has taken up the subject of the gas distribution and cites instances to show that the rates charged for gas are lower in towns where the plant is owned by the municipality. He also claims that the same is true in regard to electrical power and telephones. At the same time he claims that a profit is made from these undertaking which reduces the tax rate considerably; he quotes the ostensible profits made by some cities.—*St. R'y Jour.*, January 10.

Biographical—This continuation of the serial on pioneers in electrochemistry, gives the life and work of H. Y. Castner, with portrait. —*Electrochem. Ind.*, December.

New Books.

Elektromotoren fur Gleichstrom. Von G. Roessler. Berlin: Julius Springer. 136 pages, 49 illustrations. Price, 4 marks.

As is indicated by the title, this is a text-book on the construction of motors for continuous currents, and is chiefly intended for the use of electrical students. The book commences with an exposition of the general principles of electrical currents, succeeded by a discussion on electromagnetism. The various forms of motors for continuous currents are then taken up in half a dozen succeeding chapters, in which the magneto, electromagneto, series motors and shunt and compound, corresponding generators are treated in such a manner as to draw particular attention to the *differences* between the motor and the generator. In conclusion there is a chapter on hysteresis. The book is a text-book and deals with little less than the theory of design, without attempting to show any inevitable reconciliations necessary to adapt even the best theories to practical constructions.

BOOKS RECEIVED

The How and Why of Electricity. By Charles Tripler Child. New York: *Electrical Review*. 126 pages, 40 illustrations. Price, $1.00.

Design of Dynamos. By Silvanus P. Thompson, D. Sc., F. R. S. New York: Spon & Chamberlain. 253 pages, 100 illustrations. Price, $4.50.

Elektromagnetische Aufbereitung. Handbuch fur Elektrochemie. By F. Langguth. Halle: Wilhelm Knapp. 84 pages, illustrated. Price, 3 marks.

Physico-Chemical Tables, Vol. I. Chemical Engineering and Physical Chemistry. By John Castel Evans. London: Charles Griffin & Co. 548 pages. Price,

Proceedings of Society for the Promotion of Engineering Education; Tenth Annual Meeting. New York: *Engineering News* Publishing Company. 300 pages. Price, $2.50.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

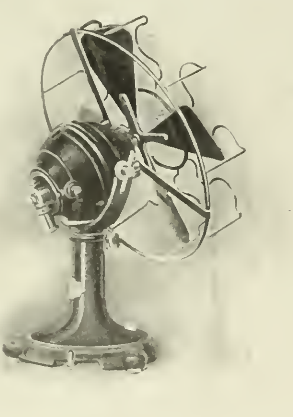
Electrical Contractors' Association of New York State, Secretary, Wm. J. Davis, Ithaca, N. Y.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Lundell Fan Motors.

The Lundell fans, manufactured by the Sprague Electric Company, have been long and favorably known, and a detailed description at this time seems hardly necessary. They are made in various sizes and types, which are sufficient to meet all requirements of the trade. Last year the 12-inch and 16-inch swivel and trunnion desk and bracket models were introduced and received the cordial indorsement that has always been accorded the Lundell patterns.



DESK FAN, SWIVEL AND TRUNNION TYPE.

The Lundell fan motors are of the bipolar round type and have a single field coil, which energizes both pole pieces, thus insuring a simplicity and compactness that is ideal. The motor is non-sparking and has a strong torque permitting the use of fan blades of considerable pitch, so that they will drive a large volume of air at a given speed with a small amount of current. The fan blades are firmly riveted to a spider, so that there is not the remotest chance for a blade to fly loose under the highest speed at which a fan motor can be run. The motor has self oiling and self aligning bearings. The self oiling cups invented by Mr. Lundell have been found admirably adapted to their work.

All styles and patterns of Lundell fans are carefully finished and tastefully decorated. The guards are strong in construction and artistic and graceful in appearance. The fans run easily and quietly and require practically no attention. The Lundell fans have stood the test of service in all parts of the world and the manufacturers are anticipating a large business during the coming season.

Moskowitz System of Electrically Lighting Steam Railway Cars From the Axle.

In this system of car lighting each car has its own portable self-contained lighting plant, able at all times, in motion or at rest, to furnish current for lamps or fans. Each car carries a small generator driven from the revolving car axle; also a small storage battery. Cars run at all speeds up to 80 miles per hour, and the variable axle rotation is communicated to the armature of the generator. This would cause a variable electrical output, but owing to the completeness in which this system is worked out in controlling the generator, the voltage remains practically constant.

The generator is an iron-clad machine, built especially for use in railway car trucks, and is spring suspended. It delivers its full output of electrical energy when the car attains a speed of 15 miles per hour. At 60 miles per hour it has, therefore, quadrupled its armature speed, and it is thus apparent some automatic regulation or control must be introduced to prevent lamps and batteries from being destroyed.

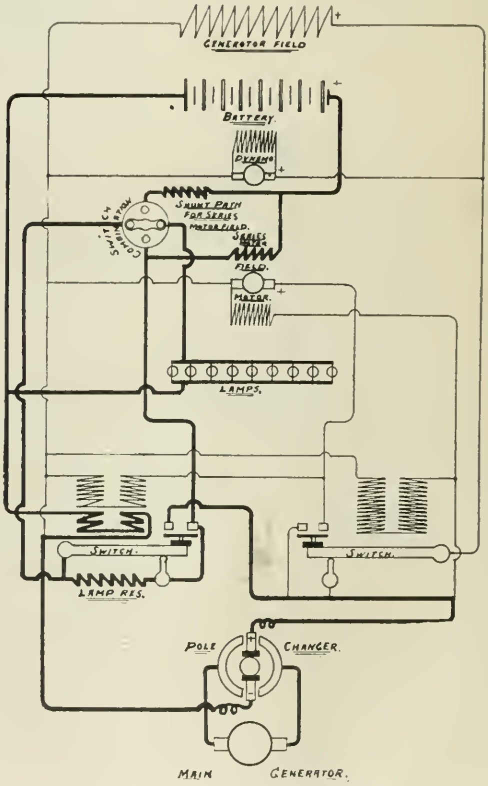


FIG. I.—DIAGRAM OF CONNECTIONS, AXLE-LIGHTING SYSTEM.

The regulation of the generator is accomplished by a small motor-generator placed for convenience on the switchboard in the car. This motor-generator acts as exciter and regulator for the generator in the car truck. The exciter is entirely under electric control. The motor-generator has both of its armatures wound on one shaft and runs in oilless bearings, forming a very small and compact machine.

As railway cars travel in either direction, it is necessary that provision be made to cause the external current from the generator to flow in one and the same direction, irrespective of the rotation of the car axle. The pole changer under discussion rectifies and keeps the current flowing in the proper direction in a direct and simple way, altogether eliminating the use of gears, cams or additional bearings. A steel projection secured to the armature shaft of the generator is caused to operate a substantially constructed electric switch in either one or the other direction. This projection having performed its work is withdrawn by centrifugal force caused by the rotation of the armature shaft. When the car reverses its direction the same action occurs in an opposite sense. It will be understood that the projection having been withdrawn at about 4 miles per hour of the car's speed there is no wear taking place, as all movements of the pole changer cease until the car slows down again.

The method of power transmission consists of a belt of special material, the tension of which between the two pulleys is kept approximately constant through the medium of a spring.

When the car is at rest the battery supplies current to the lamps. It will be seen that the pole changer switch on the accompanying diagram occupies a neutral position, but the car under motion will cause the switch blades (marked positive and negative respectively) to engage or make contact alternately with either one or the other set of contacts. The result is that the current is always rectified in the pole changer.

Now, assuming the car has attained a speed of 10 miles per hour, the main generator armature excites its own field as an ordinary shunt machine. It also supplies current to the small dynamo, starting the same as a motor. It also excites the shunt field of the small motor. It will be understood that the small motor and dynamo armatures are wound on one shaft. The electromagnetic switch on the lower right-hand side being shunt wound and connected across the pole changer, will attract its armature, thereby closing its upper switch and opening its lower one. This closes the armature circuit of the small motor and at the same time cuts out the shunt field from the large generator; it also cuts the current from the small exciter dynamo. The small motor now being in motion and driving the small dynamo, the latter exciter now excites the field of the large generator acting as an independent exciter for the main generator. When the car reaches a speed of about 15 miles per hour the compound electromagnetic switch on the lower left-hand side of the diagram attracts its armature, thereby closing the upper switch and opening the lower one. This switch closes the external circuit between the generator and the battery, or between the generator, the battery and the lamps, causing the main generator to light the lamps direct and charge the battery as well. The closing of this switch also introduces a small lamp resistance, as shown on diagram, which was previously short-circuited to protect the lamps from the additional voltage necessary to overcome and charge the battery. Further reference to the diagram shows a series field winding for the small motor. The series winding on

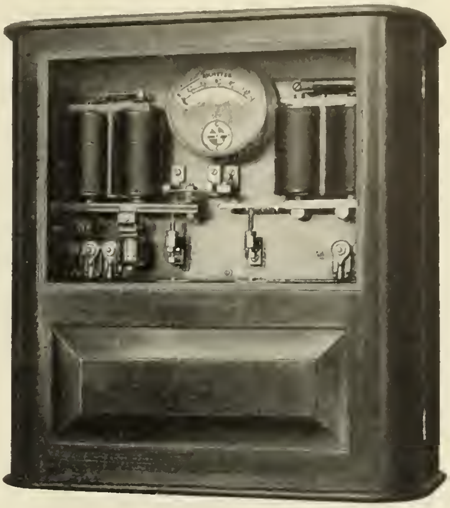


FIG. 3.—VIEW OF SWITCH CABINET.

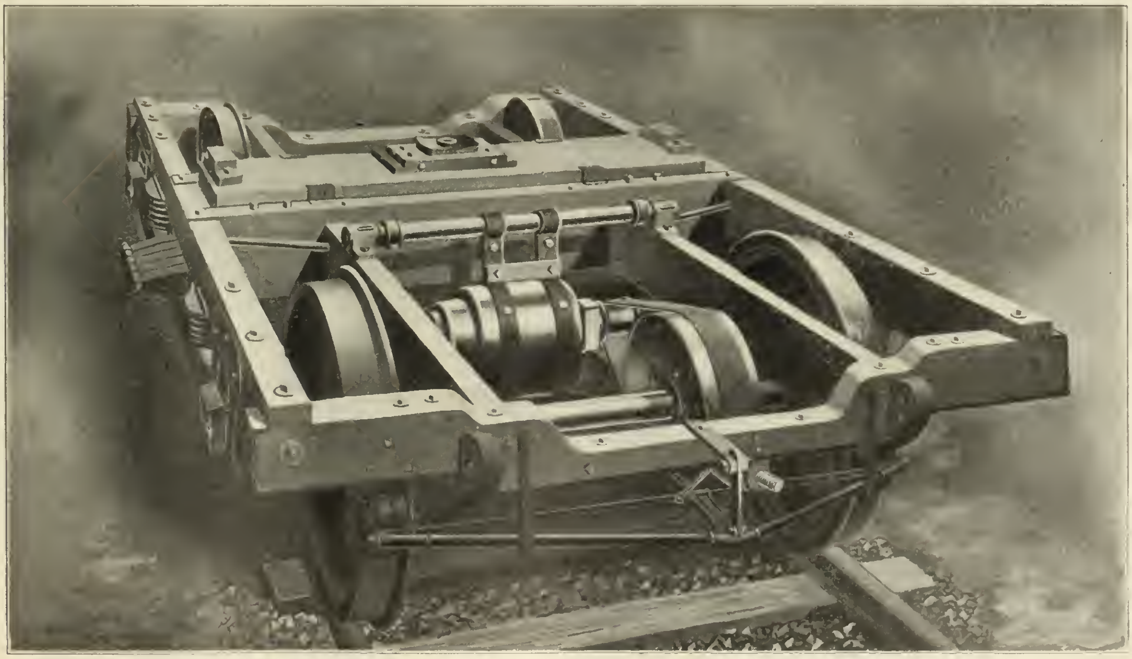


FIG. 2.—VIEW OF CAR TRUCK SHOWING GENERATING APPARATUS.

the motor is cumulative, and since the full load of the main generator passes through the series winding, the effect is to cause the small motor to slow down in its speed and the small generator to deliver less current to the field of the large generator. This continues as a perfect balance through all speeds up to and above 80 miles per hour, maintaining the e.m.f. of the main generator approximately constant through exceptionally wide ranges of speed.

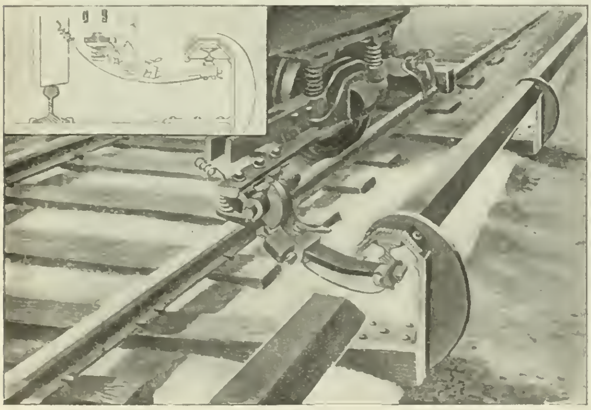
During the day when the lamps are not lighted it is desirable to charge the battery with a larger current. This is compensated for with an additional resistance shunt path for the series field of the motor generator, and is controlled by a combination switch which is cut in when the lights are turned off manually. As the speed of the car falls below 15 miles per hour there is a tendency on the part of the battery to reverse itself through the main generator, causing the compound on the make and break switch to become differential and neutralize its magnetism. This allows the iron armature to fall down, thereby opening the circuit between the battery and the generator. An examination of the diagram will show that when the automatic switches open there is practically no current flowing, thus insuring long life to them. The system above described has been developed by the United States Lighting & Heating Company, of New York.

Walkins Inverted Third Rail System.

The accompanying illustrations show an inverted third-rail system recently patented to Louis E. Walkins, of Springfield, Mass. It consists of the ordinary rail turned upside down and suspended at proper intervals by a bracket to one side of a line of rails so formed to allow a sliding trolley shoe, projecting from the car truck, to slide on the under side tread of rail conductor inverted and secured to brackets about 15 feet apart.

The third rail is fastened to the brackets by a lock-joint insulated wedge, and the full length of the third rail, top and both sides, are insulated, so that contact cannot be made by man or beast, unless deliberately reaching underneath the rail. The inverting and covering of the rail keeps it always dry and prevents the accumulation of ice, snow, sleet or rain, thus stopping much of the delay caused through loss of contact, flashing and sparking of the shoe.

Such a system is claimed to remove in a simple and efficient manner all of the dangerous features of a third-rail conductor as now in use on the Elevated Railways of New York, Chicago and Boston, meets the objection to the third-rail conductor through causing delays by accumulation of ice or snow on the tread of power conductor, obviates flashing and sparking of shoe, leakage of power, and loss of current by dampness. It is stated that careful estimates show that the cost of installation of this system is but a very little more per mile than the present system of third rail in use on the Second Avenue line of the Manhattan Elevated Railway.



INVERTED THIRD-RAIL SYSTEM.

The inverted third rail trolley shoe has been designed with a view to simplicity and the highest degree of efficiency, and to obtain results overcoming many of the obstacles met with in the use of other trolleys or trolley shoe devices. It combines great strength and flexibility and can be readily thrown to one side, and up against the car-truck at such times as needful to remove it out of the way. It is stated that a series of practical tests has thoroughly demonstrated that as improved the trolley shoe under any momentum of speed makes a more certain contact upon the inverted tread than the shoe now in use on the third rail conductor surface contact. The shoe does not jump during any speed, and at sections where the shoe passes from one third rail section to another provisions are made for easy mesh of shoe with the rail, if the motorman does not remove the shoe as is provided.

This system of third rail can be operated in connection with the overhead system, the electric trains, or cars being equipped with both the overhead and the third-rail trolley shoe, which can be instantly removed and placed in a firm position out of the way, and quickly replaced when desired by the motorman, thus enabling electric trains to be run through without delay or stopping of electric car now necessary in changing from one system to another.

The New Woodward Water Wheel Governor.

The governor selected for use in the three-phase power plant of the United States Arsenal at Rock Island, Ill., is a new type of Woodard governor made by the Woodard Governor Company, at Rockford, Ill. This governor, shown in Figs. 1 and 2, is somewhat similar to and operates on the same principle as the friction governor which this company has been manufacturing for thirty years past. In its construction no radical departures have been made from the successful principles of its vertical governors. The new governor is arranged to secure greater simplicity and rigidity and ease of repairs.

Referring to the accompanying illustrations, the power to operate this governor is supplied from the main shaft of the water wheel, which is belted to the large pulley seen in the rear. On the shaft on which this pulley is fixed, there is mounted a compressed paper friction clutch or drive. Supported on the sleeves of this main shaft are two pans, which when pressed against the compressed paper move the gates of the turbine in either direction, by means of double gear connection to an intermediate shaft, which is connected in turn to a turbine gate shaft. The governor balls are separately driven from the main shaft of the water wheel. As the speed changes, the rod of the speeder rises and lowers, causing either one of two tappets to engage with a cam which is revolved continuously

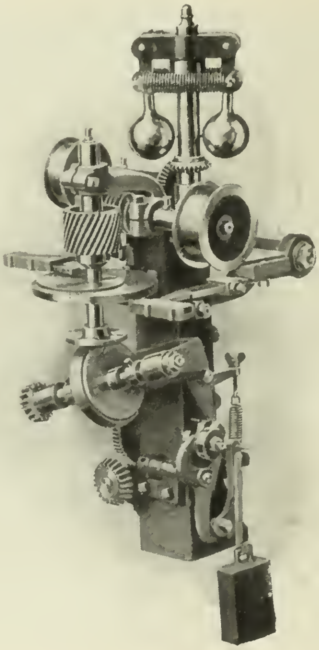


FIG. 1.—WATER WHEEL GOVERNOR.

by means of worm gearing. This cam is driven independently of the governor by a belt from the main shaft of the governor. The motion of the tappets is conveyed through crank shafts to the main shaft and as this shaft is forced back and forth, friction is brought to bear on the opening or closing plan. When the speed is normal, the cam revolves between the upper and lower tappet without engaging either. The cam mechanism is capable of very close adjustment so the governor acts on very small changes of speed, but at the same time it will not act when the speed and load are steady and consequently there is less wear on gate mechanism than with a governor that keeps a gate in continuous motion, although so slight as not to affect the speed. Just below the cam and fastened to the same shaft is a concave disc which rides upon a compensating wheel traveling loosely on an oblique shaft. This oblique shaft is geared to the intermediate shaft so that it travels only when there is a movement of the gates. The object of this is to avoid racing of the governor. When the speed is normal the compensating wheel seeks the center of the disc, which is supported upon it, because this disc is constantly revolving with the cam. When the movement of the gates occurs, the compensating shaft is revolved, and the wheel will travel along its shaft in such a direction that it will disengage the cam from the tappet when the gate has been moved to that point which will give the correct speed after the momentum of the machinery has been overcome. During this interval, the disc will return the compensating wheel to the original position. This device can be designed to properly compensate for any conditions as the time required in regulation can be varied not only by varying the pitch of the screw, but also by varying the speed of the oblique shaft by a change of gears. This compensating mechanism is the same as has proved so satisfactory in the vertical type of governor and, it is said, absolutely prevents racing. The governor illustrated is the largest one made, having friction wheel 24 in. in diameter with sufficient force to transmit if necessary 5,000 foot-pounds per second to the turbine gates. At present three governors are in operation in the Arsenal plant at Rock Island, with a fourth to be installed. These are geared to close the gates from full open in six seconds. The Ottawa & Hull Power & Manufacturing Company, of Quebec, has used one of these governors in its temporary plant for some time and is putting two of them in its large new station. Each governor will control four turbines, operating a 1,500-kw generator. A 1,000-hp turbine under 90 ft. head in Rochester has also been controlled by this type of governor for some time, which shows the class of work it is being used on.

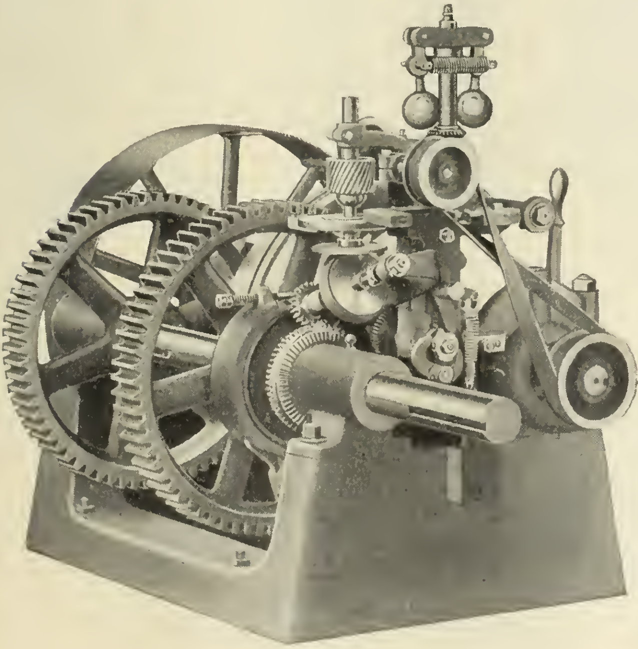
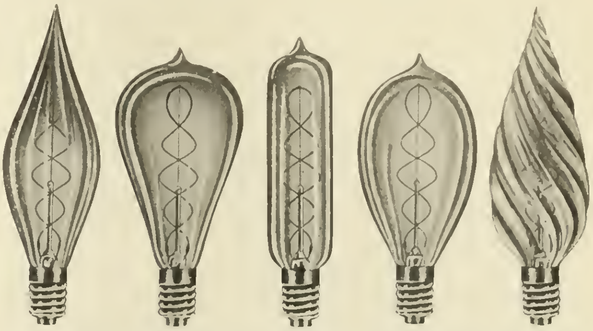


FIG. 2.—WATER WHEEL GOVERNOR.

Double Spiral-Filament Lamps.

The accompanying illustrations show some of the forms of double spiral-filament lamps manufactured by the Sterling Electrical Manufacturing Company, Warren, Ohio. This special form of filament, which is successfully utilized in the company's commercial lamps, is employed quite as successfully in the smaller sizes, the demand for it being so great, it is said, that the company is using it in all of its lamps. The range of the small lamps takes in the special shapes for telephone, elevator, signal, dental and surgical work, and in addition to these the company is bringing out a new type of lens lamp.



VARIOUS STYLES OF DOUBLE-FILAMENT LAMPS.

By the use of this form of filament it is stated that the standard lamps give an intensity of 16 cp from all light-giving points of the bulb, with corresponding results from the smaller sizes.

The company makes, besides its standard commercial lamps, a complete line of battery lamps, miniature series multiple and candelabra lamps, ranging from ½ to 8 cp, and from 2½ to 125 volts.

Universal Ohmmeter and Faradmeter.

Hitherto, portable testing sets for the measurement of resistance and capacity, and for the location of crosses and grounds, have often been complicated, and frequently heavy. There has been a demand for a compact, simple, direct-reading set, by means of which the above-mentioned tests might be made with small expenditure of time and labor. A new set designed to meet this want has just been put on the market by Elmer G. Willyoung, 11 Frankfort Street, New York City. The set, which is called a "Universal Ohmmeter and Faradmeter," is shown in an accompanying cut. Its operation is founded upon the principles of the well-known slide wire bridge and may be explained as follows: In the central portion of the apparatus is a wire, divided for convenience into four sections. These sections are connected in series by means of heavy brass blocks, thus equivalating a single wire of a length of forty inches. This wire is stretched upon a scale graduated in two ways. Above the wire the scale is divided in such a manner as to give the value of an unknown resistance or capacity directly in ohms or microfarads, as the case may be. Below the wire the scale is divided in equal spaces, each of which is 1/1000 the total length of the stretched wire.

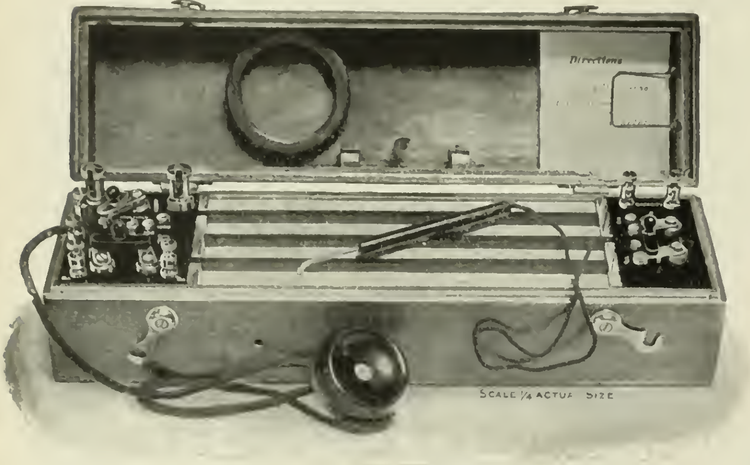
At the left of this central portion is a hard rubber block which carries binding posts for the insertion of an unknown resistance, also binding posts for receiving terminals of a telephone or galvanometer, and for the use of an outside battery if desired, although a battery sufficient for all ordinary purposes is contained in the base of the set.

Two switches are also provided on this end of the set. One, shown near the back, controls a variable resistance, which may be inserted as a standard with which to compare the value of an unknown resistance. The other switch, near the front, controls a small induction coil situated in the base of the set. By means of this switch, either a direct or a rapidly alternating current may be employed in making measurements.

At the right is a second hard rubber panel, carrying binding posts for the insertion of an unknown capacity. A double-throw switch is also shown, which is thrown toward the front for resistance measurements, and toward the back for measurement of capacity.

The simple operation of the set is as follows: Suppose a resistance is to be measured. It is inserted in the binding posts at the left of the set, the rheostat arm being placed at 1, 10, 100 or 1,000, according to the magnitude of the resistance being measured. The telephone is held to the ear, closing the battery key, which is located on the telephone, by pressing a button with the forefinger. The pointer is held in the other hand, and its end touched to one of the four sections of wire. If the double pole switch at the left of the instrument is toward the right, a continuous buzzing is produced in the telephone when the pointer touches the wire, except at one definite point. When this point is found, the reading of the scale directly underneath this point gives the value of the unknown resistance, if the rheostat be at 1 ohm. If the rheostat be 10, 100 or 1,000 ohms, the reading is to be multiplied by the corresponding value of the rheostat. As this is always a multiple of ten, the operation is exceedingly simple. With the controlling switch in opposite position, a click is produced in the telephone, instead of a buzz, except at the balance point. Results obtained are the same whichever method is used.

In the measurement of capacity, the unknown is inserted in the binding posts at the right, and having moved the switch shown at the right to the proper position, the value of the unknown is obtained in a manner exactly similar to the measurement of resistance. A standard capacity of 1/10 microfarad is contained in the base of the set, so that the reading of the scale directly under the balance point is to be multiplied by 1/10 to obtain the value of the unknown capacity.



OHMMETER AND FARADMETER.

Grounds and crosses may be located, using the ordinary loop tests, the circuit under test being connected as for the measurement of resistance. Open wires in a cable may be located by a measurement of the electrostatic capacity of the broken wire.

The use of an induction coil, giving an alternating current in the secondary, allows determinations to be made of the resistance of electrolytes. The electrolyte under test is held in a glass tube, provided with platinum electrodes. Connection is made to the set exactly the same as in the case of ordinary resistances.

A battery of four powerful dry cells is contained in the base of the set. This battery is controlled by a key located upon the telephone case, as already described. When not in use this key opens automatically the battery circuit. The telephone terminals may be removed, and any sensitive galvanometer may be substituted therefor, if desired, while any outside battery may be connected to the set if deemed necessary.

The induction coil provided is of special design, and free from liability to stick or to give trouble in any way. In case adjustment should be necessary a screw driver may be inserted through a hole in the side of the case, provided for this purpose.

The set is put up in polished mahogany case, provided with hinged cover, with patent clasps, and carrying handle. The complete set weighs only six pounds and measures 16¾ in. x 5 in. x 4½ in.

A set similar to the above is also made, but without the portion at the right, i. e., without the portion necessary for capacity tests. Otherwise the instrument is exactly the same and will make all resistance and loop tests. This latter set is called the Willyoung Universal Ohmmeter, and measures 14¼ in. x 5 in. x 4½ in., and weighs only five pounds.

When not in use the telephone and pointer are securely clamped on the inside of the cover of the case, but may be instantly removed when needed for service.

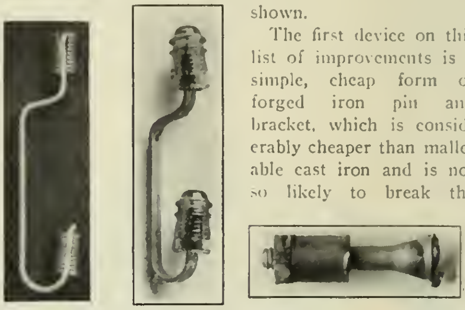
The instrument should be appreciated by everyone connected with the installation and maintenance of cables and aerial lines, the testing of field coils and armatures in dynamos and motors and any work where resistances and capacities are to be quickly and accurately measured. Resistances up to 200,000 ohms and capacities as high as 20 microfarads may easily be measured.

◆

Improvements in Insulator Brackets and Fastenings

It is perhaps too frequently thought that some of our present methods of line construction are the result of so many years of experience that but little improvement is possible. How untrue this is has been recently shown by some very decided and important improvements that the Chicago Telephone Company has been availing itself of with a great resultant saving in the labor connected with certain details of line construction, as well as greater reliability of the work when finished. These improvements were devised by C. L. Peirce, Jr., formerly of the construction department of that company. Mr. Peirce is now introducing these devices for use on all kinds of electric line work and their merits have created an immediate demand for them wherever shown.

The first device on this list of improvements is a simple, cheap form of forged iron pin and bracket, which is considerably cheaper than malleable cast iron and is not so likely to break the glass insulator screwed upon it. This consists simply of a piece of bar iron, galvanized and bent to the desired shape and having a slight bend on the tip (Fig. 1). Over this flat iron bracket, when an insulator is to be screwed on, is placed a split pin of wood with threads turned upon it. This wood is like the threaded part of an ordinary wood pin-sawed in two longitudinally. Before the insulator is screwed on, the wood split pin is in the position shown at the bottom in Fig. 1. As the insulator is screwed on, it draws these wooden pieces toward the bent tip of the bracket and wedges one half against the bent tip, as in the top pin, Fig. 1. The result is a very tightly screwed insulator, Fig. 2, but at the same time it is one that has the benefit of wood cushioning. This form of pin is covered by broad patent claims.



FIGS. 1, 2 AND 3.—INSULATOR BRACKETS.

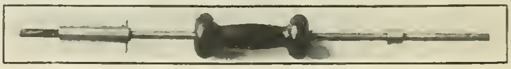


FIG. 4.—HAMMER DRILL.

The pins can be bent into any form of bracket, being simply bar iron, galvanized. They can be bolted to a wall or pole or to metal cross arms or distributing rings.

Having devised a more satisfactory form of bracket than the ordinary wood or malleable iron casting, the next step was to improve on the usual methods of fastening brackets to brick walls. Many expansion bolts have been devised, the principal objections to which have been the cost and multiplicity of parts. The Peirce expansion bolt, Fig. 3, consists simply of a galvanized bolt with tapered head and a lead washer made by cutting off a short section of lead pipe. The lead washer is tamped in around the bolt. A special tool has been devised for putting these bolts rapidly in a brick wall. This is shown in Fig. 4. The handle slides back and forth on the stock of the drill so as to give a hammer blow after the manner of a nail puller. The drill is turned slightly after each blow by hand. A hole deep enough for a bolt can be put in a brick wall in ten seconds. The bolt is put in the hole head first, and the lead washer slipped over the bolt. The lead washer is firmly driven and tamped into the hole in the space around the bolt by a hollow tool on the opposite end of the tool stock from the drill. A bolt can be put in a brick wall in twenty seconds, as against about as many minutes where a wooden plug is used in the old-fashioned manner. It was thought at first that the lead might slip out of the hole—unless the hole were made larger in diameter at the bottom than at the surface, but it was found that this is an unnecessary refinement, as the bolts will hold until they break off or until the brick pulls out of the wall, with a hole the same diameter throughout. The Chicago Telephone Company is using about 10,000 per month of the brackets described together with the new expansion bolts for brick walls, and it is finding a rapid introduction among other telephone and electric light companies. These devices are now made by C. L. Peirce, at Chicago.

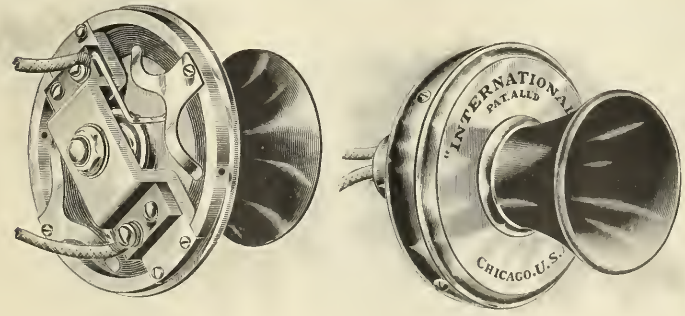
The International Telephone Transmitter.

A new and interesting form of telephone transmitter is that now being put upon the market by the International Telephone Manufacturing Company, of Chicago. The accompanying cuts show an exterior view and an interior rear view of this instrument.

The case is a little less than three inches in diameter and is properly proportioned and neat in design. The front is a heavy, nickel-plated brass casting on which are rigidly mounted all the working parts. The diaphragm is a flat metal disc and is provided with a rubber band around its edge to perfectly insulate it from the frame. The diaphragm is firmly clamped by two fork-shaped springs holding it evenly at four points, to leave the diaphragm with the greatest possible freedom for vibrating.

The carbon chamber is a very light metal cup mounted on the center of the diaphragm. The front electrode is spun into the bottom of the cup to leave no room for the granules to settle under its edge. The back electrode is mounted on a brass stud, which is provided with a washer and nut, to firmly clamp a mica ring. The outside of the mica ring is clamped by the rim of the light metal carbon chamber sealing the chamber perfectly.

The back electrode stud is set into a clamping device that is made in the form of a spring collet, allowing the electrode to be moved the slightest degree for adjusting, so that it can be firmly clamped without disturbing the adjustment.



FIGS. 1 AND 2.—TELEPHONE TRANSMITTER.

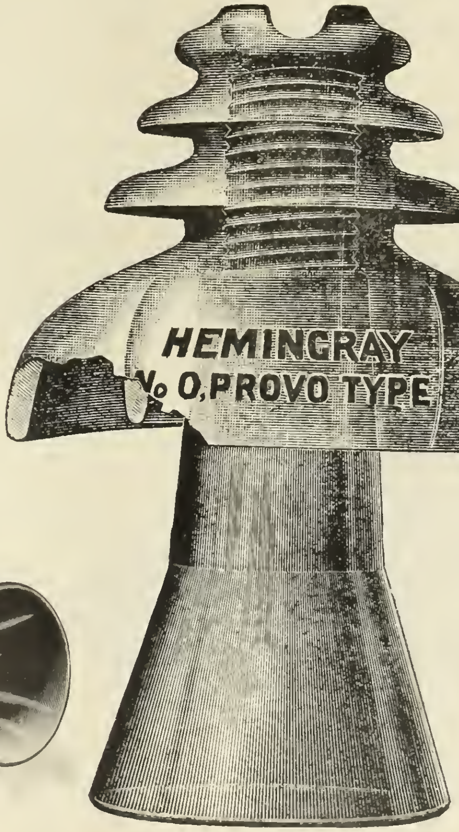
This adjustment clamping device is so arranged that it holds the electrode perfectly central with the diaphragm and obviates any indentation or side strain, which usually occurs from the side set screw. The adjusting device is set into a heavy, squarely-formed brass bridge from which it is properly insulated with hard rubber bushing and mica insulation. It is constructed very rigidly to avoid all possibility of throwing the instrument out of adjustment from heavy strains.

The circuit from the front electrode is taken from the diaphragm to an insulated block mounted on one side of the bridge and the circuit from the back electrode is taken from the back electrode stud to an insulated block on the other side of the bridge. These conductors are of light metal punchings, properly formed to make rigid and durable connections without being required to solder any joints of delicate wires. Both sides of the circuit are taken from the two terminals by insulated cord, through the arm to the terminal or induction coil, avoiding the use of any exposed parts of the transmitter frame or arm for any part of the circuit.

Every detail part of this instrument is made by a special compound sub-die to make all like parts absolutely uniform, and so that the instrument can be assembled without filing any part for fitting it. Any part becoming accidentally broken at any time can be readily replaced without returning the entire transmitter to the factory. The electrodes are of extra hard carbon, highly polished, and the granules are clean, hard granular carbon. The diaphragm is placed under the proper tension and the cup vibrates with the diaphragm, which keeps the granules agitated and live at all times, which is said to absolutely prevent "packing" or the instrument becoming out of order.

"Provo" Insulator.

In the insulator shown in the accompanying illustration the pin is surrounded by an insulating sleeve, which affords considerable additional insulation to the total, inasmuch as it keeps the pin dry and clean. This sleeve, however, is adapted only for a treated wooden pin, since with a pin of metal or other conducting material a high-tension current would bridge the space between the sleeve and pin.



INSULATOR.

Insulators of this construction have been in service on the Missouri River Power Company's transmission system a sufficient length of time to prove them to be satisfactory and reliable, and they are recommended by the manufacturer, the Hemingray Glass Co., Covington, Ky., for pressures ranging from 55,000 to 60,000 volts.

These insulators are 6½ in. high and 8½ in. diameter, and weigh 8 lb. 4 oz. each.

Combined Fan Guard and Deflector.

A notable improvement in connection with electric fans is being placed on the market by the Coleman Mfg. Co., 71 Cortlandt Street, New York. This consists of an arrangement whereby by means of a simple attachment to the guard, the current of air from the fan proper is successively directed through an angle which may be varied from 50 to 140 degrees.

Referring to the accompanying figures, and particularly to Fig. 2, it will be seen that a belt from the fan shaft drives a worm, which in turn gives motion to a worm wheel. A connecting rod pivoted to the latter gives a reciprocating motion to an arm rigidly connected to one of several vertical pivoted vanes, which motion is transferred to the other vanes by means of a rod or pitman loosely pivoted to each.

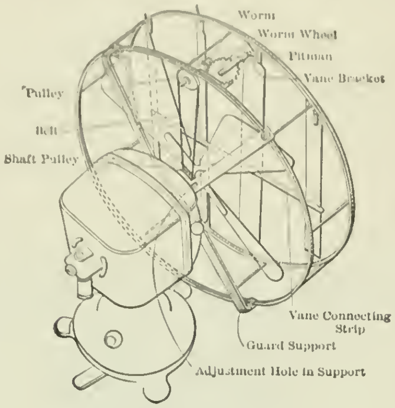


FIG. 1.—FAN GUARD AND DEFLECTOR.

The driving belt is a 1-16 in. rubber band. To change the angle of deflection it is merely necessary to readjust the connecting rod, which can be done with a screw driver. To change the rate of deflection, another pulley can be substituted on the worm gear. The guard is standardized to fit any of the ordinary makes of fans, to which it can be attached by any user. It is merely necessary to take off the old guard, then the fan, slip a small pulley on the shaft, replace the fan and attach the combined guard and deflector.

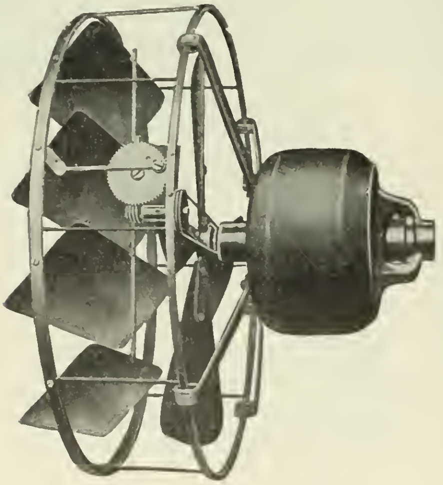
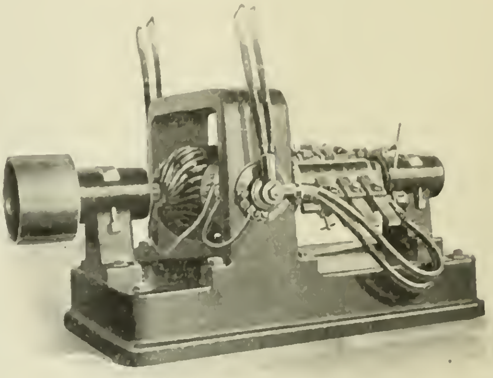


FIG. 2.—FAN GUARD AND DEFLECTOR.

A New Electrolytic Generator.

The rapidly increasing demand for low-voltage, heavy-current generators for plating, electrotyping and other varieties of electro deposition has led to the production of a line of machines designed to meet the severe requirements of modern service, one of the smaller sizes (of about 500 amperes) being shown in the accompanying cut. This line, which is now being put on the market by Charles J. Bogue, 213 Center Street, New York, is one of the most recent designed from start to finish solely with reference to the ability to produce rapid and heavy deposits, and to operate continuously. They are designed on a very ample scale and are all guaranteed to their rated load 24 hours a day without overheating or showing any of the ordinary symptoms of overload.



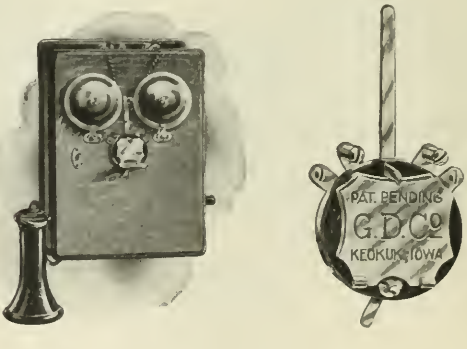
GENERATOR FOR ELECTRO-PLATING.

Their general appearance is perhaps familiar, but a careful redistribution of material has resulted in a "watt per pound" output in advance of previous results.

The machines are well built mechanically and are reliable in operation. They have been produced under the supervision of an engineer having an intimate acquaintance, extending over a long period, with the practical requirements of electroplating and electrotyping in all its branches and are a worthy addition to the well-known apparatus now made by Mr. Bogue.

Telephone Extension Closer.

A new model telephone extension closer for ringing a battery call bell is illustrated in cuts herewith, Fig. 1 showing the simplicity of the device and Fig. 2 showing it attached to the ordinary telephone magneto. The device is mounted on an electrose base, the metal parts being nickeled. A radical departure is made in employing the movement of the bell clapper, instead of the usual magnets, to release the drop shutter. There is a small switch provided, shown at the bottom of Fig. 1, which may be used to open the extension circuit so that the extension bell will not ring when the shutter falls. This device is known as the G-D Extension Circuit Closer, and is being manufactured by the Garton-Daniels Co., of Keokuk, Ia.



FIGS. 1 AND 2.—EXTENSION CLOSER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered with liberality, the rates at the close being easier at 4½ per cent. for 60 to 90 days and 4¾ a 5 per cent. for 4, 5 and 6 months. The stock market was dull, but showed increased firmness. Speculation, however, was narrow and public interest was very limited. General favorable railway earnings are noted, but the fact that net revenues for November and December suffered on account of the increase of wages and general expenses is an element which investors and the street at large have to take into consideration, there being, however, an idea that the increases in rates which went into effect about January 1 will produce better results as regards the current revenues. Otherwise the market presented few features of interest. The industrials were quiet, but some activity was shown in Amalgamated Copper, which was manipulated against the short interest. The United States Steel stocks were firm, but did not show any decided activity. Of the tractions, Brooklyn Rapid Transit was firm, closing at 67⅜, which is practically unchanged from the last quotation. On the other hand, Metropolitan Street Railway showed weakness and declined 2¼ points on sales of 23,375 shares, the closing price being 136½, which was ½ point better than the lowest figure, the highest being 139¾. Manhattan Elevated closed at 144½, ex-rights, which is a net gain of ¾ of a point. General Electric made a jump of 10 points, closing at 197, 1 point below the highest figure, the lowest quotation being 187½. The sales of this stock aggregated 14,160 shares. Westinghouse common closed at 215½, being a net gain of 1 point, and Western Union at 90, a net gain of ⅝. The Boston market was quiet with somewhat irregular prices, General Electric closing at 9 points higher and American Telephone & Telegraph 1 point lower. Following are the New York closing quotations of February 3:

NEW YORK.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
American Tel. & Cable	86	86	General Electric	191	192½
American Tel. & Tel	162	162	Hudson River Tel	..	..
American Dist. Tel	37	37	Metropolitan St. Ry	138½	137¾
Brooklyn Rapid Transit	68	67⅞	N. E. Elec. Veh. Trns	..	3/16
Commercial Cable	..	..	N. Y. & N. J. Tel	161	162
Electric Boat	23	20	N. Y. E. V. T. Co	10	10
Electric Boat pfd	30	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3	Western Union Tel	90	89¾
Electric Vehicle	7⅞	7	Westinghouse com	215½	214
Electric Vehicle pfd	12½	12½	Westinghouse pfd	220*	210

BOSTON.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
American Tel. & Tel	162	161½	Western Tel. & Tel. pfd	99½*	98
Cumberland Telephone	..	..	Mexican Telephone	2	2¼
Edison Elec. Illum	*277½	..	New England Telephone	135	137
General Electric	192½	..	Westinghouse	107	106
Western Tel. & Tel	24	24	Westinghouse pfd	108	107

PHILADELPHIA.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
American Railways	..	..	Phila. Traction	98¼	98
Elec. Storage Battery	80½	..	Phila. Electric	8¼	7⅞
Elec. Storage Battery pfd	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9¼	9⅛	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Jan. 27.	Feb. 3		Jan. 27.	Feb. 3
Central Union Tel	..	..	National Carbon pfd	98	98
Chicago Edison	165	162¼	Northwest Elev. com	..	..
Chicago City Ry	228	235	Union Traction	12	9
Chicago Tel. Co	..	158	Union Traction pfd	45	40
National Carbon	20	21			

*Asked.

ELECTRIC VEHICLE AFFAIRS.—The activity in the securities of the Electric Vehicle Company is accounted for partly by increased business that has resulted from the company's exhibit at the automobile show and partly by the new revenue accrued from royalties paid by rival concerns for licenses to infringe on some of its different patents. It is estimated that the company received $150,000 new business at the automobile show. With regard to royalties an interesting situation has developed. For a considerable time, says the *Wall Street Journal*, several rival companies have been infringing on a number of important patents held by the Electric Vehicle Company, not only for the manufacture of automobiles but of automobile parts as well. The company took action to protect its patents and in 1901 obtained decisions against the Winton Motor Car Company and the Buffalo Gasoline Motor Company—the former being well known—for alleged infringement. No other important litigation took place, but since then the company has been quietly impressing upon infringing companies the advisability of coming to time, with the result that fully a dozen large automobile manufacturers besides many manufacturers of automobile carts are now paying it handsome royalties. Action is also being taken against importers whose machines infringe on the company's patents and a week ago a suit was brought against Smith & Mabley, of New York City, importers of French and German cars.

CENTRAL UNION TELEPHONE COMPANY.—According to the annual report just out, the net profits of the Central Union (Bell) Telephone Company for the year ended December 31, 1902, were $180,345, or approximately 3.3 per cent. on the present outstanding capital of $5,437,902. President Sabin, in presenting the figures, announced: "Your directors believe that the sum shown as net revenue should, in the interests of conservative management, be credited to line repair and maintenance." The company issued no balance sheet, but the following revenue statement was presented:

REVENUE.

	Dec. 31, 1901.	Dec. 31, 1902.	Increase.
Subscribers' rentals	$1,716,341	$2,041,608	$325,267
Toll revenue	710,011	800,784	90,773
Miscellaneous revenue	158,437	161,325	2,888
Totals	$2,584,789	$3,003,717	$418,928
Expenses:			
For administration, taxes, operating and maintenance	$1,973,501	$2,341,989	$368,488
Operating profits	$611,288	$661,728	$50,440
Less interest, including interest on bonds	386,762	481,383	*94,621
Net profits	$224,526	$180,345	$44,181

* Decrease.

THE AMERICAN DE FOREST WIRELESS TELEGRAPH COMPANY was incorporated on January 5th at Kittery, Me., with a capitalization of $5,000,000, $500,000 of which is preferred cumulative and participative. The company is to operate under the patents of the De Forest Wireless Telegraph Company, throughout the United States and Porto Rico. The following is a list of the directors: Dr. Lee De Forest, Ph. D. Yale, scientific director; A. White, President Greater New York Security Company; Ferdinand W. Peck, capitalist, Chicago, Ill.; Henry Doscher, capitalist, Standard Terra Cotta Company; C. C. Galbraith, manager, Armour & Co.; W. N. Harte, Title Guarantee & Trust Company; M. M. MacRae, Strawbridge & Clothier, Philadelphia, Pa.; Clarence G. Tompkins, Berkshire Electric Company; Dr. Samuel V. Abel.

DIVIDENDS.—The Westinghouse Electric Manufacturing Company has declared the regular quarterly dividend of 1¾ per cent. upon the assenting stock, payable February 16. The American Graphophone Company has declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 16. The Butte Electric & Power Company has declared a quarterly dividend of 1¼ per cent. on the preferred stock, payable February 2. The New England Telephone & Telegraph Company has declared a regular quarterly dividend of 1½ per cent., payable February 16. The Boston Elevated Railway Company has declared a regular semi-annual dividend of 3 per cent., payable February 16.

BELL TELEPHONE SOUTH.—The Cumberland Telegraph Company is preparing to spend $1,000,000 on improvements and new lines in Louisville. The growth of its business has been wonderful notwithstanding an independent company is now in the field. The Cumberland, which is a Bell property, has 20,000 local subscribers, and is building two new exchanges in the eastern and western districts of the city. It is rapidly extending its lines all over the State and the South.

DETROIT EDISON BONDS.—Spencer Trask & Co. are now offering $1,800,000 of Detroit Edison Company's first mortgage 5 per cent. gold bonds at 104 and accrued interest to date of delivery, figuring out 4¾ per cent. The company's business shows an interest charge for 1903 of only one-half the actual net income for 1902, and 40 per cent. of the estimated net revenue for 1903. The new station of the company will have an initial capacity of 12,000 kw, in turbo-generators.

LOUISVILLE TROLLEY IMPROVEMENT.—The Louisville (Ky.) Railway will spend $1,000,000 this year in building interurban lines and in other improvements. An addition will likely be made to the power house at a cost of $300,000, and about 50 to 100 new and modern cars will be ordered, a part of them being already under construction. The money will be raised by selling new stock at par, in all probability.

CHICAGO TELEPHONE COMPANY.—Note was recently made in this department of the growth of the Chicago (Bell) Telephone Company. According to President Sabin's annual report, just out, earnings of the company for the year were equal to 10.02 per cent. on the present outstanding capital, which, in the course of the year, was increased by $2,332,078. The comparative showing of revenue and expenses follows:

	1901.	1902.
Gross revenue	$3,775,001	$4,570,805
Gross expenses (operation, taxes, maintenance, and reserve for deferred maintenance)	2,691,129	3,368,334
Net earnings	$1,083,872	$1,202,471
Dividends	960,000	1,075,192
Surplus for year	$123,872	$127,278

		Per cent.
Gross increased	$795,804	21.07
Expenses increased	677,205	25.16
Net increased	118,599	19.42

The company has had a prosperous career under Mr. Sabin's management. He is the originator of the nickel telephone and the measured service system, and, owing to these innovations, the number of telephone stations in the last two years has increased from 36,414 to 79,043 at the end of last year.

SOUTHERN NEW ENGLAND TELEPHONE.—The Southern New England Telephone Company's annual report for year ended December 31, 1902, compares as follows with previous year:

	1902.	1901.	Changes.
Gross	$919,556	$813,062	Inc. $106,494
Expenses	746,812	652,755	Inc. 94,057
Net	$172,744	$160,307	Inc. $12,437
Dividends	172,500	161,865	Inc. 10,635
Surplus	$244	Def. $1,558	Inc. $1,802
Total surplus	73,576	73,331	Inc. 245

Instruments outstanding increased 3,546, making a total of 21,110.

Commercial Intelligence.

THE WEEK IN TRADE.—Trade developments in January, according to *Bradstreet's*, confirm the sanguine expectations and predictions made at the beginning of the month. Wholesale and jobbing trade in spring dry goods and other wearing apparel is steadily improving and the business at leading cities East and West is the best ever recorded in that month. Among the industries the activity of the recent past continues unabated. The car shortage probably increases rather than grows better. Smaller than expected movements of grain and lumber to market, of fuel from producing centers to consumers and of general merchandise from wholesalers and jobbers to retailers are reported the country over. Preference is still being given to coal shipments, and some railroads are reported refusing all dead freight outside of fuel. Iron and steel production is at its highest point, despite fuel and car shortages, and prices are higher. Activity in lumber is also noted throughout the entire country. While buyers of domestic iron are rather slow to come forward, foreign supplies sell quite freely. December imports of iron and steel were very large. Copper is strong and shows a steadily advanced tendency. Large sales are rumored. The closing quotations were 12½ a 12⅝c. for Lake, 12⅜ a 12½c. for electrolytic in ingots, wire bars and cakes; 12⅛ a 12¼c. for cathodes and 12¼c. for casting stock. The business failures for the week ending January 29, as reported by *Bradstreet's*, numbered 230 against 253 the week previous, and 303 the corresponding week of last year.

UNITED STATES EXPORT TRADE.—The export trade of the United States has resumed its normal and expansive condition. From the low figure due to the failure of the corn crop last year and the unusual demand at home, the export figures have increased from $88,000,000 in June to $148,000,000 in December, and reached the highest mark ever made by exports in the month of December. June, July and August of the year 1902 were the only months since August, 1899, in which the export figures fell below the $100,000,000 line, and this was due to the causes above indicated. On the import side the figures are equally suggestive of growth. The December imports are larger than in any preceding December in the history of our import trade, being $94,307,204, against $79,929,271 in December, 1901, and $68,697,297 in December, 1900, and larger than in any preceding month except April, 1897, when the imports were abnormally large by reason of the approaching change in tariff. Importations free of duty are $40,663,113 against $29,145,669 in December, 1900, indicating that the increase is chiefly in manufacturers' material, which form the bulk of the nondutiable articles. The total imports for the year ending with December are far in excess of any preceding year, being $969,270,009, against $880,419,910 in 1901, $829,149,714 in 1900, $823,397,726 in 1890, $696,807,176 in 1880, and $461,132,058 in 1870. The importations of 1902 are $88,850,099 greater than in the preceding year, of which increase over $60,000,000 was in manufacturers' materials.

ELECTRICAL EQUIPMENT FOR MALAY SMELTING WORKS.—The Straits Trading Company, of Singapore and Penang, which operates at the latter place the largest smelting works in the old world, has ordered through Bagnall & Hilles, Yokohama, considerable American equipment. An extensive cable system is to be installed. Three endless cables have been ordered from the American Steel Cable Company, of San Francisco, Cal. Two of the cables will each be operated by a similar number of 10-hp motors of General Electric Company's manufacture. The third cable is to be worked by a 25-hp General Electric motor. The works will be operated throughout by electricity. For lighting use, two 25-kw Sprague dynamos will be installed. The engines are to be of Ames make.

ANOTHER MEXICAN WATER POWER PROJECT.—Guillermo Brockman, of the City of Mexico, has been granted a concession by the Mexican authorities for the purpose of constructing hydraulic works to utilize the storm waters of the Tlalpujahua River, located in the districts of Iscthlahuaca and Maravatio, in the States of Mexico and Michoacan, in that part of the river's course comprised between its source and the point called Cruz Blanca. The franchise permits of the water being used either directly for the production of motive power on the spot or for conversion into electric energy and transmission to a distance.

THE ELECTRIC CARRIAGE CALL COMPANY, 1402 Broadway, New York City, have closed through their Washington agent, the National Electric Supply Company, a contract for installing their admirable system at the White House. The matter has been thoroughly investigated and it is found that this is the only means to abolish the confusion and annoyance experienced so often outside the Executive Mansion, at the various receptions there. Inquiries have recently reached the New York offices from Johannesburg, South Africa, showing that business and pleasure are becoming more active in that part of the world.

CONTRACTS PENDING FOR CANADIAN WATER POWER PLANT.—The Rainy River Pulp & Paper Company has secured a water power on Sand Island River, located a few miles north of Mine Centre. The water power has a 16-ft. fall and is estimated to be capable of developing 1,800 hp. The men primarily interested in the undertaking are Hon. Geo. E. Foster and W. J. Elliott, of Toronto; William Blackwood and R. M. Simpson, of Winnipeg, and William A. Preston and Louis Hamel, of Mine Centre. Contracts for equipment, etc., are expected to be let very shortly.

THE OTIS ELEVATOR COMPANY reports the following contracts recently closed: North German Lloyd Steamship Company, Hoboken, N. J., ten electric passenger elevators; Kean Van Cortlandt & Company Building, 28 to 32 Pine Street, four hydraulic elevators; Hotel Willard, Washington, D. C., four hydraulic elevators and two electric elevators, and the Belvidere Hotel, Baltimore, Md., seven plunger elevators with a car travel of 160 feet.

SPANISH ACTIVITY.—The late Spanish-American war seems to have impressed upon the engineers of the Spanish Government the need of adopting the most modern methods in the manufacture of munitions of war. It is installing Westinghouse motors in its gun shops at Trubia, and the arsenal at Ferrol is also shortly to be equipped with a number of motors and other electrical machinery.

PERUVIAN WATER POWER PLANT.—The Empresa Electrica de Santa Rosa, of Lima, Peru, has placed a contract with the Pelton Water Wheel Company, 143 Liberty Street, New York, for two wheels capable of developing 2,000 hp, to be direct-connected to General Electric generators. The Pelton people have also taken a contract for 2,100 feet of 60-inch pipe.

TURBINES FOR VENEZUELA.—Eduardo S. Larralde, an extensive sugar and coffee planter from Caracas, Venezuela, is now in New York for the purpose of purchasing considerable equipment, including some small water turbines. He can be reached care of the Export Club of Mexico, 82 Wall Street.

AMERICAN CONDUIT FOR ST. PETERSBURG.—The American Vitrified Conduit Company, 170 Broadway, will manufacture the major portion of the conduit to be installed in St. Petersburg, Russia, in connection with the new municipal telephone system.

MEXICAN HYDRAULIC PROJECT.—Jose A. Camarena, of the City of Mexico, has been granted a franchise for the purpose of utilizing 1,000 liters of water per second from the River Tenchitlan, located in the State of Jalisco, Mexico.

NORTH EASTERN RAILWAY CONTRACT.—It will interest our readers to know that some of the contracts for the electrification of about 40 miles of one of the Newcastle branch lines of the North Eastern Railway have now been given out. The British Thomson-Houston Company, of Rugby, has been awarded the contract for the permanent way and rolling stock, though the contract for the high-tension cables and the sub-stations has not yet been placed. The work on this railway is all the more interesting, as when completed this will be the first section of an established steam railway to have been converted to electrical operation, the attendant results of which will be most important as foreshadowing the history of all steam railways in the not very far distant future. The British Thomson-Houston Company will most probably use an 80-lb. third rail for the positive side of the circuit, and will bond the joints in the existing track rails for the return circuits. Under this contract are included all the low-tension cables required to connect the bus-bars of the sub-station with the third rail along the track and all switching devices, sectionalizing pillars, etc. The contract for the rolling stock consists of the electrical equipment of 50 motor cars and 50 trail cars. Each motor car equipment will consist of 2 G. E. 66 motors, 1 C. P. 14 air compressor, 1 complete equipment of the British Thomson-Houston master train control. This apparatus is somewhat similar to that which the British Thomson-Houston Company have supplied for the Central London Railway and the Great Northern & City Railway. They are also supplying one motor truck and one trailer truck for each of the motor cars, and the contract includes two complete electric locomotives, with 40 tons weight on the drivers. Each of these locomotives will be equipped with four G. E. 55 motors, and one C. P. air compressor, and complete master train control equipment, similar to that used on the motor cars. The entire air brake gear for the locomotives will also be supplied by the British Thomson-Houston Company. The lines at Newcastle of the North Eastern Railway to be equipped consist of two miles of four-track line, about 35 miles of double-track line, and 5 miles of single-track line, including the sidings, etc. For the operation of the system power will be taken from the Newcastle Electric Supply Company.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week just ended: Antwerp—25 pkgs. material, $1,375. Argentine Republic—175 pkgs. material, $4,915. Arnheim—1 pkg. machinery, $20. British Guiana—12 pkgs. material, $783. British Australia—49 pkgs. machinery, $5,000. British Possessions in Africa—30 pkgs. material, $1,502. British West Indies—8 pkgs. material, $94. Barcelona—3 pkgs. machinery, $203; 18 pkgs. material, $500. Bristol—75 pkgs. machinery, $5,100. Berlin—2 pkgs. machinery, $125; 5 pkgs. material, $500. Copenhagen—17 pkgs. machinery, $1,520. Cadiz—3 pkgs. machinery, $600. Chili—11 pkgs. material, $759. Colombia—42 pkgs. material, $339. Cuba—50 pkgs. material, $915. Central America—26 pkgs. material, $536. Dutch West Indies—9 pkgs. material, $91. Egypt—45 pkgs. material, $688. Genoa—1 pkg. machinery, $40; 1 pkg. material, $50. Hamburg—69 pkgs. material, $2,954. Havre—25 pkgs. material, $1,270; 2 pkgs. machinery, $20. London—16 pkgs. machinery, $1,095; 159 pkgs. material, $8,451. Liverpool—518 pkgs. machinery, $11,569; 49 pkgs. material, $1,840. Lisbon—7 pkgs. material, $104. Mexico—47 pkgs. material, $1,062; 2 pkgs. machinery, $300. Manchester—5 pkgs. machinery, $2,581. Newfoundland—2 pkgs. material, $32. Naples—1 pkg. material, $75. Newcastle—8 pkgs. machinery, $915. Peru—9 pkgs. machinery, $211. Rotterdam—24 pkgs. machinery, $906. Stockholm—1 pkg. material, $795. San Domingo—3 pkgs. material, $34. Northampton—138 pkgs. material $986; 2 pkgs. machinery, $200. Trieste—2 pkgs. machinery, $100. Uruguay—9 pkgs. machinery, $611. Vienna—1 pkg. machinery, $60.

THE RONEY MECHANICAL STOKER maintains its popularity as an important factor in steam plant operation. A few recent stoker orders comprise: North Jersey Street Railway Company and Jersey City, Hoboken & Paterson Street Railway Company, 12 quadruplex stokers for plant extensions aggregating 6,250 hp; Indianapolis Street Railway Company, 12 duplex and quadruplex stokers for 4,200-hp B. & W. and Zell boilers; Indiana, Lebanon & Frankfort Railway, 12 duplex stokers for 3,000-hp plant of Stirling boilers; Utah Light & Power Company, Salt Lake City, 6 duplex stokers for a lighting plant containing 1,250-hp Heine boilers; Phœnix Iron Company, 6 quadruplex stokers, for rolling mill plant, fifth order, 2,700-hp extension, Heine boilers; Schlitz Brewing Company, Milwaukee, 4 duplex stokers for plant extension, 600-hp horizontal return tubular boilers; Youngstown (Ohio) Consolidated Gas & Electric Company, third order, quadruplex stokers for central lighting, railway and power plant, 1,050-hp B. & W. boilers; American Locomotive Works, Schenectady, central power station, fifth order, 700-hp Heine boilers, quadruplex stokers; Carnegie Steel Company, sixth order, 500-hp Aultman-Taylor horizontal boilers for pumping station, duplex stokers; Rhode Island & Suburban Railway, plant extensions, quadruplex stokers, 1,050-hp B. & W. boilers, 12,000 hp ultimate; Pennsylvania Railroad, Altoona, Juniata Shops, quadruplex stokers for Sederholm boilers; Pressed Steel Car Company, seventh order, duplex stokers, Aultman-Taylor horizontal boilers, 1,000 hp, new power plant; Hartford Carpet Corporation, Thompsonville, Conn., new plant, 760-hp Aultman-Taylor horizontal boilers, quadruplex stokers.

ELECTRICAL SUPPLIES FOR ABROAD.—The Manhattan Electrical Supply Company, 32 Cortlandt Street, New York, has lately taken some substantial orders for its various specialties for shipment to South American countries and China, the orders for the latter country having come principally through Wilhelmi & Co., 116 Broad Street. The Guanajuato Power & Electric Company, which is to build a 5,000-hp water power plant on the River Duero to generate energy for transmission to the city of Guanajuato, Mexico, 110 miles distant, has placed a contract with the Manhattan people for a large lot of construction material. Domestic orders recently secured include substantial ones for dry-cell batteries for telephone systems. The New York department stores have also been ordering quite a quantity of medical batteries lately.

MORE AMERICAN EQUIPMENT FOR DURBAN ROAD.—The British electrical engineering and contracting firm of Macartney, McElroy & Company, through its New York offices in the Havemeyer Building, has let contracts for further American equipment for the Durban (South Africa) municipal electric traction system. Some 35-hp double motor equipments have been ordered from the General Electric Company. The J. G. Brill Company, of Philadelphia, has been allotted another order for trucks. Two hundred and fifty car seats have also been contracted for. The Heywood Brothers & Wakefield Company, of 129-135 Charlton Street, New York, and Hale & Kitchin, of Philadelphia, Pa., got the orders. Two compressors for use in connection with the power house are about to be ordered.

MINING CONTRACT FOR MEXICO.—The Terrenates Consolidated Mining Company, of Parral, Mexico, has contracted with the Denver Engineering Works, of Denver, Colo., for the installation of a complete plant for the transmission of 600 hp, to be used for the operation of hoisting and pumping machinery, in the celebrated Terrenates mines of the company. De Laval steam turbine generators will furnish the current, which is conveyed about one and one-half miles by aluminum conductors to the hoists and pumping stations. The work will all be under the direction of Mr. Frank B. Rae, 52 Broadway, New York, consulting engineer for the Terrenates Company.

CONTRACTS PENDING FOR MEXICO.—The Compania Tabasquena Electro-Motriz Sociedad Anonima—the Tabasco Electro-Motor Company, Limited—has just been organized in San Juan Bautista for the purpose of furnishing current to light that Mexican city, which has a population of about 10,000. The charter was granted by the municipal authorities to Senor Manuel Gabricio. The capital of the concern is $150,000. The directors are Gonzalo Ramos Alfonso Jose Bulnes Tavares, Jose Gonzales Lamadrid, Jose Bulnes Villavicencio and the concessionaire, all located in San Juan Bautista. Contracts for equipment, etc., will be let very shortly. It is expected that the plant will be completed May next.

A RUBBER-ASBESTOS CABLE CODE.—The International Cable Directory Company, at the request of manufacturers and dealers in rubber, asbestos, packing, belting, etc., has compiled and published a supplement to the Western Union Telegraphic Code, intended for the use of those engaged in these branches of industry. Every known technical term used in the different lines is embodied in the book. The book comprises 200 pages and 25,000 terms and phrases, and contains a list of the leading rubber manufacturers and dealers, together with their registered cable addresses and code words to represent the titles of the companies and firms.

THE NORDEN-BITTNER ELECTRIC COMPANY has been awarded the contract for the electrical display and decoration for the Arion ball, which is to be held at Madison Square Garden February 6, 1903, by Mr. F. Hildebrandt, chairman of the Decorative Committee of the Arion Society. The Norden-Bittner Electric Company is the inventor of the Norbitt specialties, as manufactured by the Crouse-Hinds Electric Company, which is the sole manufacturer and licensee.

RUSSELL ENGINES FOR JAPAN.—The Russell Engine Company, of Massillon, Ohio, is about to make a shipment of engines to Japan for a Yokohama electric lighting plant. The order was secured through Bagnall & Hilles, Yokohama, whose Mr. Hilles is still visiting the United States, and may be found at the offices, 114 Liberty Street, of the New York Insulated Wire Company.

ORDERS FOR BALL ENGINES.—The Detroit Iron & Steel Company, Detroit, Mich., is installing three 350-hp horizontal direct-connected units. The Ball Engine Company, Erie, Pa., furnish the engines. The Charles City Lighting & Heating Company, of Charles City, Iowa, is about to install two direct-connected units of 600 hp capacity. The Ball Engine Company will build the engines.

General News.

THE TELEPHONE.

LOS GATOS, CAL.—The Saratoga Mutual Telephone Company has been organized here. R. A. Husted is president and J. T. Richards secretary and treasurer. The company will begin construction work at once.

WASHINGTON, D. C.—The Chesapeake & Potomac Telephone Company, of Washington, has awarded to Richardson & Burgess, of this city, the contract for the erection of a new telephone building on Twelfth St., between G and H Sts. Rapid progress is being made in placing all wires underground in the northwestern section of the city. About 200 poles and 800 miles of overhead wire are to come down.

LAKE CITY, FLA.—The Whetstone Telephone Company has been incorporated by L. F. Whetstone, R. W. Adams and others. Capital $10,000.

FORT MYERS, FLA.—The Indian River Telephone Company, with a capital of $5,000, has been incorporated by W. H. Harris, Geo. E. Coon and others.

BELVIDERE, ILL.—The Belvidere Independent Telephone Company is about to build a toll line to connect with the new independent system at Rockford, thus giving subscribers connection with numerous points in northern Illinois. During the past year, the local company has installed 10,000 feet of cable and built 16 miles of toll line. It now has 700 subscribers, at rates of $12 and $24.

VERNON, IND.—The stockholders of the Naylor & Vernon Telephone Company have organized by the election of the following officers: President, W. R. Naylor; secretary, C. L. King; treasurer, M. Crosby.

BETHEL, IA.—A telephone company has been organized in Post township. E. Swenson is president.

GARNER, IA.—The Hancock County Rural Telephone Company has been incorporated by Thos. Duff, C. M. Gowdy and others.

GEORGETOWN, KY.—The exchange room of the Georgetown Telephone Company was wrecked by an explosion recently. A box containing dynamite for blasting post holes had been left in the office. Several of the operators were injured.

SPRINGFIELD, MASS.—A number of business men from Springfield have visited and examined the automatic exchange system at Fall River. The mayor was one of the party which went under the guidance of Dean & Shibley, of Providence, who may finance the Hampden Automatic Telephone Company, of Springfield. A very favorable opinion seems to have been formed of the working of the system.

ST. PAUL, MINN.—The Star Telephone Company of New Market, Scott County, has been incorporated with a capital of $50,000. The incorporators are P. J. Welter and J. N. Sanford, of New Market, and Henry Sprain, of Webster.

JACKSON, MISS.—The Rural Telephone & Telegraph Company, of Panola County, has been incorporated with a capital stock of $5,000.

NATCHEZ, MISS.—A franchise has been granted the Cumberland Telephone Company in Natchez, Miss., on condition that several long distance connections shall be built and that present rates shall not be increased.

PRINCETON, N. J.—The Automatic Telephone Company, of Princeton, N. J., is installing its new automatic switchboard of 1,000 capacity and 150 telephones installed, which it recently purchased from the Automatic Electric Company, of Chicago. A number of years ago the Princeton Company entered the telephone field with an automatic switchboard and fifteen stations connected up. The service grew in public favor until the ultimate capacity of the board, which was 100 stations, was exhausted, at which time the management gave the manufacturers an order for an entirely new outfit.

SCHENECTADY, N. Y.—The Home Telephone Company has begun its service and has 275 telephones connected up.

KINGSTON, N. Y.—The Deep Notch Telephone Company, of Kingston, has increased its capital stock from $500 to $5,000.

ELMIRA, N. Y.—The York State Telephone Company, which recently bought the Binghamton Telephone Company's plant, has elected officers for the ensuing year as follows: President, W. D. Barnard, Philadelphia; vice-president, Edward Davis, Philadelphia; secretary and treasurer, Robert M. Dougal, Philadelphia; directors: S. L. Johns, McSherrytown, Pa.; Boyd McDowell, Elmira; Ward R. Bliss, Chester, Pa.; W. D. Barnard, St. Davids, Pa.; Ellis L. Orvis, Bellefonte, Pa.; R. G. Parke, Philadelphia; Meade D. Detweiler, Harrisburg, Pa.; T. B. Crary, Binghamton; H. H. Light, Lebanon, Pa.; Eli S. Rheinhold, Mahanoy City, Pa.; E. M. Yarnell, Philadelphia; C. M. Clement, Sunbury, Pa.; Edward Davies, Philadelphia; G. R. Van Allen, Northumberland, Pa.; E. M. Leader, Shamokin, Pa.; W. A. Thompson, Coatesville, Pa.; S. P. Light, Lebanon, Pa.; Eugene Diven, Elmira. Directors of the Elmira Telephone Company were re-elected.

REIDSVILLE, N. C.—The stockholders of the Reidsville Telephone Company have elected G. D. Williams, president. A 10 per cent dividend was declared.

ASHEVILLE, N. C.—According to a recent report it is probable that the Asheville Telephone Company holds the world's record for the percentage of subscribers as compared with the population, there being one subscriber to every thirteen inhabitants.

BLOOMDALE, OHIO.—Claude Wygandt, of Toledo, has been granted a telephone franchise in this place.

DEFIANCE, OHIO.—The Northwestern Toll Line Company has increased its capital stock from $20,000 to $50,000.

McCOURT, OHIO.—The Council has granted a franchise to M. Cotterman, of Deshler, for a telephone exchange in this place.

BARBERTON, OHIO.—The Farmer's Telephone Company will build a line into Barberton to connect with the local exchange.

MECHANICSBURG, OHIO.—The Mechanicsburg Telephone Company has increased its capital stock from $[illegible],000 to $35,000.

WAYNESFIELD, OHIO.—The Anglaize Telephone Company has increased its capital stock from $5,000 to $15,000. Harper Stiles is president.

BUCYRUS, OHIO.—Arrangements have been perfected by the Bucyrus Telephone Company for the construction of a new rural line on the Wyandot road.

MARION, OHIO.—The United States Telephone Company (long distance) is building a toll line from Marion to Bucyrus, connecting the exchanges in both places.

NORWALK, OHIO.—A number of prominent business men have formed an association and decided to use only one telephone system. The company that offers the best terms and service will get the contracts of all.

WAPAKONETA, OHIO.—The Minster Home Telephone Company has opened for business with about 70 telephones. The Minster exchange has complete connection with the different independent exchanges in this part of the country.

BELLEVUE, OHIO.—The Flat Rock Telephone Company has elected these officers: C. C. Pfund, president; E. F. Leinhard, vice-president; W. H. Gardner, treasurer; T. E. Wyant, secretary, and S. D. Huff, general manager.

MARTIN'S FERRY, OHIO.—The Belmont Telephone Company has elected the following named directors: J. C. Dent, J. B. Driggs, J. C. Heinlein, A. J. Heinlein, C. L. Weems, E. G. Smith, Henry Schulback and J. W. Doudna.

FITCHVILLE, OHIO.—The Clinton Line Telephone Company has been organized and will install a farmer's community system. Connection will be made with the exchange at New London. E. K. Jennings is president of the company.

OTTAWA, OHIO.—The Farmers' Mutual Telephone Company and the Ottawa County Home Telephone Company are preparing to install systems in the town under the provisions of franchises recently granted. It is the plan to consolidate the exchanges in that vicinity.

WESTON, OHIO.—The Weston Home Telephone Company has reorganized with the following named officers: D. E. Lasbley, president; G. B. Spencer, treasurer. The above, with George Potter, Howard Kline, W. A. Dewese, S. A. Murphy and Milton Dunbridge, are directors.

AKRON, OHIO.—The Akron People's Telephone Company has elected these directors for another year: Will Christy, J. R. Nutt, H. C. Lang, C. W. DeVoe, R. M. Pillmore, P. R. Iredale. The report of the secretary indicates that the company gained 602 telephones during the past year.

RAVENNA, OHIO.—The Ravenna Home Telephone Company has elected the following named directors: President E. R. Taylor; secretary, H. L. Beatty; treasurer, W. S. Krake, W. W. Stevens, C. H. Pitkin, C. C. Byers, J. F. Babcock. The company is planning to enlarge its exchange.

WESTON, OHIO.—The Standard Telephone Company, capital $100,000, has been incorporated by W. D. Mudge, Azor Thurston, Merton Bamer, Sumner Cottingham and others. The company has absorbed exchanges at Weston, Grand Rapids and Deshler. It will extend its lines throughout Ottawa, Lucas, Seneca, Putnam, Paulding, Fulton, Defiance, Henry and Williams counties.

WAPAKONETA, OHIO.—The Peninsula Telephone Company, which is building an exchange at Tampa, Fla., is planning for the construction of exchanges in several other towns in that State. Senator W. G. Brorein, J. H. Cooke, Guy Hoffman and S. A. Hoskins, of this city, are at the head of the company.

DELAWARE, OHIO.—The Delaware Citizens' Telephone Company has elected the following named officers: W. M. Heseltine, president; W. G. Hormell, vice-president; G. H. Carter, secretary, and F. P. Hills, treasurer. The above, with C. D. Young, W. G. Jones and W. B. Hedges, are directors. The company has increased its capital stock from $60,000 to $100,000, and is planning a number of extensions and improvements.

PITTSBURG, PA.—A new independent telephone company, backed by Eastern capital, is to tap Pittsburg and erect a network of lines in adjoining counties of Western Pennsylvania and a trunk line to the East. The company will soon be chartered in Pennsylvania as the Union Telephone and Telegraph Company, with a capital of $3,000,000.

VIBORG, S. D.—The Viborg and Centerpoint Telephone Company has been incorporated with a capital of $10,000. M. V. Olsen is president and F. L. Larson secretary. It is their intention to build a line to Centerpoint from Viborg and also to run rural lines in all directions from these two places.

MEMPHIS, TENN.—The Memphis Telephone Company will expend between $200,000 and $400,000 in new lines in the territory tributary to Memphis.

MANCHESTER, VA.—Negotiations are on foot for a consolidation of the Southside Telephone Company, of Manchester, and Chesterfield, Va., with the Southern Bell Company.

RICHMOND, VA.—An important bill has been introduced in the State Legislature to require telephone companies to connect with other telephone lines and to transmit messages originating on other lines at the same rates charged their own subscribers. The bill if enacted will give small independent lines connection with the Bell Company's lines and will enforce telephone cooperation. The bill will be strongly opposed.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will expend $650,000 in building lines in the Superior district.

MADISON, WIS.—The Platteville, Rewey & Ellenboro Telephone Company has changed its headquarters from the town of Lima to Platteville.

MILWAUKEE, WIS.—The Badger State Telephone & Telegraph Company has been organized, with a capital of $100,000, to succeed the Badger State Long Distance Telephone Company. The promoters are H. A. Upham, D. H. Van Dyke, Chas. C. Russell and J. R. Fish, of Milwaukee, and Richard Valentine, of Janesville.

ELECTRIC LIGHT AND POWER.

HUNTSVILLE, ALA.—The election for issuing $20,000 bonds for an electric light plant at Huntsville has been carried.

BRUNSWICK, GA.—At a meeting of the Electric and Water Company, of Brunswick, it was decided to issue $250,000 25-year 4 per cent. bonds.

CARTERSVILLE, GA.—Plans have been practically completed for the development of power in the Etowah river, at Cartersville, by the Etowah Power Company in connection with the estblishment of a $1,500,000 cement plant by Chicago capitalists. W. E. Dorwin, president of the Portland Cement Company, proposes to erect the latter plant.

KINMUNDY, ILL.—There is talk of the city electric light plant being shut down on account of the high price of coal. At the present price the receipts at the plant will not pay the coal bill.

CAIRO, ILL.—The Cairo Electric Light and Power Company has secured an option on the plant of the Egypt Electric Company. The price agreed upon is in the neighborhood of $40,000. The Egypt Company operates the original street car line here, besides furnishing light and power. The new owners are the Holliday interests, Maj. E. W. Holliday being at the head of the Cairo Electric Company. By this deal the entire street car system of the city, as well as the entire electric lighting, will be under one management. It is rumored that one result of the consolidation will be the construction of an electric railway connecting Cairo with Mound City, Mounds and Villa Ridge.

FORT DODGE, IA.—The Fort Dodge Light and Power Company is to expend from $275,000 to $300,000 in improving its plant in this city. Work is to be commenced at once. The plans of the company contemplate the extension of its street car line and the operation of many additional cars, the entire rebuilding of the present gas house and the equipment of the electric light plant with new machinery and generators.

BOSTON, MASS.—A majority interest in the Milton Light & Power Company, the Dedham Electric Company and the Blue Hill Electric Company has been purchased by a syndicate headed by C. L. Edgar in the interest of the Edison Electric Illuminating Company of Boston. The syndicate will immediately proceed to dismantle the plants of all three companies, removing boilers, generators, etc., and making the power-houses distributing points for the power which will be supplied by the Edison Company from Boston.

MONROE, MICH.—The municipal electric lighting plant has been closed for an indefinite period owing to the inability to secure fuel.

MONROE, MICH.—The council has been asked for a franchise for a steam heating and electric lighting system. Toledo people are said to be back of the project.

KALAMAZOO, MICH.—The Otsego Power Company, Limited, capital $200,000, has filed articles of association. The officers are Glenn L. Smith, Jackson, chairman; Edward B. Marrinane, Grass Lake, secretary, and Jacob H. Bootes, Jackson, treasurer.

NEW ALBANY, MISS.—A $50,000 electric light plant is to be established in this town.

JOPLIN, MO.—The city light plant of this place has shut down for want of fuel.

ST. LOUIS, MO.—The Missouri Edison Company is adding 1000-kw capacity to its plant.

ST. LOUIS, MO.—The Citizens' Electric Light and Power Company has increased its capital stock from $25,000 to $250,000.

MOUNTAIN GROVE, MO.—The citizens have voted to grant a twenty-year electric light franchise to the Ozark Cold Storage Company of this city.

ST. LOUIS, MO.—The Ewing-Meikle Electric Company has filed letters of incorporation with a capital stock of $50,000, paid up. The shareholders are Nathaniel Ewing, William Brown, Milton Mill and Wm. Meikle.

CHARLOTTE, N. C.—George Vanderbilt has purchased additional and extensive lands in Western North Carolina, including a fine water power where the power is secured for the old Patton Mills and the wool carders. There is some talk that the water power may be developed and carried to Brevard, N. C.

TOLEDO, OHIO.—The Maumee Valley Electric Company has re-elected its old officers.

WAPAKONETA, OHIO.—The lighting plant at St. Mary's has closed down for lack of fuel.

SIDNEY, OHIO.—Sidney was in darkness for several nights recently owing to inability to secure fuel for the municipal lighting plant.

SANDUSKY, OHIO—The Central Heating & Lighting Company, of Toledo, has asked for a franchise to install the Yaryan heating and electric lighting systems throughout the city.

PRAIRIE DEPOT, OHIO.—The owner of the village lighting plant has shut down because he claims he cannot afford to pay the price demanded for coal. The town has a lighting contract and the authorities threaten to take charge of the plant.

RAVENNA, OHIO.—The Ravenna Gas & Electric Company has elected Charles Merts, president; W. J. Hayes, vice-president; W. A. Root, secretary; W. H. Beebe, treasurer, and E. C. Lindsey, superintendent. These with W. S. Krake, A. D. Knapp, W. H. Linton and W. H. Riddle constitute the board of directors. The company will improve its lighting plant.

FREMONT, OHIO.—The property of the Fremont Gas, Electric Light & Power Company has been transferred to the Logan Natural Gas & Fuel Company, but the old name will be retained for local purposes. S. A. Wheeler, of Lancaster, is president of the company; P. W. Lupher, Pittsburg, vice-president; John Lamsden, Norwalk, secretary, and Wm. Adams, Fremont, superintendent.

PORTSMOUTH, OHIO.—The Merchants' Heating, Light & Power Company has been formed by W. E. Anderson, Felix Haas, Leon Eisman, Wm. Burt and other merchants of this city, who are dissatisfied with the high rates of the local lighting company. It is the intention to establish a lighting plant and furnish light, heat and power to stores and residences. The company has a capital stock of $22,000 and has secured a 25-year franchise from the town.

CHATTANOOGA, TENN.—The city of Chattanooga will build a $125,000 electric light plant if the proposed bill for improvements goes through the Legislature.

SPRINGFIELD, TENN.—The Springfield Electric Light and Power Company has combined with a local ice plant and laundry, and will install new electrical laundry and ice machinery. The new concern will be known as the Springfield Ice, Light, Laundry and Power Company.

THE ELECTRIC RAILWAY.

FLORENCE, COLO.—The Florence Electric Street Railway Company of Colorado has recorded a trust deed for $2,700,000. The Eastern Trust Company of this city is named as trustee. The purpose of the company is to build 125 miles of electric railway to connect cities and towns in the Arkansas Valley.

JACKSONVILLE, FLA.—The Jacksonville Traction Company has been chartered with $400,000 capital. The incorporators are G. W. Shook and P. A. Dignan, of Jacksonville, and others.

CHARLESTON, ILL.—The city council was prevented from passing the ordinance granting a franchise to the Central Illinois Traction Company by an injunction. The case will be heard before the judge of the County Court later.

CAIRO, ILL.—Efforts have been under way for some time to consolidate the two street car lines and electric light companies of this city. It is now stated that the Cairo Electric Railway Company and the Cairo Electric Light and Power Company have an option on the entire property of the Egypt Electric Company and that the transfer of the property is to be made in a few days. The consideration asked for the property is nearly $40,000. The purchasers will conduct the two systems under the management of the present officers.

SHELBYVILLE, IND.—The Indianapolis, Shelbyville & Southeastern Traction Company will extend its road to Batesville.

WABASH, IND.—The Fort Wayne & Southwestern Traction Company has made financial arrangements for the extension of the road to Marion.

LOUISVILLE, KY.—Articles of incorporation of the Louisville & Interurban Railway Company have been filed. The capital stock is fixed at $500,000. The stockholders are T. J. Minary, J. B. Speed, Attilla Cox, John Stites, Harry Bishop, Clarence Dallam and J. M. Gaulbert. The new company proposes to operate electric lines in Jefferson, Shelby, Oldham, Bullitt and Spencer counties, and several different lines are contemplated. The company is authorized to borrow $3,000,000. All of those named are prominently connected with the Louisville Railway Company, and with the exception of Clarence Hallam are the present officers and directors of that company.

AUGUSTA, ME.—Work will be begun in the Spring on an electric road from Camden to Liberty, 19 miles. The capital stock will not exceed $500,000, the charter has been applied for and there is no opposition. The men to furnish the funds are: H. M. Bean, E. T. Knowlton, Willston Grinnell, Reuel Robinson, Robert L. Bean, W. E. Schwartz, Lucius Morse, of Camden; Charles E. Littlefield, of Rockland; H. L. Shepherd, of Rockport; Charles W. Henry, Philadelphia, and John G. Crowley, of Taunton.

JACKSON, MICH.—The Jackson & Battle Creek Traction Company, has made arrangements for two classes of service on the road. One class will be a limited service, on which the cars will be speeded up to a mile a minute, and no stops will be made except at stations. The other service will be a "pick-up" service, by combination express and passenger cars. The limited service, it is said, will make the forty-five miles between Jackson and Battle Creek in an hour and twenty minutes.

ALBANY, N. Y.—The West 86th Street Railway Company of New York City has been incorporated to operate an electric street surface railroad, 2,000 feet long, on West 86th street, from Eighth avenue to Amsterdam avenue. The capital is $10,000 and the directors are Charles E. Warren and D. B. Hasbrouck, of Brooklyn; Oren Root, Jr., M. G. Starrett, R. W. Meade, R. Martin and Denis O'Brien, of New York City; De Clifford Moorehead, of Jamaica and F. D. Edmunds, of Flushing.

NORWALK, OHIO.—The Lake Shore Electric Railway Company is preparing to establish a sub-station at Vermillion.

TOLEDO, OHIO.—It is stated that the Lake Shore Electric Railway is securing a right of way for a spur line from Genoa to Elmore, Port Clinton and Lakeside.

CINCINNATI, OHIO.—B. H. Kroger, one of the chief promoters of the Cincinnati, Milford & Goshen Electric Railway, states that contracts for the construction and equipment of the road will be placed February 15.

EAST LIVERPOOL, OHIO.—The Youngstown & Southern Railway has accepted the franchise granted in East Liverpool. The section between Lisbon and East Liverpool is to be built first and contracts are to be closed in the near future.

CLEVELAND, OHIO.—The Everett-Moore syndicate admits the truth of the report that an eastern syndicate has made overtures looking to the lease of the property of the Toledo Railways & Light Company, of Toledo, and the Detroit United Railway, of Detroit.

BOWLING GREEN, OHIO.—The Port Clinton Peninsular Electric Railroad Company has been incorporated by Charles York, of Port Clinton; W. M. Tuller, Dr. F. W. Rogers, R. N. Beatty and Charles M. Draper, of Bowling Green. It is proposed to build a line from Port Clinton to Marblehead and Lakeside by way of Oak Harbor and Elmore.

GUTHRIE, OKLA.—The Mountain Park Electric Railway Company, of Mountain Park, has been incorporated with a capital of $50,000, by R. D. Simpson, C. J. Galena, Mark Roberts and J. C. Brown.

WHEELING, W. VA.—Directors of the Wheeling Traction Company have declared a 1 per cent dividend, amounting to $20,000. It is the first dividend paid by the company.

NEW INDUSTRIAL COMPANIES.

THE McCREARY ELECTRIC COMPANY, of New York, has been incorporated, capital $25,000. Directors: A. A. McCreary, H. W. Brooks, Jr., and H. W. Brooks, New York.

THE SUNDH ELECTRIC COMPANY, New York, has been incorporated, capital $100,000. Directors W. E. Quimby, New York, Austin Colgate, Orange, N. J.; W. J. Tuigue, Greenwich, Conn.

THE CHARLES L. EIDLITZ COMPANY, of New York, has been incorporated to install electric light, heat, and power plants, capital $50,000. Directors: C. L. Eidlitz, F. M. Dyer and Roger Lewis, New York.

THE CENTRAL ELECTRIC AND MANUFACTURING COMPANY, Youngstown, Ohio, Capital $20,000, has been incorporated by W. L. Goodhart, E. F. Foreman, L. C. Glass, E. G. Anderson and C. H. Denison.

THE INTER URBAN CONSTRUCTION COMPANY, capital $10,000, has been incorporated at Toledo, Ohio, by H. F. Shunck, A. F. Klauser, J. H. Pheat and others. It will construct telephone systems, lighting plants, etc.

THE CABLE JOINT COMPANY OF AMERICA, of New York City, has been incorporated to manufacture cable joints and electric appliances. Capital, $12,500. The directors are J. D. Maguire, W. M. Murphy, of New York City, and G. F. Valentine, of Larchmont.

THE NATIONAL CONSOLIDATED COMPANY, of Middletown, N. Y., has been incorporated to manufacture gas and electricity for villages in Orange and Sullivan Counties, capital $50,000. Directors: Charles M. Priggen and G. R. Larwill, Brooklyn; Henry Floy, New York.

THE D. L. BATES & BROTHERS COMPANY has been incorporated at Dayton, Ohio, with $20,000 capital stock, by D. L. Bates, R. H. Bates, Harry Bates, E. J. Monstephen and Alex. Euchenhofer. The company will manufacture electric fans, motors and other electrical goods.

THE ACME CONDUIT COMPANY has been incorporated under the laws of the State of New Jersey, with a capital stock of $300,000. The incorporators are William C. Ball, Rutherford, N. J.; Thomas D. Holland, New York City; John Peck, Jr., Brooklyn, N. Y.; William L. Eaton, Brooklyn, N. Y., and John J. O'Leary, New York City. The company will engage in the manufacture of conduits, pipes, etc.

LEGAL.

WESTERN UNION RAILROAD LINES.—The Western Union Telegraph Company has taken an appeal in the case recently decided by Judge Buffington in favor of the Pennsylvania Railroad Company. The court refused to permit Western Union to file a bond to condemn certain portions of the right of way of the Pennsylvania Company and also declined to enjoin wires of Western Union, if they were not removed by June 2, 1903.

OBITUARY.

SIR G. C. STOKES.—Electrical engineers and physicists in this country regret to note that Sir George Gabriel Stokes, Master of Pembroke College, Cambridge, and formerly President of the Royal Society and of the British Association, is dead. He was created a baronet in 1889. He was born at Skreen, County Sligo, Ireland, in 1819. He was a younger son of the Rev. Gabriel Stokes, Rector of Skreen. He was educated at Bristol College, and then at Pembroke College, Cambridge, where he was senior wrangler in 1841. In the same year he was elected Fellow of Pembroke. Ten years later he was made a Fellow of the Royal Society, and from 1885 to 1890 he was its President. He received the Prussian Order of Merit and was Member of Parliament for Cambridge University from 1887 to 1892, when he became Master of Pembroke. He was an honorary D. C. L. of Oxford and an honorary LL.D. of Edinburgh, Dublin, Glasgow, Aberdeen, and Cambridge, as well as Sc. D. of the last. He had published several valuable books upon mathematics and physics—"The Philosophical Transactions of the Royal Society." "The Cambridge Philosophical Transactions," both in scientific serials.

PERSONAL.

PROF. J. J. THOMSON has, we learn with regret, declined the offer of the Chair of Physics at Columbia University.

MR MARCONI deferred his departure to Europe to attend a banquet given in his honor by the Montreal board of trade, and sailed on the Etruria last Saturday.

MR. H. F. SANVILLE, Girard Trust Building, Philadelphia, has recently added to the line of well-known manufacturers of street railway materials whom he represents, the local agency for the Johnson Wrecking Frog.

MR. W. H. BRYAN, M. E., consulting engineer, lectured on February 3 before the Washington University Association, of St. Louis, on "The Mechanical Engineer: His Duties, Responsibilities and Opportunities."

MR. H. H. LITTELL, who was lately elected president of the Central Illinois Consolidated Railway, has gone to Louisville, Ky., and is pushing work in his usual vigorous manner. Additional lines are to be built at once.

MR. ALEX DOW, general manager of the Detroit Edison system, was a visitor at this office last week. He has been visiting the East in regard to matters connected with the growth of that company and its new plant.

SIR HIRAM MAXIM is as versatile and mentally active as ever, and writes to the *New York Herald* from Nice a very interesting and amusing discussion of systems in gambling. The pith of his argument is that no system is sure, but any is better than none.

MR. KERN DODGE, of the firm of Dodge & Day, modernizing engineers, of Philadelphia, read a paper before the Franklin Institute on Jan. 22, on "Power Cranes in Machine Shops." This paper with illustrations is to be printed in full in the Journal of the Franklin Institute.

MR. MARCONI, who sailed for Europe on Saturday last by the Cunarder Etruria, has decided to make an effort with the liner's wireless outfit to send a message from midocean to the station at Nantucket. It is probable that he may, when midway between the Nantucket and Cornwall stations, act as the "central" or relay for messages between them.

MR. EDWARD H. SNIFFIN.—At the last American Street Railway Convention in Detroit, Mr. E. H. Sniffin presented a most interesting paper on the commercial aspects of the steam turbine. This has now been reprinted and issued in pamphlet form, and is a worthy addition to any engineer's library. It is a special publication by Westinghouse, Church, Kerr & Co., of New York.

MR. S. TADA, a lieutenant in the Japanese Navy, is now in this country supervising some Westinghouse electrical work for a new steel plant in Japan. He has been visiting New York and these offices during the past week, and was accompanied by Messrs. C. Aoyama and I. Hata, who are also here for the purpose of investigating and purchasing telephone apparatus and supplies for the Japanese Government telephone system.

PROF. DUGALD C. JACKSON and his brother, W. B. Jackson, M. E., have established themselves as a firm of consulting electrical and mechanical engineers, etc., with headquarters at Madison, Wis. They are both highly known and widely esteemed, and should enjoy a large practice. Mr. Jackson will be in active charge of the office, etc., and Prof. Jackson will continue his valuable services at the University of Wisconsin.

MR. GEORGE H. GIBSON has resigned his position with the Westinghouse Companies' Publishing Department, of Pittsburg, Pa., to accept a position with the B. F. Sturtevant Company, of Jamaica Plain Station, Boston, Mass., the well-known manufacturers of blowers, heating, ventilating and forced-draft apparatus, electrical machinery and steam engines. Mr. Gibson was formerly a member of the editorial staff of *Engineering News*, and is a graduate of the Engineering School of the University of Michigan.

MR. A. N. BRADY, who returned last week after an absence of several weeks in Paris, whither he had gone to negotiate for an interest in the gas company of that city, gave out the following statement regarding the results of his efforts: "Upon an invitation from some financial interests of Paris, we have visited their city with the view to invest capital in the gas plant. After looking over the situation, we have made them a proposition to join them in the enterprise, which proposition is being considered at the present time. There has been no definite conclusion reached as yet, but it is expected that the matter will be decided within a short time."

NEW YORK ELECTRICAL SOCIETY.—At the meeting of the Society on January 29, the following members were elected: Harold D. Patterson, Richard H. Johnston, Anderw Moss, Almon B. Fuller, Wm. Edw. Hurley, Wm. Taylor, Robert Chas. Cole, Joseph Burkhart, F. L. Scheffey, Ralph Ryder, Chas. F. Case, Seth C. Adams, W. J. Floyd, A. E. Baker, F. E. Osborne, Prof. Magnus C. Ihlsing, Charles G. Whyte, Louis Dornbusch, Edwin Hopkins Seaman, Wallace Cudliff, Joel B. Ives, F. Schwanbausser, Norman A. Paul, Harry French, Edward Hartmann, Frank Cleary, John Benj. Brown, John Ryan, Edward B. Stott, William Weidman, L. R. Wetherwax, Ernest W. Muller, Carl Steuve, Anson S. Rice, Walter M. McBride, John Bittner, E. W. Stevenson, William J. Ladley, Edgar B. Benjamin, Francisco Laurent Godinez, W. F. Hurlbut, and J. F. Bidstrup.

MR. E. W. WINTER becomes president of the Brooklyn Rapid Transit Company, vice Mr. Greatsinger, who has retired. The Brooklyn system is using up able men in rapid succession. Reports of Mr. Greatsinger's coming resignation have been current for several months. Mr. Greatsinger, it is reported, will probably return to his former position of President of the Duluth and Iron Mountain Railroad, which he left in March, 1901, in order to become president of the Brooklyn Rapid Transit system. E. W. Winter has been acting as adviser to the Executive Committee of the company for several months. It is not expected that he will make any change in the operating staff, as the men now in charge were brought on from St. Paul on his advice. Mr. Winter was formerly a resident of that city, where he was interested in the Twin City Rapid Transit Company, the Northern Pacific Railway Company, and other railway enterprises.

MANVILLE-ROMAINE.—Miss Henrietta Estelle Romaine, daughter of Frank Hall Romaine, was married on Jan. 28, in the Church of the Heavenly Rest, New York, to Hiram Edward Manville, of Milwaukee, Wis., by the Rev. Dr. D. Parker Morgan. Mrs. Clarence Levey was the matron of honor; there were no bridesmaids. Mr. F. W. Rockwell was the best man, and Mr. Frank Hall Romaine, Jr., a brother of the bride, D. C. Pye, R. C. Caldwell and W. Mayne were ushers. A reception and wedding breakfast at Sherry's followed the ceremony. Among the invited guests were: Mr. and Mrs. J. G. Cannon, Mr. and Mrs. W. H. Porter, Mr. and Mrs. C. V. Manville, of Milwaukee, parents of the bridegroom; Mr. and Mrs. H. R. Trainer, Mr. and Mrs. C. R. Manville, Mr. and Mrs. Henry B. Hatch, Mr. and Mrs. W. T. Dickson, Mr. and Mrs. Samuel W. Wollverton, Dr. and Mrs. Geo. Manville, Mr. and Mrs. T. T. Lyman, Mr. and Mrs. W. C. Durland, Mr. and Mrs. T. F. Manville, Mr. and Mrs. Joseph Sachs, Mr. and Mrs. J. W. Perry, Mr. and Mrs. J. E. Meek, Mr. and Mrs. J. W. Gordy, Mr. and Mrs. J. G. Millar, Mr. and Mrs. W. Angevine, Mr. and Mrs. G. W. Wright, of Milwaukee; Mrs. Henry Gawtry, Mr. and Mrs. R. Stone, Mr. and Mrs. J. B. Brown, Mr. and Mrs. H. U. Kibbe, Mr. and Mrs. L. H. Fish and Mr. and Mrs. A. Parker Smith.

Trade Notes.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., is sending out a card showing the latest type of incandescent night lamp outfit.

THE INTERNATIONAL PAPER COMPANY has just placed its sixteenth order with the Burt Manufacturing Company, Akron, O., for an oil filter, to be made out of copper.

THE MAIN BELTING COMPANY, Philadelphia, has issued a very attractive pocket memorandum book. The covers are celluloid and contain respectively an illustration of "Leviathan" belting in operation and a calendar for 1903. The book contains besides, blank memoranda pages, some very useful information concerning the installation and proper care of belts.

BATTERY FAN MOTOR.—Messrs J. Jones & Son, 64 Cortlandt St., New York, announce that their 1903 type of battery fan motor is ready for delivery. In appearance this fan differs very little from the standard type of fan motors which are operated from supply circuits. The fan is 10 inches in diameter and has 4 blades, a regulation fan-guard with each machine.

THE CLEVELAND CONSTRUCTION COMPANY, Cleveland, Ohio, engineers for the Washington, Baltimore & Annapolis Railway, has placed contracts with the Ohio Brass Company for insulating material; Mayer & Englund Company, Philadelphia, for cross arms, pins, hardware and bonds; American Steel & Wire Company for trolley wire and the Roebling Sons' Company for stranded wire. Other contracts are being closed.

A LONG TIME CALENDAR.—Messrs. Raber and Watson, Old Colony Building, Chicago, Ill., have issued a neat attractive desk calendar which by an ingenious device is made to cover a period from January, 1903, to December, 1910. The firm has very modestly refrained from covering the calendar with a mass of advertisement, incorporating on its face merely its name and address, with a memorandum of its specialty in three words—Cedar Telephone Poles.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., has issued an attractive 1903 calendar. Instead of containing the usual more-or-less decorative picture, a fine illustration in colors of the Holtzer-Cabot 1903 factory appears at the top. The work is well executed and a bit of harmonious coloring is the result. The calendar pad itself is a combination of brown and yellow and the entire production seems to have been planned for continuous utility rather than impressive gaudiness.

BELTS.—It is boldly asserted that tbe users of power machinery run no risk whatever in trying Graton & Knight's "Royal Worcester" and "Heart" brands belts. The position of the makers is logical. To make assurance doubly sure, they offer these belts solely on their ability to transmit power economically, and in order to push their claims to the limit, agree to send a belt to any reliable manufacturer to test in his own way, and if it is not found to be the most economical belt to use, it may be returned free of cost and full credit is given.

THE STANDARD POLE & TIE COMPANY, of No. 135 Front Street, New York City, is doing a large pole and tie business and covering a wide field in the Middle West. This company has enlarged its yards in the South and with added facilities and a rapidly increasing staff in all its offices, aims solely to please its customers. The standard of inspection is such that any orders sent to the New York office of the company will be satisfactorily filled. The company has removed to new offices in the Venezuela Building, 133-137 Front Street, New York.

500-VOLT FAN.—The Robbins & Myers Company, Springfield, Ohio, has brought out a 500-volt ceiling fan, upon the design of which the greatest care has been bestowed. To withstand this voltage extra heavy insulation has been provided on the windings, with such satisfactory results that the company is able to guarantee a degree of durability and efficiency which hitherto have been regarded well nigh impossible. This fan running at normal speed (200 r.p.m.) consumes 2 amperes. The company will be glad to send a copy of its circular, No. 25, describing this fan.

THE ELECTRIC STORAGE BATTERY COMPANY. of Philadelphia, has recently adopted a policy concerning the renewals of plates in exide batteries which will attract the favorable attention of users of electric vehicles in that it reduces to a minimum the cost of these new parts. Information regarding this may be secured from any of the sales offices of the company or from the Exide battery depots at Philadelphia, New York, Chicago, St. Louis, Buffalo, Rochester and Detroit. At the recent Automobile Show at Madison Square Garden, New York, it was noted that of the eight manufacturers of electric vehicles exhibiting, six used the Exide batteries.

THE GREGORY ELECTRIC COMPANY, of Chicago, reports business as exceptionally brisk. This company is constantly increasing its foreign trade and is now known in every foreign land as well as in its own country as headquarters for bargains in second hand electrical apparatus. Owing to its advantages, geographical location and fine shipping facilities this company is quoting delivered prices to customers if desired and is securng orders against the strongest competition in regions where freight rates might ordinarily be considered prohibitive. The repair shops of this company are also very busy at present—upward of 90 men being now employed in this department alone.

ELECTROTHERM.—We have received from the H. W. Johns-Manville Company, New York, advance sheets of an interesting leaflet now being brought out by the company on the subject of its Electrotherm. As is already well known the Electrotherm is a flexible sheet or pad into which are woven wires insulated and protected by asbestos. When the pad is connected to an incandescent circuit, the current produces in it a constant and uniform degree of heat. These pads are designed for the local application of heat in bodily ailments, and are far superior to the hot-water bottle for this purpose. The advantages and uses of the Electrotherm and other particulars are given in the leaflet.

STOREY MOTOR & ELECTRIC COMPANY, of Newark, N. J., is in receipt of the following significant letter from Mr. S. W. Putnam, vice-president of the Putnam Machine Company, of Fitchburg, Mass.: "We have just completed the 14" lathe upon which the ¾-hp motor, recently purchased of you, was installed, and desire to state that we are very much pleased with the apparatus as furnished. Mr. P. M. Brotherhood has some interesting samples of work done on this lathe, and we suggest that when convenient you call at the New York office of Manning, Maxwell & Moore to see same, as we think they will be of interest to you, especially the sample of screw cutting, which we do not hesitate to say cannot be done on any belt-driven lathe without stopping lathe and pulling belt by hand."

THE ELECTRICAL POWER STORAGE COMPANY, LTD., 4 Great Winchester St., E. C., London, England, emphasizes to what extent the distribution of advertising matter may go. Its contribution to 1903 souvenirs is a complete office desk pad. Across the top, temporarily fastened by brass clips is a day calendar for the month. This calendar is removable so that the proper month is always before the user. At the left of the pad is a diary for the entire year, containing the usual spaces for daily entries, cash account, alphabetical indexing, etc., while the remainedr is desk pad proper. This pad carries with it life insurance against accident in the United Kingdom to the amount of £500. The desk blotter is of immense practicability and the company is to be congratulated on distributing such a useful advertisement.

THE STUART-HOWLAND COMPANY, Winthrop Square, and 261 Devonshire Street, Boston, has for several weeks been making alterations, erecting offices, shelving, etc., in its enlarged quarters, and its store and offices are now a model of neatness and convenience, the equal of which would be hard to find. Everything is arranged for the quickest possible handling of goods and at a minimum of cost. There are three elevators, which are kept active, and in addition, two immense slides for receiving heavy goods in the basement. The store has a frontage of about 60 feet on Winthrop Square and about 200 feet on Devonshire Street. Judging from the activity of the shippers, and the quantities of goods on the sidewalks awaiting draymen, the business of this enterprising firm promises soon to outgrow its enlarged facilities. The company is New England agent for the entire line of "Peerless" fans, and also handles General Electric alternating desk and Tuerk alternating ceiling fans.

AUTOMATIC TELEPHONES IN IOWA.—The Central Telephone Construction Co. is buying up various independent telephone exchanges in the State of Iowa and equipping them with automatic exchanges made by the Automatic Electric Co., of Chicago, under the Strowger patents. The Central Telephone Construction Company is closely allied to the Illinois Telegraph & Telephone Company, which is building the automatic telephone exchange in Chicago. Rufus C. Dawes is the president of the central company. Charles H. Geist, vice-president and general manager, and A. G. Wheeler, Jr., secretary and treasurer. Independent exchanges have been purchased in Iowa at Waterloo, Cedar Falls, Normal, Waverly, El Dora, Traer, Parkersburg, Reibeck, Shell Rock, Ackley, Dysart, Clarkville, Allison, La Porte City, Briston, Dumont, Hudson, Tripoli and Grundy Center.

THE GARDNER ELECTRIC DRILL & MACHINERY COMPANY is now putting out a number of sizes of its electric rock drill, which has been in use in the far Western mines for several years. Now that electricity is coming to be used to such an extent in mining, the elimination of compressed air, which has commonly been used for rock drills, is sometimes desirable. These drills are not on the solenoid principle, but make use of motion transmitted from an electric motor through a flexible shaft to the drill mechanism. The motor is placed in some convenient position near the drill. The stroke is not quite as long nor the plow quite as heavy as in the air drill, but the strokes are more rapid, being from 550 to 600 per minute. Where current for operating the drill is at hand in a mine, the initial cost is much less for the electrical than for the compressed air equipment, where only a few drills are to be used.

JANDUS FANS.—How to keep cool is a question that enters the minds of a good many millions of people during hot weather, and, although this problem is not yet forcing itself upon the attention of the public it soon will be doing so. In anticipation of the great demand for fan motors the coming season the manufacturers of these comfort-giving machines are busily engaged on their 1903 product. The Jandus Electric Company, Cleveland, Ohio, will bring out one or two designs this year, which will embody several improvements. The company is at work on a complete line of alternating and direct-current fans, of 12-in., 15-in., and 16-in. sizes. They will be better than last year's designs, notwithstanding the high degree of perfection attained in the latter product. One of the novelties this year will be a ceiling fan, consisting of two revolving fans, adjustably mounted so as to throw the air at any desired angle. Any size fan, alternating or direct current, can be interchangeably mounted on the fixture. A feature of the Jandus fan is that it is a desk, bracket and trunnion fan all-in-one.

PASS & SEYMOUR CATALOGUE.—The Catalogue No. 14 of Pass & Seymour, Inc., Solvay, N. Y., is a fine specimen of what can be done with good cuts, good paper and intelligent press work. It contains 78 pages and contains about as handsome illustrations as it is possible to find in any similar publication. A full line of things in porcelain is shown, covering about 60 pages. As is mentioned in the introduction to the catalogue, there is purposely omitted a long description of each of the pieces. In fact, of the 60 pages which are given over to illustrations of various Pass & Seymour specialties, there are contained on only nine pages any descriptive matter concerning the pieces shown. It is left to the reader to understand to what uses the various specialties are to be put; and the reputation of the company has made it unnecessary, the author feels, to enter into any extended argument to the effect that the Pass & Seymour products are good of themselves. Hence, the catalogue is a concise, comprehensive list of what Pass & Seymour make, showing the various sizes of the pieces and indicating the various adaptations of each. In addition to the illustration and description of the sizes and adaptations already referred to, there is contained in the catalogue a trade number of each particular piece, together with a code word. On one or two pages in the catalogue is given an explanation of the manner in which the code operates. At the back of the catalogue is a table entitled "Useful Information," which has to do with the description of some of the electrical units. Then follows a very comprehensive code. The general plan of the code is that any word beginning with a certain letter stands for a complete sentence and may, therefore, be easily located and its meaning ascertained, while some other word beginning with an entirely different letter refers to the name of a company. Then there are combinations of three letters each in a numerical code which enables a combination from 1 up to 10,000 and covers dollars and cents as well as numerals. Following this table in the catalogue is what is known as a numerical code, whereby if anyone knows the trade number of any of the Pass & Seymour pieces, it may easily be found by reference to this index, where the numbers are arranged in numerical order with the code word set against it, followed in turn by the page number of the catalogue in which this piece is shown. Following that again is the alphabetical code index in which all of the code words are arranged in alphabetical order and the page on which the various pieces are shown as indicated, after which comes the general index showing all of the pieces arranged in alphabetical order according to their names. It is a very complete publication that Pass & Seymour have issued.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 27, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

718,660. THERMAL ELECTRIC CUT OUT; T. E. Scantlin, Lafayette, Ind. App. filed September 5, 1901. (See page 243.)

718,797. SAFETY FUSE. J. Sachs, Hartford, Conn. App. filed September 30, 1901. (See page 243.)

719,003. SURFACE CONTACT STRUCTURE, E. M. Hewlett, Schenectady, N. Y. App. filed Oct. 20, 1897. A contact button is threaded to the end of a bolt placed in an axial cavity in a wooden block, the cavity being filled with insulating material surrounding the bolt.

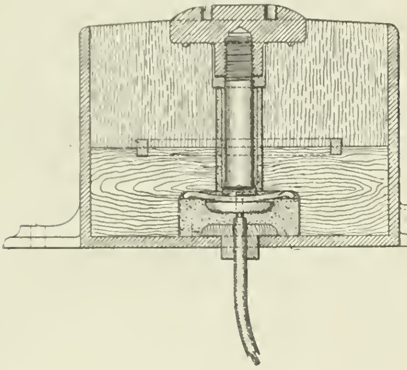
719,005. TUNING DEVICE FOR WIRELESS TELEGRAPHY; W. S. Hogg, United States Navy. App. filed March 4, 1902. (See Current News and Notes.)

719,006. TROLLEY; A. J. Johnson, Cleveland, Ohio. App. filed April 14, 1902. The force of the spring acting upon the pole is automatically altered to correspond with the angular position of the pole.

719,016. ELECTRIC RAILWAY; M. T. A. Kubierschky, Berlin, Germany. App. filed March 22, 1900. The electromagnetic switches in the branch circuits to the working conductor control two circuits, one leading through the car motor and the other through the coil of an advance switch, to the return.

719,018. AUTOMATIC ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, New York, N. Y. App. filed May 7, 1901. A hammer-arm normally restrained, is released when the electromotive force passes a certain limit.

719,020. RAILWAY ELECTRIC MOTOR COOLING SYSTEM; C. O. Mailloux, and W. C. Gotshall, New York, N. Y. App. filed Oct. 6, 1902. A controller acts periodically upon a valve which admits compressed air from any suitable source into a piping system which conveys the air to the motors for cooling purposes.



719,003.—Surface Contact Structure.

719,024. ALTERNATE CURRENT TRACTION SYSTEM; W. M. Mordey, London, Eng. App. filed Nov. 14, 1902. (See Current News and Notes.)

719,025. ELECTRIC FUSE OR CUT OUT; H. L. Morse, Boston, Mass. App. filed Feb. 24, 1902. An indicator consisting of a piece of fabric stretched across an opening in a fuse case, is thrust outward by the pressure created by the disruption of the fuse.

719,026. ELECTRIC FUSE OR CUTOUT; H. L. Morse, Boston, Mass. App. filed July 25, 1902. A modification of the preceding patent.

719,055. SWITCH CONTROLLING APPARATUS; C. W. Squires and J. B. Squires, Springfield, Mass. App. filed July 2, 1902. Various improvements in electro-magnetic apparatus for throwing a railway switch. The magnet is operated on a circuit independent of the motor and the arrangement is such that the switch tongue is held immovable during the passage of a car.

719,092. ELECTRIC SELF PLAYING PIANO; G. H. Davis, New York, N. Y. App. filed March 22, 1899. The invention relates more particularly to the connections between the electric motor and the drum controlling the movements of the music sheet and has special reference to the rewinding mechanism.

719,093. ELECTRICAL SELF PLAYING MUSICAL INSTRUMENT; G. H. Davis, Brooklyn, N. Y. App. filed Nov. 26, 1900. A modification of the preceding patent.

719,095. LINE-TAPPING DEVICE FOR TELEGRAPH OR TELEPHONE CIRCUITS; C. Dietz, Munich, Germany. App. filed August 2, 1902. (See page 243.)

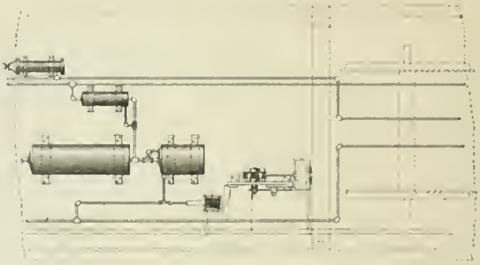
719,112. TROLLEY WIRE SUPPORT; E. Hill, South Norwalk, Conn. App. filed May 7, 1902. The trolley wire clip is extended in length and grasped by a number of hangers.

719,114. ELEVATOR; N. Hiss, New York, N. Y. App. filed May 22, 1902. An electro-dynamic brake for the hoisting apparatus and means for successively controlling the movement of the motor and applying the brake.

719,122. AUTOMATIC ELECTRIC SWITCH; W. Lasar, St. Louis, Mo. App. filed Feb. 11, 1902. An elevator switch is operated from any floor by means of a rope accessible on the various floors; indicators on the floors show the result of the operation.

719,149. ELECTRIC ARC LAMP; A. F. Shore, New York, N. Y. App. filed Jan. 29, 1900. Ring-shaped carbons are controlled through suitable worm-gearing by a solenoid.

719,167. MAGNETO ELECTRIC MACHINE; J. M. Wilson, Battle Creek, Mich. App. filed April 14, 1902. A spring acting upon the armature shaft is put under tension and suddenly released to create an impulse of high potential.



719,020.—Railway Electric Motor Cooling System.

719,180. ELECTRIC CAR SIGN; I. B. Brower, Philadelphia, Pa. App. filed April 4, 1902. A sign box containing lights is mounted upon a peculiarly constructed pivot through which the circuit leads.

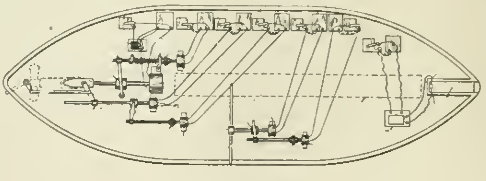
719,219. TELEPHONE SYSTEM; W. Hohne, Schöneberg, Germany. App. filed April 17, 1902. (See page 243.)

719,265. ELECTRIC SOCKET; A. P. Seymour, Syracuse, N. Y. App. filed Feb. 10, 1902. Details.

719,315. STORAGE BATTERY; C. H. Everett, Atlanta, Ga. App. filed July 8, 1901. Arms extend laterally from a vertical support and sustain sheet metal strips which are threaded over them, to form the metallic portion of an electrode.

719,355. ELECTRIC TELEGRAPHY; A. Muirhead, Shortlands, England. App. filed Aug. 11, 1902. The combination in a telegraphic relay, of a receiving coil energized by message impulses, an index actuated by the coil, means applied directly to the index, independently of the coil, to give directive force thereto and further means serving to turn a part of said first-named means to give directive force to the index and thereby correct the "zero" thereof.

719,388. ELECTRIC DANGER AND SAFETY SIGNAL FOR RAILWAYS; H. F. Spurr, Jr., Boston, Mass. App. filed April 24, 1902. Details of a block system in which the signals are displayed in the cab of the locomotive.



719,405.—Appliance for Electrically Operating Vessels and Torpedoes from a Distance.

719,397. DRY ORE SEPARATOR; R. E. Waugh and E. Waugh, Denver, Colo. App. filed Sept. 21, 1901. The crushed ore is delivered upon a porous belt and is separated by the combined action of gravity, electromagnetism and compressed air, the air being forced through the pores of the belt.

719,405. APPLIANCE FOR ELECTRICALLY OPERATING VESSELS AND TORPEDOES FROM A DISTANCE; L. Wilson, Brooklyn, N. Y. App. filed April 21, 1902. The torpedo is fitted with a number of motors for performing the various functions of propelling, steering, etc., and each motor is controlled by an independent wireless receiving apparatus of which the corresponding transmitting apparatus is located on shore.

Electrical World and Engineer

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CONTENTS.

Editorial 265
Annual "Library" Dinner of American Institute of Electrical Engineers.. 268
Electric Water Power at Manchester, N. H., Mills 269
Ampere-hour Capacity of the Lead Storage Battery. By A. L. Marsh.... 271
An Arrangement for Power Stations for Operating Steam Railways Electrically. By C. J. Spencer 272
The Shawinigan Plant 273
The Construction of Aerial Telephone Lines—III. By Arthur V. Abbott, C. E. 274
Carbide Furnace. By Clinton Paul Townsend 278
Municipal Ownership Convention 278
Developments in the Indiana Telephone Field 279
New Telephone Patents 279
The Engineering of Illumination 280
Independent Telephony in Kansas 280
The Cuyahoga Telephone Company 280
Current News and Notes 281
LETTER TO THE EDITORS:
  Stresses in Alternator Frames. By A. Hansson 282
Digest of Current Electrical Literature 283
New Telephone Equipment 287
The Protection of Street Car Motors 287
Integrating Direct-Current Wattmeters 288
10,000-Volt Motor-Generator 289
DEPARTMENTS:
  Financial Intelligence 290
  Commercial Intelligence 290
  General Notes 293
  Trade Notes 296a
  Record of Electrical Patents 296a
Cable Construction for Telephone Lines ....Supplement

THE INSTITUTE DINNER.

The annual dinner of the American Institute of Electrical Engineers grows in interest and importance, and the money spent upon it seems to be an excellent investment, regarded as a means of focussing attention on the work and aims of that progressive body. Another point shrewdly considered by the officers is that of giving to each dinner some special feature, so that while Marconi and the ether were the fitting theme in 1902, this year the library associated with the names of Wheeler, Carnegie and other donors is the topic. The banquet at Sherry's on Monday night, attended by nearly three hundred inclusive of leaders in the industry and science, must be regarded as in every respect a great success. Had no other element of interest characterized it, the remarkable speech of Mr. Carnegie would have made it memorable. It was indeed a delightful "human document," and every one was thrilled as he recounted his own early struggles in the telegraph field and started on that wonderful career of wealth creation and accumulation that is crowned by his magnificent grants in aid of literature and knowledge.

◆

FATAL NON-GROUNDED LOW-TENSION CIRCUIT.

The importance to electric light and power companies of making use of the recommendations of the national code, which permit the grounding of low-tension circuits, was recently sadly illustrated in a small central station plant in the middle West. In this case it was the chief engineer of the plant who suffered the conseqnences, but this fact serves only the more to show the importance of safeguarding the low-tension circuits by grounding them. Evidently there was a defective transformer, or a cross somewhere in the station between the high-tension and incandescent lighting circuit wires. One of the employees of the station received a severe shock from a drop light. The chief engineer went to disconnect the extension cord, by unscrewing the plug, and was accidentally killed Shocks had been received from this circuit previously. It is astonishing that men of intelligence should take such risks as did this engineer, immediately after direct evidence that the circuit was crossed with some high-tension line. Had the incandescent lighting circuit been grounded, this man would have been protected even against his own carelessness. Customers of an electric lighting company are entitled to this protection.

◆

ELECTRICAL VERSUS COAL CAR TRANSMISSION.

Ever since transmission at high voltage began to be talked of there has been much theoretical discussion on the advisability of locating large generating plants at the coal mines to transmit the power to points of consumption, instead of locating power stations near the various places where power would be used. The proposition is naturally an attractive one to the engineer, who is always on the lookout for methods which, by skillful engineering, may do away with freight and labor charges. As a matter of fact, however, the coal car as against the high-voltage transmission line, seems to have won out in most cases. Of course, there are places in the mountainous districts where the cost of transporting fuel is enormous and where consequently there is little question as to the advisability of transmitting power rather than hauling coal. In a fairly level, open country, on the other hand, it seems to be a difficult matter for the transmission line to compete with the coal car. In Colorado the comparison between these two methods has perhaps been more actively considered than in any other locality in recent years. In the mountains of Western Colorado there are cases where there is no question as to the economy of transmitting at high voltage rather than hauling fuel to the station at some inaccessible mine. In the Cripple Creek district, conditions are such as almost to balance the two methods. In this latter district can be found power transmitted 20 miles at high voltage from a plant located near the coal mines, and also power supplied from a plant in the district. In this case the country is mountainous. But there is little difference between the cost of power when transmitted and the cost when generated in the district, is shown by the fact that engineers of national reputation have been responsible for the building of both types of plants. Farther east in Colorado, at Denver and Colorado Springs, where the country is comparatively level, nearly every large generating plant that has been built during the past few years, has been executed only after a careful consideration of the ultimate cost of power from a plant located at the coal mines as compared with a plant located in the city. Coal is found near both Colorado Springs and Denver. So far, however, only one plant has been built at any considerable distance from a city for the purpose of getting its coal at the mines. The cost of hauling coal in a level country by modern railroad methods seems to be so low that ordinarily the cost of a transmission line with the fixed charges thereon will wipe out any advantage to be gained from using the coal directly at the mines, and transmitting the power.

But the cost of coal transportation is not the only thing to be considered in this connection. One engineer, who has had occasion to figure on numerous plants of this kind, and who has considered fully the practical as well as the theoretical elements entering into the problem, points out that skilled labor of the kind necessary to operate a large generating plant, can be obtained at the mines only at a much higher rate than if the plant were located in more congenial surroundings. Mining communities are likely to be lonely places for a man who is skilled in power house operation; and if the right kind of men are to be kept there, they must be paid for staying. This is a fact well known to mining men, but not so well known to electrical engineers who figure on problems of this kind. Furthermore, it is frequently figured that if the station is located at the mine, it is for the purpose of utilizing the slack and coal dust that would not be shipped because of its low grade. If this kind of fuel is used, it requires a large boiler capacity per kilowatt, because in practical operation there is always the possibility that a poor streak of fuel will get into the furnace about the time the heaviest load comes on. To provide for such emergencies, the boiler capacity provided must be larger than would otherwise be necessary. As between a large investment and a small one, it is always the case that a decided saving must be shown over and above fixed charges to justify the larger investment. In a level country the high-voltage transmission line, as a competitor of a railroad, does not seem to be yet able to show this saving.

ENTROPY.

An animated discussion appears in recent electrical journals between Mr. James Swinburne and certain of his opponents, upon the definition of entropy. Very few people know what entropy is, and a consultation of dictionaries is apt to inflame the curiosity at the expense of the satisfaction. Mr. Swinburne gives a definition in 52 words without symbols, and an alternative definition in 26 words employing an integral to help him. It must be confessed that neither of the two definitions is very simple, although both are definite enough. Mr. Swinburne says that the ordinary definition of entropy as appearing in the text-books is wrong, and contrary to the meaning of Clausius, the inventor and first employer of the term. It is clear, however, that the entropy defined by Mr. Swinburne is a different thing from the entropy as defined in the text-books, and different names should attach to these two things.

THE AMPERE-HOUR CAPACITY OF THE LEAD STORAGE BATTERY

The electric automobile has done much to reduce the weight of storage batteries. Every extra pound in an automobile battery is one pound more of dead weight to be propelled up hills. The figures given in Mr. A. L. Marsh's article on page 271 show the present limitations of the lead storage cell in regard to weight and output. In the pasted form of cell described, the energy output is stated to have been 16.1 watt hours per pound of complete cell (or 35.5 watt-hours per kilogramme), in a 24-hour discharge; reducing to 11.4 watt hours per pound (25.2 watt hours per kilo) in a 4-hour discharge. The weight of lead peroxide was 17.8 per cent. of the cell weight, so that the above outputs should be increased in the approximate ratio of 6 to 1 in order to obtain the output per unit mass of active material. Very little room appears to exist for the further lightening of such a cell. The weight of the active material formed 55 per cent. of the weight of positive plates. In other words, the positives were less than half grid and more than half peroxide. The negative plates are stated to have presented substantially similar conditions. Consequently, taking all the plates together, the active material formed about half the mass, and the peroxide or positive active material about one quarter of the mass. Only about half of the active material applied appears to have come into useful action, representing, therefore, a useless plate weight of about 75 per cent.

The 24-hour discharge has interest by way of determining the available limits of output; but with automobile cells it is of little practical concern. The 4-hour discharge, or the 3-hour discharge, is the important question. Taking the 4-hour discharge of 11.4 watt-hours per pound, as virtually stated in the article, the cell would be capable of lifting its own weight through a height of about 5¾ miles, in expending this energy without waste. When we remember, however, that a piece of good coal contains enough potential energy to lift its weight 2,000 miles against sea-level gravitation, it is clear that a lump of coal is 350 times richer in energy than a lump of storage battery. Unfortunately, we can only get about 5 per cent. of the energy of coal usefully out of it in an automobile, whereas we can get 80 per cent. usefully out of a storage cell, at the motor axles; so that the disparity is reduced from 350 to about 20. Even at 20 to 1, the energy storage capacity of coal or petroleum is clearly much greater than that of electric storage cells.

THE TRUE EFFICIENCY OF A CENTRAL STATION.

It was said by Edison, many years ago, that the business of a central station company is to sell light. Though this pregnant statement has been reiterated many times since, it is nevertheless opportune to again call attention to the fact that a central station man is too often prone to consider that he is selling current or electrical energy rather than light. The remarks made by Mr. V. R. Lansingh, of Chicago, before the Western Society of Engineers, mentioned elsewhere in this issue, to the effect that central station men are too apt to spend a great amount of money in securing high electrical efficiency, while neglecting entirely illuminating efficiency, found hearty endorsement on the part of several progressive and practical central station men who were present at that meeting. That the central station man may have sometimes been inclined to sell electrical energy rather than light, and to concern himself little with what became of the current after it passed the consumer's meter, is, of course, due to the modern system of selling electrical energy by meter rather than selling candle-power hours. If it were possible to sell candle-power hours, that would, of course, be the ideal basis of charge for electric light. This not being feasible, we are obliged to go back another step in the transformation of energy, and measure the electrical energy used in making the light. Central station men have given a great deal of attention to make [illegible] possible by good voltage regulation the use of high-efficiency lamps, and much of the best engineering thought has been given to this matter. It is neither logical nor business-like that he should say arbitrarily to his customers what shall be done with the energy after it reaches the lamp filament or the arc, but nevertheless a central station man can, if he will, conduct a campaign of education in the proper use of electric light among his customers so as to secure the best possible illumination with a given amount of electrical energy.

The narrow-minded theory that the more current a customer uses the better, without regard to how he uses it, has long ago been discarded by progressive and business-like central station men, as well as by gas men. It is entirely to the interest of central station companies that lamps and methods of illumination used by consumers be of the highest possible efficiency, so as to reduce the cost of light to the consumer as far as possible. While this may mean that one consumer will get along with smaller bills than he would otherwise have to pay, it also means that the company will add three or four new customers where otherwise it would add none. If a man finds that his neighbor is getting electric light at a very reasonable rate, and sees that the illumination that he is securing is superior, he is tempted to become a customer; while, on the other hand, if he finds that his neighbor is paying a high rate for poor service, he stays out of the game. While it is true that the consumer, especially in a large city, likes to use his electric light in his own way, it is also true that there is a great chance to educate the consumer as to the arrangement of lights and the use of reflecting and diffusing globes, which will give the best results. To this end central station men should make a careful and conscientious study of illumination. Many of them have been so busy chasing leaks around the central station distribution system that they have had no time to become thoroughly posted on this branch, but the day is coming when this will be necessary.

* * *

Distribution of Power for Railways.

The question between sub-stations and distributed stations in electric railway working, once more raised by Mr. Spencer's paper in the current issue, is one which we have often discussed. The advantages of one system or the other have been often exploited, and it seems to us that Mr. Spencer might have made out a far stronger case than he has for distributed stations if he had confined their use to street railways instead of recommending them for heavier work. In point of fact, the single commanding gain in using power distribution at high voltage for extended street railway systems is the very one that Mr. Spencer disclaims, while the gains he cites are the very ones which it is difficult to substantiate. The loss in transmission, including a proper allowance for maintenance and the loss in the rotaries, is very far from being "slight." It is, in fact, so considerable as in many instances to quite offset the advantage of size and position in the central station. We call to mind divers instances in which power transmission is a costly luxury, which has been indulged in as a mere matter of fashion. So long as the energy transmitted has to be put through rotary converters to fit it for use, the gain in generating the power at a single point is problematical in perhaps the majority of cases. Of course, when water power can be utilized a different question arises, but we are speaking of the more common cases where steam is the motive power. In some instances real estate is a material part of the first cost and there may be a gain in investment by proper location of the main station.

As a rule, however, the gain in power transmission comes from improved efficiency of the generating plant and particularly in the matter of load factor. It is true that on many systems the peaks at the sub-stations fall at about the same time, but this does not imply coincidence of the brief and severe demands for current that characterize railway work, so that the average load on the central station is often much nearer its maximum load than in the case of any sub-station or any separate station that would replace it. The gain in load factor is the most important one in the majority of railway systems using power transmission at high voltage. This applies with double force to the case of electrically equipping the main line of a railway, because a brief examination of the schedule almost invariably shows that the load of any given sub-station would be subject to great variations while that on the central station would be fairly uniform. This is an inevitable outcome of the comparatively small number of trains per unit length of track. The la railway, therefore, has particularly good reason to favor transmission. Could the conversion to direct current b om-plished by apparatus requiring no more attention than transformers, the scope of power transmission would be ensely extended, but up to the present nothing more si and efficient than the rotary converter has come into use. Our correspondent, by the way, seems to think that rubber-ered cables are customarily used for high-voltage transmission, while actually nearly all such work is done over bare wires very moderate cost.

The main difficulty to be overcome in case of large railway work is not the transmission of the power as such, but the low voltage which is up to the present generally employed on the working conductors. This is a very serious matter in large work. The ordinary freight or express train as now made up for railway service would require from 1,000 to [illegible] amperes at 600 volts, and no method has yet been devised for collecting so large an amount in a satisfactory manner. The one direction in which to look for great and revolutionary improvements such as will make heavy electric traction commercial is the utilization of high voltage on the working conductors. Until this is accomplished the great cost of working conductors and the difficulty of gathering currents of the magnitude now required will stand as an effective bar against serious trunk line work. Of course, were only passenger traffic under consideration a large number of single large motor cars could be used which would somewhat relieve the current-collecting difficulty, but no scheme of electric traction confined to passenger service is likely to appeal strongly to the conservative railway manager. Hence we are inclined to think that our correspondent's scheme of salvation is faulty. The usefulness of storage batteries to steady the load on small stations will hardly be questioned, however, though a battery for this service is better in the station than away from it. This matter of applying electric traction on trunk lines is a most important one, but it involves some practicable method of using several or many thousand volts on the working conductor, whether it is to be utilized in the motors as alternating or direct current, at high or low voltage, and in this connection we look forward with keen interest to the approaching trials of the Arnold, Lamme and Ward Leonard systems. Until such a method is demonstrated, heavy electric traction must be confined to special cases in which electrical operation is of fundamental importance irrespective of minor questions of economy in generating the power. There is an ample field for it even with these limitations.

Annual "Library" Dinner of the American Institute of Electrical Engineers.

The annual dinner of the American Institute of Electrical Engineers, devoted this year to the celebration of the success of the library, was held on Monday, February 9, at Sherry's, and was attended by nearly 300 ladies and gentlemen. It was in every respect a notable affair, many of the prominent members being present from all branches of the profession, including Past President Dr. F. B Crocker, Louis A Ferguson, president, and H. L. Doherty, past president National Electric Light Association; F. W. Jones, J. C. Barclay, L. B. Stillwell, C. W. Price, Dr. F. B. Herzog, Frank J Sprague, J W Lieb, Jr., T. E. Murray, G. A. Hamilton, A. B. See, A. A. Knudson, Dr. L. Waldo, Dr. O'Reilly, Prof. W. L. Robb, F. H. Taylor, C. A. Terry, Joseph Wetzler, F. V. Henshaw, P. A. Bates, A. L. Doremus, W. C. Andrews, Kern Dodge, C. Day, P. B. Delany, Oberlin Smith, C. G. Young, Capt. E. L. Zalinski, W. C. Gotshall, W. S. Howell, G. H. Guy, E. G. Bernard, Ira W. Henry, H. G. Reist, H. A. Lardner, J. J Mahony, C. J. Field, M. M. Davis, R. A. Fliess, H. Wray Weller, F. A. Scheffler, F. A. Pattison, R. W. Pope, C. Blizard, D. Burnett, C. E. Knox, J. Appleton, J. Rijur, C. A. Bragg, Alex Churchward, H. B. Coho, Eugene Lewis, M. Kenyon, Dr. Max von Recklinghausen, Lambert Schmidt, Gospard, A. K. Warren, T. C. Wood, Theo. Dwight, Prof. W. E. Mtrough, J. H. Hallberg, F. Darlington, R. D. Lillibridge. both takuas A. Edison was also present accompanied by his wife, Andrew C. keen interest in all that was going forward, and Mrs. The commiie was also a guest with her famous husband.

hard, were Mesin charge of the affair, all of them who worked Hammer, W. S. Ba. T. C. Martin, chairman and toastmaster; W. J. Gherardi, Jr., Arthur W, E. H. Mullin, Prof. W. Hand Browne, B. S. Sheldon, S. L. Nich Williams, Calvert Townly, F. C. Bates, Dr. G. F. Sever, Max Loewen on, Calvin W. Rice, S. W. Asle, Prof. beautifully illuminated and al and L. B. Marks. The room was the Elblight Company of Am corated through the generosity of and the New York Edison Company through Mr. Russell Spulding. and current to the Elblight cables and who supplied special circuit of colored lamps all around the ballroom signs. There were festoons and above the speakers' table were a large walls, draped in milax, in colored lamps and two signs of lamps badge of the Institute rapher's greeting. At the speakers' table reading "73," the telegwere seated President C. F. Scott, Mr. Andrew Carnegie, Dr. S. S. Wheeler, Mr. T. C. Martin. Dr. S. Sheldon, John Fritz, Theodore L. De Vinne, C. O. Mailloux, R. R. Bowker, Dr. J. S. Billings, Mr. Edward D. Adams, Dr. J. C. Bayles, Prof. Elihu Thomson, and Hon. R. G. Monroe, commissioner of gas and electricity for New York.

A special menu had been prepared for the occasion representing in fac-simile, in large quarto, the volume owned by the Institute of the works of Albertus Magnus, printed in 1494. This was in three colors showing the vellum back, labels, wooden board sides and brass clasps. Inside were reproduced in fac-simile two pages of the text, and there were four pages devoted to menu, programme, list of committees, donors to the library, etc. There was also a printed memorandum on the library and its constituent parts.

The intellectual part of the evening's programme began with a salutatory from President Scott, who noted that during his year of office the Institute had done honor to Mr. Marconi and Lord Kelvin. He advanced the idea that electricity was the foe of narrowness and that it increased human and individual efficiency. As for the Institute, its standard for full membership was exclusive, for associate membership inclusive; and on these lines the growth had been rapid of late, crossing the 2,000 mark; while chapters were springing up all over the country. He preached the doctrine of co-operation and showed that in endeavoring to secure better quarters for its library and its meetings, the Institute was anxious to proceed along the lines laid down by President Pritchett, of the Massachusetts Institute of Technology, when he said: "Isolation indicates a low state of civilization," and who urged co-operation. Mr. Scott referred gracefully in this connection to the work done by the Institute in assisting to found the John Fritz gold medal for engineering achievement.

It may well be doubted whether Mr. Carnegie ever made a better speech than that which he delivered on "Libraries," or whether he ever had a more royal reception than was given him by the members by way of acknowledgment of his gift of $7,000 toward the Institute Library work He has founded nearly 800 libraries, but as one who earned some of his first wages as a telegraph messenger and operator, he claimed the right to be especially privileged to associate himself with the profession that had grown up since he first worked at the key. To quote from his own quaint reminiscences that sent a thrill through the sympathetic audience and moistened many an eye: "Before the electrical engineer was, we—Mr. Edison, Mr. Barclay and myself, we messenger boys—were. There was no engineering electricity in those days, but I have delightful reminiscences. I chew the cud over them many times. The greatest change that ever came to me was when I was passed from the dirty cellar of an engine room—I was firing the engine and running it, too, and many times afraid it would explode—and translated to a telegraph office, where they had clean paper, clean pens and clean windows. That, ladies and gentlemen, was my first glimpse of a paradise on earth in making a livelihood. When I first became able to touch that instrument, and, pounding the key, call up New Orleans—I had been practising surreptitiously before the operator came in the morning, receiving the princely salary of $25 a month, I said to myself this is what Swedenborg said about Heaven: space was annihilated. So when I see Mr. Edison and others, then, I think, why, boys, you're a new generation. But knowing what you do, no fond father was ever prouder of his boys than we are, Edison, Barclay and I."

In introducing Dr. Wheeler, founder of the Institute Library, and donor of the Latimer Clark collection, Mr. Martin recalled the fact that 18 years before Dr. Wheeler and he had drawn up a scheme for an Institute home and library, predicated upon the acquisition of the Clark books. Dr. Wheeler, who was received with three hearty cheers, gave a modest story of his acquisition and referred gracefully to the gifts of his fellow members which had since gone to build upon that foundation.

At this juncture an amusing incident occurred. The toastmaster read a telegram from the Cincinnati chapter, which met that night 55 strong, and sent its congratulations to the parent society, adding: "Tell Carnegie we also could use a library." Amid great laughter the toastmaster handed this to Mr. Carnegie, who brought down the house by deftly waving it aside and saying: "No, no; give that to Wheeler," thrusting it at the same time into Dr. Wheeler's hands. It was some time before the merriment subsided.

Mr. R. R. Bowker, editor of the *Publishers' Weekly*, and formerly vice-president of the New York Edison Company, then followed with a brilliant speech on the "Unity of Science," which he closed with an original poem inscribed to "The Man of Science," on the scope of the work of the modern electrical engineer. He was succeeded by Dr. John S. Billings, director of the New York Public Library, who treated with great skill on the subject of "The Technical Library," and showed how usefully it could supplement the work of the larger, more popular institutions. He referred with hearty approval to the lines of work laid down by Mr. W. D. Weaver, the chairman of the Institute Library Committee.

Mr. Theodore L. De Vinne, the celebrated American printer and bibliophile, then spoke earnestly on the "Debt of Mechanics to Science," and on the part played by electrical engineers in creating wealth and opportunity and in harmonizing the relations not only of mechanics and science, but of capital and labor. The final speech, full of brilliant wit and good-natured fun, largely at the expense of the technical press, was made by Dr. J. C. Bayles, M. E., technical editor of the *New York Times*, who convulsed his audience even at that late hour with clever stories and keen thrusts of wit. The toastmaster then declared the function ended, and recognized while doing so the handsome voluntary contributions of such men as Mr. Edward D. Adams, who had recently given the Institute a full set of the transactions of the Royal Society of England.

The memorandum prepared by the chairman of the Library Committee gave interesting data about the various gifts and the personal interest taken in the members was evidenced in the fact that no fewer than 40 of them have contributed already to the collection. The chief contributors, members and others, named on the menu, besides those noted above, were Messrs. C. O. Mailloux, Cary T. Hutchinson, Joseph Wetzler, C. L. Clarke, Bion J. Arnold, N. S. Keith, Edward Caldwell, American Bell Telephone Company and the New York Electrical Society.

Electric Water Power at Manchester, N. H., Mills.

Electrical supply systems operating with water power are serving large as well as small consumers of energy. An example of a great industrial plant operated with power from distant waterfalls through the medium of an electrical supply system exists at the Manchester Mills, Manchester, N. H. These mills draw energy for the operation of 976 hp in induction motors and the equivalent of 7,050 16-cp incandescent lamps from the sub-station of the Manchester Traction, Light and Power Company in that city.

This company, as recently pointed out in these columns, draws its energy mostly from four water power stations located at points respectively 3, 6, 10 and 13.5 miles from the sub-station in Manchester. The Manchester Mills are located about 1.25 mile from the sub-station of the light and power company, and two circuits are run from the sub-station directly to these mills and are used exclusively for the service there. Each of these circuits delivers energy at 3-phase, 60-cycles, and at about 2,300 volts. One of these circuits, devoted exclusively to lighting, is composed of three aluminum cables, each having a cross-section of 500,000 cm. The other circuit consists of three aluminum cables, each with a cross-section of 750,000 cm, made up of 37 No. 7 wires, and this circuit is devoted to the operation of induction motors. Either of these circuits can be opened at a point about one-fourth mile distant from the Manchester Mills by a 5-amp switch located on the switchboard there. No fuses are used between the 2,300-volt lines and the motors at these mills, oil circuit-breakers being depended on entirely to open the connections in case of overloads.

The lighting load at Manchester Mills that is operated from the lighting circuit previously mentioned includes incandescent lamps numbering 4,092 of 16 cp each, and 1,012 of 24 cp each; also 24 enclosed arc lamps, taking 6.6 amp at 73 volts. These lamps are supplied by the 2,300-volt, 3-phase line through seven transformers of 30 kw, 5 transformers of 25 kw, and 2 transformers of 20 kw each, giving an aggregate capacity in lighting transformers of 375 kw.

Drawing energy from the electrical supply system at these mills are two motors of 200 hp each, 6 motors of 75 hp each, 1 motor of 50 hp, 1 motor of 30 hp, 3 motors of 10 hp each, 1 motor of 15 hp, and 1 motor of 1 hp. The combined rating of these motors is 976 hp. The 2 200-hp motors and 4 of the 75-hp motors are connected directly to the 2,300-volt motor circuit, no transformers being used to lower the voltage for these 6 machines. The remaining 276 hp of motor capacity which draws energy directly from the supply system are operated through transformers at 550 volts.

All of the motors thus far named are of the 3-phase, 60-cycle induction type. Each of the 200-hp motors operates at 500 r.p.m., and is direct-connected to 2 arc dynamos, each of these dynamos being rated at 125, 6.6 amp, 73-volt arc lamps. Two 75-hp motors at 600 r.p.m., one 50-hp motor at 720 r.p.m., 1 15-hp motor at 1,200 r.p.m., and 3 10-hp motors at 1,200 r.p.m. are belted to shafting in various parts of Manchester Mills. The four arc dynamos operate enclosed arc lamps in the several mills, and about 400 of these lamps are now in use.

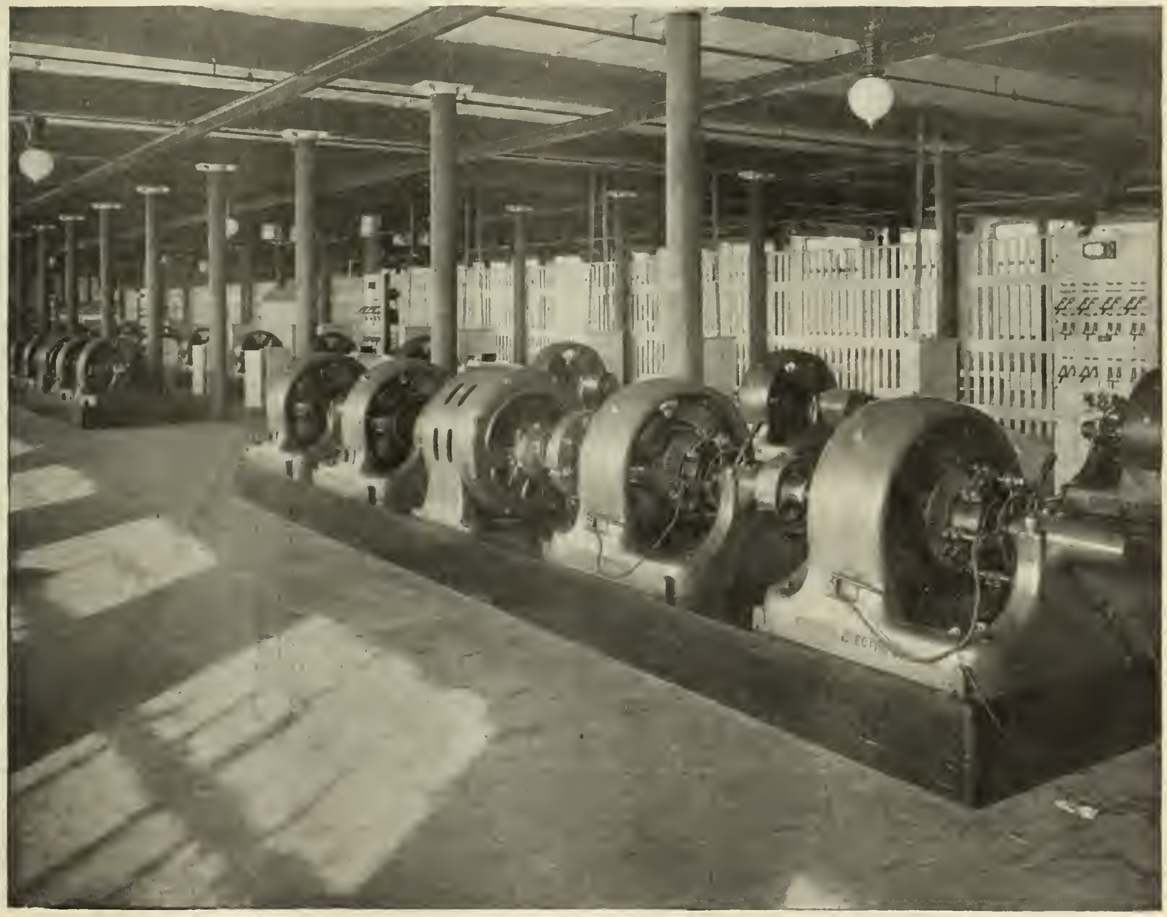


Fig. 1.—Induction Motors Driving Dynamos, Manchester Mills.

Manchester Mills are famous for their fine cotton prints, and the printing of these cottons is done by electrically-driven machines. Sixteen of these printing machines are in use and each is driven through a belt connection by a 25-hp, 220-volt, direct-current motor. The requirements of this printing work include close regulation of the speed of each machine from zero to the maximum rate. In order to secure this regulation of speed and at the same time maintain a high efficiency, current is supplied to each of the 25-hp motors at variable voltage. For each 25-hp motor driving a printing machine there is provided a 20-kw, 250-volt, direct current dynamo, which supplies current to the motor armature. The shunt magnet winding on each of the 16 motors of 25 hp, and on each of the 16 dynamos of 20 kw, is supplied with current by an 80-amp, 250-volt dynamo used exclusively for the purpose. This exciting dynamo is direct connected to and driven by a 30-hp, 550-volt induction motor operating at 720 r.p.m. Four induction motors, each rated at 75 hp, 2,250 volts and 720 r.p.m., drive the 16 20-kw dynamos, four of these dynamos being direct connected to each motor.

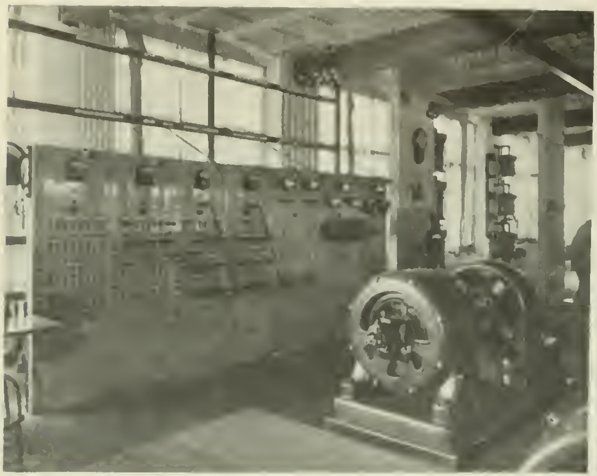


FIG. 2.—MOTOR-DRIVEN EXCITER AND SWITCHBOARD.

The four 75-hp motors and the 30-hp motor, just named, operate with their connected dynamos at constant speed. The voltage of the 80-amp. 250-volt exciting dynamo is held constant, and this voltage is maintained at the terminals of the magnet windings of each of the 25-hp motors that are belted to the printing machines. In the circuit of the magnet winding of each of the 16 20-kw dynamos that operate the 25-hp motors there is connected a rheostat of 51 contact segments, and this rheostat is located close to the printing machine that is driven by the motor which the 20-kw dynamo in question supplies. By this arrangement each operator, while standing at his printing machine, can vary its speed through wide limits by shifting the handle of his rheostat. As the handle of any rheostat is moved in the way that puts more resistance into the magnet winding of its dynamo the voltage at the terminals of this magnet winding drops. This causes a decrease in the voltage developed by the armature of the dynamo and delivered to the motor armature which this dynamo supplies.

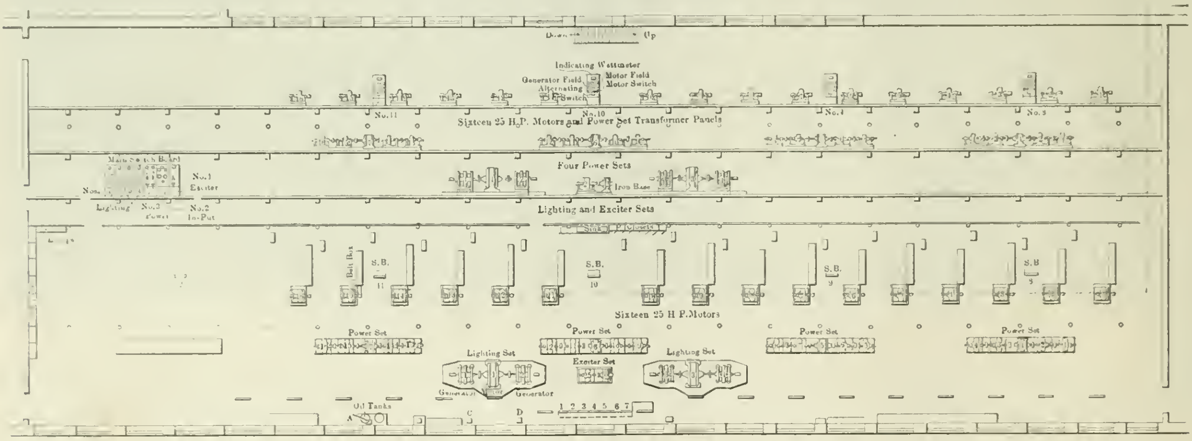


FIG. 3.—ELEVATION AND PLAN OF MANCHESTER MILLS PLANT.

Following the lower voltage at the motor armature comes a decrease in its speed which may be carried down to any point within the range afforded by the rheostat. A reverse operation, that is manipulation of the rheostat in a way to decrease the resistance in the circuit of the magnet winding on a dynamo, raises the voltage of the dynamo armature and also the voltage at the terminals of the armature of its motor, thus increasing the motor speed. While these speed changes are in progress the armature of a dynamo is able to deliver its full rated current of 80 amp, and the motor armature receiving this current and located in a constant magnetic field operates with uniform torque. Each of the 16 dynamos devoted to motor operation is wound with a magnet coil in series with its armature, in addition to the coil that is separately excited and in which the variable resistance of the rheostat is located. This series magnet coil, taking the entire armature current, probably tends to keep down sparking at the dynamo commutator during any rapid increase in the volume of armature current, especially when the exciting power of the separately excited magnet coil is low. Formerly the dynamos supplying motors were used with only the separately excited magnet coils, but operation has been more satisfactory since the series coils were added to the dynamo magnets.

In order to show the extent of speed regulation attained by the method just described, also the changes in voltage at the dynamo magnet windings and motor armatures by which this regulation is effected, the following results of a speed test at the roller of one of the printing machines are given. As may be noted, the printing roller increased in speed from 1¼ to 19 r.p.m., while the rheostat handle was shifted from segment No. 1 to 51. This shows a gain of 17.75 revolutions for the printing cylinder during 50 movements of the rheostat arm, or an increase of only .355 revolutions on an average for each of the 50 steps. As the motor armature was mechanically connected by belt and gears with the cylinder of the printing machine, it may be assumed that the speeds of the cylinder and the motor armature varied together. While the speed of the cylinder went up from 1¼ to 19, or 15.2 times, the voltage at the terminals of the motor armature increased from 26 to 315, or 12.1 times. With constant strength of motor magnet the speed of its armature should increase directly with the voltage at its terminals, provided that the amperes flowing through the armature are constant.

From the figures just quoted it appears that the current in the motor armature must have declined with the rising speed. Influence of the series coil on the dynamo magnet is notable in the record of volts at the separately excited magnet coil on the dynamo magnet, and at the motor armature. While the volts at the separately excited coil of the dynamo magnet rose from 2 to 250, or 125 times, the volts at the motor armature increased from 26 to 290, or only 11 times. This rapid rise of voltage generated by the dynamo armature and delivered to the motor armature is more than can be accounted for by the changes of current in the separately excited coil of the dynamo magnet and by the changing permeability of this magnet. The magnetizing action of the series coil is the other force necessary to produce the recorded results.

As has been seen, all the power for the operation of the 16 printing machines, with their 16 belted motors and 16 dynamos, is derived from the 4 induction motors of 75 hp each, and 1 induction motor of 30 hp. Connected to the same wattmeter with the five motors just named is 1 of 15 hp and 1 of 1 hp, making the total capacity of motors which receive energy through this meter 346 hp. Of this capacity, 330 hp, or 95 per cent., is devoted to the operation of the printing machines. Knowing the amount of energy consumed by these motors during a definite period with the printing sets at work, an approximate idea of the efficiency of these sets and of their method of speed regulation can be obtained. During 260 hours of working time for the 346 hp of motors just considered, these motors absorbed 19,740 kw-hours, the equivalent of 26,461 electric hp-hours. At their full rated capacity of 346 hp, these motors would deliver 346 × 260 = 89,960 hp-hours of work during 260 hours of operation. Comparing this possible delivery of work at full load and maximum speed with the energy actually absorbed by the motors, it appears that the latter was only 29.4 per cent. of the former, though the speeds were varied through a wide range.

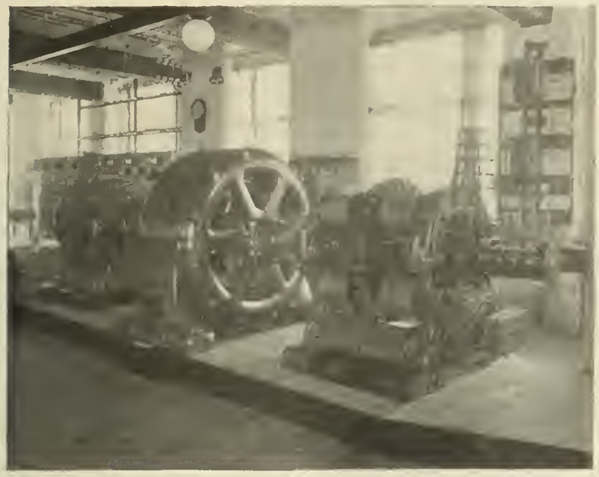


FIG. 4.—200-HP INDUCTION MOTOR DRIVING ARC DYNAMO.

This electrical equipment at Manchester Mills is a striking illustration of the extent to which electric water power systems may operate large manufacturing plants. The adoption of variable-dynamo voltage for motor speed control on so large a scale is also notable. All of the transformers, motors and dynamos above mentioned, with the necessary instruments, were furnished by the General Electric Company.

For the facts here given relative to this interesting plant especial thanks are due to Mr. H. Schaeffer, superintendent of the print works, and to Mr. F. L. Clarke, the electrical engineer of the plant.

Ampere-Hour Capacity of the Lead Storage Battery.

By A. L. Marsh.

In this article it is intended to deal only with active materials, and more particularly with the positive active material, lead peroxide. The theoretical ampere-hour capacity of lead peroxide, per pound of material, may be calculated from the formula, $C = \frac{12145.552}{W}$, where C is the capacity in amp-hours per pound, W is the chemical equivalent of the substance, and 12145.552 is a constant. In the case of lead peroxide, assuming the compound to have the simple composition represented by the formula, PbO_2, $W = 119.46$. Therefore, the compound, PbO_2 will theoretically give 101.8 amp-hours per pound.

It is interesting to note how closely this figure has been approached by cells designed for commercial purposes. In order to bring out this point in a particular case, the following test was made on a cell designed for automobile use. The cell was not made especially for the test, but was taken at random from the stock of a well-known manufacturing concern. Both the positive and negative plates were of the pasted type. The size of the cell (outside dimensions) was 5¼ in. by 6 1/16 in. by 10 in. high, and weighed, complete, 35 pounds. There were 10 positive plates and 11 negatives. The positive grids weighed 8 ounces each and the weight of the active material averaged 10 ounces for each grid. The total positive active material, then, weighed 100 ounces, or 6.25 pounds.

The discharge curve shown in the figure was for a constant current of 11 amp, lasting for 24 hours and 45 minutes. This gives a total of 272.25 amp-hours. The superficial area of all the positive plates was 5.5 sq. ft., so the discharge was at the rate of 2 amp per sq. ft. This rate also corresponds to 1.76 amp per pound of positive active material, or about 1 amp per pound of positive plates. The average voltage of discharge was 2.07. The ampere-hour capacity per pound of complete cell was 7.8 and the watt-hour capacity was 16.1. This low rate of discharge is favorable to obtaining a high capacity from a cell, it being a well-known fact that the efficiency of a cell is much higher at low rates of discharge than at high rates.

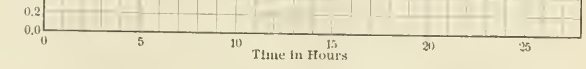
Since one pound of lead peroxide should give 101.8 amp-hours, the total positive active material (6.25 pounds) should give 636.25 amp-hours. The cell gave 272.25 amp-hours, so the actual capacity was 42.8 per cent. of the theoretical.

The same cell gave 200 amp-hours at a 4-hour discharge rate. This represents an amp-hour capacity of 31.4 per cent. of the theoretical. A part of the data given above is here tabulated for convenience in reference:

Weight of cell (complete)	35 lbs.
Weight of positive active material	6.25 lbs.
Rate of discharge	11 amperes.
Time of discharge	24 hours and 45 minutes.
Average voltage	2.07
Total ampere-hours	272.25
Ampere-hours per pound of complete cell	7.8
Watt-hours per pound of complete cell	16.1
Theoretical amp.-hrs. capacity per pound of PbO_2	101.8
Total active material of cell should give 636.25 amp.-hrs.	
Total active material of cell actually gave 272.25 amp.-hrs.	
Ampere-hour capacity at 25-hr. rate is 42.8% of ideal.	
Number of ampere-hours given at 4-hr. rate	200.
Ampere-hour capacity at 4-hr. rate is 31.4 % of ideal.	

Assuming the hypothesis of Wade to be correct, the ideal amp-hour capacity of lead peroxide becomes reduced to 50 per cent. of that given (101.8 amp-hours per pound). At the 25-hour rate, then, the cell actually gave about 86 per cent. of what was possible for it to give. The cell at the time this discharge was made had not reached its greatest capacity, for it had been given less than a dozen charges and discharges after the forming process had been discontinued. In practice, the forming process is seldom, if ever, allowed to continue until the active material is completely formed, so the cell has to be "worked" for some time before it reaches its point of greatest capacity.

The number of amp-hours given at the 25-hour rate represents a very fair capacity, though no doubt it can be improved upon. The amp-hour capacity at the 4-hour rate of discharge, however, leaves more to be desired, it being only about 63 per cent. of what is perhaps possible to obtain. This figure is not bad, considering the small amount of scientific work done in the development of the storage battery. At best there is, of course, a great deal of hit and miss experimenting necessary in the development of a complicated apparatus like the storage cell, but there is an opportunity for intelligent guessing or, if you prefer, a display of judgment in the selection of experiments to be tried, such that a chemist and physicist is better able to exercise than an electrical engineer.



DISCHARGE CURVE.

The above test, as well as many others, shows that batteries made for actual service will give an ampere-hour capacity approaching 50 per cent. of the calculated value if the discharge rate is low. The principal problem, then, seems to be to obtain this high capacity for high rate of discharge. The logical and generally accepted way to accomplish this result is to make the active material more readily available to voltaic action by increasing the porosity of the active mass. By porosity is not meant that the mass should be full of large holes, for large openings take up a great deal of space and help but little towards the desired result. The invisible pores are the ones that count. They break up the mass so as to expose a very great surface to the action of the electrolyte, and should be of just sufficient size to hold the acid necessary for the proper discharge of the surrounding surface. The term "molecular porosity" has been used in this connection and perhaps best defines the ideal condition. This porosity combined with mechanical strength ought to permit of efficient discharges at high rates and at the same time greatly increase the life of the battery. There are materials found in nature that are very strong and very porous. It seems possible that these conditions may be realized for lead peroxide, though the nature of the peroxide may make the solution of the problem rather difficult.

The grid of the cell used in the above test was one of a lead antimony alloy and proved to be very durable in service. As the figures show, the weight of the grid was a little less than half the weight of the entire plate. From the weakness of lead we can hardly expect a considerabe decrease in the percentage weight of the grid without a corresponding decrease in the life of the cell.

Only about half the weight of the positive plate is active material and, according to theory and practice, only about half of the positive material is really active. About the same conditions prevail for the negative plates. About three-fourths of the weight of the plates is, therefore, dead weight. Then there must be considered the electrolyte, lugs, connectors and containing cells, so the capacity of the lead cell, per pound of total weight, must necessarily be low. The cell used in the above test contained 6.25 pounds of lead peroxide. Assuming 50 per cent. of this weight to be active, we have about 3 pounds of really active positive material from which it may be possible to obtain 318 amp-hours, although only 272 amp-hours were obtained in the test. Approximately the same weight of negative material is necessary to give this discharge of 318 amp-hours. In order for the six pounds of active material to give its current it must be accompanied, according to the data for the above described cell, by a weight of material about five times greater than itself.

The proportion of dead weight in the lead cell seems to be rather great, and no doubt this has led many inventors to believe that the weight of the cell for a given output could be materially reduced. However, the grid cannot be made much lighter without sacrificing the life of the cell; the sulphuric acid electrolyte is necessary for the discharge and cannot safely be reduced in amount below that used in the present automobile cells; the weight of the hard rubber containing cell is so small that no important saving in weight can be made here; the connectors must be about the weight used in order to get sufficient strength and current-carrying capacity.

But since at the 4-hour rate of discharge only 200 amp-hours were obtained where 318 amp-hours were possible according to Wade's hypothesis, the chief possibility for the improvement of the lead cell lies in the active material. It is possible that Wade's hypothesis is incorrect and that by proper methods more than 50 per cent. of the active material may be made useful in giving current. Certain solid deporalizers in primary cells can be used up closer than 50 per cent., and if this could be accomplished with lead peroxide, the increased capacity of the lead storage battery would be considerable.

I think the figures given above show clearly that improvements in the lead storage battery are to be accomplished along the line just indicated, which line has been pointed out before by myself and others.

A Correction.

The article which appeared in the issue of Electrical World and Engineer of January 17, entitled "The Largest Electric Water Power System in New England," contains two errors, as follows: On page 106 the voltage of the generators at Garvin's Falls is stated to be 1,200 instead of 12,000; and on page 107 near the head of the second column, the size of the conductors of the three-phase circuits is given as "No. 1/10" instead of No. 1-0.

An Arrangement of Power Stations for Operating Steam Railways Electrically.

By C. J. Spencer

SEVERAL steam railroads are considering the question of electric operation. These roads present some features that are different from the ordinary trolley system, in that they have their own right of way and much adjoining ground, they carry coal or can readily obtain it, and transport it to any location along their tracks; they have numerous sources of water supply, and they have a large force of employees at the various passenger stations. The trolley systems consist of many roads, the greater part of which are over thickly settled and consequently valuable land, they are on public streets and the owners must buy additional property for the power stations; they do not carry coal, and have no facilities for transporting it; they must create the necessary sources of water supply, and they do not have passenger stations.

The advantages gained by the trolley systems in generating current in one central station at high voltage and distributing to substations for conversion into current available for operating the cars, are saving in real estate, the one generating station taking less room than several small ones; saving in cost of carrying coal, the slight loss in the transmission line allowing the station to be placed near a water front or railroad; saving in cost of water supply, since the station can be located near a cheap source; and saving in cost of attendance, the few large machines in one station requiring less attention than many small machines in several stations. Since the present steam railroads have an abundance of real estate, coal, water, and attendance, it is evident that the advantages gained by the central power station will be less for railroads than for trolley lines.

It might be claimed that the total capacity of the central station in engines and boilers need not be as great as the combined capacity of several smaller stations, owing to the fact that the maximum load on the central station is not as great as the sum of the maximum loads on the sub-stations; but when the load is of one kind, the peak load comes on all the substations at the same time, and the central station must have a capacity sufficient to supply the total load. Another distinctive feature of steam railroads is that they extend in one line for a considerable distance, while trolley systems are composed of several roads running parallel. There must therefore be a greater part of the load at a distance from the center of load in the case of steam railroads than in that of trolley systems.

If we accept the above as applicable to a steam railroad under consideration, then the advantages of the method of generating high-voltage alternating current in one central station and distributing this to sub-stations for conversion into direct current over the simpler and more direct method of generating direct current in several stations distributed along the road should be very thoroughly investigated before making a decision as to the best method. Considering the more favorable of the central station methods, that in which no raising transformers are employed in the generating station, the current being generated at high potential, the machines that must convert the potential energy of the coal into mechanical energy at the car axle are the boilers, engines, dynamos, lowering transformers, rotary converters or motor-generators, and car motors, making a total of seven machines in all to replace the boiler and engine of the locomotive.

This array of machines is startling to any one not brought up in the electrical profession, even before the tremendous and expensive switchboards and cables are mentioned. The electrical engineer is in great danger of extending too much of his energies towards controlling high voltages without sufficient investigation as to its advantages. Cables with 5-32 inch of rubber or insulators at $1 each amount to quite a large item for a transmission line of forty or fifty miles. Alternating-current motors are being tried, which, if successful, will reduce the cost of substations, though the low frequency adopted by one company should so increase the cost of transformers as to leave this open to question. The substation attendance cost will, however, be eliminated, which is a very considerable item. At the present time the 600-volt direct-current motor is the only one in general use for traction purposes, and it would be extremely unwise for any one to attempt to make two such innovations so radical as the operation of a steam railroad electrically and the operation of a new type of motor for traction purposes at one time.

Let us therefore assume that the trains must be supplied with direct current at 600 volts, and investigate the method of generating and distributing the current. It may be considered an easy matter to estimate the cost of installing and operating a central station with substations, and similar costs for a system of distributed power stations for comparison; but the personal equation of the engineer enters so largely into any estimate he might make as to materially affect the result. For the reason that steam railroads present many features more advantageous to a distributed system of power stations than to a central station system, the writer believes that, in the near future, there will be several cases in which the central station system will be adopted when the distributed system of stations would be more desirable.

In applying electric traction to a typical steam railroad, I would recommend for consideration 600-volt direct-current generating stations spaced along the road approximately 10 miles apart, with storage batteries in the station and a storage battery plant between each two stations. This would require a length of distribution of but two and one-half miles for fluctuating loads and five miles for steady loads. Owing to the fluctuating character of the load, storage batteries would be essential. These have been condemned by many good engineers of late, for no other reason than because accurate records are kept of the losses incurred by their use. There is no other part of the station apparatus, of which records are kept of both the input and output. If these same engineers would keep as careful a record of the amount of coal burned when the storage batteries are in use and when running without them, they would change their views on the subject. The difference in core loss between a large and a small dynamo will more than make up for the storage battery loss. Besides this, the energy must be stored somewhere, which is in the boiler steam drums when a battery is not used, and a sudden heavy load has the effect of causing a rush of steam with consequent fall of steam pressure and much entrained water is carried over, thus diminishing the capacity of the engines at time of greatest load.

A battery, properly cared for, will easily reach 85 per cent efficiency when floating on the line. This amounts to a total efficiency of 92.5 per cent when the battery supplies one-half the load. The battery, besides increasing the efficiency of the plant and saving the wear and tear on the engines, boilers and dynamos, costs only about one-half of what the same capacity in dynamos, engines and boilers cost. It will, besides, admit of overloading 100 per cent or more for a short time, while the dynamo will flash over or "buck" at a 50 per cent overload. The plant placed between generating stations is also cheaper than the cable required to transmit an uneven load with the same efficiency.

Suppose a feeder to this point must supply 720 kw-hours per day, the load being momentary and amounting to 1 hour total per day. Then, without the battery the cable must be designed to carry 720 kw. Let the efficiency be 80 per cent, then the voltage at the generating station must be boosted up to 750 volts for a 600-volt system, and since the current is 1,200 amperes and the drop in potential 150 volts the cable resistance must be 0.125 ohm, which will require five 1,000,000-c.m. cables for a transmission of 30,000 ft. about five miles. In the case of the storage battery, the cable must be designed to carry 30 kw, or 720 kw-hours per day. Assume the voltage as being boosted to 750 volts as before and that the battery has an efficiency of 85 per cent, leaving 44 volts to be lost on the line. The current amounts to 50 amperes and the cable resistance must be 0.88 ohm, which requires one 700,000-c.m. cable. The weight of five 1,000,000-c.m. bare cables for 30,000 ft. is 472,500 lbs. The weight of 30,000 ft. of 700,000-c.m. cable is 65,700 lbs. The difference in weight, 406,800 lbs., will pay for the battery without allowing anything for the extra insulators or for increasing track bonds, which would be required if no battery is used. The part of the battery between stations costs one-third of the extra expenditure that would be required for station equipment without batteries, while the part of the battery in the station costs one-half of the expenditure that would otherwise be required.

Returning to the system of generating current, the greatest objection offered to installing several stations is the amount of reserve machinery considered necessary. No more reserve machinery would be necessary, however, than in the central station system, for if one plant is out of service the several stations on either side will supply the current, if the plants have a slightly drooping characteristic similar to the ordinary shunt-wound dynamo. By making the third-rail circuit of very low resistance and sacrificing the regulation, any number of plants can be made to supply almost equal portions of the load.

By the use of steam turbines and mechanical draft, a further advantage is gained, in that the plants may be made portable and moved to more advantageous points with change of traffic. This arrangement would not be greatly different from the present existing conditions, the difference being that the engines and boilers would be operated while stationary and at constant load, instead of when running at forty or fifty miles per hour with greatly varying loads. There would be no need of stopping the trains for coal supply, and the moving machinery would be less complicated and less liable to get out of order than the locomotive. With several motor cars per train, the probability of an accident so serious as to cause stoppage, would be very remote, and sharp curves could be passed at a higher speed than at present attained. The wear on the tracks, roadbed and bridges would be considerably reduced with the weight thus distributed. Then there is the greatest advantage of all to be gained by electric drive, the increased frequency of service.

It would then appear that these advantages gained by electrifying steam roads are sufficient, without trying to increase the efficiency by installing a high-voltage system, and thus neutralize all good results gained by having a breakdown in the central station and stop all traffic. With the distributed system of stations, there is but one part of the system to fail and thus stop a train, a third-rail section. With the central station there are three parts, the central station, the transmission line, and a third-rail section. Moreover, a failure of a vital part in the central station would stop all traffic, and a failure of a transmission line would stop a large part of the traffic, while a failure to the third-rail is as liable to happen as in the distributed station system.

It would therefore appear that there is little to be gained and a great deal to lose by applying the central station method of generating current to steam railroads.

The Shawinigan Plant.

On Saturday, February 7th, the Shawinigan Water & Power Company successfully started its power transmission plant between Shawinigan Falls and Montreal. The transmission line, which is of aluminum cable, is a fraction of over 84 miles in length. The transmission is at 50,000 volts, 30 cycles. The line has a maximum capacity of 8,000 hp. The apparatus at present installed is capable of delivering 2,500 hp, and additional apparatus is being put in as rapidly as possible for 2,500 hp more. The step-up and step-down transformers and switchboard apparatus were furnished by the Westinghouse Company and the synchronous frequency changers for changing from 30 to 60 cycles were furnished by the Bullock Company. This apparatus was all set up, ready for operation seven months from the date of the order for it. The 50,000-volt line insulators were furnished by the R. Thomas & Sons Company, of East Liverpool. The aluminum cable was supplied by the Pittsburg Reduction Company.

The station buildings for the transmission were designed by Mr. Wallace C. Johnson, chief engineer of the Shawinigan Water & Power Company, who also had in charge the carrying out of the construction work. The transmission was laid out and the construction directed by Mr. Ralph D. Mershon, consulting engineer for the company.

A New Street Car.

It is stated that a new type of street car is being made for the Twin City Rapid Transit Company, of St. Paul. Separate entrances and exits through the rear vestibule are contemplated, and a plan is being worked out for a means of ingress through the motorman's cab. Both the front and rear vestibules are to be lengthened a foot or two. A partition will divide these vestibules in half. At the right will be the entrance, and at the left the exit. Thus passengers may enter and leave the car without jostling. It is believed that with the separate entrances and exits the time for stops will be reduced by one-half, as there will be simultaneous movement on the part of passengers getting off and getting on.

The Construction of Aerial Telephone Lines—III

By Arthur V. Abbott, C. E.

The last section dealt with the various stresses upon poles. The next subject to be taken up is that of guying.

Guying.—Let *A B*, Fig. 6, be the vertical elevation of a pole, entering the ground at the point *B*, and let *A C* represent the resultant of all the stresses due to the tension of the circuits acting in the direction *A C*. To resist this tension it is customary to reinforce the pole by attaching a wire rope, or iron rod, in the neighborhood of the point *A* extending to the ground, or to some other point of attachment at a convenient distance from the pole at say *D*, as is shown at *Y*, Fig. 6. It is now required to determine the stresses on the guy *A D*, and on the pole *A B*, under the action of the force *A C*, in order that such a pole may be properly designed. The height of the pole *A B* is known, also the distance *B D* from the base of the pole to the point of attachment of the guy, and the stress, *A C*. To any convenient scale of pounds draw *A'C'* parallel to *A C*, and make *A'C'* equal to the resultant *A C* of all the tensions on the pole. From *A'* erect the perpendicular *A'D'*. Make the length of *A'D'* bear the same proportion to *A'C'* that *A B* does to *B D*, or in other words, divide the length of the pole *A B* between the application of the resultant and the ground by the distance *B D* from the base of the pole to the point at which the guy enters the ground, and multiply *A'C'* by this quotient to find the length of *A'D'*. This result is the compression in the pole. Connect the points, *C'D'*, then the length of the line *C'D'* to the same scale as *A'C'*, and *A'D'* will give the tension in the guy rod. For example, assume a 30-ft. pole line, carrying 5 ten-pin cross arms, or 50 wires, each stretched to a tension of 150 pounds. The resultant *A C* of the tension in all the wires will be 7,500 pounds, and the point of application, midway between the top and bottom arm at say 25 ft. from the ground. Suppose the guy to be set 10 ft. away from the base of the pole, then *A B* divided by *B D* gives 2.5. Fig. 6, *Z*, shows *A'C'* drawn to represent 7,500 pounds (scale 4,000 per inch). *A'D'* is made 2.5 times as long as *A'C'*, showing the compression in the pole to be 18,750 pounds, and *C'D'* is found to be 2.69 times as long as *A'C'*, giving 20,200 pounds (approximately) as the tension on the guy. The necessary size required for the pole is readily calculated by remembering that the pole is a column supported at the base, and the diameter may be obtained by the use of the preceding formulæ. As guys are always in tension it is usual to make them of wire rope, or iron rods, but it is necessary to remember that not only must the material of the guy itself be sufficiently strong to resist the stress applied upon it, but its attachment both to the pole and to the ground, or other object, must be sufficient to withstand all of the force applied. It is a common practice to fasten guys by bolting the end of the strand to a log of wood termed a "dead man," and burying it in the earth. Another, more modern, and in some respects more mechanical method, employs a device resembling an enormous auger, which can be screwed into clay or loam, and makes an excellent fastening in such soils. A still more recent device consists of a pointed iron pipe, which can be driven into the earth, and after it is set, one or more sharp spur-like grappling irons can be projected through the wall of the pipe into the earth. These devices are shown in Fig. 7.

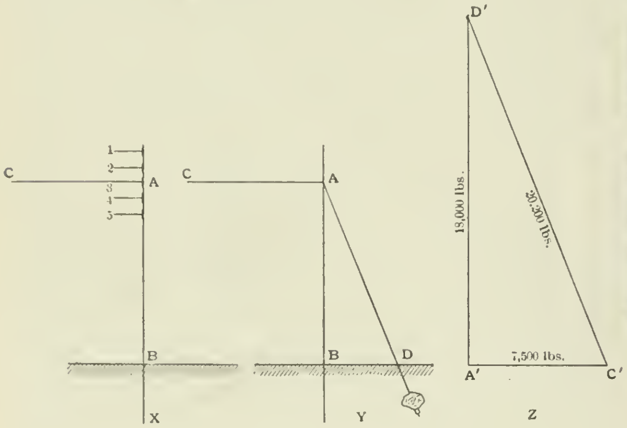
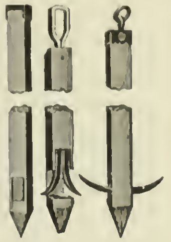


FIG. 6.—GUY DIAGRAM.

Sometimes, especially in soils that are marshy or have quicksand it is usual to bolt the pole onto two long timbers, that form a base on which it may stand, and to the end of which the guy is attached. Now the pole may fail by overturning, and the timber foundation must hold weight enough of earth to prevent this. Take the example of Fig. 6. The tendency of the pole to tip over is measured by multiplying the height of the pole to the resultant (25 ft.) by the resultant of the line tension (7,500 × 25 = 187,500 foot-pounds). This is called the moment of the force tending to overturn the pole. On the timbers bolted to the base of the pole rests a quantity of earth; the moment of which (its weight multiplied by the distance of its center of gravity from the pole) must be equal to or more than the overturning moment. The distance of the center of gravity of this earth from the base of the pole is half the distance of the guy from the pole, or in this example 5 ft., then the weight of the earth must be $\frac{187,500}{5}$, or 35,500 pounds. Earth weighs about 100 pounds per cubic foot, hence $\frac{33,200}{100} = 332$ cubic feet of earth are needed. Suppose the timbers to be 10 ft. long and buried 6 ft. below the surface, then the width of the timbers or the planking they carry must be $\frac{332}{10 \times 6} = 5.5$ ft. This will exactly balance the pole, but in addition a fair factor of safety should be allowed.



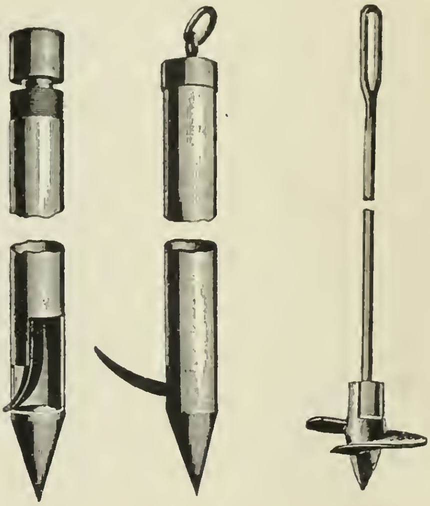


FIG. 7.—VARIOUS STYLES OF GUY ANCHORS.

There are few parts of a telephone plant in which as many mistakes are made as in guying. Fig. 8 is an illustration of some of the methods in which guying has been done. At *A* the well-known form of Y-guying is illustrated, which is probably the best device of this nature. Here the upper portion of the guy is split into two parts, one of which is attached to the top of the pole and the other directly beneath the lower cross-arm. By this means there is less tendency for the tension in the circuits to bend the top of the pole than by any other method. Erroneous methods of guying are shown in the other four examples of this illustration, the difficulties to which they give rise being so self-evident that further explanation is unnecessary.

Anchor Poles.—City lines are called upon to carry large numbers of wires and cables, and it is often necessary either to turn very sharp corners or to terminate an entire line, at say its entrance to the underground system, so that poles must frequently resist very severe longitudinal stresses. A line upon which 80 or 100 wires terminate, carrying three or four cables, will be subjected to a stress at the top of 30,000 to 35,000 pounds, and poles designed to carry such tension, are termed "anchor poles." By far the neatest solution of this problem lies in the erection of a pole built of structural iron, similar to that shown in Fig. 9. It is easy to design such a pole to carry any desired line stress, suitable for the most restricted location, of city streets and, withal, present even a pleasing architectural appearance. But poles of this kind are expensive, the one in the illustration costing upward of $500. As a compromise it is possible to reinforce a wooden pole in such a manner as to make it both structurally strong and of good appearance. This is accomplished by fitting the top of the pole with a lattice work of angles, stiff enough to transmit all the tension of the circuits to the guy rod without bringing an undue bending moment on the top of the pole. An illustration of the "composite anchor pole" is, as this device is termed, given in Fig. 10 and the details of construction shown in Figs. 11, 12, 13 and 14. Fig. 11 is the general elevation and ground plan of the entire structure. The pole may be any suitable stick of sufficient height, say 40 ft to 60 ft., to carry the lowest circuit at the requisite elevation above ground level. The top diameter should not be less than 10 inches and the diameter at the ground from 18 inches to 24 inches. As is shown in Fig. 11, the pole is framed into two yellow pine sticks shown in elevation at *B* and in plan at *D D*. These sticks carry a platform of 3-in. plank, as shown in the elevation. This platform serves to carry sufficient weight of earth to keep the pole from overturning. Table 4 shows the dimensions of the timber needed for various capacities of pole lines, the sizes given in the columns headed *A B*, etc., refer to the dimensions of Fig. 11 designated with the same letter. On the top of the pole a simple lattice of angle iron is placed, made as shown in Fig. 12. This lattice should reasonably fit the top of the pole and be long enough to cover the entire space occupied by the cross-arms. At proper intervals a transverse angle iron is rivetted to the lattice to hold the cross-arms. Fig. 12 is a detail drawing of the various sizes of lattice needed, while all dimensions are given in Table 5. As is seen in Fig. 10, the lattice is placed on the back of the pole; i. e., is away from the direction in which the circuits extend and secured by iron bands. The guy is a Y-guy and also secured by iron bands which encircle both pole and lattice. An enlarged cross section and side elevation of the bands appears in Fig. 13. Table 6 gives dimensions for guy rod bands and Table 7 data for pole bands. The guy rod consists of an iron rod with a nut at the lower end to attach it beneath the earth platform, and a clevis at the upper end, to which the guy rod bands are attached, as shown in Fig. 10. Fig. 14 gives

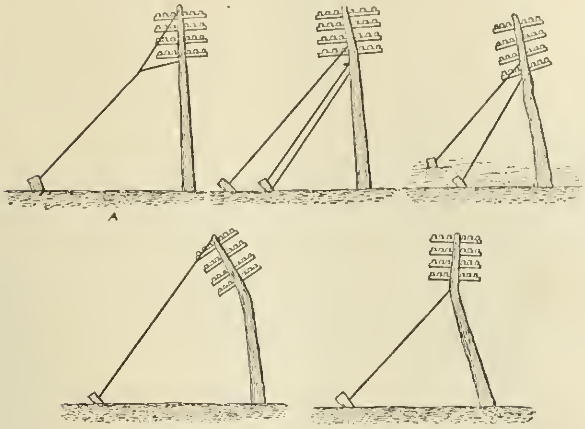


FIG. 8.—WRONG METHODS OF GUYING.

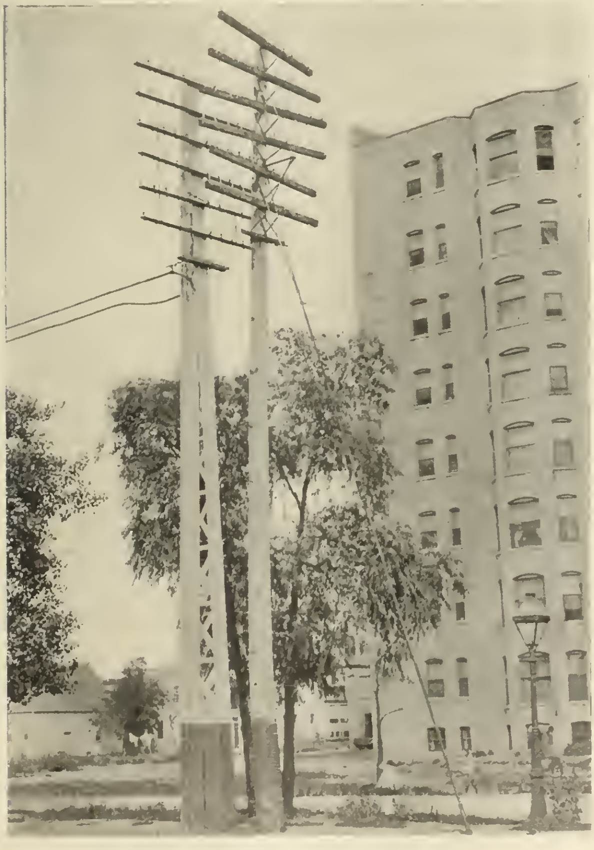


FIG. 9.—STRUCTURAL IRON POLE.

TABLE 4.

DIMENSIONS OF ANCHOR PLATFORM.

Number of Cross-Arms.	Number of Cables.	A	B	C	D	E	F	G
4	0	12'0"	20'0"	12"	8"	6'0"	6"	12"
6	0	12'0"	20'0"	12"	8"	6'0"	6"	12"
8	0	13'0"	22'0"	12"	10"	8'0"	8"	12"
10	0	13'0"	22'0"	12"	10"	8'0"	8"	12"
4	1	12'0"	20'0"	12"	8"	6'0"	6"	12"
6	1	13'0"	22'0"	12"	10"	8'0"	8"	12"
8	1	13'0"	22'0"	12"	10"	8'0"	8"	12"
10	1	14'0"	24'0"	12"	12"	10'0"	10"	12"
4	2	13'0"	22'0"	12"	10"	8'0"	8"	12"
6	2	13'0"	22'0"	12"	10"	8'0"	8"	12"
8	2	14'0"	24'0"	12"	12"	10'0"	10"	12"
10	2	14'0"	24'0"	12"	12"	10'0"	10"	12"
4	3	13'0"	22'0"	12"	10"	8'0"	8"	12"
6	3	13'0"	22'0"	12"	10"	8'0"	8"	12"
8	3	14'0"	24'0"	12"	12"	10'0"	10"	12"
10	3	14'0"	24'0"	12"	12"	10'0"	10"	12"

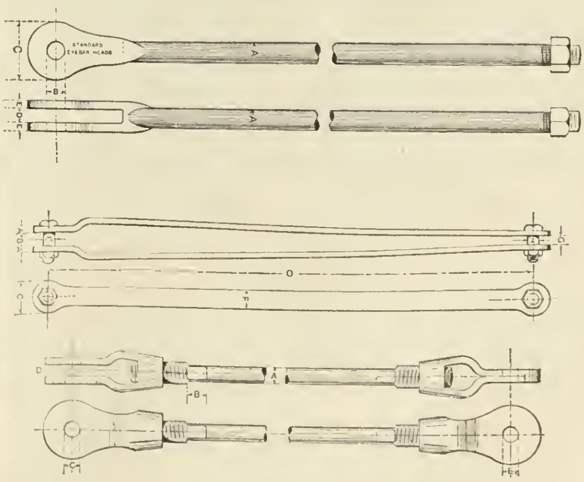


FIG. 14.—DETAILS OF GUY RODS.

TABLE 5.

		DIMENSION OF POLE LATTICES.									POSITION OF GUY ROD BANDS.		
No. of Cross-Arms.	No. of Cables.	Size of Angle Iron.	Weight of Angle Iron in foot.	No. of Angles.	Length of Angles.	Lattice Wide. A	Lattice Wide. B	Thick. C	Thick. D		Upper Band.	Lower Band.	No. of Clamping Bands.
4	0	6"×3½"×⅜"	11.7	2	12'0"	..	..	3"	¼"		Midway between 2d and 3d arm.		2
6	0	7"×3½"×7/16"	15	2	12'0"	..	..	3"	¼"		Midway between 3d and 4th arm		2
8	0	6"×3½"×⅜"	11.7	2	18'0"	..	..	3"	¼"		Midway between 2d and 3d arm	Midway between 6th and 7th arm	3
10	0	7"×3½"×7/16"	15	2	21'0"	..	..	3"	¼"		Just above 3d arm	Just below 8th arm	3
4	1	7"×3½"×7/16"	15	2	12'0"	..	..	3"	¼"		Just below 3d arm		2
6	1	6"×3½"×⅜"	11.7	2	12'0"	..	..	3"	¼"		Midway between 2d and 3d arm	Just below 6th arm	2
8	1	7"×3½"×7/16"	15	2	18'0"	.	..	3"	¼"		Just below 3d arm	Just below 8th arm	3
10	1	7"×3½"×7/16"	15	2	21'0"	..	..	3"	¼"		Midway between 3d and 4th arm	Midway between 9th & 10th arm	3
4	2	6"×3½"×⅜"	11.7	2	12'0"	..	..	3"	¼"		Just above 2d arm	Midway between 4th & cable-arm	2
6	2	6"×3½"×⅜"	11.7	2	12'0"			3"	¼"		Midway between 3d and 4th arm	Midway between 6th & cable-arm	2
8	2	7"×3½"×7/16"	15	2	18'0"	..	..	3"	¼"		Just below 3d arm	Just below 8th arm	3
10	2	7"×3½"×9/16"	24.9	2	21'0"	.	.	3"	¼"		Just above 4th arm	Just above 10th arm	3
4	3	6"×3½"×⅜"	11.7	2	12'0"	..	.	3"	¼"		Just above 2d arm	Just above cable-arm	2
6	3	7"×3½"×7/16"	15	2	18'0"	..	..	3"	¼"		Midway between 3d and 4th arm	Midway between 6th and cable-arm	2
8	3	7"×3½"×9/16"	24.9	2	18'0"			3"	¼"		Midway between 3d and 4th arm	Just below 8th arm	3
10	3	7"×3½"×9/16"	24.9	2	21'0"	..	.	3"	¼"		Just above 4th arm	Just below 10th arm	3

TABLE 6.

DATA FOR GUY ROD BANDS.

		Upper Band.															Lower Band.															
No. of Cross-Arms.	No. of Cables.	A	B	C	D	E	F	G	H	I	K	L	M	N	O		A	B	C	D	E	F	G	H	I	K	L	M	N	O	Rivets.
4	0	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½		..	..	..	..	..	..	..	..	..	..	..	..	.	..	¾
6	0	.	..	⅜	1⅜	1⅜	¾	..	5¾	2	6½	1⅜	12	8	4		..	..	..	..	..	..	..	..	..	..	..	..	.	..	¾
8	0	.	..	⅜	1⅜	1⅜	¾	.	4¼	1½	5¼	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	¾
10	0	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
4	1	.	..	⅜	1⅜	1⅜	¾	..	5¾	2	6½	1⅜	12	8	4		..	..	..	..	..	..	..	..	..	..	..	..	.	..	¾
6	1	.		⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	¾
8	1	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
10	1	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1⅞	6	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	⅞	..	4¾	1⅞	6	1⅜	12	7	3½	¾
4	2	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	⅞
6	2	..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	¾	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
8	2	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1⅞	6	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	⅞	..	4¾	1⅞	6	1⅜	12	7	3½	¾
10	2	..	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4		..	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4	⅞
4	3	..	..	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½		..	.:	⅜	1⅜	1⅜	¾	..	4¼	1½	5¼	1⅜	12	7	3½	1
6	3	..	..	⅜	1⅜	1⅜	⅞	..	4¾	1¾	5¾	1⅜	12	7	3½		..	..	⅜	1⅜	1⅜	⅞	..	4¾	1¾	5¾	1⅜	12	7	3½	¾
8	3	.	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4		.	..	⅜	1½	1½	1	..	6	2⅛	7	1½	12	8	4	⅞
10	3	..	..	⅜	1⅝	1⅝	1	..	6½	2⅜	7½	1⅝	12	8	4		..	..	⅜	1⅝	1⅝	1	..	6½	2⅜	7½	1⅝	12	8	4	1

TABLE 7.

DATA FOR POLE BANDS.

		Upper Band.										Middle Band.										Lower Band.									
No. of Cross-Arms.	No. of Cables.	A	B	C	D	E	F	G	H	I	K	A	B	C	D	E	F	G	H	I	K	A	B	C	D	E	F	G	H	I	K
4	0	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	0	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	0	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	0		..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
4	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	1	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
4	2	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	2	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	2	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	2	..	..	⅜	1⅜	1⅜	¾	..	..	..	..	9	6	⅜1	..	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
4	3	..	..	⅜	1⅜	1⅜	¾	⅜1	⅜	..	..	9	6	⅜1	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
6	3	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	..	..	..	..	..	..	..	..	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
8	3	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6
10	3	..	..	⅜	1⅜	1⅜	¾	..	1⅜	9	6	..	..	⅜	1⅜	1⅜	¾	..	1⅜	12	6	..	.	⅜	1⅜	1⅜	¾	..	1⅜	12	6

TABLE 8.

MAIN GUY ROD.

No. of Cross-Arms.	No. of Cables.	A	B	C	D	E
4	0	1⅝"	2½"	7"	1½"	¾"
6	0	1⅞"	2½"	7"	1¾"	¾"
8	0	2"	2½"	7"	1½"	⅞"
10	0	2"	2½"	7"	1½"	⅞"
4	1	1⅞"	2½"	7"	1¾"	¾"
6	1	2"	2½"	7"	1½"	⅞"
8	1	2"	2½"	7"	1½"	⅞"
10	1	2¼"	2½"	7"	1½"	⅞"
4	2	2"	2½"	7"	1½"	⅞"
6	2	2"	2½"	7"	1½"	⅞"
8	2	2¼"	2½"	7"	1½"	⅞"
10	2	2½"	3"	7¹³/₁₆"	1¾"	1"
4	3	2"	2½"	7"	1½"	⅞"
6	3	2"	2½"	7"	1¼"	⅞"
8	3	2½"	3"	7¹³/₁₆"	1¾"	1"
10	3	2⅞"	3½"	9½"	2¼"	1"

TABLE 9.

BRANCHES FOR GUY ROD.

No. of Cross-Arms.	No. of Cables.	A	B	C	D	E
4	0	1⅝"	2½"	7"	1½"	¾"
6	0	1⅞"	2½"	7"	1¾"	¾"
8	0	2"	2½"	7"	1½"	⅞"
10	0	2"	2½"	7"	1½"	⅞"
4	1	1⅞"	2½"	7"	1¾"	¾"
6	1	2"	2½"	7"	1½"	⅞"
8	1	2"	2½"	7"	1½"	⅞"
10	1	2¼"	2½"	7"	1½"	⅞"
4	2	2"	2½"	7"	1½"	⅞"
6	2	2"	2½"	7"	1½"	⅞"
8	2	2¼"	2½"	7"	1½"	⅞"
10	2	2½"	3"	7¹³/₁₆"	1¾"	1"
4	3	2"	2½"	7"	1½"	⅞"
6	3	2"	2½"	7"	1½"	⅞"
8	3	2½"	3"	7¹³/₁₆"	1¾"	1"
10	3	2⅞"	3½"	9½"	2¼"	1"

TABLES 5, 6, 7, 8 AND 9.—CONSTRUCTION OF AERIAL TELEPHONE LINES.

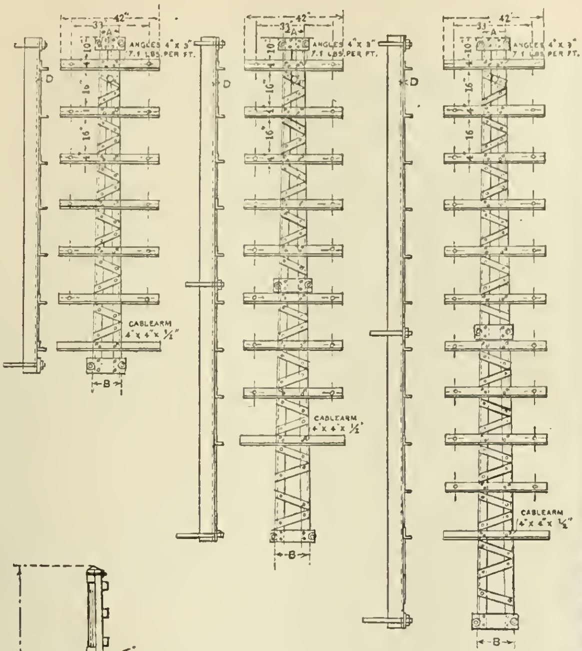


FIG. 12.—DETAILS OF COMPOSITE POLE TOP.

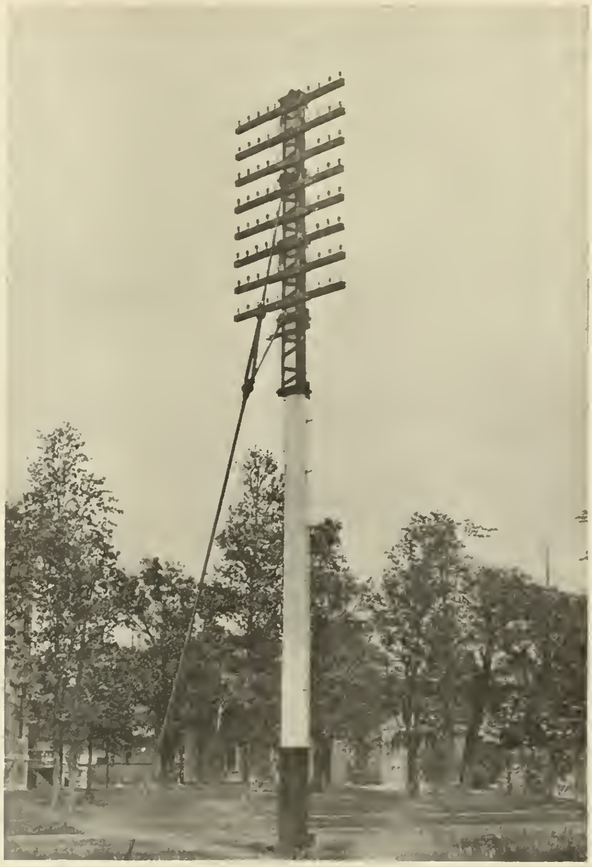


FIG. 10.—COMPOSITE ANCHOR POLE.

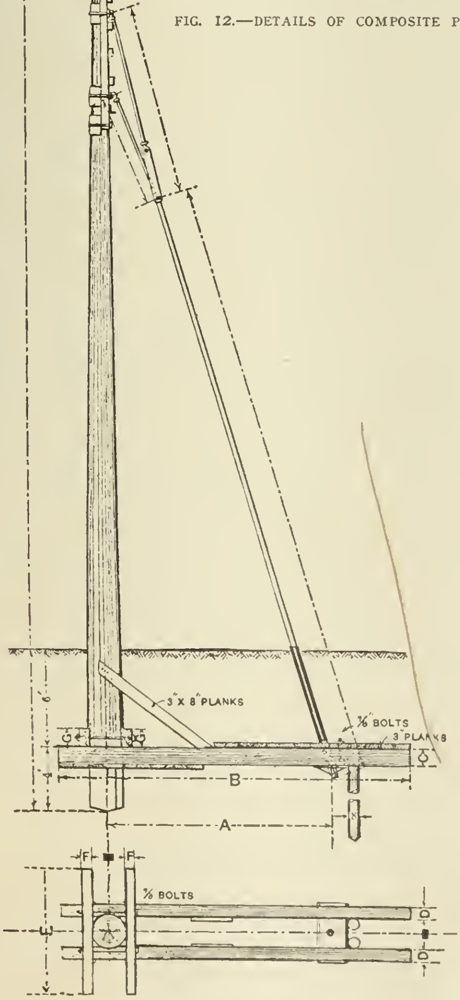


FIG. 11.—ELEVATION AND PLAN OF COMPOSITE ANCHOR POLE.

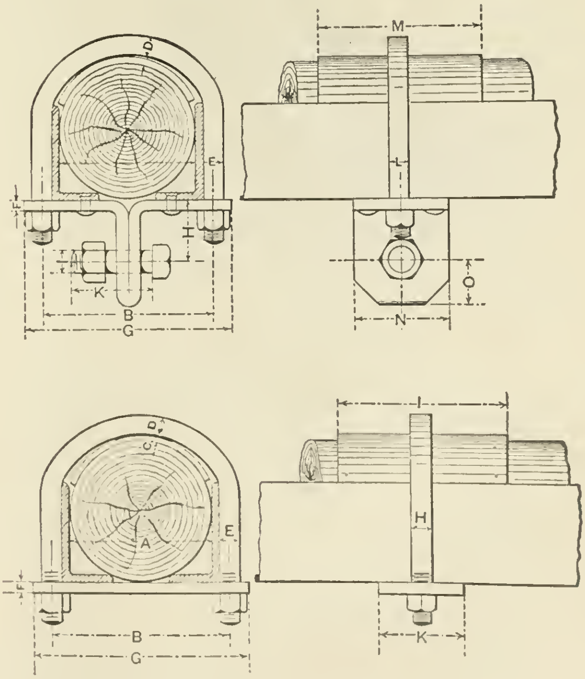


FIG. 13.—CROSS SECTIONS AND SIDE ELEVATIONS OF BANDS

DETAILS OF COMPOSITE TELEPHONE POLE CONSTRUCTION.

detail drawing of each piece. Table 8 the dimensions of the main rod, Table 9 the sizes of the branches and Table 10 data for extension plates. Poles of this description can be built at a cost of from $100 to $150, depending on line capacity. Their strength seems ample, for the author has known several blocks of a hundred wire line with five cables to go down, leaving an anchor pole of this description the solitary sentinel at the end of the line.

TABLE 10
GUY ROD EXTENSION PLATES.

No. of Cross Arms	No. of Cables	A	B	C	D	E	F	G
8	0	¾	3¼	7	54	2½	3	1¼
10	0	¾	3¼	7	54	2½	3	1¼
6	1	¾	3¼	7	48	2½	3	1½
8	1	¾	3¼	7	54	2½	3	1½
10	1	¾	3¼	7	54	2½	3	1½
4	2	¾	3¼	7	48	2½	3	1½
6	2	¾	3¼	7	48	2½	3	1½
8	2	¾	3¼	7	54	2½	3	1½
10	2	¾	3¾	7 13/16	54	3	4	1¾
4	3	¾	3¼	7	48	2½	3	1½
6	3	¾	3½	7	48	2½	3	1½
8	3	¾	3¾	7 13/16	54	3	4	1¾
10	3	¾	4¼	9½	54	3½	5	2¼

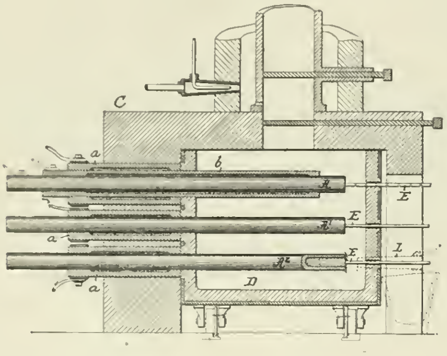
* * *

Carbide Furnace.

By CLINTON PAUL TOWNSEND.

The revoluble calcium carbide furnace of Mr. Hudson Maxim has been described in these columns. This early furnace might be considered, for practical purposes, as a centrifugal machine wherein a bed of fluid carbide is held against the periphery of a refractory revolving casing, and by the passage of an electric current through it, is sufficiently heated to convert superposed portions of the charge. This furnace bears the impress of its early date, when calcium carbide was regarded as a readily liquifiable compound, to be tapped from the furnace or handled therein like molten iron.

A patent recently issued to the same inventor deals with the true calcium carbide—a body which exists as a mobile mass only at temperatures which involve both a vast expenditure of heat and a vast waste. The carbide is no longer to be tapped or run from the open mouth of a drum, but is obtained as slabs or ingots embedded in the unconverted charge and permitted to cool in place in the crucible in which it is formed. The present furnace is rather analogous in its operation to the constructions of Roberts and Hewes. The electrodes are horizontal, parallel and embedded in the charge, and the circuit is closed across their ends for initiating the reaction by means of a resistance plate, conveniently formed of the carbide from a previous operation. This temporary connection is soon dissipated or fused, and the circuit is thereafter closed through the newly-formed carbide, which by the gradual and equal retraction of the electrodes is built up into a plate-like mass.



MAXIM ELECTRIC FURNACE.

The construction will be clear from the figure. A crucible, *D*, provided with a refractory lining, is perforated at one side to permit the introduction of several superposed pairs of electrodes, *A*, *A'*, A^2, and slotted on the opposite side for the introduction of the temporary short circuiting plates of carbide, *L*. The electrodes may be hollow, and finely divided carbon may be fed through them for the better protection of their working ends. The several electrodes are slidably arranged in the wall of a surrounding masonry furnace, *C*, and are preferably arranged to slide within a sleeve, *a*, inset as shown and provided with a filling of divided carbon to insure good electrical contact. In some cases a longer intermediate sleeve, *b*, as shown, fitted to the upper electrodes, is used to provide additional support for the projecting carbons. A suitable device, of ordinary form, is shown for charging the crucibles as they are brought into operative relation with the electrodes, and means are also shown for preliminarily heating the charge before introduction into the crucible. In operation the circuit is temporarily closed between the two electrodes constituting each horizontal pair, and the electrodes are then slowly retracted in such manner as to build up a plate of carbide extending horizontally across the crucible. At the end of the operation the electrodes are withdrawn entirely from the crucible and the latter is moved forward upon the tracks, another of similar construction taking its place. The furnace is thus essentially intermittent in type.

* * *

Municipal Ownership Convention.

Under the auspices of the New York Reform Club a national convention will be held in this city on municipal ownership and public franchises, February 25, 26 and 27. The following programme has been prepared by the advisory board:

Wednesday, February 25 (morning session, 10 A. M., at No. 233 Fifth Avenue).—Address of welcome by Mayor Low, of New York, and Mr. John G. Agar, chairman; "Recent History of Municipal Ownership in the United States," brief contributions by Wm. Wirt Howe, former president American Bar Association, New Orleans, La., Clinton Rogers Woodruff, of Philadelphia, secretary of the National Municipal League, L. N. Case, manager of water and light plants, Duluth, members of the staff of the New York School of Commerce, and by others; "Recent British Experience of Municipal Ownership," Mr. Robert Donald, editor of the *Municipal Journal*, London; "Recent German Experience of Municipal Ownership," Mr. Ed. T. Heyn, of Berlin; "Comparison of European and American Methods and Results," Hon. Robert P. Porter, director of the Eleventh Census of the United States; discussion. Afternoon Session, 2.30 P. M.—"Transportation," paper by Charles T. Yerkes, of London and New York, address by Mayor Harrison, of Chicago; discussion; "City Owning and Leasing," Mr. Edward M. Shepard, counsel to the Rapid Transit Commission, New York; "Massachusetts' Experience," Mr. Louis D. Brandeis, of Boston; discussion. Thursday, February 26 (morning session, 10 A. M.).—"Gas and Electric Lighting" (I, Electric Lighting), Lieutenant Cahoon, secretary and ex-president of the National Electric Light Association; discussion; II, Gas Lighting, Walton Clark, general superintendent Gas Improvement Company, Philadelphia, Pa., past president American Gas Lighting Association, Alton D. Adams, engineer, Boston, Mass.; discussion opened by Prof. Ed. W. Bemis, water commissioner, Cleveland, Ohio. Afternoon Session, 2.30 P. M.—Water and Telephones, "European Experience of Public Ownership of Telephones," Mr. Bennett, engineer for Glasgow and other British municipal telephone systems; "Argument for Public Ownership of Telephones," Prof. Parsons, of the Boston Law School; "The Superiority of Corporation Ownership of Telephones," Mr. U. N. Bethell, general superintendent New York Telephone Company; discussion; "City Ownership of Water Supply," Mr. Wm. R. Hill, president of the American Water Works Association; discussion. Friday, February 27 (morning session, 10 A. M.).—"How Should Public Service Corporations be Controlled?" Mr. R. R. Bowker, formerly of the Edison Electric Illuminating Company, New York; discussion; "Regulation and Taxation of Public Service Corporations," Mr. Allen Ripley Foote, editor of *Public Policy;* discussion opened by Prof. John R. Commons, secretary Taxation Committee National Civic Federation. Afternoon Session, 2.30 P. M.—"Labor Clauses in Franchise Grants and the Labor View of Municipal Ownership," ex-Mayor Chase, of Haverhill, Mass.; discussion; "Taxation of Franchise Values," Mr. Frederick Howe, of Cleveland; discussion opened by Mr. Wheeler H. Peckham, president of City Club, New York.

Developments in the Indiana Telephone Field.

The developments in Indiana during the past year are in some respects without a parallel in the history of telephony in that State. The investment of capital in constructing new lines and establishing modern exchanges, improving and extending old systems surpassed all previous figures. The formation of new companies and the opening up of new fields continued actively during the entire year, while indications for still greater possibilities in the near future are apparent on every hand. In Delaware and Madison Counties, the gas belt district of Indiana, exchanges were built by the Delaware & Madison Counties Telephone Company in Anderson, Muncie, Elwood and Alexandria, with toll lines connecting these exchanges together with all the smaller towns and villages in the gas belt, giving the citizens of this industrial section of the State a complete up-to-date telephone service. This system is connected with the new long-distance lines of Indianapolis, giving them a complete long-distance service over the entire State of Indiana. The increasing business of this company has gone far beyond the expectations of the management. Preparations are now being made for extensions together with additional facilities to carry on both the local and long-distance business. There has also been an independent plant built at Logansport and South Bend, which gives an independent telephone exchange in every city and town of any consequence in the State.

A great many extensions have been added to the system of the National Telephone & Telegraph Company, of Fort Wayne, which controls the long-distance work of northern Indiana. The managers report that there is considerable work to be done in the independent field during the coming year in the way of developing the farmers' trade. Already estimates are being made and purchases will soon be effected in order to start this work as early as possible. The demand for farm telephones is so great in this section of the State that the various telephone companies will be kept busy in that direction during most of the present year.

In Blackford and adjoining counties, which is covered by the United Telephone Company, there has been considerable growth. The toll business has increased 25 per cent. on the lines of the United Telephone Company and the number of telephones has increased a little over 20 per cent. All new apparatus that is being put in is of the very latest and best, so that the service is improved, as well as increased in volume. Entirely new central energy boards were put in at Huntington and Marion, both exchanges are equipped with entirely new telephones, as well as all the rest of the apparatus. A new board was put in at Montpelier and considerable extensions were made at Hartford City. The farmers of this district are now beginning to call for telephones and where they are treated fairly they prefer to connect direct with the exchanges and pay the extra price, $1.50 per month, rather than try to build their own lines. There is, therefore, no friction and the service is first class.

The Cumberland Telephone Company operates in thirteen counties in southern Indiana, and has in operation at this time more than 10,000 telephones. It is perhaps the only company that has anything that approaches a comprehensive long-distance telephone system. The central exchange for this system is in the city of Evansville and the situation there is extremely interesting and perilous. The city authorities have declared that the Cumberland Company's franchise has expired by limitation, and have brought suit to oust it from the streets of the city. The company's defense is that it has a perpetual charter and is confident the court will sustain its right to continue business in Evansville. In either event there is great prospect for improvements and extensions in this field. If the city wins it will install a new municipal telephone plant, and it is so sanguine of its position that steps in that direction are already being taken. The New Telephone Company and the New Long-Distance Telephone Company, of Indianapolis, covers central Indiana thoroughly and has made many improvements and long-distance extensions during the year. These improvements, however, are to be followed by still greater during the present year. This company has looked carefully to its relation to the financial world evidenced by its reports made to the stockholders.

As great as the telephone business of Indiana now is, there still remain a few unoccupied fields and the possibilities in construction and the improvement and extension of plants already in operation, will call for vast expenditures of money for labor and material during the present year.

New Telephone Patents.

A few weeks since brief mention was made under this heading of a patent covering an arrangement of telephone circuits wherein by the use of more than one induction coil at the subscriber's station, increased efficiency of transmission was claimed. In a patent issued February 3, 1903, entitled, "Telephonic apparatus," and granted to the same inventor, C. G. Burke, of Brooklyn, N. Y., another device of the same nature is described. In this latest circuit, shown in Fig. 1, wherein the right-hand end of the line only is provided with the modified apparatus, there is inserted in the main line the many-turn, high-resistance secondaries of several induction coils, the primary windings of which, of less turns and less resistance, are connected together and to an auxiliary receiver to be used to supplement the usual receiver, M^1. In his specification Mr. Burke states that by such a combination the speech transmitted is much improved, both in volume and clearness, and that the improvement increases with each additional auxiliary induction coil. He also states that to obtain the best results the auxiliary coils should not be duplicates, but should have different ratios of conversion and different resistances.

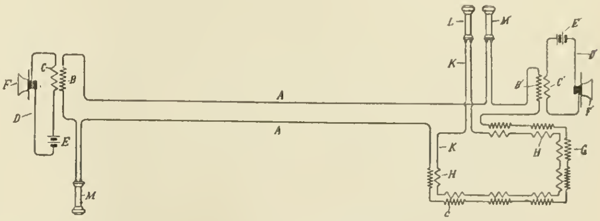


FIG. 1.—BURKE TELEPHONE.

A careful consideration of the circuit fails to reveal any reason for any real gain in efficiency, and the inventor himself is evidently at a loss to explain it, for he says in regard to it, "I do not advance any theory in explanation of this fact." It is, however, quite easy to see how with the arrangements of circuit shown an apparent gain is obtained, for each additional induction coil adds to the proportion of the energy available for the auxiliary receiver and subtracts from that available in the low-resistance line receiver. The net total energy, of course, must be reduced by the additional iron losses, which prohibit any real gain.

A patent issued the same date to Charles H. Gaunt, of St. Paul, relates to combined telegraphy and telephony on that system where each metallic circuit is available for the simultaneous transmission of one message of each kind. Fig. 2 shows the rudimentary circuit wherein 2 2 is a telephone line having the bridged stations, *A A*, and the telegraph stations, *C C C*. As is seen, taps are carried at the telegraph stations, one from each side of the line, through the non-inductive resistance coils, 11, 11; through the inductively equal coils, 3 to the point *E*, and thence through the telegraph instruments. The novelty in the invention lies in the mutual relations of the coils, 11, 11 and 3. These latter, the inductance coils, are wound to the same number of turns each, and are so connected as to form an inductive circuit for the telegraph currents and a non-inductive path for the telephone currents. In order not to shunt an appreciable portion of the telephone currents, these coils, 3, are wound to a high resistance, as are also the coils, 11, 11, which are not made exactly equal, but are adjusted to compensate for any inequality of resist-

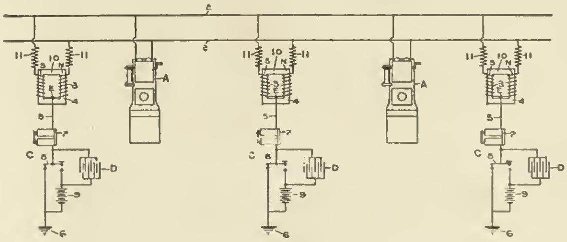


FIG. 2.—GAUNT COMBINED TELEGRAPH AND TELEPHONE SYSTEM.

ance in coils, 3. All this results in a reduction of disturbance to the telephone system from the telegraph signals, first, by dividing the telegraph currents exactly equally between the two sides of the line, and second, by prohibiting any abrupt changes of potential on account of the choking effect of the inductance coils.

The third telephone patent of this issue provides a new message-counting, or service meter system, the inventors being Messrs. A. M. Bullard and L. A. Falk, who have assigned the patent to the American Telephone & Telegraph Company. This system provides a message counter, adaptable to party line service, to be located at the several stations and yet under control of the central office operator.

In Fig. 3 is shown a connection completed through a central energy central office of the Bell type, involving a single-station line and a two-station line. At each station at *H* is shown the counting mechanism, controlled by a polarized electromagnet, *v*, and wired in the branch line circuit of the station. At *u* is shown a non-inductive shunt circuit, so proportioned that while the meter-operating current will properly affect the counter, the alternating ringing current will not affect it. At the same time it provides a path around the inductive meter coil of inappreciable effect in reducing the transmission. At the central station there is provided the direct-current generator, S^2, which runs at a constant potential much higher than that of the battery, *S*, and which has one pole, the reverse from that of the battery, grounded. When this generator is connected to a subscriber's line having the receiver off the hook, a current much greater than the normal and in the reverse direction flows, with the result that the properly poled meter operates to count one message.

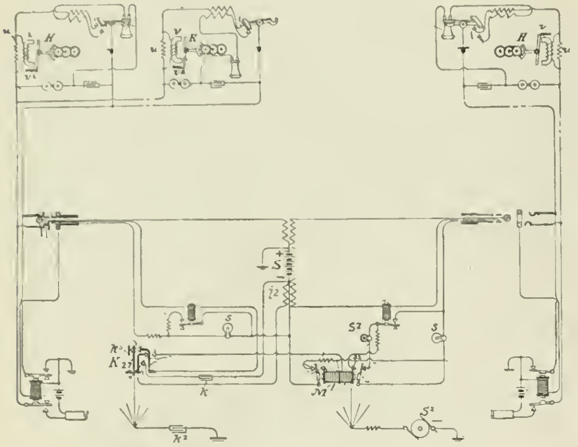


FIG. 3.—BULLARD AND FALK TELEPHONE METER AND APPARATUS.

This is the gist of the invention, but two interesting refinements are introduced. One of these is the especial arrangement of the meter key, *K*, and the condensers, *k* and k^2, by which, when the key is depressed to make a count, the line circuit which is to be transferred from the battery to the generator is connected to ground through the condenser, k^2, while the repeating coil winding, i^2, whose circuit is to be opened, is shunted by the condenser, *k;* with the result that all coil discharges find a path through the condensers, relieving the subscribers' telephones of part of the disagreeable resulting rush of current. The second refinement is the provision of the switching relay, *M*, and the signal lamp, S^2, so related that the operator is given a signal to register the call by the answering of the called party.

Both of the remaining telephone patents are granted to James A. Wotton and assigned by him to the Wotton Electric & Manufacturing Company. The first of these describes a new transmitter, while the second is for a method of manufacturing electric condensers. The novelty of the transmitter lies in the insulating of what may be termed the back electrode, from the case or carbon chamber, and the supporting of the movable electrode upon a metallic diaphragm. Thus in a transmitter of the general type of the Bell solid back, the mica disc is replaced by a metallic annular disc serving as a flexible and conducting connection between the frame and movable electrode, while the stationary electrode is mounted upon rigid insulating material. This would seem to be an admirable idea and result in an efficient instrument.

The improvement in the manufacture of condensers lies in the use of ordinary, unimpregnated paper during the building up of the condensers and the simultaneous removal of the moisture from, and the impregnation of the paper with, suitable filling insulator, by treating the built up condensers in a heated bath of wax. By this means the cost of manufacture of the condenser is said to be much reduced.

The Engineering of Illumination.

Mr. V. R. Lansingh addressed the Western Society of Engineers in Chicago on February 4, 1903, on the subject, "The Engineering of Illumination." Mr. Lansingh is a specialist in illuminating engineering in Chicago.

He introduced his remarks by calling attention to the fact that a great deal of thought has been given by engineers in times past to securing the highest efficiency from power house apparatus, and the lowest losses in the distribution of electric current and in transforming it into light. When, however, it comes to using the light supplied by this current, there is great wastefulness. It is safe to say that 25 per cent. of the electric light in this country used is unnecessarily wasted. There is evidently more chance to secure greater efficiency by studying the engineering of illumination than anywhere else in connection with electric light work.

Mr. Lansingh then went into a discussion of interior illumination. The first requisite of good illumination, he considered to be steadiness, particularly in inside lights, and one casting shadows involves constant labor on the part of the eye to adapt itself to changing conditions, and is entirely unsuited to interior lighting. Next in importance he placed diffusion of light, so that the illumination is even throughout the space to be illuminated. In this connection the relative intensities of the flames of various illuminants were given. The third requisite is that the light must be out of the direct line of vision. The influence of the color of walls on interior illumination was discussed, it being shown that white walls reflected about 80 per cent. of the light, while black absorbs about that much. Mathematical formulæ were given for obtaining the illumination at various distances from the source of light. Shades and reflectors were discussed briefly, and the undesirable effects of mirror reflectors without some form of diffusion were shown.

Independent Telephony in Kansas

About 100 managers of independent telephone exchanges in Kansas met in Topeka on January 28, 29 and 30. A contract was made with the Kansas City Independent Telephone Company to connect Kansas City and Topeka by an independent system within four months; Topeka and Wichita and Topeka and Belleville within six months.

Among the papers read on the 29th were: "The Engineering of the Kansas City Exchange," by M. C. Polk; "Progress in Southeastern Kansas," by M. L. Robeson, of Galena: "Hic Jacet Berliner," by Charles E. Wells, of Marion, and "Our Needs as I See Them," by W. H. Nelson, of Smith Center.

New officers of the association for the coming year were elected as follows: A. A. Godard, of Topeka, president; J. M. Doyle, Belleville, vice-president; Charles V. Wells, Marion, secretary, and J. W. Smith, Minneapolis, treasurer. The new Executive Committee is composed of C. H. Munsell, Hiawatha; J. E. Byers, Ottawa; W. H. Nelson, Smith Center, and A. R. Champlin, Newton.

The Cuyahoga Telephone Company.

The report of President Dickson, read at the annual meeting of the Cuyahoga Telephone (independent) Company, of Cleveland, Ohio, which was held on February 4, shows a very satisfactory condition of the company's affairs. The report for 1901 showed a deficit of $29,684, while that for 1902 shows a surplus of $542. Mr. Dickson calls attention to the fact that it cost the company $10,000 a year to collect the rentals, whereas the work is done by other companies of corresponding size for $6,000. He will inaugurate economies in this direction, and will reduce the number of employees. The expenses of management, he says, have been far too high in the past, and he promises to effect a saving by discontinuing useless departments and consolidating others. Extravagance in the previous management of the company's affairs was the keynote of his report. The officers elected are: F. S. Dickson, president; E. W. Moore, vice-president, and J. B. Hoge, secretary.

President Dickson proposes to raise $400,000 necessary to make required improvements and betterments by offering $2,000,000 worth of 6 per cent. cumulative preferred stock to stockholders at 60. The plan provides for the liquidation of the Federal Telephone Company's claims against the Cuyahoga Company, by the acceptance by the former of 7,415 shares of the new stock.

CURRENT NEWS AND NOTES.

CHINESE TELEGRAPHS.—In spite of its recent assertion that it had abandoned the proposed scheme, the Government of China has again announced that it has decided to assume control of the Commercial telegraph line and the local Taotai at Shanghai has formally requested the consuls to forbid foreigners to purchase shares in these lines.

ST. LOUIS WORLD'S FAIR DEDICATION.—The grounds and buildings of the St. Louis World's Fair will be dedicated on April 30 next by President Roosevelt and an address will be delivered by ex-President Cleveland. A military pageant will precede the dedication ceremonies, which will take place in the Palace of Liberal Arts. Arrangements are being made for the seating of 60,000 people within the building, which is 720 feet long by 525 feet wide. A grand display of fireworks will take place in the evening.

OHIO ENGINEERS.—The Ohio Society of Mechanical, Electrical and Steam Engineers will hold its next meeting in Warren on February 14. Several papers of interest to those engaged in these branches of engineering will be presented. Among them are the following: "Oiling Systems for Power Plants," by P. E. Moock, of Canton, and "Gas Engines *vs.* Steam Engines," by E. M. Adams, of Akron. The officers of the association are E. E. Miller, Canton, president; C. J. Miller, Canton, secretary, and R. H. Probert, Akron, treasurer.

AUTOMOBILE MAKERS MEET.—Officers for the coming year were elected by the National Association of Automobile Manufacturers at a meeting of the Board of Directors, held in New York City last week, as follows: President—M. J. Budlong, Hartford, Conn.; First Vice-President—H. W. Leonard, Bronxville, New York; Second Vice-President—W. T. White, Cleveland, Ohio; Third Vice-President—Charles Clifton, Buffalo, N. Y.; Secretary—H. T. Unwin, New York City; Treasurer—Percy Owen, New York City. The association is directing its efforts at present toward making a success of the National Good Roads Convention to be held at the Auditorium, Chicago, on February 14.

LECTURE ON SUBMARINE CABLES.—Dr. A. E. Kennelly, of Harvard University, is to lecture before the New York Electrical Society on Wednesday, February 18, at 8 P. M., at the American Institute, 19 West Forty-fourth Street. The lecture, which will be illustrated profusely with lantern slides, and to which ladies are specially invited, will deal with the Doctor's own experiences in laying recently an all-American cable across the Gulf of Mexico, and will thus combine the personal element with a great deal of useful and up-to-date information. Dr. Kennelly has in a marked degree the gift of popular exposition, and the lecture will be one of the events of the society's very successful season.

MARCONI WIRELESS TELEGRAPH NEWS AGENCY.—A cable dispatch from London of February 7 says: The Chancery Court to-day granted the Marconi Wireless Telegraph Company an extension of its powers by which it is entitled to carry on the business of news agent and publisher on shipboard. This probably refers to the scheme of publishing a daily newspaper on shipboard, the news being received by wireless telegrams. Mr. Marconi, who was a passenger on the *Etruria*, said the idea of publishing a daily newspaper with wireless dispatches had taken tangible form. When the *Etruria* was twenty miles west of Browhead a summary of the day's news was transmitted, printed and distributed to the passengers.

THE ENGINEERS' CLUB.—The Engineers' Club has acquired the property, 32 and 34 West Fortieth Street, New York City, a plot 50 x 98.9, facing Bryant Park and the new Public Library site, and now occupied by two five-story English basement houses. The seller of the property is William M. Martin. It is the intention of the Engineers' Club to erect a new clubhouse on this site, although it is not likely any active steps in the matter will be taken for some time to come, as the club's lease on its present quarters at 374 Fifth Avenue has four years yet to run. The Engineers' Club is the second organization to select this block on Fortieth Street as the location for a new house. A little further to the west, nearer to Sixth Avenue, stands the new twelve-story structure of the Republican Club, only recently completed. The great New York Library will occupy the center of the block, facing on Fifth Avenue.

CHICAGO MUNICIPAL OWNERSHIP.—Cheaper light and heat for the people of Chicago will be the argument on which the civic committee will urge the legislature to pass the Finn bills, providing for public ownership of gas and electric light plants, adopted by the City Council. Chairman Finn of the committee says: "Not only would the people of Chicago get cheaper light under municipal ownership, but heat could be furnished to every home at such a price as would make another coal famine an impossibility. Were the electric light bill passed the city should at once proceed to put it into operation, and as a first step should secure from the sanitary district the right to the invaluable water power at Lockport. With this cheap power not only could we light all our streets with electricity at comparatively small cost, but we could furnish electric light to the people much cheaper than rates which now rule for gas." In fact, we don't see why anything need cost anybody a cent.

MARCONI SYSTEM IN CANADA.—Some opposition has been offered to the establishment of a Marconi station at McGill University, Montreal, Canada, on the ground that such a station would seriously impair the usefulness of the physical labaratories, but more important still, the operation of a wireless telegraph station in Montreal or its vicinity would increase the danger of fires arising from defective insulation of electric wires of all kinds throughout the city, and might, therefore, increase to the university, in common with all the citizens of Montreal, the cost of insurance against fires. Willard D. Green, general representative of Mr. Marconi in Canada, denies that the establishment of a wireless telegraph station on Mount Royal, 700 yards away, will affect the instruments in the McGill laboratory. He also denies that there will be any danger from fires in case of defective insulation or that the transmission of a message will cause great noise. He intimates that some of the governors of McGill are very much interested in telegraph and cable companies, and that this may account for their opposition. Sir William Van Horne, R. B. Angus, Lord Strathcona, James Ross, and other large telegraph shareholders are also governors of McGill.

WIRELESS STOCK QUOTATIONS.—Last week quotations of the curb stocks were sent in New York City by wireless telegraph to the office of Dow, Jones & Co., at 44 Broad Street. An automobile with a De Forest wireless apparatus on board sent the messages up a seven-foot brass pole into the air. The "responder" was put up in one of the inside private offices of Dow, Jones & Co. in the basement of the Edison Building and the door was closed. A ground connection was made by connecting the little machine with a water pipe. The sending operator sat on the side of the automobile and clicked away on an ordinary telegraph key. The curb reporter hands the quotations to the operator on the wagon instead of to messenger boys, thus saving three or four minutes on each quotation. Stocks sometimes go up three points in a minute on the curb and reporting them has been slow compared with the exchange quotations. President White, of the De Forest Wireless Telegraph Company, said that Henry Clews & Co., Miller & Co. and several other firms were going to try the experiment of having receivers in their offices in Broad Street, where the curb market is. There was no doubt, he said, that messages could be sent to Broadway offices, too. The company has had four automobiles constructed with the sending apparatus and poles for this purpose and propose eventually, so its promoters say, to supply a news service.

WIRELESS TELEGRAPH STATIONS FOR YACHTS will, it is stated, be established at Newport and on the north shore of Long Island, so that yachts on the Sound, which they frequent so numerously all summer, can be constantly in touch with the land, for all manner of purposes.

"ONE-A-PENNY."—In England, the Sunderland Town Council has decided to try the experiment of supplying electricity for the lighting of the workmen's dwellings owned by the municipality on the penny-in-the-slot principle. The corporation propose to supply an 8-cp light which will last five and one-fifth hours for one penny

TRAIN WIRELESS TELEGRAPHY.—A cable dispatch from Berlin of January 29 says: The experiments on the military railroad between Berlin and Zossen in connection with keeping a moving train in continuous wireless communication with the signal station have been completely successful. The Braun system was used.

CHEAP RADIUM.—A cable dispatch from London of February 7 says: In connection with the articles on radium and the price of that extraordinary metal, a correspondent writes to one of the newspapers: "I am selling pure radium bromide at 8 shillings per milligram, which is equal to £400,000 per kilo." This is about $900,000 per pound. Scientists are the only purchasers.

CONNECTICUT THIRD RAIL.—At Hartford, on February 5, in the State House of Representatives Senator Ney presented a bill for the incorporation of a trust company in Hartford by attorneys for the projected third-rail railroad between Hartford, Middletown, and New Haven, the capital stock to be within $10,000,000. The trust company, it is understood, is for the purpose of financing a projected parallel to the New Haven Road.

TRANSPORTATION IN LONDON.—A royal commission has been appointed to inquire into the question of the locomotion and transport needs of London and the desirability of establishing some authority or tribunal to which all schemes of railway and street car line construction should be referred. Sir David Barfour is appointed Chairman of the commission, which includes among its members Earl Cawdor, Sir John Wolfe-Barry, and a dozen other prominent men.

RAILROAD TROLLEY FEEDERS.—A most interesting article appears in the valuable periodical, the *World's Work*, for February, by Sylvester Baxter, on the manner in which the Boston & Maine Railroad, under the far-sighted policy of President Tuttle, has built up a fine subsidiary trolley system as a feeder and parallel to its main steam lines, not only supplementing them, but creating new traffic under new conditions. Mr. Baxter points out how in many ways the traffic differentiates from that of the old steam system.

DIGEST OF AUTOMOBILE AND HORSELESS CARRIAGE PATENTS.—The American Patents Publishing Company, Washington, has issued a supplement from June, 1899, to January, 1902, to the "Digest of United States Patents of Automobiles and Horseless Carriages," since which latter date digests of these patents have been published in the *American Electric and Automobile Patents Monthly*. One of the important features of the Supplement is a list of all references cited against each application in its course through the Patent Office.

AMERICAN INVENTION IN 1902.—The report of the Commissioner of Patents for the calendar year 1902 shows a total of 49,490 applications for patents, including designs, and that 27,776 patents, including designs, were issued. In addition there were 110 patents reissued, 2,006 trade marks registered, and 767 labels and 158 prints registered. During the year 23,331 patents expired. 4,471 applications allowed were forfeited because of non-payment of fees, and 9,284 allowed applications are still awaiting final fees. The excess of receipts over expenditures was $159,514.

BIRKELAND ELECTROMAGNETIC GUN.—A cable dispatch from Berlin of January 31 says: Birkeland's electromagnetic cannon, the one described in the technical press a year ago, is now engaging the attention of German artillerists, in an improved shape. Although it is only available in forts and is too complex to be trusted to an ordinary gunner, the German experts regard it as the forerunner of a new type of ordnance. The principle of the gun is the passing of a powerful current through wire spirals in the bore without heating. It throws a fifty pound projectile more than three miles with accuracy. But Birkeland says he can increase the distance four-fold. This is the first electric gun the German artillerists have found practicable. The above, we surmise, originated with the press agent of the gun.

MARCONI SYSTEM ABROAD.—A commission appointed by the Italian Government to consider the establishing of wireless communication between Italy and the Argentine Republic has made a favorable report on the subject. It is understood that the government will allot $140,000 to equip the Italian station, which will also serve subsequently as a means of communication with Erythrea and Sardinia. The Marconi system has also been adopted to complete telegraph communication between Cape Town and Cairo. Telegraph wires are already erected from Cape Town to Ujiji, a distance of more than 3,000 miles. It is expected that wires will soon be finished from Cairo to Fashoda. Owing to the country between Fashoda and Ujiji presenting serious engineering difficulties the wire lines will be linked by the etheric system, at least temporarily.

GERMAN ELECTRICAL CONSOLIDATION.—Referring to reports already published in these pages, a cable dispatch from Berlin of February 10 says: The Siemens-Halske and Schuckert Electrical Companies have decided to unite, subject to the approval of the stockholders. An impulse towards amalgamation was given by the Allgemeine and Union combination on December 22. The Siemens-Halske Company has a capital of $13,625,000, and $7,500,000 in debentures. The Schuckert Company, which lately was in financial difficulties, has a capital of $10,500,000 plus $7,000,000 of the Continental Financing Company. The new concern is to be a limited company with a capital of $25,500,000. It will be known as the Siemens-Schuckert Works. It is understood that the old companies share about equally in supplying the capital. All the "watered" stock and worthless assets will be eliminated and only the factories, material on hand, and sound accounts will figure on the new books. All the shares of sub-companies will be excluded, as well as those of the Siemens Dynamo Works at Charlottenburg and the cable works at West End. The combination will take over the old companies in April. All the electrical works of Germany are now practically included in the two companies, and it is believed that the latter will make common prices.

LETTER TO THE EDITORS.

Stresses in Alternator Frames.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the article in your issue of January 24 on "Stress on Frames of Alternating-current Generators," I wish to call your attention to the fact that the author has neglected torque in the inner circumference of the core, which tends to move the point of greatest stress from the center in the direction of rotation, and which certainly enters as an important factor in regard to stress. The force due to this torque in the example given would be about 10,000 lbs. at 500 kw and 100 r.p.m., which is about the same as the total weight of the stationary part.

But I think it unnecessary to develop the formula, as this method of calculating is of no consequence whatever. The frames of great machines must be calculated in relation to the airspace, that is, the deflection must be calculated just as in the case of a shaft, and the frame dimensioned accordingly. I think it unnecessary to give any formula relative to this case, as there is an excellent article, "The elastic curve of three-phase machines with great diameters," by Hans Linsenmann, in the *Elektrotechnische Zeitschrift*, Nos. 5 and 6, 1902.

At the same time I wish to congratulate you for taking up this matter in your paper, as it should stir up American designers and prevent the present enormous waste of material in alternating-current generator frames. The European manufacturers are in this case very much ahead of the American, possible on account of the serious economical crisis in the electrical industry and the high prices of material. They have tried, as is well known to designers of electrical machines, to avoid absolutely the use of cast iron for the strained parts. In this particular construction, the "strutted" frames of the A. E. G. and the wrought iron frames of the Siemens & Halske firms are typical examples. Where cast iron is used, they have tried to diminish weight by the use of strain bolts and the application of special supports in the foundation for the lower half of the frame.

The saving of weight is enormous and in a 5,000-kw frame, where the magnetic iron has a weight of 40 tons, the total weight of a strutted frame is 50 tons, as compared with 235 tons of an American cast-iron frame of the ordinary construction.

Wilkensburg, Pa. A. Hansson.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Heyland Motor.—Heyland.—The first part of a detailed illustrated description of the latest form of construction of his non-synchronous machines with compensation and compounding. Different firms have taken up this type and have reached the same construction. He first discusses the choice of the dimensions of these machines and then deals with the theory of commutation in the exciting commutator. This theory is essentially different from that of the commutation in direct-current machines, and a new winding (polyphase winding with branches connected in parallel) has been developed which is now used in all larger machines. This form of winding avoids entirely all disadvantages which were still found in the earlier forms of this machine. In discussing the choice of the dimensions of the rotor, he gives a comparison between non-synchronous machines and synchronous machines, and shows that the difference between his excited non-synchronous machine and the ordinary non-synchronous machine is the same as between a normally excited synchronous machine and a synchronous machine without excitation; the excited non-synchronous machine is superior to the synchronous machine in all points in which the ordinary unexcited non-synchronous machine differs from a synchronous machine without excitation. He says that these points have been of great advantage, as they enable him to build broader machines with smaller diameter and of more compact form than the ordinary machine, and to use a simple form of slot with a few large open slots per pole. He then discusses the dimensions of the commutator and states that in his machines the commutator surface per kilowatt is only about 5 to 10 per cent. of that in direct-current machines of the same capacity; he shows that this is due to the use of a short-circuited armature. The number of brushes is given by the number of phases; for a compensated three-phase machine three brushes are required, and if the machine is compounded, three more brushes for the compounding current, i. e., in the whole six brushes. The minimum number of segments per pair of poles is, therefore, 6 segments for the compensated machines and 12 for the compensated and compound machines; i. e., 3 or 6 segments per pole. These numbers of segments are used in small machines, while in large machines the maximum number of segments used per pole is 12. The most important part of the machine is the winding of the rotor; it has to fulfill a double purpose; it must be a short-circuited winding, and it must at the same time permit the supply of the magnetizing currents to the rotor by means of a commutator. This problem has been solved in a perfect manner in the latest type of winding. The author begins with a general discussion of the theoretical principles of the commutation in his machine. The paper is to be continued.—*Elek. Zeit.*, January 22.

REFERENCE.

Action of Shunt-Wound Motor when Driven by a Series-Wound Dynamo.—McAllister.—An illustrated article in which the author analyzes the phenomena connected with the operation of shunt-wound motors driven from series-wound generators.—*Am. Elec.*, February.

Lights and Lighting.

Electric Train Lighting.—Dowling.—An abstract of a paper read before the Dublin Section of the (Brit.) Inst. Elec. Eng. The author briefly describes some of the most important systems of electric lighting in use in America, Continental Europe and England, and then gives a detailed description of the Stone system. Each coach has a complete installation of dynamo and storage batteries quite independent of any other coach; the connections and regulation of the power supplied to a generator by means of a belt which slips after attaining a certain speed, are discussed. In the discussion, Tatlow suggested that the arrangements for supplying oil to the bearings of the dynamo were elaborate, and asked whether the ordinary ring method of lubrication would not answer all requirements. It was also asked whether any explosion of the gases in the containing boxes of the storage batteries had occurred. In replying, Dowling stated that the conditions are very exacting, and it is necessary to exclude dirt and grit; space is very limited and there is probably not sufficient room to admit of the adoption of the oil-ring method of lubrication. He had seen a cell explode on one occasion, when the gases were ignited by a spark.—Lond. *Elec.*, January 23.

REFERENCE.

The Electric Arc.—A didactic article on the electric arc, discussing the various causes for the differences in the color of the light emitted from the arc.—*Am. Elec.*, February.

Power.

The Water Powers of Switzerland.—Thormann.—An account of an investigation as to whether it is possible to obtain from waterfalls the electric power required to operate all the railroads of Switzerland. He finds that the complete substitution of electric power for steam is quite possible, but it would not entail an appreciable decrease in the actual cost of operation. The five principal railroads existing to-day in Switzerland require a daily motive power of more than 30,000 hp. To organize a general electric service, it would be necessary to have available high-tension alternating currents of an appropriate power of 60,000 hp, besides an indispensable reserve. Without taking into account the numerous waterfalls which have so far not been utilized, there are on Swiss territory 21 large stations, producing sufficient energy to furnish at present 86,000 hp. Among them are the Siel and the Lanfenburg stations, each of 20,000 hp, and those of St. Moritz, of Nangen-sur-Aar, of Bernan, and of Voeggisthal, each of 5,000 hp. These 21 stations would, of themselves, be more than sufficient to distribute the necessary power to the Swiss railways. The cost, however, of the conversion of the railways to electric traction would amount to nearly 32½ million dollars. The adoption of electric traction would have the advantage of doing away with the present consumption of coal, now imported from other countries, and the use of electric power would encourage the development of several national industries.—*L'Elec.*, noticed briefly in Lond. *Elec. Eng.*, January 16.

Electric Operation of Bridges and Canal Lifts.—A note stating that the electric operation of a bridge over the River Weaver at Northwich has been so successful that the navigation authorities have decided to work the Anderson Canal lift by electricity also. This lift is at the point where the River Weaver is connected to the Shropshire Union Canal. When this conversion to electric operation has been completed one man in the switch house will be able to control all the necessary movements, whereas heretofore eight men have been necessary to work the lifts. The electrical plant comprises two motors for working the lock gates at the end of the Shropshire Union Canal, which is 70 feet above the level of the Weaver; one motor on each of the pontoons controlling by means of ropes the lock gates at either end, and one motor in the engine house directly connected to a variable-stroke pump to supply water under pressure of 700 pounds per square inch to the same. The two vertical cylinders of the hydraulic lifts are connected so that as one pontoon sinks it forces up the other; an additional supply of water under pressure is, however, necessary to overcome friction and any difference in weight between the two pontoons.—Lond *Elec Eng*., January 16.

REFERENCES.

Care of Induction Motors in a Large Factory.—WEEKS.—A short article giving much practical advice on the starting and operation of induction motors in factories.—*Am Elec.*, February

Electric Control for Elevators.—JAMES.—An illustrated article describing the fundamental features of the semi-automatic push button system, which is an elaboration of the magnet system of elevator control.—*Am. Elec.*, February.

TRACTION

Surface Contact System.—A well-illustrated description of the Cruvellier surface contact system for long distance traction, with 3-phase currents at 3,000 volts. The adjoining diagram shows two sections of the road, *A B* and *B C;* they are supplied with current from the distributing boxes, *D, E* and *F;* these are double, each half corresponding to a distinct section; the sections are applied at both ends. The studs of the section *A B* are marked P_1, P_2 and P_3; those of the section *B C* are P'_1, P'_2. The last three studs of the section *A B* are connected with the left-hand side of *E*, and the first three with the right-hand side of *D*. All the studs on the same line, *P* for instance, are connected together by an armored underground cable laid along the road; each stud forms a junction box. At both ends of each section are placed the boxes marked *M*, connected with the preceding and the following sections; their object is to facilitate the crossing from one section to the other, without interruption of the current; the position of these boxes is determined by the train speeds. When a train is at a standstill on the section, *A B*, there will be no current on this section; as soon, however, as the driver works the controller, the first contact of the latter sends through one of the lines (that of the studs, P_1, for instance), by means of the electric sliding pieces, the current from a small storage battery, which acts upon two small electro-magnets placed in the two corresponding contact boxes; the connections at both ends of the section are thus established and the section is under current, so that the train will be able to proceed. As soon as the train has left the section the electro-magnets no longer have current, and the contacts drop by the combined action of their weight, and that of the electro-magnet cores; the section is thus cut out of circuit. The diagram shows the manner in which the connection is established between the 3,000-volt cables and the sections of studs by means of the distributing boxes. The triple contact, which makes the connection, is governed by the direct-current solenoid, *S*, the core, *F*, of which operates the triple make-and-break; the solenoid, *S*, is supplied with current from a storage battery carried on the engine or car, and connected to one of the wires and to earth. The connection with one of the line wires is by the small make-and-break, *i*, governed by a small solenoid, *c*, connected in series with one of the line wires, the core of which operates a bolt, *v;* this maintains the contacts, although the exciting of the direct-current electromagnet be cut off. When there is no train on a section, the core, *F*, is down, the alternating contacts are open, and the core, *a*, has disengaged the bolt, which establishes the contacts at *i*. When a train runs on the section, it delivers to *S* a direct current through the make-and-break, *i;* the direct-current contacts close, the current flows through the alternating-current solenoid, *e*, the core, *a*, is drawn in, the bolt, *v*, engages the core, *F*, and the direct current is cut off at *i*. The section remains under current by the sole action of the electro-magnet, *e*, and there is no longer connection between the studs and the road, the circuit of the solenoid, *S*, being cut out. When the train runs off the section the alternating current is cut out at *e*, the bolt, *v*, disengages the core, *F*, the triple contact is broken and the section is idle. At the same time the make-and-break, *i*, will close and be ready to receive direct current from the following train. Should it be decided to establish a block, it would be sufficient to insert a small winding between the electro-magnet, *e*, and the contacts, *i*, and to connect it with the following section; no train could then proceed on the section so long as there is one on the following section. A small electro-magnet on the locomotive or car serves to cut off the connection between the storage battery and earth, so that when running there is never a pole to earth. The current is collected by a special type of sliding contact, formed of small laminations, and which, during exhaustive experiments, has withstood a strain equal to that of a total run of 6,300 miles at a speed of 112 miles an hour, there being practically no wear and tear. The length of the different sections of the road depends upon the traveling speed required; for a speed of 60 miles an hour each section would be 1,640 ft. in length; for double the speed they would be 3,280 ft. in length, and in both cases each section would remain alive for 18 seconds only. The system has insulated mains, there is no return through the rails; the pressure in the aerial feeders is 3,000 volts; the underground cables are also at a 3,000-volt pressure and supply the studs; the latter are placed about 30 ft. apart. Compared with the third-rail system, it is claimed that this system shows an economy of cost of working of about 30 per cent. in electrical energy. Nothing is said about the motors which are to be used.—Lond. *Eng'ing*, January 2.

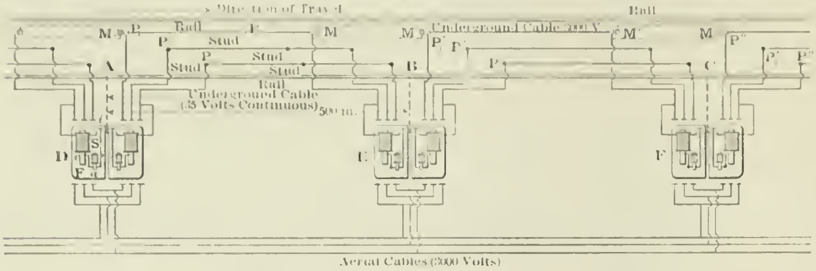


DIAGRAM OF CRUVELLIER SURFACE CONTACT SYSTEM.

British Tramway Statistics.—As a supplement to this issue the annual table of electric tramways and railways is published, which shows a large increase in the number of lines in operation in the United Kingdom. At the beginning of last year 85 electric tramways and railways were running; to-day there are 113, an increase of nearly 33 per cent. This, moreover, is irrespective of the number of lines which have been added to existing systems, and it is probable that the mileage of electrically-driven lines has been almost doubled. There are fewer lines "in progress" and "projected" than last year, but this points rather to the extreme rapidity with which electric tramways are now pushed through, than to any decrease in the activity in electric traction. Most of the new lines are on the overhead trolley system. A single instance of the Siemens "bow" collector is nearly completed at Sheerness, and there are a modern conduit system at Bournemouth and a surface conduit system at Wolverhampton, both of which are running satisfactorily.—Lond. *Elec.*, January 23.

Large Three-Phase Locomotive.—A note stating that Ganz & Co. have secured an order for three 3,000-volt, 3-phase locomotives for the Adriatic Railway. These will be the largest electric locomotives in Europe, being intended for a speed of 40 miles per hour, with a normal tractive effort of 8,000 pounds and a maximum tractive effort or 12,000 pounds. When drawing freight trains at 20 miles per hour, the normal tractive effort has to be 14,000 pounds and the maximum 22,000 pounds. The locomotives are of the 4-axle type and will weigh 56 tons. The motors will be connected in cascade for drawing freight trains and for starting passenger trains.—Lond. *Elec.*, January 23.

REFERENCE.

Railway Signals.—PIGG.—A long and well-illustrated paper on railway block signalling.—Lond. *Elec. Eng.*, January 2.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electrical Equipment of a Large Department Store.—KNOX.—An illustrated article describing the mechanical plant of R. H. Macy & Co.'s department store building in New York City. The building is electrically lighted, and electricity is also used to drive motors, parcel conveyors, pneumatic blowers, carpet and sewing machines, ventilating fans, glass-cutting machines, laundry and kitchen machinery, etc. The plant, which is situated in the sub-basement, has a total capacity of 2,000 kw, and comprises 4 400-kw generators, direct-connected to horizontal tandem compound Corliss engines, and two 200-kw generators direct-connected to horizontal tandem compound high-speed engines. The engines are run non-condensing at 130 pounds initial pressure. The equipment of the dynamo panel differs from the usual arrangement in several respects; in the first place, the equalizer bus-bar, usually placed at the back of the dynamo panel, is omitted, the equalizer connections between the dynamos being made at automatic switches near the dynamos; the second departure from the usual practice is the omission of the dynamo main three-pole switches; each of these switches is replaced by a small knife-switch and small circuit-breaker, which control the operating circuit and the 3-pole automatic electro-magnetic dynamo switch located near each dynamo. Altogether there are 11,000 incandescent lamps and 1,200 enclosed arc lamps.—*Am. Elec.*, February.

Wires, Wiring and Conduits.

Distribution of the Current in a Network of Wire.—Feussner.—An account of an investigation founded upon Kirchhoff's laws as basis for calculating the distribution of currents in a network of wires. These laws permit in any case of the formation of a system of linear equations from which the current strength in each wire may be obtained as the quotient of two determinants. The author develops a method of simplifying the calculation of more complicated cases. He calls N the common denominator of all the different currents in a network, and formulates a number of theories involving this quantity. Thus the resistance of any given network between two points, A and B, is obtained by dividing the N of the network by the N of another network produced by joining the points, A and B. Moreover, the N of a network which may be split up into partial nets with or without connecting wires, is a sum whose first term is the product of the sum of the resistances of the connecting wires into the *N's* of all partial nets, while the terms which follow are the same products with the *N's* replaced by the *N's* of the same nets with their junctions together.—*Ann. d. Phys.*, 1902, No. 13; abstracted in Lond. *Elec.*, January 23.

REFERENCES.

Cable Conduits.—Schmidt.—The first part of a long and well-illustrated article on details of the mechanical construction of conduits for underground cables, and in general of such devices which are used for protecting underground cables against injuries.—*Elek. Zeit.*, January 22.

Three-Wire Direct-Current Wiring.—Percy.—An article with illustrations and wiring tables for the 3-wire system of distribution.—*Am. Elec.*, February.

Electro-Physics and Magnetism.

Graphical Methods for Alternating-Current Phenomena.—Orlich.—An article on the limitations of the graphical methods. The representation of alternating-current values by means of geometrical vectors was originally based on the assumption of pure sine waves. This method was later applied to the general case of any wave form, the length of a vector being assumed to represent the effective value; but it was found that this method cannot be strictly correct in the general case. The present author discusses the graphical representation of the 3-star e.m.f.'s of a 3-phase system, and proves that a generally correct treatment is impossible by a graphical method; the only assumptions which he makes for the graphical method are that the length of a vector equals the effective value and that the law of the geometrical addition of vectors is fulfilled. He proves that a generally correct representation of the facts by graphical methods is impossible, even if the vectors are not limited to a plane, but to a space of three dimensions.—*Elec. Zeit.*, January 22.

Principles of the Dynamics of the Electron.—Abraham.—A long theoretical paper in which he formulates the equations governing the motion of an electron. He assumes the latter to be a rigid spherical particle carrying the electricity uniformly distributed over its surface or through its volume. He assumes with Kaufmann that these spheres whose radius is about a billionth of a millimeter, have no mass in the ordinary sense. Their inertia is of a purely electro-magnetic nature, and is different for forces along and across the line of motion. He shows by means of vector analysis that Newton's first axiom applies to the electron in the following form: If its motion was from the beginning a uniform motion of pure translation, and if the velocity is less than that of light, then no external force is necessary to keep the motion uniform. If the velocity of the electron is no longer small in comparison with the velocity of light, the impulse is no longer proportional to the velocity. The longitudinal and transverse masses depend in a different manner upon the velocity. The author sees nothing in the way of building up a complete system of mechanics upon an electro-magnetic basis.—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

Discharge in an Electric Field.—Cantor.—An account of an investigation of the influence of an electric field upon a discharge potential. When a spark-gap is immersed in a transverse electrostatic field, the discharge potential is reduced, and this is the case not only when the field is steady, but also when it is alternating. He produced the alternating field by a condenser fed by an induction coil and attached the wire conveying the condenser discharge to a tube which contained the spark-gap; it was then found that the discharge potential of the latter fell from 3,200 to 2,200 volts. In another experiment two copper discs 100 mm in diameter were mounted at a distance of 40 mm apart and insulated. One of them was then connected with the wire conveying the alternating discharge, while the other was connected with the knob of an electroscope. A positive charge of the eletctroscope was maintained intact, but a negative charge was quickly dissipated; there was no trace of a discharge between the plates, nor was any difference made by introducing a slab of paraffin between the plates. In all these respects, therefore, the alternating electric field produces the same action as would be produced by ultra-violet light. The electric oscillations used had a wave-length of about 100 meters.—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

REFERENCE.

Thermomagnetic Properties of Bismuth.—Lowndes.—An account of an investigation of the change of electrical resistance in the magnetic field, the Hall effect, and the conductivity for heat in and out of the magnetic field for the same crystal specimen of bismuth, the temperatures ranging from 22° to 186°.—*Phil. Mag.*, January; abstracted in Lond. *Elec.*, January 23.

Electro-Chemistry and Batteries.

Electrolytic Rectifier.—An illustrated description of an electrolytic rectifier developed by the French engineer Nodon and now being put on the market. The construction is extremely simple and consists merely of a hollow cylinder of a zinc-alluminum alloy, immersed in a solution of ammonium phosphate; an iron containing vessel forms the other electrode. A few minutes after starting a film commences to form on the surface of the aluminum electrode; it is this film which permits current to pass in one direction only. In order to utilize both half-waves of the alternating current the well-known Graetz arrangement is used, as shown in a diagram. With polyphase systems it is necessary to use a number of cells equal to twice the number of wires used in distribution. Each cell may be used for 50 to 140 volts; for higher voltages two or more cells must be connected in series, allowing 140 volts as a maximum for each cell. Regulation in connection with these valves having a capacity of more than 4 kw may be effected either by a choking coil on the alternating-current side of the apparatus or by the adjustment of insulating sleeves, which may be made to cover or expose the aluminum-zinc cylinders at will. The efficiency is claimed to remain practically constant at 75 per cent. for all loads, the loss consisting in a reduction of 10 to 12 per cent. of the e.m.f., and a leakage of alternating current within the rectifier corresponding to from 10 to 12 per cent. of the energy utilized; this lost energy is dissipated as heat, which raises the temperature to almost 50° C. The frequency within ordinary limits appears to have no effect on the efficiency of the apparatus. The apparatus is provided with a fan for forcing cooling air through the aluminum cylinders, which are made hollow. The current density is about 5 amp per square decimeter of active surface of aluminum. Nodon has also designed an electrolytic condenser of considerable capacity on the same principle, for use in starting alternating-current motors and for similar purposes.—Lond. *Elec.*, January 23.

E.M.F. of Daniell Cell.—Carhart.—An article in which he discusses the problem why the e.m.f. of the Daniell cell changes with the density of the solutions. He had formerly given a new explanation of the dependence of the e.m.f. of a Daniell cell on the concentration of the two solutions, this explanation being based on the fact that the thermo-electromotive force between a metal and a solution of one of its salts, increases with the concentration of the solution. J. W. Richards has offered another explanation, based upon the variation in the heat of formation of zinc and copper sulphates with the concentration. The present author describes some experiments which he has recently made and which appear to him to be decisive as to the competency of his own explanation, although he does not claim that his explanation excludes others when the subject is approached from a different point of view. He measured the e.m.f. of a Daniell cell in two cases in which the zinc sulphate solution was first one-sixteenth normal and later a normal solution; the difference of the e.m.f.'s in both cases was found to be 0.021 volt at 20° C. The value calculated from the thermo-electromotive forces at the zinc plate is 0.020 volt; hence the thermal electromotive forces are ample to account for the observed variation in the e.m.f. of the cell. The change in the e.m.f. of a Daniell cell when one zinc sulphate solution is substituted for the other is the same as the e.m.f. of a concentration cell set up with zinc electrodes and the two solutions; this was proven experimentally by joining two Daniell cells with different concentrations of the zinc sulphate in opposition and adding in series with them a zinc sulphate concentration cell set up with the same solutions; the 3 cells balance within 1/1000 volt; he remarks that this fact is not in agreement with a theorem of Nernst. Ideally, a concentration cell is one containing no internal chemical energy to be transformed; this is the case when the solutions are so dilute that they generate no heat when mixed; the heat of dilution is then negligible, and the first term of the Gibbs-Helmholtz equation is zero, while the second one, involving the absolute temperature and the temperature coefficient is the sole expression of the e.m.f.; but the temperature co-efficient is the sum of all the thermo-electromotive forces at the several junctions in the cell, all taken with their proper signs. Such a cell converts heat into electrical energy. At the limit when there is no internal chemical energy, all the heat is absorbed from the surroundings.—*Electrochem. Ind.*, January.

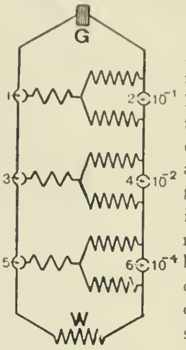
Aluminum.—Burgess and Hambuechen.—An article giving some laboratory observations on aluminum. The authors show the great influence which the ever-present, thin, invisible film on an aluminum surface has upon the success of various operations. This film is supposed to have considerable strength and continuity, and if it is broken or removed by mechanical means the aluminum immediately forms a new one. In soldering aluminum the principal difficulty seems to be due to the failure of the alloy used as a solder to adhere to the aluminum, a condition attributable to the protective film which must be eliminated before the metals can unite. A successful solder consists of about 21 per cent. of zinc, 76 per cent. of tin and 3 per cent. of aluminum; it may be applied directly to a cleaned aluminum surface without the use of a flux, and at a temperature but little above that which is necessary for soldering copper or iron. There are certain advantages in the apparent complication which the use of a flux involves; a suitable solvent for the oxide film increases the rapidity of the soldering process, increases the certainty of adhesion and enables cheaper soldering mixtures to be used. The requirement for such a flux is that it should dissolve the coating and leave a clean surface for the solder to unite with, upon application of heat; it seems that water cannot be a component of a suitable flux. A material which, for certain solders, forms an admirable flux, is stearic acid; by applying it to a freshly-scraped aluminum surface and then applying a tin-lead-zinc alloy, the matter of soldering aluminum presents scarcely greater difficulties than does the soldering of other metals. This almost ever-present coating upon aluminum is also the source of difficulty in the deposition of a permanent coating of other metals upon aluminum surfaces; while it is very easy to deposit a layer of metal upon aluminum from almost any plating solution, in the great majority of operations the resulting coating can be readily removed; sometimes in remarkably thin and continuous layers. The prime requisite in successful depositions on aluminum is the complete removal of the protection film, so that the electro-deposited metal may be applied over the complete surface of and in intimate contact with the aluminum; if this condition is fulfilled, and the coating is non-porous, it will be durable. The converse of this operation, i. e., the electro-deposition of aluminum upon other metals, appears to be impossible from aqueous solution. From the fact that, for equal weights, aluminum possesses about four times the energy as does zinc, considerable attention has been given to the problem of substituting aluminum for zinc in primary cells; but as a matter of fact, aluminum does not behave well as the electro-positive metal of a battery and attempts to use it in practice have almost universally failed. The results of measurements made by Mott, of the potential of aluminum in various electrolytes (measured against a normal electrode) are given in diagrams and tables. It appears that, of the various materials tested, ammonium fluoride would be the best material to use in connection with aluminum for battery purposes.—*Electrochem. Ind.*, January.

REFERENCE.

Aluminum as a Reducing Agent in Metallurgy.—Scholl.—An illustrated article on the theory and the various applications of the well-known Goldschmidt process.—*Electrochem. Ind.*, January

Units, Measurements and Instruments.

Movable-Coil Galvanometers.—Volkmann.—A paper on the use of the movable-coil galvanometer, which, since the rapid expansion of electric tramways, has been largely introduced in laboratories because it is comparatively unaffected by external disturbances. But its use requires many precautions with which the physicist is not yet familiar, the most puzzling thing being the effect of the resistance in the circuit upon the sensitiveness. If the latter is reduced by inserting a high resistance, the damping is inconveniently diminished; the expedient of shunting, on the other hand, usually produces excessive damping. The author gives some hints as to how to combine shunting and series resistance in a generally effective manner; every change of sensitiveness should leave the damping and the resistance in the circuit as they were before. The adjoining diagram represents a combined shunt and resistance box in which three plugs are sufficient to produce the following eight degrees of sensitiveness:



MOVABLE-COIL GALVANOMETER.

Plugs in.			Sensitiveness.
2	4	6	1
1	4	6	0.1
2	3	6	0.01
1	3	6	0.001
2	4	5	0.0001
1	4	5	0.00001
2	3	5	0.000001
1	3	5	0.0000001

—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

REFERENCES.

Prony Brakes for Motor Testing.—An illustrated article with elaborate tables, on the Prony brake; the tables giving weights corresponding to various horse-powers and speeds, with different lengths of brake-arm.—*Am. Elec.*, February.

Construction of the D'Arsonval Mirror Galvanometer.—Cerny.—An article with dimensional drawings on the construction of a self-adjusting D'Arsonval galvanometer, the main features of which were taken from one made by Ducretet.—*Am. Elec.*, February.

Miscellaneous.

Vortex Lightning.—Klingelfuss.—A description of a new kind of lightning discharge which was discovered by him by means of photography. The reproduction shows a series of spirals resembling twisted columns of light mapped out by parallel screw lines, of which some 50 or 60 go to the thread. The photograph was obtained at Basel during a thunderstorm last summer. The direction of the discharge was from north to south, in the magnetic meridian. The author reproduces for comparison one of Ruhmer's photographs of a spiral discharge obtained with an induction coil and a liquid interrupter, but this is by no means as perfectly spiral as the lightning flash. The photograph of the latter is incidentally interesting as showing that the discharge was not alternating, but pulsating, since otherwise the vortices could not have been produced. The simultaneous magnetic records at Potsdam showed no extraordinary variation of the magnetic elements.—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

New Books.

BOOKS RECEIVED.

Die Kunstlichen Kohlen. Fur Elektrotechnische und Elektro chemische zuecke, ihre herstellung und prufung. By Dr. Julius Zellner. Berlin: Julius Springer. 295 pages, 102 illustrations. Price, 9.20 marks.

Elektro-Ingenieur Kanender. 1903. By Arthur H. Hirsch and Franz Wilkins. Berlin: Oscar Coblentz. 287 pages, illustrated. Price, 2.50 marks.

Sammlung von Leilungo-Skizzen for Schwastrom Anlagen. By C. Erfurth. Vienna: A. Hartleben. 81 plates. Price, 3 marks.

Einfuhrung in die Elektrochemie. Nach der Elektrolytischen Dissociationstheorie. By Peter Gordes. Halle: Wilhelm Knapp. 124 pages, 48 illustrations. Price, 4 marks.

Specielle Elektrochemie. Handbuch der Electrochemie. By Dr. H. Danneel. Halle: Wilhelm Knapp. 80 pages. Price, 3 marks.

Electrical Problems. By Prof. William L. Hooper. Boston: Ginn & Co. 170 pages, illustrated. Price, $1.35.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Electrical Contractors' Association of New York State, Secretary, Wm. J. Davis, Ithaca, N. Y.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Interstate Independent Telephone Association, Secretary, E. M. Coleman, Louisville, Ky.

Kentucky Independent Telephone Association, Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

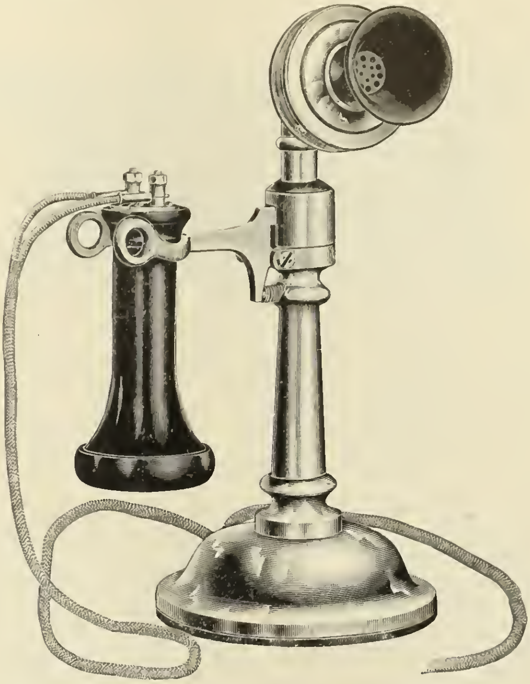
New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York. Next meeting, February 18, American Institute. Illustrated Lecture by Dr. A. E. Kennelly, "Submarine Cables."

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

New Telephone Equipment.

The telephone instrument shown herewith is made up with a solid bronze standard, heavily nickeled, and is fitted with improved concealed contacts covered by a slip shell so that they are easily accessible when it is desired to examine them. These contacts are an improvement over the butting type generally used on this style of a telephone, they being placed side by side, which allows of a positive rubbing contact. They are also made with insulated hook and insulated under contact where so desired for battery, call or special work. The base is made so that the induction coil can be mounted therein. If, however, they are desired with induction coil mounted on a terminal block, a terminal block is supplied with incased coil for this purpose. This apparatus is supplied by the Connecticut Telephone & Electric Company, Meriden, Conn.



DESK TELEPHONE.

The Protection of Street Car Motors.

Perhaps the best appliance for protecting a street car equipment from too great overloads is the automatic circuit-breaker, serving, also, as a canopy switch when installed within easy reach of the motorman. The great advantage of this arrangement is that it is easily accessible, can be quickly closed and is in no way dangerous, thus avoiding the usual delay and risk incident to replacing a fuse.

Where it is not thought advisable to incur the expense of equipping all the cars of a line with automatic circuit-breakers, the next best thing is a fuse block possessing the same qualities of easy accessibility, replaceability and freedom from danger. The fuse block shown in the accompanying illustration can be easily gotten at for renewing the fuse and, when open, the contacts on which the fuse is supported are cut out of the circuit, making it perfectly safe to replace the fuse while the line is alive. A straight piece of copper wire is used as a fuse and is secured in place and clamped in the contacts by the act of closing the block. When a fuse blows, all that is necessary is to open the block, drop a piece of straight copper

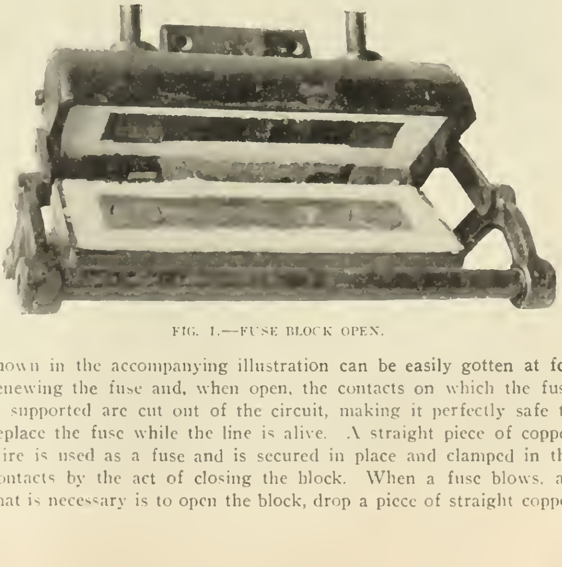


FIG. 1.—FUSE BLOCK OPEN.

wire in place, and then close it again. The fuse block shown herewith, which is made by the Westinghouse Electric & Manufacturing Company, is iron clad, being completely enclosed in an iron casing, excepting where the vent for the arc extends through the bottom

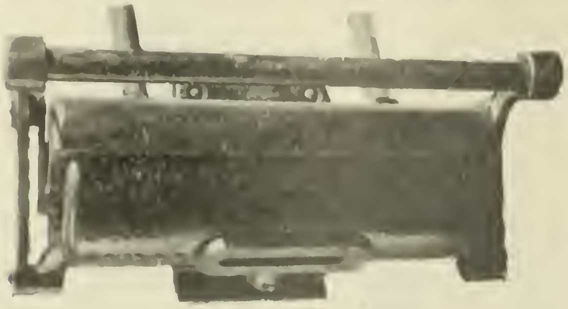


FIG. 2.—FUSE BLOCK CLOSED.

The Westinghouse Company also manufactures an automatic car circuit-breaker, which has given excellent satisfaction in the protection of car equipments.

Integrating Direct-Current Wattmeters.

Some months ago (May 17, 1902) we printed an account of 57 meter patents granted in one issue to Mr. Thomas Duncan, and embodying a number of new principles in meter construction. Meters under these patents are now being manufactured by the Duncan Electric Mfg. Co., of Lafayette, Ind., and we give below a description of the direct-current integrating wattmeter type. The meter represents the work of years of experience and is designed to meet every requirement of those whose duty it is in the central station to test, install and inspect meters, that their work may be facilitated, and assist in keeping the operating expense of the meter department at a minimum.

The castings of the meter are made from nickel aluminum, making it light in weight, while every part is easy of access and interchangeable. The terminals are at the top of the meter and connect the series coils with the inleading wires from the circuit, thereby removing these leads away from the retarding magnets at the bottom, and insuring in consequence a greater permanency and life for the magnets—something impossible when the inleading wires enter a meter quite close to the retarding magnets owing to the magnetic field they set up exerting a demagnetizing effect upon the magnets when in close proximity thereto, and which becomes very pronounced in case of heavy overloads and short circuits.

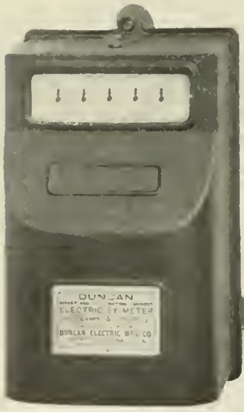


FIG. 1.—METER ENCASED.

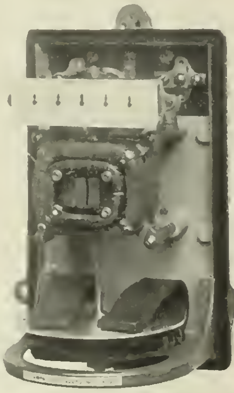


FIG. 2.—CASE REMOVED.

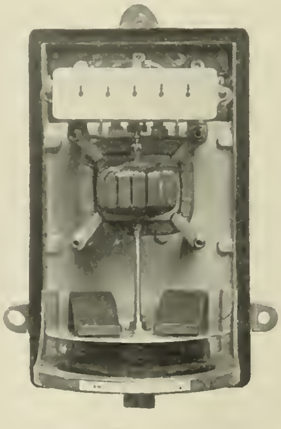


FIG. 3.—FRONT, SERIES COIL REMOVED TO INSPECT ARMATURE.

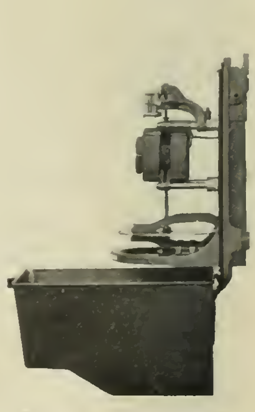


FIG. 4.—SIDE VIEW SHOWING DETACHABLE AND HINGED CASE.

The registering train is made large, and all of its parts are carefully adjusted to insure perfect ease of operation and freedom from "sticking" which creates so much trouble in smaller trains, even to stopping the meter. The pinions and gear wheels are cut very accurately by automatic machinery, and assembled by experienced watchmakers. It is provided with dowel pins, so that when it becomes necessary to remove it from its bracket, it can be again put back exactly into its position, thereby enabling the worm wheel and worm to mesh as originally set. The dial is also much larger than is usually employed, making it easy to read at a distance, and has a porcelain face. The circles and figures are printed in heavy type and read in kilowatt hours, or dials can also be furnished to read in watt hours, horse power hours, board of trade units or dollars and cents.

A feature of the meter is that it is direct reading, that is, the dial shows at all times the actual amount of energy that has been consumed without having to employ a "constant" or "multiplier" by which the reading would otherwise have to be multiplied.

The cast back or support of the meter is provided around its outer edge with a groove that is lined with heavy felt and over which the case closely fits, thereby rendering the meter dust and insect proof. The dust proof case is hinged at the bottom and is provided with a single screw at the top, which answers for screwing it tightly into position and sealing the meter at the same time.

The series coils are machine wound and heavily insulated with linen tape, after which they are immersed in copal varnish then baked for several hours until they are thoroughly dry. This enables them to withstand any commercial pressure without breaking down. The front series coil can very easily be removed from the meter by simply taking out the four screws that hold its corner clamps to the brass supporting rods. This removable feature of the front coil furnishes a quick and excellent means for inspecting the armature. The resistance wire is wound in sections upon a flat insulated support having saw-tooth edges, so that the difference of potential between each adjacent section is reduced to a minimum.

The commutator is made of a special alloy which will retain its polish even in the presence of sulphurous gases. The segments are accurately cut and thoroughly insulated from each other and from the spindle so as to prevent any possibility of the armature circuit becoming grounded at this point. The brushes are easily detached by the removal of two small screws, which permits of their being lifted out for inspection without interfering in any way with the shunt circuit wires. When they are detached they can be thoroughly cleaned and polished if necessary and replaced again without any fear whatever of changing their original tension; something quite essential.

The spindle is provided with a removable pivot point, which is made from the best quality of steel piano wire hardened in mercury, then polished to a very fine finish with Vienna lime and rouge. The point of these pivots is carefully rounded off by a machine expressly designed for the purpose, so as to give the least tendency to wear and at the same time reduce the friction to a minimum. The Duncan company has succeeded in procuring an especially high grade of Ceylon sapphire that comes next to the diamond in hardness. They are made in accordance with a special design, and polished until they are entirely free from scratches or flaws of any kind. The size and form of the cup is such as to give the best possible results with the aforementioned pivot point, resulting in low friction and long life. To protect the jewel against jarring and vibration, it is seated upon a small spring, which is adjusted to exactly balance the weight of the revolving element; and upon the slightest jar being imparted to the meter the spring takes it up and relieves the jewel from any possibility of being damaged.

To those who wish to use the best bearing possible, the makers of this meter can furnish a diamond jewel bearing. It consists of a diamond step having a sapphire guide mounted upon it, and within which the spindle point revolves, the whole being seated upon a delicately adjusted spring to protect it against jarring in a manner similar to that of the sapphire bearing. Tests of meters equipped with these diamond jewels have demonstrated that as many as five million revolutions of the spindle with its accompanying armature and retarding disc, failed to produce the same wearing effect that usually results with a sapphire jewel and one-tenth the number of revolutions.

Realizing the importance of having retarding magnets that will withstand variations in temperature and mechanical vibration incident to shipping and handling and still maintain their strength for the purpose of enabling the meter to remain accurate for an indefinite period, the manufacturers have given a great deal of study, and made many experiments with the view of producing magnets whose permanency or magnetic retentivity could be relied upon.

The usual means to compensate for the changes in friction of the meter, is also provided to insure low load accuracy. This consists of a small coil wound with many turns of fine wire and connected in series in the armature circuit and placed within the front series coil adjacent to the armature. It is held in position by four small wire brackets and thumb nuts, which prevent it from changing its position during shipment.

The testing constant (*K*) of each meter is marked upon the disc. This testing constant is used only in testing the meter. The dials are direct reading and do not require any constants.

This meter, while especially adapted for measuring the energy or direct-current lighting and power circuits, will also accurately measure alternating currents of any power factor, wave form, or frequency. This is made possible by its being of the commutated type without iron in its series coils or armature, and its pressure current practically free from inductance.

10,000-Volt Motor-Generator

We show herewith a view of the sub-station from which the San Bernardino Valley Traction Company obtains the power for its lines running from San Bernardino to Colton, Cal. Current is supplied to the sub-stations from a 10,000-volt distributing line of the Edison Electric Company, of Los Angeles, the current in this line having been stepped down from 33,000 volts, the voltage of generation.

Fig. 2 shows a plan and section of the motor-generator set in the sub-station, made by the Bullock Electric Manufacturing Company. This consists of a 200-kw direct-current street railway generator running at 500 r.p.m., direct-connected to a 10,000-volt, 50-cycle, 3-phase synchronous motor. The motor, which is of the revolving field type, is so built that the field may be easily removed from within the armature frame should the armature coils require inspection or repair. The machine is of sufficient size to supply extensions of the railway to Highland and Redlands, which will shortly be constructed. The motor has a single coil per phase, and is started from the direct-current side by means of a small rotary converter. The current supplied to the motor is measured by a Thomson 10,000-volt polyphase wattmeter.

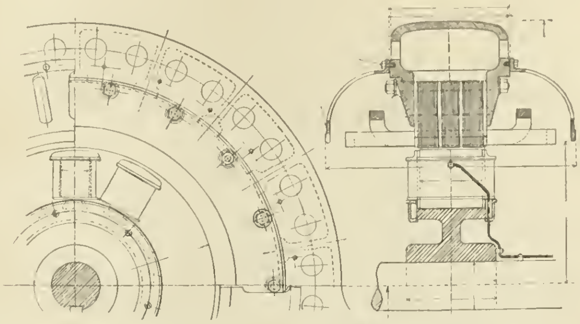


FIG. 2.—PLAN AND SECTION OF MOTOR GENERATOR.

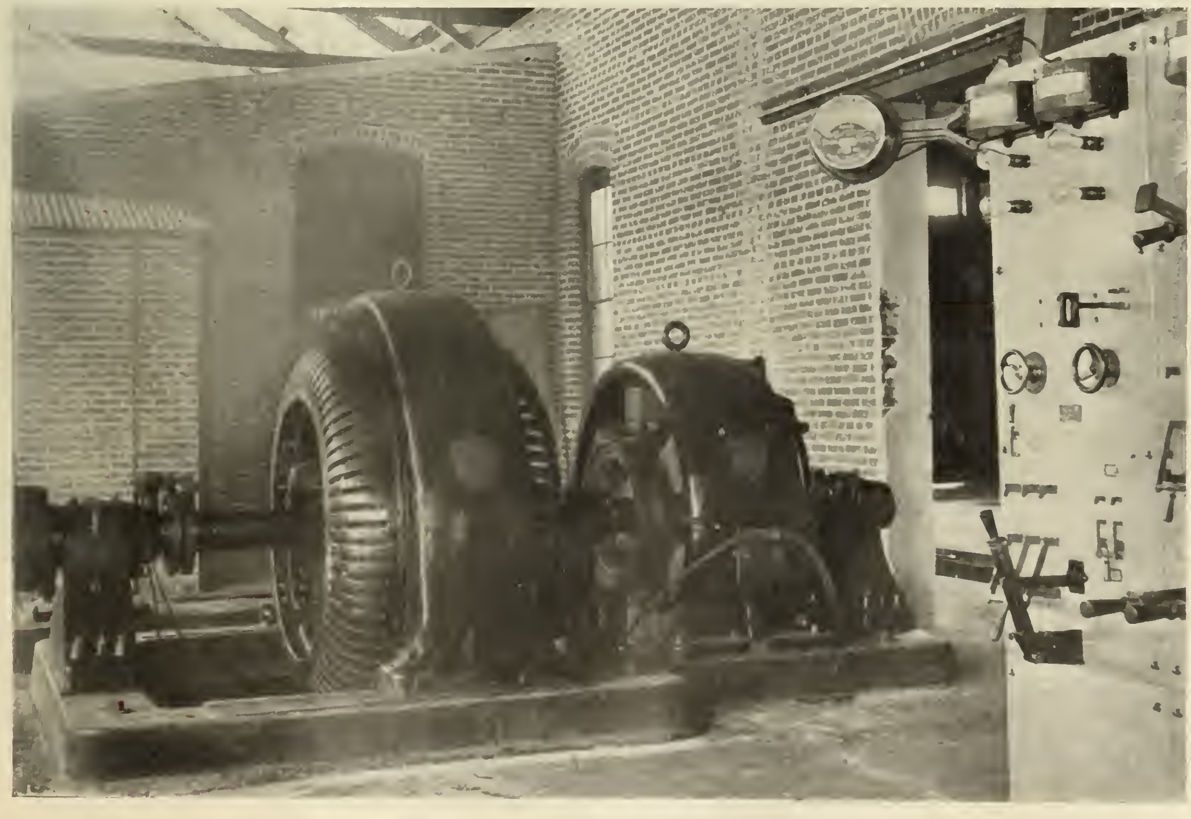


Fig. 1.—Three-Phase Motor Generator in Sub-Station of San Bernardino Valley Traction Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was easier throughout the week and freely offered, closing at 4½ per cent for 60 to 90 days, 4½ a 5 for 4, 5 and 6 months. While the stock market was rather dull, it presented an appearance of increasing strength, especially in the anthracite shares, the standard railways and the better class of industrials. Increasing ease in the money market was a dominant factor and the market was favorably affected by various developments including the decision in the United States Steel litigation. Amalgamated Copper showed much strength, the rise in the price of the metal having undoubtedly caused support to be given by the inside interests. The change in the management of the Brooklyn Rapid Transit Company was favorably regarded and caused buying of that stock, which had a good effect on traction shares as a group. Brooklyn Rapid Transit closed at 68⅞, being a net gain of 1½ points, and Metropolitan Street Railway at 137, a net gain of ½ point. General Electric closed with a net loss of 3¼ points, at 193¾, and Westinghouse common at 213¾, ex-div. Western Union kept steady throughout the week, fluctuating within very narrow limits and closing at 90. Other closing quotations and net changes were: American Telephone & Telegraph, 163⅛, a loss of 2⅜; American Telegraph & Cable, 86⅛, a loss of 7⅝, and American District Telegraph, 38½, a gain of 1½. Following are the closing quotations of February 10:

NEW YORK.

	Feb. 3.	Feb. 10		Feb. 3	Feb. 10
American Tel. & Cable	86	85	General Electric	192⅝	195⅝
American Tel. & Tel.	162	164	Hudson River Tel	..	..
American Dist. Tel	37	37	Metropolitan St. Ry.	137¾	137¾
Brooklyn Rapid Transit	67⅜	69¼	N. E. Elec. Veh. Trns.	3/16	1/16
Commercial Cable.	..	..	N. Y. & N. J. Tel.	162	162
Electric Boat	20	20	N. Y. E. V. T. Co.	10	10
Electric Boat pfd.	37	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	3	3	Western Union Tel.	88¾	89½
Electric Vehicle.	7	6	Westinghouse com.	214	210
Electric Vehicle pfd.	12⅝	11½	Westinghouse pfd	210	210

BOSTON.

	Feb. 3.	Feb. 10		Feb. 3.	Feb. 10
American Tel. & Tel	161½	164¾	Western Tel. & Tel. pfd.	98	99
Cumberland Telephone.	..	..	Mexican Telephone	2¼	2¼
Edison Elec. Illum.	..		New England Telephone	137	135
General Electric.	..	194¼	Westinghouse	106	105
Western Tel. & Tel	24	24	Westinghouse pfd.	107	105

PHILADELPHIA.

	Feb. 3	Feb. 10		Feb. 3.	Feb. 10
American Railways	..	..	Phila. Traction.	98	98
Elec. Storage Battery.	..	..	Phila. Electric	7⅞	8
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle.	..	..
Elec. Co. of America.	9⅛	9⅛	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Feb. 3.	Feb. 10		Feb. 3.	Feb. 10
Central Union Tel.	..	..	National Carbon pfd.	98	98
Chicago Edison.	162¼	160	Northwest Elev. com.	..	..
Chicago City Ry.	235	225	Union Traction	9	10¾
Chicago Tel. Co	158	..	Union Traction pfd.	40	35
National Carbon.	24	21			

STANDARD UNDERGROUND CABLE.—At the annual meeting of the Standard Underground Cable Company it was shown that the earnings of last year aggregated $3,984,531, an increase of $664,000 over the year before, and the greatest in the history of the company. The surplus of the company has been swelled to $760,350. It was $265,564 at the opening of 1901. Since then the company has, out of earnings and surplus, made tremendous additions to its plants, part of which were paid for out of the proceeds of a new stock issue. At the stockholders' annual meeting in the offices of the company in the Westinghouse Building, Pittsburg, 17,947 shares out of 20,000 shares were represented in person or by proxy. During 1902 the company paid one extra dividend of 2 per cent. aggregating $154,862. This was in addition to regular quarterly dividends of 2 per cent. The company's consumption of copper wire in 1902 was 8,200,000 pounds and of lead 18,126,000 pounds. This was used in its manufacture of underground, submarine and aerial cables for all classes of electric work at the plants in Pittsburg, Oakland, Cal., and Perth Amboy, N. J. The new and extensive copper rod and wire mills built during the past year at Perth Amboy, N. J., have gone into operation, and will hereafter produce from the copper bars the wire used by the company in the manufacture of its cables and insulated wires and some will go to the market. The new mills are housed in buildings covering a ground space of 300 x 180 feet, a portion being three stories and basement in height.

COMMERCIAL CABLE.—The $1,666,000 of the capital stock of Commercial Cable Company, to list which on the Stock Exchange application has been made, is the stock that was in the treasury until a couple of weeks ago, when the directors authorized it to be issued in order to use the proceeds in paying for the Pacific cable. Including this amount, the outstanding stock amounts to $15,000,000. An additional $10,000,000 will be authorized at a special meeting of the stockholders to be held before long, which will bring the total authorized capitalization up to $25,000,000. It has not been definitely stated for what purpose the $10,000,000 of new stock may be used, but it is presumed that it will be issued from time to time in connection with executing the plan of the company.

HOUSTON ELECTRIC.—Houston Electric Company, of Texas, reports as follows for the year ended December 31:

	1902.	1901.	Changes.
Gross	$360,017	$292,744	Inc. $67,273
Exp. and taxes	210,772	177,363	Inc. 33,409
Net	$149,245	$115,381	Inc. $33,864
Interest	75,000	......	......
Surplus	$74,245	......	......

MINNEAPOLIS GENERAL ELECTRIC reports for the year ended December 31 as follows:

	1902.	1901.	Changes.
Gross	$500,586	$425,164	Inc. $75,422
Expenses	265,444	222,030	Inc. 43,414
Net	$235,142	$203,131	Inc. $32,008
Charges	98,410	97,046	Inc. 1,364
Surplus	$136,732	$106,088	Inc. $30,644

THE SAVANNAH ELECTRIC COMPANY, of Savannah, Ga., reports as follows for the year ended December 31:

	1902.	1901.	Changes.
Gross	$480,510	$434,293	Inc. $46,217
Expenses and Taxes	267,991	264,992	Inc. 2,999
Net	$212,519	$169,301	Inc. $43,218
Interest	115,000	......	......
Surplus	$97,519	......	......

WHAT ELECTRICITY CAN DO.—The quarterly report of the Manhattan Railway Company for the period ended December 31—when complaints of overcrowding were loudest—shows that no fewer than 64,822,675 passengers were carried, an increase over the corresponding quarter a year ago of 7,596,825, while gross earnings increased $374,224 and net $423,559—this in spite of the fact that the increased cost of fuel for the quarter was $150,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Most favorable conditions continue in practically all lines of trade and industry and from all sections of the country come reports of a large volume of business for this season of the year. Referring to these conditions, *Bradstreet's* says: "Confirmation of fine January trade reports is had in the largest aggregate of clearings ever reported in that month (despite dull stock speculation) and the smallest total of January failures recorded for ten years past. Spring trade * * is earlier and of larger volume than in any previous year, and the remarkable steadiness in prices is evidence that stability in present conditions is expected for some time to come." The recent spell of mild weather has brought about an improvement in the coal situation. Better net returns of railway earnings are made, while gross receipts are increasing largely. In the Central West business has been of good volume, despite the interference resulting from heavy storms; on the Pacific coast cold weather has retarded business somewhat; in the Northwest jobbing distribution for spring account was of goodly volume, and in the South trade was of fair proportions, being specially active in machinery, lumber and naval stores. In the East trade is of good volume. In iron and steel finished products continue as active as heretofore, rails, structural materials, wire, bars and railway material being in active request. There are orders on the books for 5,500,000 tons, the largest future business on record. The copper market was firm, with higher prices, although little activity was shown by purchasers. Lake and electrolytic are quoted at 12.37½c. a 12.62½c.; casting stock, 12.25c. a 12.50c., and Standard, 11.87½c. The number of business failures for the week ending February 5, as reported by *Bradstreet's*, aggregated 208,, as against 230 the previous week, and 247 the corresponding week last year.

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, has taken a contract from the William Wharton, Jr., Company, manufacturer of frogs and switches, Philadelphia, for several motors varying in capacity from 2 hp to 40 hp; a 40-kw generator and a 75-kw generator, complete, with switchboards, etc. The smaller generator will be operated by a 12-in by 12-in. engine, to be supplied by the Watertown Engine Company. The larger generator will be direct connected to a 14-in. by 14-in. Watertown engine. The machinery is intended for power purposes. Six C. & C. motors varying from 4 hp to 50 hp will be put in the new Berkeley Building, Broad Street, New York. They will be used for driving ventilators to be installed by the B. F. Sturtevant Company. The Gould Storage Battery Company, of 18-20 West Thirty-fourth Street, New York, has ordered a 20-kw 3-machine booster for its Depew (N. Y.) plant. Two 30-hp slow-speed motors will be used for operating Sturtevant ventilators in the Ethical Culture School, 109 W. Fifty-fourth Street, New York. The Standard Steel Works, of Burnham, Pa., has sent in its eighth order within three months, to the C. & C. people for a 50-hp motor. A repeat order—the fifth—has also been received from the High Point (N. C.) Machine Works for a 120-kw belted generator for central station work. The Quebec Steamship Company's new steamer now being built in England for the New York-Bermuda service is to be furnished with a 16½-kw generating set for lighting purposes. The engine will be manufactured by the New York Safety Steam Power Company, 113 Liberty Street. The Seaboard Realty Company, of 127 West Forty-second Street, New York, has ordered two 30-kw generators and three switchboards, which will serve as lighting equipment in new up-town hotels. Strouss, Eisendrath & Co., manufacturing clothiers, Chicago, have requisitioned for 13 floor-type motors for connection by line shafting to sewing machines. The motors vary in capacity from 2 hp to 5 hp.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, of Madison, Wis., has just completed and is now operating a power plant for the generation of the power and lighting current required in its works. There are two generating units—a 200-kw Northern Dynamo, direct connected to a 225-hp Vilter-Corliss engine at 100 r.p.m., and a 50-kw Northern Dynamo, direct connected to a 75-hp Ball engine at 290 r.p.m. The large generator is used for the day load, while the small machine supplies the current for operating the machinery and furnishes light required by the night shift. Two 250-hp boilers constitute the steam plant, using a Cochrane feed water heater. A 120-foot steel stack is used. The current is carried from a six-panel marble switchboard through a tunnel into the distributing board in the shop. Exhaust steam is used for heating the works. The power plant is housed in a new brick wing, 87 ft. 8 in. x 100 ft. 4 in. An additional wing 38 ft. x 100 ft. 4 in. was constructed simultaneously; the additions accommodate—in addition to the generating station—paint shop, pattern shop, brass workers' department and boxing department, which previously occupied crowded quarters in the main works.

NEW WATER ELECTRIC POWER PLANT AT DULUTH.—A mammoth water power plant, rivalling that at Sault Ste. Marie, is under way at Duluth, Minn., and it is promised that it will be in operation in about two years. An immense steel gravity dam modeled after that recently completed near Houghton for the Atlantic & Baltic Copper Mining Companies, will be constructed at the head of the rapids on the St. Louis River, and the water will be conserved in a forebay covering one-half square mile. From this a lined canal two and a half miles in length, 62 feet in width and 17 feet deep will carry the water to the brow of a hill and steel pipes will convey it down the slope a mile to the power house, under a working head of 365 feet. From the power house transmission lines will be run to sub-stations at both Duluth and Superior, a distance of 12 to 15 miles. The plans are for an ultimate capacity of 100,000 hp. but the first installment of machinery will be for six units of 5,000 hp each, and the arrangements will be such that additional units of the same size may be added from time to time. Specifications are now being prepared and bids will soon be solicited.

CONTRACTS PENDING FOR ALABAMA PLANT.—Specifications are now being drawn up for the purpose of constructing a plant to generate energy for light and power use in Sheffield and Tuscumbia, Ala. The same plant is intended to furnish water for these places. The power house will contain a boiler equipment of 600 hp. There will be a 450-hp tandem compound condensing engine and also an engine of similar type of 375 hp capacity. The generator to be utilized for lighting purposes will be a 250-kw machine. A 300-kw generator will be employed. The pumping equipment will comprise a triple-expansion engine of 3,000,000 gallons capacity, also a 1,000,000-gallon engine. The contracts will be let by Henry Parsons, Morris Building, New York. L. H. McIntire, at one time general manager of the Savannah (Ga.) street railway system, is consulting engineer in the matter.

ELECTRICAL CONTRACTS CLOSED.—Mr. H. S. Kemp, superintendent of construction of the Standard Electric Company, Norfolk, Va., writes us: We have just closed a contract for two miles extension of a trolley road at Valdosta, Ga. We have closed with the Pell City Mills, Pell City, Ala., contract for wiring of the same and 114 houses with an arc and incandescent circuit through the mill village. Contracts about completed are the Dalton Municipal Light Plant, consisting of power station, 10 miles of arc circuit through the streets to provide current for 75 General Incandescent arc lamps. Also at Camilla, Ga., the installation of the city arc and incandescent system through six miles of streets; and at Greensboro, N. C., about completed, seven miles of trolley road, the entire track laid on six inches slag ballast.

WIRELESS TELEGRAPHY FOR CUBA.—There was a batch of long poles lashed together on the fore deck of the Ward liner Morro Castle when the steamship sailed last week for Cuba. The poles formed part of a consignment of 102 packages shipped by the Marconi Wireless Telegraph Company of America for wireless telegraph stations throughout Cuba. The complete outfit for the equipment of the first of those stations, to be erected at Havana, is now aboard the Morro Castle. The Marconi company has obtained a concession from the Cuban Government.

MORE EQUIPMENT FOR WASHINGTON HOTEL.—Mackenzie & Quarrier, 203 Broadway, New York, have just secured a contract calling for a 12½-in. by 22½-in. by 14-in. side crank engine to be built by the Harrisburg Foundry & Machine Works for installation in the new Willard Hotel, Washington, D. C. The engine will be direct-connected to a 150-kw generator of General Electric manufacture. This will make the fourth Harrisburg engine to be installed in the hotel. The equipment is used for lighting purposes and for operating electric elevators.

PIPING CONTRACT FOR SUBWAY POWER HOUSE.—The Rapid Transit Subway Construction Company, J. Van Vleck, mechanical engineer, has determined on the important contract for steam, water and drip piping, with tanks for the power station on Eleventh Avenue, between Fifty-eighth and Fifty-ninth Streets, New York. The Walworth Manufacturing Company, of Boston, Mass., secured the contract which will represent an expenditure in the vicinity of $400,000.

COAL-HANDLING PLANT FOR BROOKLYN EDISON COMPANY.—The Brooklyn Edison Company has awarded a contract to John A. Mead & Co., whose New York offices are in the Bowling Green Building, for a large coal-handling plant. The plant is to consist of an unloading tower, cable road, McCaslin conveyor and a storage pocket to have a capacity of 3,000 tons of coal. The equipment will be largely operated by electric motive power.

THE SHAWMUT CLAY MANUFACTURING COMPANY, which is building extensive factories at Shawmut, Elk County, Pa., has awarded contract for the power and lighting plant, to the American Supply & Construction Company, contracting engineer, 120 Liberty Street, 800-hp boilers, Corliss engine, electric generator, feed water heater, pumps, piping, belts, etc. Orders for most of the material have been given out.

SOME A. D. GRANGER CO. ORDERS.—The American Type Founders' Company, of Communipaw, N. J., has ordered two Skinner engines through the A. D. Granger Company, White Building, for direct connection to 75-kw generators of C. & C. build. The Granger people have also taken an order for a 120-hp Skinner engine to be installed in the American Power & Construction Company's plant near Ulmer Park.

ELECTRIC HEATING.—M. C. Burt, of Chicago, who was on May 13, 1903, granted a patent on an electric heater, is at work on the organization of a company for the manufacturing of electric heaters under this patent. The heater conductors consist of iron plates, in conjunction with which some wire resistance is also used, and means are provided for artificially circulating the air through the heater.

KELLOGG TELEPHONES FOR HONOLULU.—The Kellogg Switchboard & Supply Company, of Chicago, have contracted to fit out the Alexander Young Hotel, Honolulu, Hawaiian Islands, with a telephone system, including 260 common battery telephones and lamp signal switchboard.

CRANES FOR NEW INGERSOLL-SERGEANT PLANT.—Pawling & Harnischfeger, of Milwaukee, Wis., have secured the contract for the overhead electric traveling cranes to be installed in the new plant to be built by the Ingersoll-Sergeant Drill Company at Phillipsburg, N. J.

FANS FOR EUROPE.—The Dayton Fan & Motor Company, of Dayton, Ohio, has secured a substantial order for desk and ceiling fans for shipment to Europe. The order was placed by the Goudey-McLean Company, of 88 Maiden Lane, New York.

EXPORTS OF ELECTRICAL MATERIALS.—Following are the exports of electrical material and machinery from the port of New York for the week ended January 31: Antwerp—9 pkgs machinery, $480; 40 pkgs. material, $1,050. British Australia—130 pkgs machinery, $7,704; 11 pkgs. material, $202. Bilboa—1 pkg machinery, $42. British West Indies—131 pkgs material, $3,055. Brazil—24 pkgs. material, $221. British East Indies—3 pkgs material, $267; 3 pkgs machinery, $90. Central America—21 pkgs material, $247. Cuba—32 pkgs material, $2,068. China—22 pkgs material, $713. Chili—61 pkgs. material, $1,093; 7 pkgs. machinery, $1,221. Colombia—31 pkgs. material, $577. Ecuador—3 pkgs. material, $98. Glasgow—37 pkgs. machinery, $1,000. Havre—12 pkgs material, $325; 20 pkgs machinery, $350. Japan—8 pkgs. material, $1,401; 12 pkgs. machinery, $12,048. Liverpool—155 pkgs. machinery, $8,424; 30 pkgs. material, $1,244. London—100 pkgs machinery, $7,734; 172 pkgs. material, $14,027. Leeds—1 pkg. machinery, $50. Mexico—50 pkgs. material, $1,210; 11 pkgs. machinery, $1,849. Manchester—58 pkgs. machinery, $6,840; 3 pkgs. material, $102. New Zealand—8 pkgs. material, $711. Philippine Islands—143 pkgs. material, $2,381. Peru—12 pkgs. material, $473. Stockholm—1 pkg. machinery, $75. Stuttgart—2 pkgs. machinery, $300.

SOME FITCHBURG ENGINE ORDERS.—The Fitchburg (Mass.) Engine Company, through Mr. Edwin H. Ludeman, manager of its New York offices, 39 Cortlandt Street, has secured the contract for the engines which are to be installed in the new Hotel Belmont, now under construction at Forty-second Street and Park Avenue, New York. There will be three medium-speed tandem compound, four-valve engines, each having a capacity of 300 hp, and one 25-hp engine. The larger engines will be direct-connected to Western Electric generators of 200 kw capacity. The fourth engine will be direct-connected to a Western Electric generator of 150 kw capacity. Mr. Ludeman has also taken a contract for a 475-hp, medium-speed tandem compound, four-valve engine to be installed in the shops of the John Stephenson Car Company, at Elizabeth, N. J. This machine will be direct-connected to a General Electric 300-kw generator. Two 300-hp Fitchburg compound engines are to be shipped the Newburgh company's new hat factory in Orange Valley, N. J. These engines will be direct-connected to Stanley alternators of 200 kw capacity.

AN ELECTRIC INTERURBAN RAILWAY 40 miles in length is to be built from Rochester, through Canandaigua, to Geneva, N. Y. The road will be known as the Rochester & Eastern Rapid Railway. The Comstock-Haigh-Walker Company is building and equipping the line, and expects to have it in operation by next July. The following electrical apparatus is being furnished by the Westinghouse Electric & Manufacturing Company, of Pittsburg, and includes two 650-kw, 3-phase, 3,000-alternations, 390-volt, engine-type alternators, which will be arranged for direct connection to cross-compound engines running at 150 r.p.m.; seven 300-kw, 3-phase rotary converters; four 500-kw and nine 200-kw, oil-cooled transformers, arranged for transformation from 390 to 16,500 volts; and two 37½-kw, direct-current, engine-type exciters operating at about 320 r.p.m. The contract also calls for switchboards, high-tension switches and lightning arresters for the main generating station and three substations.

STROMBERG-CARLSON TELEPHONE CONTRACTS.—The Leeds Telephone Company, Illiopolis, Ill., has purchased its apparatus from the Stromberg-Carlson Telephone Company, of Chicago. The Holland Township Telephone Company, Mode, Ill., has purchased a Stromberg-Carlson switchboard, and the Guthrie Telephone Company, of Guthrie, Ill., has also bought its telephones from the Stromberg-Carlson Company. Other sales reported are to the Okaw Telephone Company, of Sadorus, Ill.; the South Prairie Telephone Company, of Sadorus, Ill.; the North West Prairie Telephone Company, of Sadorus, Ill. The White County Union Telephone Company, of Carmi, Ill., has purchased additional equipment for their system from the Stromberg-Carlson Company, and the Mason City Telephone Company, of Mason City, Ill., has also purchased additional Stromberg-Carlson equipment.

UNITED BARIUM COMPANY.—George S. Ettla and Theodore L. Welles have been appointed temporary receivers of the United Barium Company, of Niagara Falls, by an order of the Supreme Court. Mr. Ettla is president of the company and Mr. Welles the superintendent, and they with J. G. Petriken, a director, signed the application for the appointment of a receiver. Augustus Thibaudeau, of Niagara Falls, has been appointed referee, and the first hearing will be on May 16. It is stated in the petition that the company's liabilities are $121,039.48, and that its assets are $91,248.61 and certain interests in patent rights that have a purely speculative and unascertainable value. It is given out by some of the men interested that the company is to be reorganized with an increased capitalization.

TELEPHONE COMPANIES SOLD.—The Maryland Telephone & Telegraph Company, of Baltimore, Md., was sold, on January 30, to a syndicate represented by the Central Trust Company. It is stated that the company's capital will be increased for betterments. The Standard Telephone Company, of Atlanta, Ga., was sold at auction, on February 4, to Robert Alexander, of the law firm of Alexander & McGill, of Philadelphia. The price paid for the company's effects and property was $200,000, which was the upset price fixed by the court. The sale was the result of a foreclosure of a mortgage held against the company by the City Trust Safe Deposit & Surety Company, of Philadelphia.

THE AUTOMATIC EXCHANGE IN CHICAGO.—The Illinois Telephone & Telegraph Company has begun the equipment of its automatic telephone exchange at 181 Fifth Avenue, Chicago. This exchange is quite a contrast to the ordinary telephone exchange building. The automatic apparatus is stored away much after the manner of goods in a warehouse, precautions being taken, of course, to exclude dust. The system is that of the Automatic Electric Company. The company is going to work at once to install instruments, and begin operations in the down-town district of Chicago. The telephones will be paid for entirely on a measured service basis, except that there will be a maximum charge.

WESTINGHOUSE GAS ENGINE ORDER.—Westinghouse, Church, Kerr & Co. have been awarded another contract for gas engines to be installed in the Winchester Repeating Arms Company's plant at New Haven, Conn. The order calls for two 16-in. by 18-in. three-cylinder Westinghouse gas engines, to be operated on the Loomis-Pettibone system of producer gas. These engines will be direct connected to Westinghouse generators of 100-kw capacity each. The existing New Haven plant consists of three similar Westinghouse engines direct-connected to Westinghouse generators. The plant furnishes current for both light and power purposes.

WESTINGHOUSE COMPANY BUYS BELDEN ARC PATENTS.—The Belden arc lamp patents have been acquired by the Westinghouse Electric & Manufacturing Company. The purchase price was in the vicinity of $50,000. The patents were the property of E. H. Belden, of Dayton, Ohio. The lamps were manufactured by the Dayton Fan & Motor Company. An extensive foreign trade has been carried on for some time past, principally through the Federal Electric Company. The lamps were exported chiefly fo India and Australia. They will now be manufactured by the Westinghouse interests.

WIRELESS FOR STEAMSHIPS.—According to a statement given out by the Marconi Company, all the fast steamers of the International Mercantile Marine Company will be equipped with wireless telegraph plants. The recent delay of the St. Louis emphasized the need of such an equipment. Clement A. Griscom, Jr., New York manager of the steamship concern, and John Bottomley, general manager of the Marconi Wireless Telegraph Company of America, have concluded a contract for the St. Louis, St. Paul and New York.

HAMILTON CORLISS ENGINE ORDER.—The Hooven-Owens-Rentschler Company, of Hamilton, Ohio, represented by Mr. W. B. Mayo, 39 Cortlandt Street, has been awarded a substantial contract for engines which will serve as an equipment in the power station of the Washington, Baltimore & Annapolis Street Railway. There will be two cross-compound condensing Hamilton Corliss engines, each having a capacity of 1,500 hp. They will be direct-connected to 1,000-kw generators.

WELSH COAL FOR PORTO RICO.—The San Juan Light & Transit Company, of San Juan, Porto Rico, which was built and is operated by the electrical engineering and contracting firm of J. G. White & Co., 29 Broadway, New York, has just purchased 1,700 tons of Welsh coal for its plant because of the difficulty in filling fuel requirements promptly in the United States.

MEAD MANUFACTURING PLANT FOR CHICAGO.—John A. Mead & Co., Bowling Green Building, New York, are constructing an extensive plant near Grand Crossing, Chicago, to be utilized for the manufacture of their coal-handling specialties. Electricity will be employed to operate the machinery. Three electric traveling cranes are to be installed.

BALL ENGINES.—The Pennsylvania Railroad Company is installing in the new Camden Station four 250-hp cross-compound engines, each direct-connected to Westinghouse alternators. These alternators will run in parallel and the engines are equipped with synchronizing devices. The Ball Engine Company, Erie, Pa., furnishes the engines.

ELECTRIC CARS TO BE BUILT IN MEXICO.—Isaac M. Hutchison, of Mexico City, who represents the Mexican interests of the American Steel Foundry Company and other progressive United States concerns, is about to build an extensive plant in the southern republic for the purpose of constructing electric and other types of cars.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—The Mission Long Distance Telephone Company, of San Francisco, represented by Gratz K. Brown, has petitioned the Supervisors to offer for sale a 50-year telephone franchise. Among the conditions are a rate of $63 per year for business and $33 for residence telephones; all slot telephones to be prohibited; a limited number of free telephones to the city and the system to be constructed for 18,000 subscribers at the start.

ROME, GA.—Offices will be established at Rome, Ringgold and other points in connection with the long distance line from Atlanta to Chattanooga.

ATLANTA, GA. The Southern Bell Telephone Company will remove its headquarters from New York to Atlanta early in the spring. A large clerical force and the offices of the auditor and secretary and treasurer are included in the move. The transfer will probably be made in April.

WALLACE, IDAHO.—C. C. Landes, P. F. Smith and others of this place have organized a telephone company.

HARTFORD CITY, IND.—The United Telephone Company will put in a rural telephone system to take in all the surrounding country.

NEW ALBANY, IND.—The Cumberland Telephone Company has extended its lines to Palmyra and Galena and will make further extensions.

ELKHART, IND.—The Paris Mutual Telephone Company has increased its capital stock to $1,000 and will install a number of new telephones.

KOKOMO, IND.—The Citizens' Telephone Company, of this city, has increased its capital from $25,000 to $100,000. Improvements and extensions will be made.

CLARK HILL, IND.—The People's Co-operative Telephone Company has been incorporated with a capital stock of $500. The incorporators are N. J. Bailey, W. E. Bryant and others.

BEDFORD, IND.—The Bedford Telephone Company has re-organized and incorporated with a capital stock of $75,000. The new organization absorbed the Ruddick Telephone Company.

WABASH, IND.—The Wabash Home Telephone Company will issue $20,000 worth of bonds to pay off the debt incurred through the destruction of the exchange by fire a few months ago.

EVANSVILLE, IND.—The municipal telephone project has progressed to the point where the preferred stockholders of the municipal telephone company held a meeting and prepared articles of incorporation.

MUNCIE, IND.—The Madison & Delaware Counties Telephone Company is stringing about 200 miles of copper wire and will install about 250 telephones in the near future. This will give it a total of 1,000 subscribers.

TERRE HAUTE, IND.—The Kinloch Telephone Company, of St. Louis, on Jan. 21 made connection with Terre Haute on its long-distance line which connects St. Louis with the Indiana system of independent exchanges, including Indianapolis.

LAFAYETTE, IND.—The Salem Co-operative Telephone Company has been incorporated to operate telephone exchanges and lines in the Salem neighborhood, Tippecanoe County. W. P. Pierce, F. M. Buskirk and M. F. Jeffers, all of Lafayette, are the incorporators.

RICHMOND, IND.—The Home Telephone Company, of this city, has re-elected its old officers. It has over 1,700 telephones in use. A line will be built into Richmond from the east by the United States Company, and Richmond will be the terminal for Ohio connections.

RILEY, IND.—The Union Telephone Company, of Vigo and Clay counties, has filed articles of incorporation. The headquarters will be in Riley. The company will establish exchanges and lines and operate a system in Vigo and Clay counties. John Schinnierer and Christian Fox are the principal officers.

GREEN CASTLE, IND.—The city council has granted the Putnam County Mutual Telephone Company a franchise to enter the city and establish an exchange. This will result in a dual system to the regret of the citizens. The company is a rural concern and will afford a large number of farmers connection with the city.

BRANCHVILLE, IND.—The Eckerty, Branchville and Connelton Telephone Company has been incorporated and the headquarters will be established at Doolittle Mills, Perry County. The corporation will construct exchanges and operate a co-operate system in Perry and Crawford counties. J. J. Esary, H. T. Lynch and T. H. Frakes, all of Branchville, constitute the directorate.

BICKNELL, IND.—The Bicknell Telephone Company has bought out the Miller interests which originally started the exchange here. The company has incorporated with $6,000 capital, with J. H. Barr, president; W. L. Lemen, vice-president; J. S. Hoover, secretary, and E. D. Miller, manager. At present the company has 110 subscribers with toll line connection throughout the county. Extensions are being planned.

CORYDON, IND.—The Independent Telephone and Telegraph Company, of this city has filed articles of incorporation with a capital stock of $15,000, reserving the right to increase the capital from time to time. The company will establish, construct, maintain and operate telephone exchanges and telephone lines in Harrison, Floyd, Washington, Orange, Crawford and Perry Counties. O. S. Wright and E. D. Mitchel are the principal officers.

CADIZ, IND.—Another telephone line is building from the north into this town—a place of 300 people. The town is now the center for twenty-two co-operative rural telephone lines none of which has less than two dozen subscribers. Besides these there are five long distance lines connecting with the co-operative lines. All Cadiz patrons have free connection with upwards of a thousand telephones over eastern Indiana. The patrons build the lines themselves and get this service for a small amount which goes toward the upkeep of the exchange.

INDIANAPOLIS, IND.—The stockholders of the New Long-distance Telephone Company have formed a voting trust, the purpose of which is to perpetuate the present management, for a period of five years. Ninety-five per cent. of the stock has signed the agreement, which provides that the stock shall be deposited with the Union Trust Company, of Indianapolis, as trustee, which will issue trust certificates to take the place of the stock certificates issued by the company. These trustee certificates are transferable, the same as the stock certificates. The effect of this action is already noticeable, in the stiffening up of the stock on the local market.

GREEN CASTLE, IND.—Over a hundred representatives from warring telephone factions in this (Putnam) County gathered in this city on Jan. 23 for a conference in regard to securing entrance to the city for the various rural telephone interests. The Putnam County Telephone Company, doing business in the southern part of the county made a demand for a franchise for a switchboard in the city, with other privileges. The council deemed such a franchise unjust to the city exchange, which has over six hundred instruments, and the meeting was called by the council in order to secure an agreement between the independent lines and the City Company, relative to the use of the city switchboard as it now exists, by the payment of a rate satisfactory to all concerned. After a heated discussion, a committee was appointed to represent the independent companies in a conference with the company's managers. This committee met the City Company with a proposition that the independent companies agree to one of three things: To build a double line to the city limits, one a single line and the other a metallic circuit, the single line to be used by every telephone holder on it free of cost; the telephone holder to pay a flat rate of 5 cents over the existing lines into the city, or to pay a rate of 25 cents a month, with the privilege of talking all they want to. A resolution was adopted rejecting the three propositions submitted to them by the city company, which were in the nature of a compromise with the country system. The failure of a peaceful settlement is very much regretted. As the matter now stands the city is threatened with a dual system.

LEMARS, IA.—An election will be held on February 16, to vote on the question of granting a telephone franchise to the Lemars Telephone Company.

BLAINE, IA.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $3,000 by F. Evans, L. W. Hiatt, J. I. Knox and others.

WATERLOO, IOWA.—During the latter part of January the Commonwealth Telephone Company was organized with headquarters at Waterloo, Iowa, and secured control of the following telephone properties in that State: Cedar Valley Telephone Company, The County Telephone & Telegraph Company, The Waverly Telephone System, The Hardin County Telephone System, The Parkersburg Telephone System, and The La Porte City Telephone System. The new company is capitalized at $900,000 and will operate in eight Iowa counties. The apparatus, made by the Automatic Electric Company, Chicago, will be installed in Waterloo, and other towns where the company operates.

PORTLAND, ME.—The International Telephone & Telegraph Company has been incorporated with a capital stock of $1,000,000. Mr. R. R. Gilman is president.

MONROE, MICH.—The Home Telephone Company, of Monroe, is to be incorporated in the near future and the promoters are planning to install the Strowger automatic system.

LANSING, MICH.—The Citizens' Telephone Company has announced an increase in rates for residence telephones of $12 to $18. Telephones now in use will continue to be charged at the old rates.

GREAT FALLS, MONT.—The Rocky Mountain Bell Telephone Company has secured an option on the Choteau-Farmington line near here.

GENEVA CITY, NEB.—A franchise has been granted to John Barsby to establish a telephone exchange in this place.

WILSON, N. C.—The American Telephone Company will open an office in Wilson, N. C., for long distance service.

COLUMBUS, N. C.—At Columbus the Polk County Telephone Company is preparing to build a line to Lynn. A long distance line has been built between Jonesboro, Sanford and Carthage, N. C., and one from Lexington, N. C., to Yadkin College.

GALLIPOLIS, OHIO.—A company is being formed here to build a telephone line from Lecta to Clay Lick.

AKRON, OHIO.—The Akron People's Telephone Company will lay conduits in the business section of the city.

MIDDLEFIELD, OHIO.—W. E. Hutchis, H. C. Gross and E. E. Newman, of Hamilton, will install an exchange at Middlefield.

CLEVELAND, OHIO.—The United States Telephone Company is preparing to string a new long distance circuit from Cleveland to Toledo.

RICHWOOD, OHIO.—The Richwood Telephone Company has increased its capital stock from $10,000 to $20,000, and will make improvements.

HAMILTON, OHIO.—The Camden Telephone Company will extend its lines to the surrounding towns. Some of the material has already been ordered.

BLOOMDALE, OHIO.—The council has granted a franchise to Claud Wygandt, of Toledo, to maintain and operate a telephone exchange in this place.

MANSFIELD, OHIO.—R. M. Brown and S. M. Lanz, of Franklin, have formed a telephone company and will build a farmers' system in that district.

MARTIN'S FERRY, OHIO.—The Belmont Telephone Company is planning to extend a farmers' system through Mt. Pleasant. A. W. Riddle is active in the enterprise.

CARROLLTON, OHIO.—The Kilgore Telephone Company, of Kilgore, will build a line from that place to Amsterdam. The company has connections with the Bell lines at the latter place.

WAKEMAN, OHIO.—The Norwalk Telephone Company has purchased the local telephone company's line from New London to Berlin Heights, by way of Clarksfield, Wakeman and Florence.

PARKMAN, OHIO.—The Parkman Telephone Company, recently organized, is preparing to install its system. The company will furnish service throughout the farming district at $12 per year.

WEST UNION, OHIO.—William Hiller, of the Ohio Telephone Company, Georgetown, is planning to build connecting lines to West Union, Blue Creek, Wamsleyville, Otway and Mineral Springs.

MIDDLEPORT, OHIO.—The Middleport Telephone Company will build a line from Middleport to Kyger. W. F. Russell is president and John Brechtel, superintendent of construction for the company.

HILLSBORO, OHIO.—The annual meeting of the Hillsboro Telephone Company indicates that the company is in a prosperous condition. It has 360 telephones in use and will install more this spring.

ATHENS, OHIO.—The Athens County Telephone Company has added another 100 line switchboard and night service has been instituted. The company is planning to extend lines throughout the farming districts.

WARREN, OHIO.—The Jefferson & Warren Telephone Company has increased its capital stock from $60,000 to $80,000. It will make numerous extensions in the territory surrounding Warren and Jefferson.

BURTON, OHIO.—The farmers' telephone system has been completed to Marshalltown and is being extended to Wadsworth and Barberton. The farmers' system in this district is said to be the most complete in the country.

LIMA, OHIO.—The Lima Telephone Company has installed an addition to its switchboard and is prepared to take care of 400 additional subscribers. The company is extending its farmers' system throughout the county.

NORWALK, OHIO.—The Norwalk Telephone Company has engaged L. W. Stanton, the Cleveland engineer, to design a new switchboard and other office equipment. The new apparatus will be installed as soon as possible.

NORTH BALTIMORE, OHIO.—The North Baltimore Telephone Company has been incorporated in West Virginia. Capital $2,000. Incorporators: C. B. Blose, F. M. Dotson, Samuel Wyant and C. F. Miles, of Toledo.

YOUNGSTOWN, OHIO.—The American Telephone & Telegraph Company has completed plans for the installation of five additional toll circuits between Youngstown and Pittsburg. The service between the two cities has been very heavy.

HAMILTON, OHIO.—The Hamilton Home Telephone Company will shortly open its exchange in this place. It is planning to extend the service throughout the county. Frank Hughes is president and J. W. Slonecker, secretary of the company.

AKRON, OHIO.—The Akron People's Telephone Company will build toll lines of its own to Canton and Massillon. At present the company uses the United States Company's lines, but these are so crowded that the service is unsatisfactory.

PROSPECT, OHIO.—The probate court has granted a franchise in Prospect to the Marion County Telephone Company. The company has been desirous for some time of extending its service, but the town has repeatedly refused a franchise grant.

BELMONT, OHIO.—The Belmont Telephone Company has elected new directors as follows: J. C. Dent, L. B. Driggs, H. Schumlbach, J. W. Doud, E. G. Smith and others. The company will make extensive improvements during the coming year.

DELAWARE, OHIO.—The Citizens' Teleohone Company has increased its capital stock from $60,000 to $100,000 and is planning important extensions throughout its territory. W. M. Heseltine is president, and G. H. Carter, secretary of the company.

MARIETTA, OHIO.—The Muskingum Valley Telephone Company has recently incorporated with $5,000, and will build lines from Swift Station to Marietta, by way of Lowell and Beverly. E. B. Vincent is president and W. W. Mason, general manager.

BELLEVUE, OHIO.—The Local Telephone Company will soon close contracts for the installation of a multi-switchboard with party line service for the Norwalk exchange. LeRoy W. Stanton, consulting engineer, Cleveland, has prepared plans for the exchange.

NEW PHILADELPHIA, OHIO.—The Tuscarawas County Telephone Company has elected these directors: P. B. Scott, president; E. A. Walter, secretary; J. L. Kennedy, treasurer; E. P. Scott, E. Weibensen, N. I. Dreyfoos, W. M. Tracey and C. D. Juvenal.

RAVENNA, OHIO.—The Portage County Telephone Company is planning to extend its system throughout Rootstown, Randolph, Deerfield, Edinburg, Atwater, and Palmyra townships. A large amount of money will be spent in extending the service throughout the county.

NORWALK, OHIO.—The Norwalk Business Men's Association has agreed not to pay the advance in price asked by the Central Union Telephone Company in this city. All of the association members will order their telephones taken out if the company persists in its demands.

KENT, OHIO.—The newly organized Portage County Telephone Company will issue $100,000 bonds to make improvements. The company has over 1,500 subscribers in the various exchanges recently consolidated. A large amount of construction work will be done this summer.

UTICA, OHIO.—The Utica & Homer Telephone Company has been incorporated, with $40,000 capital stock, to construct telephone lines throughout Licking County, with exchanges at Homer and Utica. D. E. Sapp, Frank L. Beam, W. C. Sapp, R. M. Greer, H. C. Devin are interested.

PLAIN CITY, OHIO.—The Plain City Home Telephone Company now has 343 telephones, a gain of 125 within a year. The company operates over 600 miles of toll line in Madison and Union counties and is preparing to build considerable additional mileage of lines. C. Leggett is manager.

ELYRIA, OHIO.—T. M. Brush and I. H. Griswold, of Elyria, have purchased from Barber & Brailey, of Wauseon, a large interest in the Rome Home Telephone Company, of Rome, N. Y. The property will be connected with the other independent exchanges operated by the Rawson-Brush syndicate, of Elyria.

TIFFIN, OHIO.—The Tiffin Home Telephone Company has elected the following named officers: Ed. L. Harber, president; A. L. Flack, vice-president; E. B. Myers, treasurer and K. F. Briggs, secretary. The above with E. R. Strohm, are directors. The company is planning a number of extensions throughout its district.

MARYSVILLE, OHIO.—The Marysville Telephone Company has 350 subscribers, an increase of 100 during the past year. The company has a large waiting list and will install a number of new telephones as soon as the material can be obtained. It is also putting up a large number of farmers' lines. Mr. N. E. Leggett is manager.

CLEVELAND, OHIO.—The Federal Telephone Company has arranged to sell to Eastern bankers a large block of the bonds of the United States Telephone Company. The United States property is now earning 3 per cent. in excess of its bond interest and with contemplated extensions it will be earning 5 per cent. before the close of the year.

WAPAKONETA, OHIO.—The Shaffer Construction Company, of Texas, which is building a number of telephone exchanges in Ennis County, Texas, held its annual meeting here recently. C. D. Crites and Walter Riche, of Lima, S. A. VanOss, of Minister, George B. Whitney, of Marysville, and a number of parties in this city are interested in the company.

CLEVELAND, OHIO.—The committee representing the larger Cleveland banks have declined to agree to the proposition made by President Dickson, of the Cuyahoga Telephone Company, to authorize an issue of $2,000,000 preferred stock in order to clear up the floating debts of the company. It is announced that another plan of refinancing the company will be submitted in the near future.

CLEVELAND, OHIO.—Several hundred people have threatened to sue the Cleveland Telephone Company (Bell) for failure to carry out its agreement to install a one way party line telephone for six months' trial for $1. The company took a large number of subscriptions for the new service, but ran out of instruments, and only took care of a portion of those that had paid for the service.

CINCINNATI, OHIO.—The City & Surburban Telegraph Association (Bell) is preparing plans for a large central telephone exchange, to relieve the present Vine Street exchange, which is too small. The new exchange will have a 9,000-line board and will be installed in a three-story exchange building which will cost $150,000. The company is just completing branch exchanges at Norwood, Cumminsville and East End.

LONDON, OHIO.—The West Jefferson Telephone Company, with 100 subscribers, the Charleston Telephone Company, with 200 subscribers, and the London Telephone Company, with 700 subscribers, will soon be consolidated under the title of the Madison & Clark Telephone Company with headquarters in London. The new company will build a large number of farmers' lines and will put in considerable new cable.

CLEVELAND, OHIO.—The Columbiana County Telephone Company has elected these officers: F. S. Dickson, president; Maxime Reber, vice-president; R. F. Judd, treasurer, and W. F. Crossley, manager and secretary. These with W. L. Carey, J. B. Hoge, Will Marron and W. D. McKeefry are directors. The company operates thirteen exchanges and has 2600 telephone in operation. The company will spend about $20,000 in improvements during the coming year.

AKRON, OHIO.—The Akron People's Telephone Company is planning to absorb the independent telephone exchanges in Portage County. These include the Kent Telephone Company with 600 subscribers, the Ravenna Telephone Company with 600, and the exchanges at Mantua and Garrettsville, which have about 200 subscribers each. The Akron company has 3,500 subscribers with exchanges in Akron, Barberton and Cuyahoga Falls. Will Christy is president, and W. F. Laubach, general manager of the company.

CLEVELAND, OHIO.—The Rawson-Brush telephone syndicate, of Elyria, and the Consolidated Telephone Company, of Buffalo, which is largely controlled by Cleveland people, are perfecting an agreement whereby the territory of New York State will be divided up and traffic arrangements made whereby the two syndicates may work in harmony. This will result in the doing away with the duplication of many telephone lines and will tend to improve the service in the Empire State. Heretofore the two syndicates have been in competition for territory.

CHESTERFIELD, S. C.—The local telephone company at Chesterfield has under construction and in contemplation several new telephone lines.

NEWBERRY, S. C.—The town council of Newberry has granted an unlimited franchise to the Bell Telephone Company. It is understood that work will be started at once taking out the old telephones and putting in a new system complete.

MARSHALL, TEX.—F. M. Marriott, J. B. King and P. J. Eubanks have been granted a telephone franchise by the city council.

WACO, TEX.—Ed N. Stephenson and other stockholders in the Electric Construction Company, have brought a suit against the Texas Telephone Company, the Electric Construction Company, and the St. Louis Trust Company. They ask judgment for $60,000 due them, they allege, as purchase money for the telephone exchange, and that an issue of $150,000 of bonds of the Texas Telephone Company be canceled. The plaintiffs also pray for a decree putting both the telephone company and the construction company into the hands of receivers, and that the affairs of the construction company be wound up. The St. Louis defendant is sued as custodian of part of the bond issue sought to be canceled.

RICHMOND, VA.—The Board of Aldermen of Richmond has adopted the ordinance providing for a merger of the Richmond Telephone Company and the Bell Company. The matter will have to go before the common council.

URUGUAY.—The Uruguay Government has approved the statutes of La Economica Telephone Company represented by Senhors A. C. Mendez and M. J. Perez, of Montevideo.

ELECTRIC LIGHT AND POWER.

LOS ANGELES, CALIF.—The new generating station of the Edison Electric Company, situated on Mill Creek in San Bernardino County, is rapidly nearing completion. It is known as power plant No. 3. Its capacity will be 4000-hp. There is a 1960-foot head, with a pressure of 863 lbs. to the square inch. The company has just installed one 3-phase General Electric alternator.

LOS ANGELES, CALIF.—The Edison Electric Company has decided to erect a sub-station at the corner of Main and Fourth Streets. For the present the structure will be two stories high, although the foundation is to be substantial enough to support six stories, as the company will need a larger building in the future for offices and power uses.

SAN LUIS OBISPO, CALIF.—The San Luis Obispo Light, Heat and Power Company has re-incorporated as the Pacific Coast Light, Heat and Power Company; capital stock, $500,000; paid up, $150,000. The reason for the change is to enable the company to extend its business to neighboring counties. William V. Miller, of Bakersfield, and E. S. Hoyt, of this city, are the principal stockholders.

CHICAGO, ILL.—By a unanimous vote the City Council has placed itself on record as desiring municipal ownership and operation of gas and electric lighting plants. The Legislature will be memorialized to pass an enabling act at once.

EAST ST. LOUIS, ILL.—The officials of the Interstate Transit Company, the owners of the automobile line, are circulating petitions about East St. Louis, preparatory to asking the City Council for a franchise for permission to establish an electric light plant in the city. It is promised that the rates will be made considerably lower than those now in force. The East St. Louis Electric Light Company is owned by the East St. Louis and Suburban Railroad.

WABASH, IND.—A movement is on foot to buy the Wabash electric light plant for the city. The council has been petitioned to buy it and make it a municipal plant. The contract with the company expires in a few months.

BOSTON, MASS.—The Old Orchard Electric Light Company has voted to increase the amount of its capital stock to $100,000.

SPRINGFIELD, MASS.—The efficiency of the municipal electric light plant has been greatly increased by the recent addition of a new dynamo and engine, The old dynamo was greatly overloaded. This year it is hoped to add another new dynamo for the street lighting circuit.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company has decided to equip an extensive power plant for generating purposes on the Flat River above Lowell.

CRYSTAL FALLS, MICH.—The Westinghouse Electric & Mfg. Co. has secured the contract for one 150-kw single-phase and one 90-kw generator for the electric light plant.

DETROIT, MICH.—The Lapeer Light & Power Company has been formed with $75,000 capital stock and has absorbed the lighting plants at Lapeer, Imlay City, Millville and Higley. J. Schlegel is president and Henry Schlegel, secretary-treasurer of the company.

GRAND RAPIDS, MICH.—J. H. Mitchell, Sol P. Kineon and W. H. Settle are promoters of a new electric light and power company that will operate here. They have petitioned the council for a franchise to furnish electricity for light and power, steam and hot water for heating and cold water for refrigerating purposes.

MARQUETTE, MICH.—The new sand wheel house of the Calumet & Hecla Company, which has been in progress of construction since 1901, is completed. Some months will be required to complete the installation of the great wheel. The electrical power house which will operate the apparatus is now being equipped. The American Bridge Company erected the wheel house.

ST. CHARLES, MO.—At the annual meeting of the stockholders of the St. Charles Light and Fuel Company the old board of directors and officers were re-elected. The officers are Edward Gut, president; A. Ross, of St. Louis, secretary, and L. O. Fulkerson, manager.

HEMPSTEAD, N. Y.—The sale of the lighting plant at Hempstead, L. I., to a Philadelphia syndicate, is reported by W. M. Ostrander, of Philadelphia. It was through the efforts of Mr. Ostrander that the plant at Hollidaysburg, Pa., was recently sold.

HICKORY, N. C.—The Thornton Electric Light Company, of Hickory, has been chartered with a capital stock of $8,000.

GREENSBORO, N. C.—The Greensboro Electric Company has been granted a franchise to build a gas plant in Greensboro.

OXFORD, OHIO.—It has been decided to offer the village lighting and water plant to a private corporation. Under municipal management it has been a failure.

WILMINGTON, OHIO.—The United Water & Light Company has been incorporated under New Jersey laws. It has $200,000 capital stock, and will erect a plant here.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has broken ground for its new power station. The plant will have a capacity six times that of the present station.

LANCASTER, OHIO.—The Godman Shoe Company will erect a power plant to supply light and power to several factories in this town. Contracts are being placed for engines and generators.

SPRINGFIELD, OHIO.—The Citizens' Light, Heat & Power Company, capital $10,000, has been incorporated by W. L. Weaver, W. W. Keifer, F. M. Hogan, W. P. McColloch and A. M. Kunker.

ROCK HILL, S. C.—It is reported that the plant of the Rock Hill Water, Light and Power Company has been sold to Geo. MacDonald, of New York City, and others for approximately $70,000.

ABERDEEN, S. D.—The City Council is stated to have granted a franchise to the Aberdeen Gas Company. The company will install a gas and electric light plant.

TRENTON, TENN.—A movement is on foot at Trenton for the purchase by the city of the local lighting plant for $6,000. Bonds may be issued for the purpose.

NASHVILLE, TENN.—Michigan purchasers of the Caney Fork Falls water power, 12 miles east of Minnville, will erect a $1,000,000 power house and dam, with a capacity to transmit power to Nashville. The enterprise is said to have ample funds behind it.

KELSO, WASH.—The Metcalf Shingle Company is reported to have submitted a proposition to the city to install an electric light plant.

MONTICELLO, WIS.—The village council is stated to have granted J. H. Staedtler a franchise for an electric light plant.

WINNIPEG, MAN.—The big electrical works of the Winnipeg General Power Company, on the Winnipeg river near Lac Du Bonnet, are now in course of construction. This company has commenced operations with a large force of men, and Winnipeg is now within measurable distance of obtaining electrical power by transmission over a distance of about 55 miles, which is the distance between the city and the works.

CITY OF MEXICO, MEX.—The Mexican Gas and Electric Light Company, of the City of Mexico, is negotiating with the municipal council of that city for a contract to establish an extensive telephone service there.

TAMPICO, MEX.—A new electric light company has been formed in the city of Tampico, Mexico. The capital of the concern is $200,000. It will, however, be fully twelve months before the plant it proposes to erect will be in running order. In the meantime the present owners of the plant now in operation are perfecting plans whereby the works are to be considerably enlarged. The equipment will be purchased in the United States.

THE ELECTRIC RAILWAY.

GENEVA, OHIO.—Frank Hood, of Ashtabula, has been granted a county franchise to build an electric railway from Geneva to the lake shore.

YOUNGSTOWN, OHIO.—Local people are planning to build an electric railway from the city to the new plant of the National Steel Company.

RICHMOND, VA.—The Virginia Passenger & Power Company, of Richmond, intends to rehabilitate the Seven Pines electric railway to that famous battlefield.

TOLEDO, OHIO.—The Interurban Construction Company has been incorporated, with $10,000 capital stock, by H. R. Klauser, A. E. Klauser, N. Schmidt, J. H. Pheat and H. F. Shunck.

MARTIN'S FERRY, OHIO.—The Wheeling Traction Company has asked for a franchise in Martin's Ferry and as soon as the grant can be obtained a line will be built from Martin's Ferry to Brilliant.

TOLEDO, OHIO.—The Toledo & Western Railway Company has re-elected the present directors, i. e., Hon. Luther Allen, Judge C. M. Stone, J. R. Seagrave, W. L. Hayes and E. B. Allen, Cleveland, and F. E. Seagrave and C. E. French, Toledo.

MONTPELIER, OHIO.—M. C. Peterson and George M. Clarken, of Ann Arbor, are securing right of way for the projected Hillsdale-Bryan railway. The road will be about 40 miles in length and it will be financed by Detroit and Ann Arbor people.

SANDUSKY, OHIO.—The Sandusky Southwestern Railway Company has elected these officers: John VanFleet, president; F. C. Olsen, vice-president and general manager; S. P. Douglass, secretary; S. W. McFarland, treasurer; W. H. Wyke, superintendent.

CLEVELAND, OHIO.—The Cleveland, Richfield & Akron Transit Company has been incorporated, with $10,000 capital stock, by Daniel Gindelsperger, S. P. Inman, J. R. Zmut, R. J. Wood and Fred W. Green. The company has been working for some time on a line between Cleveland and Akron.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has elected these officers: J. E. Reeves, president; E. C. Deardorff, vice-president; Theodore Wentz, secretary and general manager, and A. J. Krantz, treasurer. The above with S. W. Croxton, S. W. Adams, E. A. Wentz, and J. D. McDonald are directors.

CLEVELAND, OHIO.—At the annual meeting of the Cleveland Electric Railway Company the following named directors were re-elected: Horace E. Andrews, R. A. Harman, J. J. Stanley, James Parmelee, Myron T. Herrick, Clavary Morris and C. L. Pack. Several additional storage batteries will be installed in various parts of the city.

NEW PHILADELPHIA, OHIO. The Tuscarawas Traction Company has elected these officers: F. T. Pomeroy, Cleveland, president; J. A. Rutherford, Cleveland, vice-president; J. O. Wilson, Cleveland, secretary; Will Aikins, trasurer and general manager. The above with Theodore Wentz, George Bowers and Will Christy are directors.

CLEVELAND, OHIO.—The Cleveland City Railway Company held its annual meeting and elected these officers: M. A. Hanna, president; C. F. Emery, vice-president; John Ehrhardt, secretary-treasurer; George G. Mulhern, superintendent; W. C. Phelps, purchasing agent; E. J. Cook, chief engineer. Directors: Mark Hanna, C. F. Emery, George Mulhern, L. W. Prior, W. B. Sanders, H. E. Andrews, R. R. Rhodes, J. H. Wade and C. A. Otis, Jr.

DETROIT, MICH.—At the annual meeting of stockholders of the Detroit United Railway the following officers and directors were re-elected: H. A. Everett, chairman of board; J. C. Hutchins, president and general manager; Arthur Pack, vice-president; George H. Russel, treasurer; Edwin Henderson, secretary, and A. E. Peters assistant secretary. Directors: H. A. Everett, E. W. Moore, H. R. Newcomb, R. A. Harman and George H. Russel, Cleveland; J. C. Hutchins and Arthur Pack, Detroit; R. B. VanCourtlandt, New York, and H. S. Holt, Montreal.

PERSONAL.

Pres. A. C. Humphreys.

PRES. ALEX. C. HUMPHREYS was duly inaugurated last week at the Stevens Institute of Technology, Hoboken, N. J., succeeding the late Prof. Morton. The exercises on Thursday afternoon, February [illegible] at the Institute were followed by a brilliant banquet at Sherry's in the evening. Alexander Crombie Humphreys came with his parents to America when he was eight years of age. He was born March 30th, 1851, in Edinburgh, Scotland, of English and Canadian descent, his father, E. R., Humphreys LL.D., being a well-known educator. The family took up its residence in Boston, where the boy attended school and later, receiving an appointment to the United States Naval Academy, successfully passed a special test examination. It was then discovered that he was less than sixteen years old, and was on that account rejected. He therefore entered upon a business career, intending at the proper age again to apply at the Naval Academy. Fortunately his keen interest became aroused in other matters. His first business experience was in a Boston insurance office. In 1866 he came to New York and remained with the Guarantee and Indemnity Company until 1872. In that year he was appointed as secretary of the Bayonne and Greenville Gas Light Company, of Bayonne, N. J., with charge of its business interests, and the following year was given full charge as superintendent. Thus began what has been his life work in the line of gas works engineering. Desirous of adding to his acquirements in practice the training of a technical school, he obtained from the company's directorate permission to absent himself two mornings of each week to attend the lectures at the Stevens Institute of Technology. Night and day he labored and, entering the school in 1877, he was graduated in 1881, having devoted to his studies only such time as he could spare from business during the four years. So unusual and so praiseworthy was this that resolutions of commendation and congratulation were adopted by the Faculty of the school on June 11th, 1881, this probably being an act unprecedented in the history of education. In the year of his graduation he became chief engineer of the Pintsch Lighting Company, and thereafter erected many gas plants, conducted experimental work, and gained knowledge of railroad car equipment. In 1885 he accepted the position of Superintendent of Construction of the United Gas Improvement Company, of Philadelphia, and shortly thereafter was made its general superintendent. He has been the chief executive officer of more than 50 gas and electric light companies, and was for a time president of the Syracuse Gas Co., Syracuse, N. Y., vice-president of the United Coke and Gas Company, Philadelphia, Pittsburgh and New York, and president of the City Gas Company, of Norfolk, Va. He is now president of the Buffalo Gas Company, Buffalo, N. Y., and president of the Hibbard-Rodman-Ely Safe Company, of New York. He is a member of the American Association for the Advancement of Science and of the leading engineering societies, and was president of the American Gas Light Association for the year 1898-1899. He has been a frequent contributor to technical literature.

MR. F. J. GUERNSEY succeeds E. W. Richey as superintendent of the Union Elevated Loop in Chicago.

MR. E. W. RICHEY, superintendent of the Union Elevated Loop in Chicago, has resigned to take a position with the Illinois Steel Company.

MR. ROBERT DOBLE, consulting and supervising engineer, of San Francisco, has removed his offices from the Hayward Building in that city to 417 Rialto Building.

MR. H. W. TOMLINSON, recently appointed assistant purchasing agent for the Chase Electric Company, 26 Cortlandt Street, was killed in the recent Westfield, N. J., railroad disaster.

MR. GANO S. DUNN, chief engineer of the Crocker-Wheeler Company, is seeking respite from grippe and hard work in the sunny clime and on the hospitable shores of Jamaica, West Indies.

MR. W. H. CUMMINGS, formerly manager of the British electrical engineering and contracting firm of Maguire & Baucus, London, has sailed for Europe after several weeks' visit on this side.

MR. WILLIAM F. SINGER is now New York manager of Fairbanks, Morse & Co. at 133 Liberty Street, pushing their well-known types of motors, etc. Mr. Singer formerly had charge of the Indianapolis office.

MR. L. W. STANTON, the consulting telephone engineer of Cleveland, Ohio, has recently been very busy on several plants in the Central States, but was in New York last week, when he participated in the Institute's annual dinner.

VICE-PRESIDENT VANDERGRIFT, of the Vandergrift Construction Company, Philadelphia, has gone to Porto Rico in connection with the proposed electric traction system to be constructed between San Juan and Ponce, a distance of about 70 miles.

MR. T. M. ELLIS.—The Rockford, Ill., Morning Star, of Feb. 1 has an interesting account of the history of street railways in Rockford, leading up to the present Rockford & Interurban Railway. The article includes a portrait of general manager T. M. Ellis.

MR. H. WRAY WELLER, C. E., Canadian representative of the Babcock-Wilcox boiler interests and an old Sprague and General Electric man, has been visiting New York from Montreal. He attended the Institute dinner last Monday and has followed up several matters of engineering interest.

DR. W. M. HABIRSHAW, of the India Rubber & Gutta Percha Insulating Company, is starting on a well-earned vacation this week, and sails for Cuba. He expects to be gone about six weeks and will see a good deal of the West Indies in the time, devoting the period named entirely to rest and recreation.

MR. THOMAS CASEY, at one time superintendent of J. H. Bunnell and Company, latterly superintendent of the Bunnell Telegraph & Electric Company and who more recently acted in a similar capacity for consolidated Bunnell interests, has been appointed superintendent of the Manhattan Electric Supply Company's works at Jersey City.

MR. LOUIS A. FERGUSON, president of the National Electric Light Association, has been in New York during the past week organizing new work and arranging for the programme of the next convention. The annual meetings of the Association have reached so high a standard that the members and the public have come to expect a very attractive programme.

MR. CHARLES D. SEEBERGER, the originator of the escalator system, sailed for Europe on the *Oceanic* on February 11. Mr. Seeberger went abroad to complete arrangements for installing escalators in the stations of the new London underground railroad, the preliminary negotiations having been conducted by the Waygood-Otis Company of that city.

MR. ALLAN V. GARRATT, chief engineer of the Lombard Governor Company, of Boston, was in New York last week and reported the outlook for hydro-electric developments as splendid. Some idea of the closer regulation of dynamo turbines now effected may be formed from the fact that in the vicinity of Montreal alone 40 Lombard governors are in use. Mr. Garratt has returned recently from a Southern trip.

MR. W. JONES, a leading merchant of Tacoma, Wash., and president of its chamber of commerce, when in New York last week said: "There are within a radius of 12 miles of Tacoma, 70,000 horse-power—a great deal already developed, and the remainder in course of development. So that, with coal a few miles off, and slab wood from the numerous mills for the cost of hauling, the large electric plants can quote rates that preclude the feasibility of anything but electricity being used."

MR. RAMON VALDES, whose offices are in the Edison Building, 44 Broad Street, New York, has sailed for Porto Rico, in connection with the interests of the Rio Plata Electric Company, which concern proposes to construct a dam and power house on the Rio Plata, located in the mountains about 17 miles distant from the city of San Juan and which also contemplates the conversion of the existing narrow gauge steam road running between Catano and Bayemon, a distance of about four and one-third miles, into a broad gauge electric traction system. Mr. Valdes expects to be absent about a month.

MR. FRANK A. BURRELLE has just delivered to the Postal Telegraph Company the 20 albums containing the published obituaries of the late John W. Mackay. The labor of gathering and placing in album form was begun last July. There are 5,480 clippings to each set covering 1,536 pages of Irish linen leaves 10x12 inches. This is the largest collection of material ever gathered concerning the death of a private individual, and the kindly expression of the press of the country was unanimous. Four sets of books were ordered by the Postal Company, one set being designed for Mrs. Mackay, the second for Mr. Clarence Mackay, one for the Postal Telegraph Company and one for the Commercial Cable Company.

MR. ARTHUR WILLIAMS, who has been appointed by President Ferguson to report on decorative lighting at the coming convention of the National Electric Light Association, has sent out a letter to all the active members, asking them to send him illustrations of the different designs of display lighting installed by them. Mr. Williams will have half-tone engravings made of these designs and will have them printed in connection with his report. From replies already received there seems to be widespread interest taken in this attractive and profitable department of electric lighting, and the very complete report to be presented by Mr. Williams will add greatly to the value of the programme of the convention.

MR. GEO. GRAY WARD.—Commercial Cable officials are trying to set the world on fire as well as cable it. Lately it was Mr. Chandler, now it is Mr. Ward. Last week some one saw sparks coming from the chimney of Mr. Ward's house at 51 West Fifty-third Street and called the engines. Engine 65, going up Sixth Avenue to the fire, ran into a truck, knocking off the driver, John Carroll, of 74 Carmine Street, and a helper. Carroll's leg was broken. Mr. E. Rollins Morse came up in an automobile and lent a lamp from his machine to the ambulance surgeon who was dressing Carroll's leg. Carroll was taken to the Flower Hospital. There was a little soot afire in Mr. Ward's chimney. A scuttle of coal dumped down the chimney ended the trouble. The funny thing is that Mr. Ward is manager of the Commercial Cable Co. while Mr. Morse is at the head of the Marconi wireless enterprise in this country.

MR. J. R. BIBBINS, of the Westinghouse Companies' Publishing Department, New York City, delivered an interesting and comprehensive address at the last annual banquet of the New York Physics Club upon the subject of "Recent Developments and Use of Electric Power." The address closely followed the subjective topics of systems and appliances, power development, high tension transmission, and electric traction, and briefly treated of the conditions leading up to and the present trend of modern engineering practice in the field of power utilization. Late inventions were also touched upon in the address, prominent among them being the Hewitt vapor lamp and converter and recent single phase traction systems. Mr. Bibbins' address formed the closing number of an excellent programme of short addresses by guests of the Club upon questions pertaining to proper methods of education in physical science. The list of speakers included District Supt. D. H. Bardwell, Prof. C. R. Richards, of Teachers' College, Director Arthur L. Williston, of Pratt Institute, Dr. Julius Sachs, and Dr. Walter B. Gunnison. The banquet was held at the Chelsea, West 23rd St., with excellent attendance. Pres. J. M. Jameson, of the Pratt Institute, Brooklyn, occupied the chair.

Trade Notes.

OIL FILTERS.—An important shipment of oil filters and exhaust heads was recently made by the Burt Manufacturing Company, of Akron, O., to its agency at London, England. Other export orders went to Sweden, Japan and Argentine Republic.

BULLOCK CALENDAR.—John Tyndall, the distinguished English scientist, is the subject of the biographical sketch on the Bullock calendar for February. A colored portrait of Tyndall heads the card, the coloring of which is very pleasing.

SPENCER, TRASK & CO., 27-29 Pine Street, New York City, have issued for 1903 another edition of their excellent Statistical Tables relative to securities quoted on the New York Stock Exchange. It is a most handy and compendious little book.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has bought the old co-operative bicycle factory at St. Catherines, Ontario, and will equip it for the manufacture of incandescent lamps, with a view to supplying the Canadian trade.

THE HALL ELECTRICAL SUPPLY COMPANY, 213 West Fourth Street, Cincinnati, Ohio, got out a very neat calendar for this year. The card contains a colored print of a working boy balancing his cash account on the wall. The title of the picture is "A Penny Saved is a Penny Earned."

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., carries the largest stock of circular loom conduit in the West. The stock is well assorted in all sizes, from one-quarter inch to two and one-quarter inches inside diameter. The ability to ship directly from stock saves valuable time in delivery.

INCREASED CUTTING SPEEDS.—Flyer No. 50 of the Crocker-Wheeler Company, Ampere, N. J., is devoted to a consideration of the subject of increased cutting speeds. The information given is valuable to machinists and shopworkers, and it is pointed out that the best results in machine practice are secured by electric speed control.

THE GREGORY ELECTRIC COMPANY, 54-56-58-60-62 Clinton Street, Chicago, has made a great hit with its "wire tables," recently put out to its customers. They are beautiful works of art and are highly prized by those fortunate to receive one. The demand for these has been so great that the company has ordered another lot to be distributed shortly.

THE DAYTON GLOBE IRON WORKS COMPANY, Dayton, Ohio, has recently arranged with the Pelton Water Wheel Company, 125 Main St., San Francisco, Calif, to have the latter represent it on the Pacific Coast. The Pelton Water Wheel Company has the exclusive sales agency of the New American Turbine Water Wheel Company in its territory.

MR. FREDERICK PEARCE, 18 Rose St., New York, has just been awarded the contract to construct the new fire alarm telegraph system on Staten Island. One hundred and eighty miles of wire will be used. Mr. Pearce has just issued a very handsome catalogue of nearly 400 pages showing the various instruments made by him as well as a full line of electrical supplies.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing to the trade a pamphlet descriptive of the Alpha and Omega toggles, two new devices for which there is sure to be a large demand. These toggles are strong, well made and low priced. The pamphlet also contains a description of the new "Zero" solderless lug. Buyers of this material would do well to obtain a copy of the pamphlet.

ELECTRICITY IN MACHINE SHOPS.—A reprint of the paper read by Mr. Charles Day, of the firm of Dodge & Day, modernizing engineers of Philadelphia, before the New York Electrical Society on the 17th ult., on "Requirements of Machine Tool Operation with Special Reference to the Motor Drive," will be sent by mail postpaid, on application to R. D. Lillibridge, 170 Broadway, New York.

THE CRESCENT COMPANY, of Chicago, is elated over the long looked for tests made by several well-known large users of soldering flux. The tests were made on the Crescent soldering stick and Crescent paste and were highly complimentary. Considerable doubt was at first expressed due to the fact that the Crescent compounds were of such opposite mixture to the regular soldering material; but the tests indicate their wisdom and foresight.

THE BALKWILL PATTERN WORKS, 970 Hamilton Street, Cleveland, Ohio, has issued an artistic pamphlet containing the announcement of the addition to its already established business of a department for the design and manufacture of architectural and ornamental patterns of every description. Their designs will be strictly original and up-to-date. This concern makes patterns and models for machinery and will be glad to furnish estimates, etc. Mr. W. S. Wellman is general manager.

THE ELECTRIC STORAGE BATTERY COMPANY, manufacturer of the Exide battery, has recently opened a new Exide battery depot in Rochester, N. Y. Although an Exide battery station is located in Buffalo, owing to the increasing use of electric vehicles in this portion of New York State, the opening of the above office has been found necessary. It is located at the establishment of J. J. Mandery, at 157 South Avenue, Rochester. Owners of electric vehicles equipped with Exide batteries in that district are requested to use this depot for any matters requiring information or attention.

INTERNATIONAL TELEPHONE MFG. CO. It is said that the International Telephone Manufacturing Company, of Chicago, is having a heavy demand for its generator-call telephone for long distance toll line and heavily loaded country party line use. The International instrument is especially adapted for this class of work, it being equipped with a powerful generator of extra heavy output; adjustable ringer; far-reaching, clear and distinct transmitter; double-pole horse-shoe magnet, adjustable receiver and having all connecting wires, binding posts, terminal screws, etc., concealed and no exposed metal parts forming any part of the circuit. This make of telephones is one of the most accurately constructed, most efficient and durable line of instruments ever produced.

THE STOREY MOTOR & ELECTRIC COMPANY, which has recently enlarged its shop equipment, and broadened out its line of machinery so that it covers everything that possibly can be used in work involving direct attachment of motors to machine tools, printing presses, etc., as well as a full line of open and enclosed constant speed power motors, including the necessary generators, has opened up its New York sales office in the Corporation Trust Building, 135 Broadway, New York, and has secured the services of Mr. Halbert P. Hill, who retires from the General Incandescent Arc Light Company for this purpose. This company is now undertaking the most difficult and exacting work in the line above stated. Mr. Hill anticipates being able to personally investigate the needs of the trade, and promises prompt deliveries.

THE D. L. BATES & BRO. CO., is the title of the company incorporated in Ohio, which has taken over the business of D. L. Bates & Bro., of Dayton, Ohio. Mr. D. L. Bates is president and superintendent of the factory; H. L. Bates, secretary, and R. H. Bates, vice-president and treasurer, the latter gentleman also serving in the capacity of general manager of the business. The company has recently brought out a new improved ceiling fan for the 1903 trade. It has acquired additional floor space which greatly increases its facilities for the manufacture of its fans, which have become well-known to the trade. In this connection mention may be made of a neat calendar for this year. On the card is a life-like view of four gentlemen sitting around a table in their shirt-sleeves, three of them listening to a story told by the fourth. The picture is entitled "A Hot Story in a Cool Place," the place being cooled by a Bates ceiling fan.

THE GORDON BATTERY COMPANY, 439-445 East 144th St., New York, with western offices at 358 Dearborn St., Chicago, has appointed as Pacific coast agent the Wrenn Commercial Co., Ltd., 515 Mission St., San Francisco. The Gordon cell is so extensively used throughout the country for operating central energy systems and switchboard transmitters and has given such universal satisfaction, that it has gained a large number of stanch friends among the telephone fraternity. Gordon cells are made in different sizes, varying in capacity from 100 to 1,000 ampere hours. A constant current, depending on the type, at an emf of from .65 to .75 volts can be obtained from this cell, and as there is practically no internal resistance all the emf is available. The cell is claimed to be free from noxious fumes and gases and is said to not be affected by climatic changes. It requires no attention during its life and is not consumed by local action when not in service. The company now has in preparation an enlarged catalogue fully describing the different sizes of the cell which it will be glad to send upon request.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 3, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,079. ELECTRICAL SWITCH OPERATING MECHANISM; C. B. Russell, Marlboro, Mass. App. filed Aug. 13, 1901. Details.

719,418. ELECTRIC ACCUMULATOR PLATE; A. Bainville, Nanterre, France. App. filed July 14, 1902. The plate consists of a number of rods separated from each other by a corrugated sheet of perforated insulating material arranged to cover the face of one rod and the back of the next, so that when plates are put together, the sheet will act as a separator.

719,432. TELEPHONIC APPARATUS; C. H. Burke, Brooklyn, N. Y. App. filed November 12, 1900. (See page 279.)

719,452. TROLLEY SYSTEM FOR ELECTRIC RAILWAYS; J. S. Fox, Jackson, Mich. App. filed June 28, 1902. A third rail having a movable cap adapted to be forced inward by the trolley wheel to make contact with a conductor located inside of the rail.

719,458. COMBINED TELEGRAPH AND TELEPHONE SYSTEM; C. H. Gaunt, St. Paul, Minn. App. filed February 15, 1902. (See page 279.)

719,463. ELECTRIC SYSTEM FOR ELEVATOR SAFETY APPLIANCES; G. Hail, Providence, R. I. App. filed April 8, 1902. An arrangement of circuits for signal lights in which the current is taken from ordinary lighting systems.

719,465. ELECTRIC CLOCK; V. Himmer and V. Himmer, Jr., Bayonne, N. J. App. filed March 15, 1902. Details of the circuit controlling mechanism.

719,471. WATER PURIFIER; Ernest Kaiser, New York, N. Y. App. filed May 8, 1902. Current passes from one set of spirally arranged plates to another set interleaved with the first.

719,484. APPARATUS FOR ELECTROTHERMALLY TREATING MATERIALS; Hudson Maxim, London, England. App. filed Aug. 17, 1898. (See page 278.)

719,504. AUTOMATIC FIRE ALARM APPARATUS; H. Plowman, London, Eng. App. filed July 3, 1901. Details.

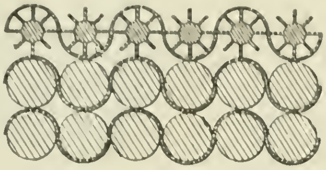
719,506. ELECTRIC LAMP; H. N. Potter, New Rochelle, N. Y. App. filed Nov. 21, 1901. A cage is arranged to shield the glower from draughts and to confine a portion of the heat of the glower and so lengthen its life.

719,507. ELECTRIC FURNACE; Henry Noel Potter, Pittsburg, Pa. App. filed Nov. 21, 1901. The furnace has a number of terminals each connected to a resistance, the object being to secure an even flow of current in the furnace.

719,508. CLAMP DEVICE FOR ELECTRIC WELDING MACHINES; A. F. Rietzel, Lynn, Mass. App. filed June 14, 1902. A clamping device arranged for quick manipulation.

719,540. LIQUID RESISTANCE SWITCH FOR ELECTRICAL PURPOSES; J. H. Wolliscroft, Sandycroft, England. App. filed Oct. 3, 1902. Details.

719,541. ELECTRIC TIME ALARM SYSTEM; Edwin T. Ackerman, Chicago, Ill. App. filed Oct. 4, 1901. Provides means whereby all or any one of a series of different alarms may be sounded automatically at certain periods.



719,418. Electric Accumulator Plate.

719,556. TELEGRAPH INSTRUMENT; E. Bing and H. Nevill, Pernambuco, Brazil. App. filed April 18, 1902. The cradle and syphon of a syphon recorder are balanced to be more sensitive in operation.

719,596. ELECTRIC BRAKE; F. E. Case, Schenectady, N. Y. App. filed July 31, 1899. A single handle actuates both the electric and the mechanical brakes, while means are provided for releasing the electric brake irrespective of the position of the handle.

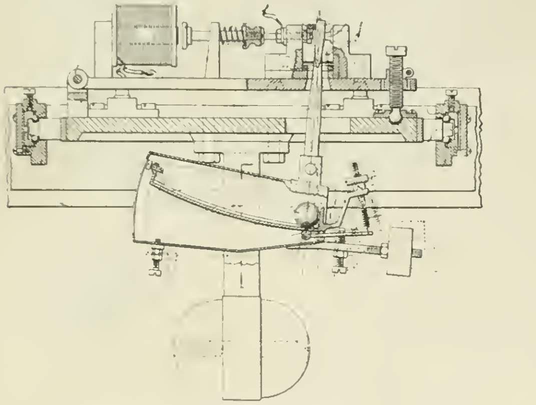
719,600. INSULATING HIGH POTENTIAL APPARATUS; W. S. Moody, Schenectady, N. Y. App. filed July 19, 1902. The brush discharge set up by the excessively high voltages extending outward from the terminals of the apparatus, is interrupted by disks of insulating material of sufficient diameter placed upon the terminals.

719,609. POWER FACTOR INDICATOR; W. H. Pratt, Lynn, Mass. App. filed June 7, 1902. Unconnected and independently movable members adapted to measure quantities each different from the other and means for combining the indications of the members to produce a single resulting indication.

719,659. GALVANIC BATTERY; H. Halsey, New York, N. Y. App. filed Sept. 21, 1901. A mechanical device for stirring the excitant liquid and for regulating the introduction of the depolarizing fluid.

719,660. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. Means for freeing the electrolyte of precipitates.

719,661. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. A plurality of concentrically arranged elements in combination with brushes and means for moving the same around the channel between the elements.



719,857. Automatic Firing Apparatus for Ship's Guns.

719,736. SERVICE-METER SYSTEM AND APPARATUS FOR TELEPHONE EXCHANGES; A. M. Bullard, Somerville, and L. A. Falk, of Boston, Mass. App. filed April 10, 1902. (See page 279.)

719,741. SEPARATOR; J. W. Burton, Maplehill, Kan. App. filed March 28, 1902. A grain separator in which permanent magnets are used to remove the metallic particles.

719,752. VOLTAIC CELL; M. E. Conrad, Atlantic, Iowa. App. filed Dec. 18, 1900. A negative electrode composed of a metallic oxysulphid.

719,753. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Dec. 7, 1900. Details.

719,763. CONSTRUCTION OF UNDERGROUND CONDUITS; T. E. Devonshire, Chislehurst, England. App. filed Nov. 8, 1902. The conduit is formed of slotted lengths having body parts consisting of concrete and metal, the latter embedded in the former.

719,778. STORAGE BATTERY TANK; B. Ford, Philadelphia, Pa. App. filed Dec. 11, 1902. The cells of the tank are separated by double walls with an air space between them to catch dust and leaking acid and thus prevent short circuit.

719,791. ELECTROLYTIC CELL; R. Grisson, Hamburg, Germany. App. filed Dec. 8, 1902. A cell in which a reformation of the deformed aluminum electrodes is constantly proceeding during operation, this result is attained by avoiding any vertical active surfaces in the electrode.

719,824. ELECTRIC BRUSH HOLDER; H. T. Maker, Milwaukee, Wis. App. filed Nov. 12, 1901. A sheet metal brush holder.

719,857. AUTOMATIC FIRING APPARATUS FOR SHIP'S GUNS; H. Von Pechy and V. Rea, Pola, Austria-Hungary. App. filed Aug. 11, 1902. A pendulum apparatus in which a firing circuit is closed when the gun assumes its calculated firing angle either by the rolling of the ship or by hand adjustment.

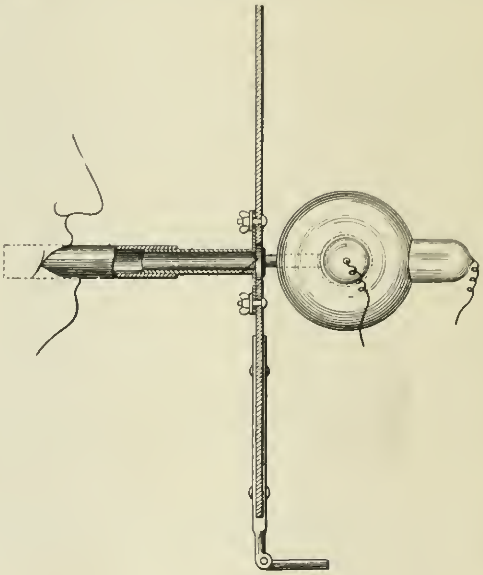
719,859. ELECTRICAL CONTACT FOR CARTRIDGE FUSES; C. D. Platt, Bridgeport, Conn. App. filed Dec. 3, 1902. Details.

719,870. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. Means for insuring a thorough and effective amalgamation of the metal deposited upon the cathode of the apparatus.

719,871. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. A modification of the preceding patent.

719,872. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. A modification of 719,870.

719,873. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed May 5, 1899. A modification of 719,870.



719,915.—X-Ray Apparatus for Treating Diseases.

719,882. METHOD OF SUB-DIVIDING BLOCKS OR INGOTS OF CARBIDE; Joseph Scales, Niagara Falls, N. Y. App. filed May 6, 1902. Holes are drilled while the block is yet hot, and water injected into the cavity through the drill to preserve the cutting edge of the drill and disintegrate the material.

719,901. PHOTOCHEMICAL AND ELECTROTHERAPEUTICAL APPARATUS; A. E. Sterne, Indianapolis, Ind. App. filed Oct. 23, 1901. Details.

719,915. X-RAY APPARATUS FOR TREATING DISEASES; H. E. Waite, New York, N. Y. App. filed March 8, 1902. An X-ray shield connected to the generator and having an opening for the passage of the rays and a tube extending from said opening, whereby the rays can be directed to a definite portion of the body and shielded from surrounding portions.

719,932. DANGER SIGNAL FOR RAILWAYS; C. P. Bass, Portland, Ore. App. filed Jan. 25, 1902. Details.

719,937. STORAGE BATTERY; B. Ford, Philadelphia, Pa. App. filed Dec. 19, 1902. A floating separator and means for holding it down.

719,953. MACHINE FOR OXIDIZING MATRICES FOR ELECTROTYPING; Charles M. Oliver, Baltimore, Md. App. filed Aug. 26, 1902. Instead of the iron-filings being brushed over the matrix surface, they are sifted on the same and washed back and forth by the copper solution, the whole being in a box with trunnions.

719,971. MAGNETO ELECTRIC GENERATOR MECHANISM; L. G. Woolley, Kenton, Ohio. App. filed May 26, 1902. A motor for moving the armature in one direction and automatically acting means for moving it in the reverse direction.

719,972. TELEPHONE-TRANSMITTER; J. A. Wotton, Atlanta, Ga. App. filed June 8, 1901. (See page 279.)

719,973. PROCESS OF MANUFACTURING ELECTRICAL CONDENSERS; J. A. Wotton, Atlanta, Ga. App. filed Jan. 23, 1902. Alternate sheets of paper and condenser plates are rolled and immersed in a bath of molten wax from which moisture has been driven off.

CABLE CONSTRUCTION FOR TELEPHONE LINES.

General Specifications.

The necessary provisions and instructions for building a cable plant are conveniently subdivided as follows:

A CONTRACT AND GENERAL SPECIFICATIONS FOR CABLE MANUFACTURE.
  1. Subscribers' Cables.
  2. Trunk Cables.
  3. Toll Line Cables.

B SPECIFICATIONS FOR SPLICES.
  1. Main Cable Splices.
  2. Branch Cable Splices.

C SPECIFICATIONS FOR TERMINALS.
  1. Cable Head Terminals.
  2. Flexible Terminals.

D SPECIFICATIONS FOR INSTALLATION.
  1. Underground Cables.
  2. Aerial Cables.

(A) CONTRACT AND GENERAL SPECIFICATIONS FOR THE MANUFACTURE OF TELEPHONE CABLES.

THIS AGREEMENT made and concluded this....................day of .... in the year Nineteen Hundred and................ by and between the..COMPANY, organized and existing under the laws of the State of........................ having its principal business office in the City of....................State of ....party of the first part and the ....COMPANY, organized and existing under the laws of the State of..................... having its principal office in the City of.............State of............. ......party of the second part, WITNESSETH:

SECTION 1.

1 Contract

That the party of the second part has agreed, and by these presents does agree, with the party of the first part, for and in consideration of the prices and agreements hereinafter stipulated, well and truly paid and performed by the party of the first part, and under penalty expressed in a bond bearing date of.................and hereunto attached, marked Section 38, to manufacture and deliver[1] and install at his own proper cost and expense each and all of the various sizes, kinds and pieces of telephone cable described in Schedule 1, Section 18, hereunto attached, entirely in accordance with these specifications.

SECTION 2.

2 Definitions

All words referring to the respective parties shall be taken of such number and gender as the character of the parties require.

(*a*) The word "Company" shall mean the .... *Telephone Company*, of.......................which has entered into this contract as party of the first part.

(*b*) The word *"Contractor"* shall mean the....................COMPANY, which has entered into this contract as party of the second part.

(*c*) The word "Inspector" shall mean the duly appointed representative of the Company, authorized to perform the various tests, inspections and examinations hereinafter specified.

(*d*) The word "Cable" shall mean an aggregate of copper wires each electrically insulated from all others and enclosed in a lead sheath or pipe hermetically sealed. Different sizes of cables shall be described by stating the number of pairs of wires which each size contains. The length of each piece shall be specified by stating the number of lineal feet it shall contain; hence each separate piece of cable is described by specifying its length in feet and the number of pairs.

(*e*) The word "Duct" shall mean a hole, or passageway, or pipe into which a cable may be placed, usually constructed beneath the surface of a street or alley, or in the walls or floor of a building, or along a pole of an aerial line.

(*f*) The word "Manhole" shall mean any chamber or space giving access to ducts.

SECTION 3.

3 Description

The work called for in this contract and specification is as follows:

(*a*) The supply of all necessary material, labor, tools and appliances to manufacture, pack, ship, transport and deliver F. O. B. cars or vessel, in the City of.............. each and every piece of cable enumerated in Schedule 1, Section 18, of this indenture. The various pieces of cable scheduled shall be made and delivered in the order specified in this schedule, in Column 6, headed *"Date of Delivery."*

[2](*b*) As fast as the cable reaches the City of................ the Contractor shall proceed to install each and every piece of cable in the places specified in Schedule 1, Section 18, in Column 9, headed "Location." The location of each piece of cable is specified by stating in Column 7 opposite each piece whether it is to be placed in underground conduit, or on an aerial line, and in Column 9 the name of the street, alley, or other location along which it is to extend, and the terminal points between which it is to be placed. Column 8 specifies the terminal to which each end shall be connected. After each piece is installed in its proper place it shall be spliced by the Contractor to any and all adjoining pieces, or connected to an appropriate cable head or heads or other terminal or terminals as specified in Column 8 of Schedule 1. If one or more cable heads are used at any point to terminate a piece of cable, the heads shall be supplied by ....but the Contractor shall, at his own proper cost and expense, supply all labor and materials to properly join the cable to the head or heads.

SECTION 4.

4 Power of the Inspector

(*a*) During the manufacture of each and every piece of cable herein called for the Inspector shall have the right to examine all materials used, and test the same as hereinafter specified, and to inspect the workmanship employed, and to test as hereinafter provided, each finished piece of cable. In case any material shall fail to meet any or all the requirements, or any workmanship shall be defective, or any finished piece of cable shall not fulfill any or all of the tests hereinafter provided, the Inspector shall reject the same. The Company may, at its option, make the final tests on the finished cable either at the works of the Contractor at.............. or after delivery of the cable in the City of....................

[3](*b*) After each piece of cable is installed in its place, as specified in Schedule 1, Section 18, and finally spliced or otherwise connected to the terminals specified, the Inspector shall examine and test the same as hereinafter specified.

SECTION 5.

5 Access to Work

The contractor shall at all times afford the Inspector all facilities to examine, inspect and test all materials, processes, machinery, finished cable and cable laid in place, and all opportunities to satisfy himself of the skill and competency of all men employed.

SECTION 6.

6 Orders to Contractor

Whenever the contractor is not present in person, when it may be necessary to give any instructions regarding the work herein called for, such directions as may be given by the Inspector shall be received and obeyed by the Foreman, or other persons in charge.

SECTION 7.

7 Legal authority

The necessary legal authority to work in and occupy the Streets of the City of........ ....shall be obtained by the Company and delivered to the contractor in the form of such written permits as may be necessary and customary in said City. If after the receipt of said permit the contractor shall allow the same to be lost or destroyed, the Company shall, on written notice from the contractor, take out a new permit and shall charge against the contractor all necessary expense thereof.

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[1] Cancel "and install" if cable is installed by Telephone Company.

[2] Cancel (*b*) if cables are installed by the Company.

[3] Cancel (*b*) if cable is installed by the Company.

SECTION 8

8
Obedience to Law and City Regulations

In all operations in any way connected with the work herein specified the contractor shall comply in all respects with all the laws of the land and all city rules and regulations affecting in any way the conduct of those engaged, or the methods of doing any or all parts of the work, or in the use of materials, tools, appliances or machines

SECTION 9

9
Responsibility of Contractor

During the progress of all parts of the work herein called for the contractor shall take all precautions, and shall assume all responsibility of whatsoever nature for the prevention of any and all injuries to any person whatsoever, whether employed by the contractor or not He shall and does hereby assume all responsibility and liability for any injury of whatsoever nature to any persons or property, and shall and does hereby assume all liens, suits or claims for damages, either to life, limb, property or person, arising from any act or omission, or from the amount or character of the work, or in the way in which it is done, and shall and hereby agrees to save harmless the Company, its officers and agents, for all claims relating to any damage or injury actual or consequential, present or future.

SECTION 10.

10
Competent men and suitable tools

The contractor shall only employ competent and orderly artisans, thoroughly familiar with the work to which they are assigned. If, in the opinion of the Company, any men are employed who are incompetent or disorderly, the Company shall notify the contractor thereof and he shall forthwith remove them from the work. The Contractor shall constantly supply and maintain any and all necessary and suitable tools, machinery, appliances and material that shall be sufficient to prosecute each and every part of the work at such a rate of speed as shall ensure in the completion thereof within the time specified in Section 13.

SECTION 11.

11
Company's right to assume work

If any portion of the work herein specified shall be abandoned, or if in the opinion of the Company any of the provisions of this contract shall not be fulfilled, or any part shall be unnecessarily delayed, the Company may notify the contractor to discontinue all or any part thereof, and the Company may by contract or otherwise complete the work, or any part thereof, and charge any and all expense of such completion to the contractor. The expense so charged shall be deducted and paid by the Company out of any moneys then due, or to become due the contractor. In case such expense is less than the sum which would have been payable under this contract if the same had been completed by the contractor, he shall be paid the difference, but in case such expense shall exceed the latter sum, the contractor shall, on demand, pay such excess to the Company.

SECTION 12.

12
Acception

[4]1. As fast as the cable is received in the City of........:......the Inspector shall inspect and examine it, and if the Company shall so elect, shall test the same as hereinafter provided. For all cable which entirely fulfills each and every provision of the specification the Inspector shall, as soon as inspected and accepted, issue a certificate of inspection to the contractor. On the issuance of this certificate the cable therein specified shall pass to and become the property of the Company and the responsibility of the contractor therefore shall end. All cable which does not fulfill each and every provision of the specification shall be rejected by the Inspector, and shall remain the property of the contractor. All cable which is rejected shall be replaced by that which shall fulfill all the provisions of the specification.

[5]2. After each piece of cable is installed, spliced and terminated, as specified in Schedule 1, Section 18, and entirely ready for operation, the Inspector shall test, inspect and examine the same, as hereinafter provided. For all cable which fulfills all the provisions of this specification and which is installed in a manner acceptable to the Inspector, properly spliced and terminated, the Inspector shall issue a certificate of acceptance to the contractor. On the issuance of this certificate the cable shall pass to and become the property of the Company and the contractor shall be no longer responsible therefor. Any cable which fails to fulfill any of the specification requirements, or which is improperly installed, spliced or terminated, shall be rejected by the Inspector and shall be at once removed by the contractor and replaced by cable which is in accordance with all the provisions of the specification and is properly and acceptably installed, spliced and terminated.

SECTION 13

13
Time of Completion

(*a*) The contractor hereby agrees to commence manufacture within . . . . .days from the date of this contract, to commence to deliver the cable called for F. O. B. cars or boat in the City of . . . . on or before the . . . . day of . . . . and to continue to deliver the cable in said City F. O. B. cars or boat at the rate of . . . . feet each and every week thereafter until the entire amount called for in Schedule 1, Section 18, shall be so delivered.

[6](*b*) The contractor agrees to commence the installation of cable on the . . . . day of. . . . . and to complete the installation of all the cable herein called for within . . . . days thereafter, Sundays and legal holidays excepted

SECTION 14

14
Damages for delay in completion

In case the contractor shall fail to complete the entire amount of the work herein specified within the time called for in Section 13, the Company shall have the right to deduct and retain out of the moneys which may be due or may become due the Contractor under this contract, the sum of . . . . .dollars as liquidated damages for each and every day that the entire work herein specified shall remain uncompleted over and above the time specified in Section 13, Sundays and legal holidays excepted.

SECTION 15.

15
Liens on the work

Upon the completion of the work and before final payments are made to the contractor he shall file with the Company suitable evidence that all causes of action for damages, and all liens have been by him entirely liquidated, released and satisfied and he shall furnish to the Company a clear title to each and all parts of the work.

SECTION 16.

16
Extra work

The Contractor shall do no work nor supply any materials of any nature not herein provided for, unless authorized by a separate and supplemental contract in writing with the Company, nor shall the contractor make any claim of any nature whatsoever for the payment of any moneys except as provided for in Section 18.

SECTION 17.

17
Conditions of Payment

Between the 1st and 5th days of each calendar month the Inspector shall render to the Company a *Certificate of Estimate*, stating the number of lineal feet each kind of cable specified in Schedule 1, Section 18, that have been tested, inspected and found in all respects to have fulfilled all provisions of this contract and specifications, and shall give the contractor a copy of the same. This certificate shall also state the amount of the contract price of the cable thus tested and inspected, calculated by the prices set opposite each kind of cable in Schedule 1, Section 18. Within ten days after the rendering of the certificate of estimate the Company shall pay to the Contractor...............per cent. of the amount called for in the certificate of the Inspector and shall reserve and retain.................per cent. thereof until the completion of the entire work.

2nd. On the entire completion of all the cable called for in Schedule 1, Section 18,[7] and the complete installation of the same, and on final inspection and acceptation of the same by the Inspector as herein provided, and upon full performance in all other respects of this contract the Inspector shall so certify to the Company. Within thirty days thereafter the Company shall make to the contractor a final payment, which shall include all balances which have been reserved from the preceding monthly payments.

SECTION 18.

18
Prices for work

The Company shall pay as full compensation for each and every lineal foot of each size of cable delivered and accepted by the Inspector, and for everything done and furnished under this contract, including all damage arising out of the nature of the work, or from the action of the elements, and all risks of every description connected therewith, and for all expenses entailed in consequence of the suspension or discontinuance thereof the amounts per lineal foot for each size of cable that are set in Column 10, headed "*Price per Lineal Foot*" of Schedule attached to this Section marked *Schedule 1, Prices to be paid per Linear Foot of Cable.* The lengths specified in Schedule 1, Column 4, shall be the distances measured along the conduit or pole lines of the Company, and shall not include any allowance for splicing or terminating cable, but shall include necessary amount for slack. The Contractor shall make on each end of each piece of cable the necessary allowance for the splice or terminal, as specified in Column 8, and shall make no change for any cable used for this purpose.

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[4] Cancel (1) if installation is done by Contractor.

[5] Cancel (2) if installation is done by Company.

[6] Cancel (*b*) if installation is done by the Company.

[7] Cancel "and the complete installation of the same," if installation is done by the Company.

SCHEDULE I.

1	2	3	4	5	6	7	8	9			10		
								Location where Cable is to be Installed			Prices per Linear Foot.		
Size of Cable in Number of Pairs for each Piece.	Gauge of Conductors, B. & S.	Electrostatic Capacity in Mf. Per mile.	Length in feet of each Piece.	Designation of each Piece.	Date to be Delivered.	Use Aerial or Underground.	Kind of Terminal at each end.	On	From	To	Delivered F. O. B. cars or boat in City of	For Installing and Terminating.	Total ready for Operation.

19 General Cable Specifications

SECTION 19.

(*a*) The cable called for under these specifications is that known as "Patterson Dry Core" or "Paper Cable." Each piece shall consist of a certain number of copper wires, each one insulated from all others by a loose wrapping of paper. The wires shall be twisted together in pairs and then a sufficient number of pairs to aggregate the total number required in each size of cable, shall be twisted together or "cabled" into a rope or "core." This core shall then be enclosed in a lead pipe. Cable shall be designed for either the following purpose:

(1) Subscriber's cable; namely, that to connect subscribers with central office.

(2) Trunk cable; that used to connect central offices together.

(3) Toll Line Cable; that used in the construction of "Toll" or so-called "Long Distance Lines."

This contract calls for the manufacture and delivery [8]and erection of

Subscriber's Cable.
[9]Trunk Cable.
[10]Toll Line Cable.

20 Marking and Packing

SECTION 20.

Each piece of cable shall be marked on each end by means of a metal tag upon which the designating number, according to Schedule 1, Section 18, Column 5, shall be stamped. The tags may be affixed to the ends of the cable in any manner to be readily legible, and secure from accidental removal during transportation and installation. Excepting in the case of short lengths, only one piece of cable shall be placed on a reel. At least eighteen (18″) inches of each end of every piece of cable shall be so disposed on the reel as to be readily accessible for testing without uncoiling or removing any cable.

21 Shipping

SECTION 21.

As fast as cable is completed at the factory of the contractor, the Inspector shall test the same, provided the Company elect so to do, under Section 4. All cable accepted shall immediately after acceptance be carefully coiled on proper reels, so boxed as to prevent injury during transportation and promptly shipped.

If the Company shall elect to make acceptance tests in the City of .... as provided for in Section 4, the cable shall be reeled, boxed and shipped as above specified, as fast as it is manufactured.

22 Conductor material

SECTION 22.

All conductors for all cable shall be of first-class *soft-drawn* copper wire. The wire shall be true and round, and full to the gauges specified. All wire shall be free from all slivers, nicks or other imperfections. Each size of wire shall be capable of standing not less than sixty twists in a length of two inches. This test shall be applied by a standard wire torsion testing machine. All wire shall have a resistance of at least 98 per cent. of pure soft copper, Matthiessen's standard, and shall be drawn in as long lengths as possible. Necessary splicing shall not be done by twisting or soldering, but by electrical welding. The various sizes of wire shall have diameters, resistances and weights per mile, not less than those specified in Table I.

TABLE I.

DIAMETERS, WEIGHTS AND RESISTANCES OF CABLE CONDUCTORS PER MILE.

Gauge No. B. & S.	Diameter in mils.	Resistance in ohms.	Weight in pounds.
10	101.890	5.2773	165.98
14	64.084	13.3405	65.658
17	45.257	26.7885	32.786
18	40.303	33.7285	25.970
19	35.890	42.5329	20.594
20	31.961	53.6362	16.331
22	25.347	85.2743	10.272

23 Insulation

SECTION 23.

Each conductor shall be insulated from all other conductors by a continuous wrap of paper. The Contractor may use either one or more wraps of paper at pleasure, provided that the subsequent provisions for electro-static capacity and insulation shall be rigidly maintained. The paper used shall be a first-class quality; it shall be completely free from all substances which might exercise any injurious action upon either the conductors or the sheath. The paper shall be about four mills in thickness and of sufficient strength so that a piece of 1″ wide shall support a weight of not less than 2 lbs. per mill of thickness.

Each individual conductor shall be wrapped with the paper in such a manner as to completely isolate electrically each wire from every other one and the sheath. Pains shall be taken to make this wrapping as loose as possible, in order that electrostatic capacity may be reduced to a minimum. Prior to wrapping, all paper used shall be kiln dried at a temperature of about 225° F., and completely freed from moisture. The method of cable making shall be such that the paper is placed on the conductors and the conductors promptly twisted, cabled and enclosed in the sheath (and, if necessary, subsequently dried) the entire process being so conducted as to ensure the paper being perfectly dry when the cable is completed.

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[8] Cancel "and erection," if erection is done by the Telephone Company.

[9] Cancel "Trunk Cable" and "Toll Line Cable" if Subscriber's Cable only is desired.

[10] Cancel "Toll Line Cable" if only Subscriber's and Trunk Cable is desired.

SECTION 24.

24
Test wires

In each piece of cable called for, one extra pair of wires over and above the number specified in Schedule 1, Section 18, shall be introduced for purposes of testing.

SECTION 25.

25
Coloring of Insulation

One pair of wires in each piece cable shall have one conductor covered with paper colored blue, and the other insulated with paper colored white or grey. All of the remaining pairs shall have the insulation of one wire colored red and the other colored white or gray. The blue paper is to designate the test pair of wires.

SECTION 26.

26
Twisting and Cabling

Each pair of conductors shall be twisted together in such a manner that the length of the twist shall not exceed 3" for wire of No. 19 gauge, or over 6" for wire of No. 17 to No. 19 gauge, and 14" for wire of No. 10 to No. 14 gauge. All pairs shall then be formed into a cylindrical core, arranged in alternately reversed layers and spiraled about one central pair with a twist, not to exceed one turn in 24 inches.

SECTION 27.

27
Sheath

The core of each cable shall be enclosed in a pipe made of (1) pure lead, and after the core is enclosed the cable shall be passed through a bath of melted tin, so applied as to give the exterior a continuous and uniform coating of tin. (2) Lead tin alloy containing about 3 per cent of tin, in no case less than 2.85 per cent. (Cancel either (1) or (2) as may be agreed at execution of contract.) On completion the sheath shall be absolutely tight and free from all cracks, blow holes, pin holes or other defects of every nature. In case the Inspector shall suspect imperfections in the sheath the Contractor on demand shall seal one end of the cable and apply an air pressure of not over 75 pounds per square inch of dried air to the other end, and while this pressure is applied the cable shall be drawn through a tank of water, not less than 18 feet long, in order to detect any defects in the sheath. If any defects in the sheath exist they will be made manifest by escaping air, and shall be remedied; or if, in the opinion of the Inspector, this is impractical, the cable shall be rejected. When presented to the Company for acceptance the sheath shall be sound in all respects, uniform in thickness and composition; shall be round and true and free from all kinks, flat places or other defects. The thickness of the sheath shall not be less nor the external character of the completed cable more than the dimensions specified in Table 2.

TABLE 2.

MINIMUM THICKNESS OF CABLE SHEATH AND MAXIMUM OUTSIDE DIAMETER OF CABLE.

No. of pairs.	Thickness of sheath: Aerial, inches.	Thickness of sheath: Underground, inches.	Diameter, inches, Maximum.
5	3/64	1/16	5/8
10	3/64	1/16	13/16
25	5/64	3/32	1 5/16
50	3/32	7/64	1 3/4
100	7/64	1/8	2
120		1/8	2 1/8
150		1/8	2 1/4
200		1/8	2 3/8
250		9/64	2 1/2
300		5/32	2 5/8
400		5/32	2 3/4

SECTION 28.

28
Sealing

As soon as manufacture is complete the end of each piece of cable shall be sealed for a distance of not less than 2 feet by boiling in melted paraffine and the sheath hermetically soldered over the end.

[11]SECTION 29.

29
Receipt of Cable

(1) On receipt by the Company of customary freight invoice, showing the arrival of each piece and every piece of cable, in the City of......................the Company shall receive, suitably care for, and store the same.

SECTION 30.

30
Tests

By Section 4 the Company may at its option test the completed cable either at the works of the Contractor or on its arrival in the City of......................[12] or after it is installed ready for use. The tests shall consist in measuring the conductor resistance, insulation resistance and electrostatic capacity of every wire in each piece of cable, and in testing each pair of wires against every other pair for cross-talk. The method to be used for measuring conductor resistance shall be that known as the Wheatstone Bridge method. The method of measuring insulation resistance shall be either that known as *Direct Deflection*, employing a galvanometer, having a sensitiveness of not less than 750 megohms, or the method of Loss of Charge.

For the measurement of capacity each wire shall be compared by direct deflection (using a galvanometer, as above specified) with a standard condenser, adjusted to approximately the same capacity as the piece of cable under test. All apparatus used in cable inspection shall be that of well known standard makers. In case any question as to the result of any test shall arise the accuracy of the apparatus shall be verified by sending it to any of the well known electrical laboratories for comparison.

For the measurements of conductor resistance a battery giving not less than 10 nor more than 100 volts shall be employed. To measuring insulation resistance and capacity a battery giving not less than 200 nor more than 500 volts shall be employed.

Tests for cross-talk shall be made by providing a sound-proof enclosure, such as a regular telephone booth, of such nature that an observer located therein cannot hear any sound from conversation carried on in a very loud tone of voice, or shouted, on the exterior. The booth shall be provided with two standard double-pole receivers similar to those supplied by the Company to its regular subscribers, and from each of these receivers a twisted pair of rubber covered wires shall be carried outside of the booth, each wire being terminated in a binding post, set on a rubber plate, secured to the outside of the booth. A standard transmitter, with proper battery and all other appliances, and receiver, similar in all respects and wired on the same circuit as regularly supplied by the Company to its subscribers, shall be provided, so arranged that one end of any cable pair may be readily connected to the transmitter and the other to the receiver. One end of any cable pair shall be connected to this transmitter and the other to the receiver. A second pair shall be taken and one of its ends connected to one of the receivers, located inside the above specified booth, and the other one to the other receiver. The Inspector entering the booth shall listen with both ears, one to each receiver, while an assistant shall talk into the above specified transmitter in a tone of voice about 50 per cent. louder, as nearly as can be estimated, than that used in ordinary telephone connections. If the Inspector can hear no sound under these circumstances he shall accept the cable for cross talk test. If he can hear any sound, but fail to distinguish articulate sounds, he may accept or reject the cable at his discretion. If he can understand conversation he shall reject the cable unqualifiedly and without appeal. The Inspector shall in this manner test each pair against each other pair, or as many pairs against as many other pairs as he may deem fit. All testing apparatus shall be supplied by the Company, but the Contractor shall supply all labor that may be needed by the Inspector in making tests.

SECTION 31.

31
Requirements

1. *CONDUCTORS.*

Each conductor shall be continuous from end to end of each piece and shall meet all the requirements of Section 22 and Table 1 therein contained.

2. *INSULATION.*

Every wire shall have an insulation resistance, after an electrification of one minute, of not less than 5,000 megohms per mile, before it is installed and connected to terminals. After any cable is installed and connected to terminals every wire therein shall have an insulation resistance of not less than 1,000 megohms per mile.

3. *ELECTROSTATIC CAPACITY.*

The electrostatic capacity of the various kinds of cable herein called are specified in Tables 3, 4 and 5, Section 32.

It is further specified that no one wire shall vary more than 12 per cent. from the capacities specified and that the average of all wires in each piece of cable shall not vary more than 7 per cent. from the amounts specified in this table.

SECTION 32.

32
Kinds of Cable

The properties of the various kind of cable herein called for are specified in Tables 3, 4 and 5.

TABLE 3.

NUMBER OF PAIRS, CONDUCTOR, GAUGE AND ELECTROSTATIC CAPACITY PER MILE OF SUBSCRIBER'S CABLE.

No. of pairs.	Conductor Gauge, B. & S.	Capacity, mf.	Conductor Gauge, B. & S.	Capacity, mf.	Conductor Gauge, B. & S.	Capacity, mf.
10	19	.080	20	.085	..	...
25	19	.080	20	.085	..	...
30	19	.080	20	.085	..	...
50	19	.080	20	.085	..	...
100	19	.080	20	.085	..	...
150	19	.080	20	.085	..	...
200	19	.110	20	.110	..	...
250	19	.110	20	.110	22	.120
300	..	...	20	.115	22	.120
350	..	...	20	.115	22	.120
400	..	...	20	.118	22	.120

TABLE 4.

NUMBER OF PAIRS, CONDUCTOR GAUGE AND ELECTROSTATIC CAPACITY PER MILE OF TRUNK CABLE.

No. of pairs.	Conductor Gauge, B. & S.	Capacity, mf.	
50	17	.065	.060
75	17	.065	.060
100	18	.075	.075

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[11] Cancel Section 29 if Cable is installed by Contractor.

[12] Cancel "or after it is installed ready for use," if installation is done by Company.

TABLE 5.

NUMBER OF PAIRS, CONDUCTOR GAUGES AND ELECTROSTATIC CAPACITIES PER MILE OF TOLL LINE CABLE.

Size and Number of pairs.	Conductor Gauge, Brown & Sharpe.	Capacity.
10	10	.040
20	14	.050

SECTION 33.

33 Defective Cable

If any piece of cable shall show cross-talk as specified in Section 30 it shall be unqualifiedly rejected. In case any piece of cable shall in any other respect fail to fulfill any of the tests herein prescribed (except that for cross-talk) the Inspector shall notify the contractor of such failure. In case the contractor desires he may endeavor to repair the cable and may present the same for a second test, and if the cable shall fulfill all provisions of this specification upon second test, the Inspector shall accept same. If, on second inspection, any wire in the cable fails to meet any of the specification requirements, the Inspector shall either finally and unqualifiedly reject the cable or specifically report it, at his discretion, as hereinafter provided, and the contractor shall not present this piece of cable for a third examination and he shall at once remove the same at his own expense from the care of the Company and replace it with cable which does fulfill all of the specification requirements.

[13](2) After each piece of cable is laid in its place, spliced and connected to the terminals as specified in *Schedule* 1, *Section* 18, the Inspector shall measure and test it as hereinbefore provided. If the cable shall fulfill all the provisions of this specification the Inspector shall accept the same. If it shall show cross-talk, as specified in Section 30, it shall be unqualifiedly rejected. If any wire fails to fulfill any other of the provisions the Inspector shall reject the same. If, after inspection, the contractor so desires, he may endeavor to repair the cable and may present the same for a second inspection. If, on second inspection, the cable shall fulfill each and all provisions on this specification the Inspector shall accept it; but if, on second inspection, any wire fails in any particular, the Inspector shall finally reject the cable, or specifically report it at his discretion, as hereinafter provided, and the contractor shall remove the same and replace it with cable which does conform with all provisions of this specification.

(3) In case the Inspector shall find any cable in which a few of the conductors (not to exceed 10 per cent. of the entire number) shall slightly fail in some single respect to meet all the test requirements of this specification he may at his discretion make a special report to the Company reciting all the facts relating to the defective cable. If the Company, on receipt of this special report, shall so elect it may accept such piece or pieces of cable. If the Company shall so elect to accept any such defective cable it shall be at liberty to deduct from the contract price specified in Schedule 1, Section 18, such a percentage of the amount that would, if the cable were perfect, be paid therefor, as the sum of the defective wires is of the total wires in the cable.

SECTION 34.

34 Mechanical Properties

Each cable shall be so manufactured that it can, without injury to the conductors or the sheath, be coiled and uncoiled at least ten times round a drum, or sheave, having a diameter of not more than twenty times the diameter of the cable, and shall have sufficient mechanical strength so that, if handled with reasonable care by those skilled in the art, it shall be able to retain its cylindrical form during handling and other processes required for erection in place.

SECTION 35.

35 Installation

In case the installation of the cable shall be done by the contractor, he shall proceed to do all the work of erecting the various pieces of cable called for in Schedule 1, Section 18, at the places specified in column 9, headed "Location," of Schedule 1, and in the manner and by the methods of specifications B, C and D, which are attached to this indenture and are hereby made a part thereof.

SECTION 36.

36 Guarantees

The contractor shall guarantee that the insulation resistance of each piece of cable shall not decrease below 500 megohms per mile, nor shall the electrostatic capacity increase over the amounts specified in Tables 3, 4 or 5, Section 33, for a period of two years from the date of this contract, unless due to manifest mechanical injury to the sheath of the cable. As surety for the faithful performance of this guarantee the bond designated as Section 37 shall remain in force for the above specified two years.

SECTION 37.

37 Execution

IN WITNESS WHEREOF the parties to these presents have caused the same to be signed by their respective executive officer and their respective corporate seals to be hereto affixed the day and year above written.

(Signature first party)

....

....

(Signature second party)

....

....

(Witnesses)

....

....

SECTION 38.

38 Bond

BOND.

KNOW ALL MEN BY THESE PRESENTS THAT WE........................ as principal, and........................ we as surety........................are held and firmly bound unto the.............. COMPANY, of....................in the sum of....................dollars, to be paid to the said........................COMPANY, its successors and assigns, for which payment well and truly to be made we bind ourselves, our heirs, executors, administrators and successors jointly and severally by these presents.

Sealed with our seal and dated at this..............................day of ...., 19...

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT

Whereas the said above bounden........................has entered into a certain agreement of date herewith in which the............................ is party of the first part, and the said..............................is the party of the second part, for the full terms used and particulars hereof express reference is hereby made to such agreement, and by this reference it is made a part hereof, to which this bond is annexed.

NOW THEREFORE, if the said........................shall in all things fully and faithfully keep and perform said agreement and each and every term and part thereof, then this obligation shall be void, otherwise it shall remain in full force.

WITNESS OUR NAMES AND SEALS.

..............................Seal.
..............................Seal.
..............................Seal.

(Witnesses)

....

....

....

(B) SPECIFICATIONS FOR CABLE SPLICES.

1. MAIN CABLE SPLICES.

SECTION 39.

39 General Method.

Splices in paper cable shall be made by stripping the sheath from one end of each piece to be joined for a distance of from 12" to 20", depending on the size of the cable, removing the paper insulation from each wire of each piece for about an inch, twisting each red-colored wire of *one* cable to a corresponding red wire in the *other*, twisting each white wire in one piece in a similar manner, to a white one in the other piece, protecting each wire joint with a paper sleeve, replacing the removed sheath with a lead sleeve wiped to the sheath of each cable, boiling out the completed joint in paraffine, and soldering the holes left in the sleeve to allow of boiling. The general method of making a splice is shown in Fig. 1.

SECTION 40.

40 Material Required

PAPER SLEEVES

of rolled paper, 3" long, ⅛" diameter, boiled in paraffine, one for each wire to be spliced.

PARAFFINE.

Best quality, of Standard Oil Company manufacture, free from moisture, acid, or any substance injurious to the cable; a sufficient quantity to fill a pot or pan in which the splice can be completely immersed.

SOLDER.

Fifty per cent. tin, fifty per cent. lead; enough to fill a solder pot.

WICKING.

COTTON; one large ball.

LEAD SLEEVES.

Pure lead. One sleeve for each splice, sizes to be as per Table No. 6.

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[13] Cancel (2) if cable is installed by the Company.

TABLE 6

SIZES OF LEAD SLEEVES FOR MAIN CABLE SPLICES.

	Length Inches		Diameter inches		Thickness Inches.
400 Pair Cable	40	×	4	×	$^3/_{16}$
350 " "	38	×	4	×	$^3/_{16}$
300 " "	36	×	3¾	×	$^3/_{16}$
250 " "	34	×	3⅝	×	$^3/_{16}$
200 " "	32	×	3¼	×	⅛
150 " "	30	×	3	×	⅛
120 " "	28	×	2¾	×	⅛
100 " "	28	×	2½	×	⅛
50 " "	28	×	2	×	$^3/_{32}$
30 " "	26	×	1½	×	$^3/_{32}$
25 " "	25	×	1½	×	$^3/_{32}$
15 " "	24	×	1	×	$^3/_{32}$
10 " "	20	×	1	×	$^3/_{32}$

While this table gives general dimensions for lead sleeves, they shall always be about ¾ inch larger than the sheathes of the cables to be spliced, from $^3/_{32}$ to $^3/_{16}$ inch in thickness, and long enough to allow the splicing of all conductors without producing bunching sufficient to prevent the splice from entering the sleeve, and with sufficient lap to cover each cable sheath at least 1½ inches.

SECTION 41.

41
Operation

Remove from 12 to 20 inches of each cable sheath, as shown in Fig. 1, bind the core at the end of each sheath tightly with wicking, packing the binding close to the end of each sheath, as shown, to prevent paraffine from following the core. Boil out each end by an immersing it in melted paraffine, heated to from 225 to 250° F., till all bubbling ceases. Each end shall be immersed so that the cotton binding is thoroughly saturated with paraffine. Slip the lead sleeve over one cable, slip a paper sleeve over each wire in one cable, splice each wire of every pair in one cable to the correspondingly colored wire in a pair in the other cable, by stripping the paper from each wire for a distance of about one inch and twisting the ends tightly together, as shown at *B* and *C*, Fig. 1. After twisting bend the twist parallel with the wire, slip the paper sleeve over the twist as insulation as at *D*. Care shall be exercised not to nick or injure any wire in removing the paper. Each twist shall include about ½-inch of paper-covered wire. No solder shall be used. The twisted wire joints shall be so distributed that the splice shall be essentially uniform in diameter throughout its length. When all the wire joints are completed the splice shall be immersed in boiling paraffine for fifteen minutes, or until all bubbling ceases. The lead sleeve shall then be slipped over the splice, so that it may lap the lead of each cable sheath for 1½ to 2 inches. The ends of the sleeve shall then be dressed into close contact with the cable sheath and each end wiped to its respective cable sheath. After the wiping is done the sleeve shall be finally boiled by immersing it in boiling paraffine. A small hole shall be drilled at each end of the sleeve to admit the paraffine and give exit to contained air. These holes shall be drilled along the axis of the cable. When cold the surplus paraffine shall be cleaned off, all wiped joints dressed and the holes soldered up smooth and clean and the job left in a neat and in a workmanlike manner. After each splice is completed the cable shall be tested for conductivity and insulation, as specified in A 1, Section 30.

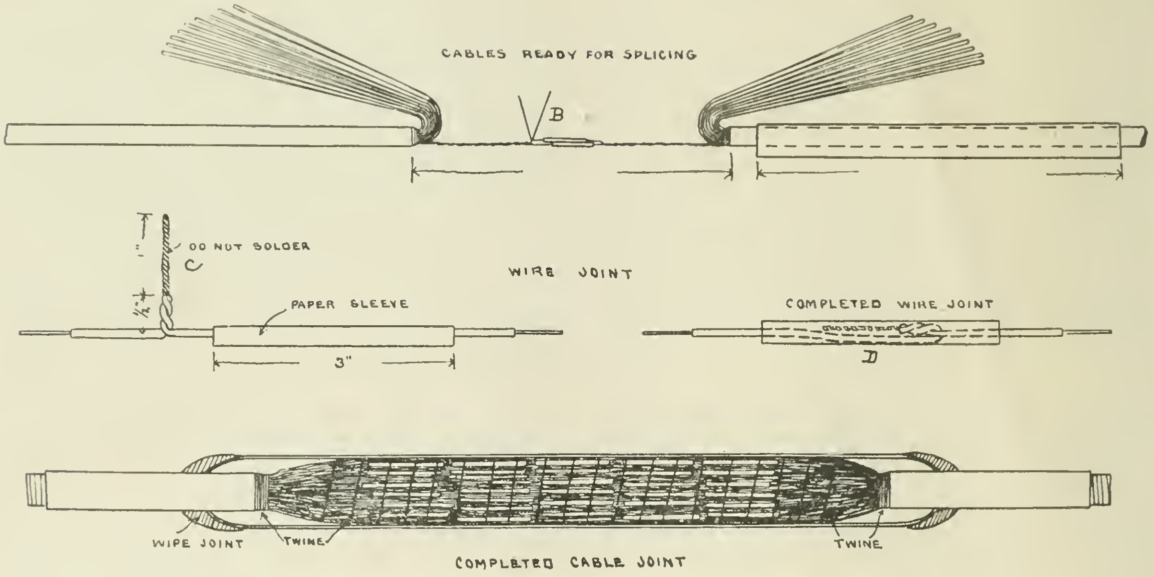

FIG. 1.

(B) SPECIFICATION FOR CABLE SPLICES

2. BRANCH CABLE SPLICES

SECTION 42.

42
General Description

The method of making splices in paper cables whereby a cable is legged to another cable, or where one cable is branched into two or more other cables is essentially similar to that described in B 1, specification for Main Cable Splices, and is illustrated in Fig. 2.

SECTION 43.

43
Materials

The materials to be used shall be the same as specified in B 1, Section 40, for the same size of cable. Where necessary, split sleeves may be used, as shown at *B*, Fig. 2. If a split sleeve is used the splice must be taped with okonite, and split in the sleeve soldered up air tight.

SECTION 44.

44
Operation Legged Cable

The method of making legged cable splices shall be exactly the same as that specified for main cable splices in B 1, excepting that each wire of the main cable shall be continuous through the splice into the main cable on both sides of the splice, and each wire of the legged cable shall be spliced on to such a wire of the main cable as is designated for this purpose. All the wires in both the main cable and the branch cable shall be numbered and the wires in the branch cable shall be spliced to such corresponding numbers in the main cable as shall be designated at the time the splice is made. On the completion of the splice all the wires of both the main cable and the branch cable shall be tested completely from one terminal to the other, both for conductivity and for insulation, as specified in A 1, Section 30, and shall fulfill all the tests therein called for.

SECTION 45.

45
Operation Branched Cable

The method of making branched cable splices shall be exactly the same as that specified for legged cable splices in Section 44, excepting that a certain number of wires in the one cable shall be designated to a corresponding number of wires in each branch and shall be spliced to the branch cable wires and shall not be continued in any other cable.

(C) SPECIFICATIONS FOR TERMINALS.

1. CABLE HEAD TERMINALS.

SECTION 46.

46
Supply of Cable Heads

The cable heads shall be supplied by..... ....and shall be delivered free of expense to ....at ....office. Cable heads shall be of the type known in the trade as the......................cable head. Pole cable heads of the type known as..............................

47
Specification
for Heads

SECTION 47.

(A) *PLAIN HEADS.*

1. Each cable head shall be supplied with a brass sleeve of proper size to fit the sheaths of the cable it is intended to terminate. This sleeve shall be strong and substantial and so fitted to the head as to make a solid and air-tight joint.

2. Each head shall be supplied with as many insulated pins extending from the inside of the head to the outside of the head thereof as there are wires in the cable to which the head is to be attached. These pins shall be so constructed as to maintain an insulation of not less than 1,000 megohm pin to pin and pin to ground. They shall be strong and substantial, and so set as to make the interior of the head air-tight. Each pin shall be supplied at each end with a nut, or screw-head, or slot for soldering, or other means for attaching the cable wire approved by the Company.

3. The space occupied by the cable wire shall be capable of being hermetically sealed in such a manner as to prevent any moisture from reaching the cable, and yet so built that access can be had to the cable with the least amount of work.

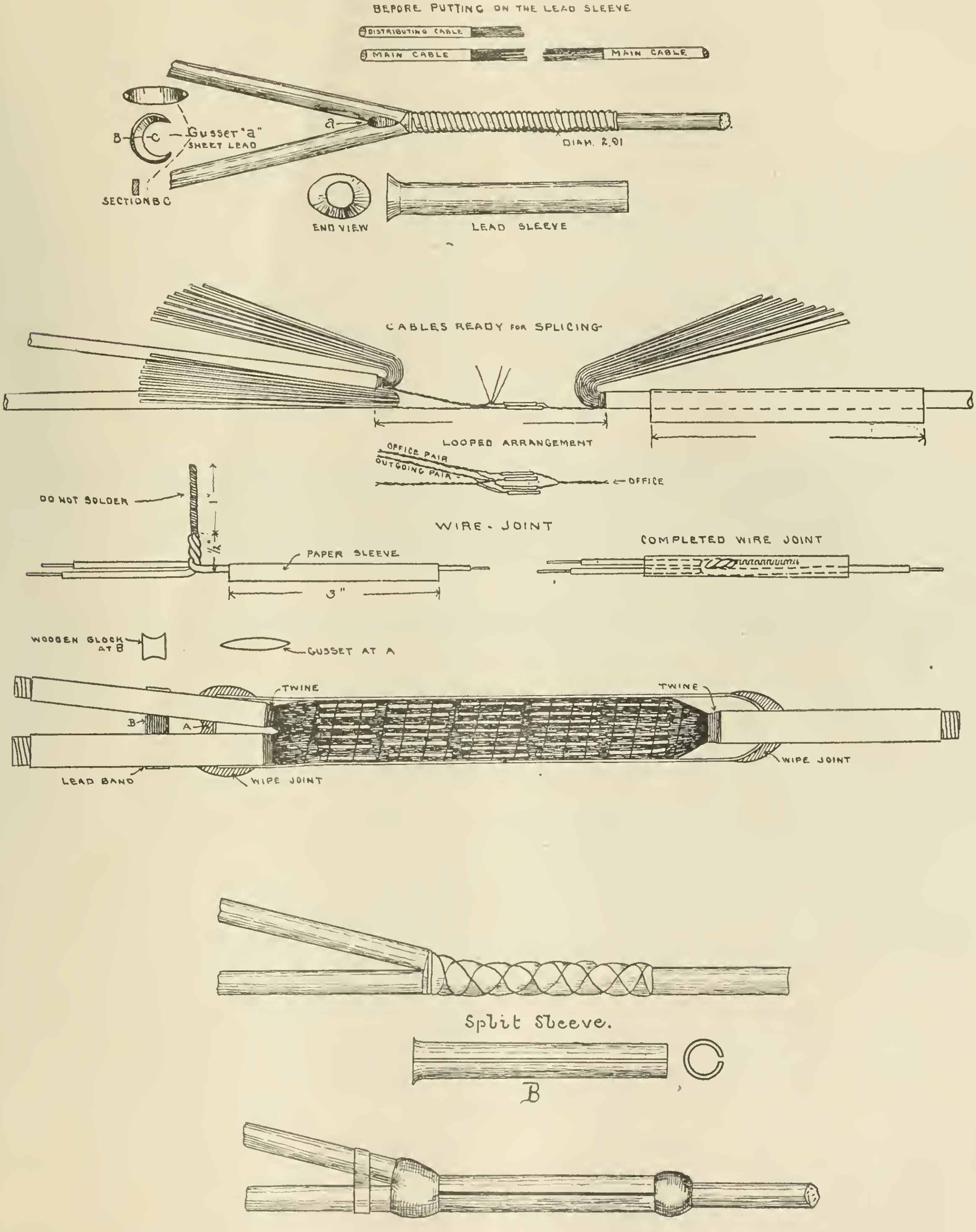

FIG. 2.

(B) *PROTECTED HEADS*

Protected heads shall fulfill all the specifications of A of this section and in addition shall be supplied with devices approved by the Company to protect the cable conductors from lightning or from strong currents, or both, as the Company may direct.

1. *LIGHTNING GUARDS.*

Lightning guards shall consist of a spark gap composed of a pair of carbon plates separated by an insulating septum of material approved by the Company not over one hundredth of an inch (.01) thick. One plate shall be connected to the line, the other to the ground. The plates shall be held in place by a metal spring or socket, so designated as to permit them to be easily replaced, yet capable of retaining them constantly in good working condition. When any arrester operates it shall permanently ground the line. The lightning arrester shall be placed between the fuse and the cable. There shall be one arrester for each wire.

2. *STRONG CURRENT ARRESTERS.*

Strong current arresters shall consist of a fuse or a "heat coil," as the Company may elect.

(*a*) Fuses for cable heads to be used on line poles shall be of the "enclosed type," consisting of a lead or lead alloy wire enclosed in an insulated tube. The fuse shall blow at not over seven amperes nor less than five amperes. The fuse gap shall be not less than 2½ inches long. Fuses shall be waterproof and so made that fuse wire is protected from accidental injury and connected to the cable head substantially and easily replacable when blown.

(*c*) Fuses for office heads may be of the type known as "Maxstadt," composed of a fuse wire supported on an insulating base. They shall have a carrying capacity of not over 1.25 amperes or less than .6 ampere. They shall be so mounted on the head as to be protected from accidental injury, yet easily replaceable.

(*d*) Heat coils shall be so designated as to open the switchboard side of the line and ground the cable side when they operate. Heat coils shall have a carrying capacity of not less than .5 ampere or more than .75 ampere. Shall be so arranged as to sound an alarm when they operate, wholly and substantially made and easily replaceable.

SECTION 48.

48 Method of Terminating

The lead sheath shall be stripped off of the cable for a sufficient distance to allow the end of the sheath to be soldered to the metallic terminal of the cable head and leave such a length of the conductors freed from the sheath as may be sufficient to make the proper wire form to reach each and all of the terminal pins on the interior of the cable head. After the sheath is stripped the core adjacent to the end of the sheathing shall be lashed with twine or wicking, as specified under B 1, Section 41. The end of the cable shall then be immersed in melted paraffine and boiled until all bubbling ceases and in such a manner that the paraffine shall penetrate at least 18 inches inside of the cable sheath and hermetically seal it. After the boiling is complete and the cable is cool the end shall be passed into the head. The core of the cable shall then be fanned out and the wires so formed and lashed with waxed twine as to make a proper form to fit the terminal arrangement of the cable head. This form may be made by any method which shall be capable of yielding a neat and workmanlike form, substantially lashed and accurately spaced to match the terminal pins in the head. On the completion of this from the paper insulation shall be stripped off for about one inch on the ends of each wire. The sheath shall then be soldered to the cablehead terminal with a wiped joint of solder, half lead and half tin, in such a manner as to make a solid, substantial and absolutely air-tight joint. When this joint is complete the form shall be bent into its proper place inside the cable head and each wire shall be carefully and thoroughly soldered to each terminal pin of the cable head or otherwise fastened thereto. In making soldered connections no acid or other corrosive soldering flux shall be used. Rosin only shall be employed to make solder flow. After each wire is properly fastened to its appropriate pin the whole form inside the cable head shall be thoroughly shellaced with thick, unstrained shellac varnish, or other approved waterproof coating, a sufficient number of coats being applied to thoroughly cover all the paper of the form and all the wires to and including the terminal pins inside of the head, with a thick, substantial coat, sufficient to exclude all moisture and to render the form waterproof. The cover of the cable head shall then be put in place and carefully sealed in such manner as to make a moistureproof joint.

(C) SPECIFICATION FOR CABLE TERMINALS.

2. FLEXIBLE TERMINALS.

SECTION 49.

49 Description

Flexible terminals shall be made by splicing to paper cables a supplementary cable or wire form of such a number of insulated wires as shall correspond to the number of wires in the cable, said supplementary form being composed of insulated wires, protected with some kind of insulation, which shall be moistureproof and which shall prevent the entrance of moisture to the paper cable. Said supplementary form shall be of such length and so arranged as to reach and match the distributing boards, terminals or other pieces of apparatus to which the cable is to be attached.

SECTION 50.

50 Okonite Terminals

The okonite flexible terminal shall consist of a form made of okonite twisted pairs sufficient to extend each of the paper cable pairs to their proper terminal pins.

SECTION 51.

51 Material

LEAD SLEEVES to be of unalloyed lead ⅛ inch thick and of dimensions according to Table 7 of this section. About three fourths the length of each sleeve should be drifted out of the proper size to cover the splice.

FLEXIBLE TERMINALS.—Twisted pairs of black and red okonite, No. 19 gauge, 3/32 inch insulation, without braid or other external covering. Each okonite pair shall project beyond the terminal for such a length as may be requisite to reach the terminating point of said pair.

OKONITE TAPE.—¾ inch wide, 1 roll.

PAPER SLEEVES.—As per B 1, Section 40.

BRASS TUBING.—One piece of thin annealed brass tube ½-inch in diameter, 2½ inches less in length than that of the lead sleeve.

WICKING.—As per B 1, Section 40.

WIPING SOLDER.—Containing 50 per cent. tin, a sufficient quantity.

SEALING COMPOUND.—Sealing compound shall be composed of 10 per cent., by weight, of heavy rosin oil and 90 per cent. of D. D. insulating compound. In place of D. D., Chatterton compound or any first-class waterproof rubber semi-elastic cable sealing compound may be used, which, when melted, will readily flow into the sleeve around the okonite wires and firmly adhere to both wire and sleeve. No compound which contains any paraffine derivative or similar substance capable of affecting the rubber of the okonite shall be used.

TABLE 7.

APPROXIMATE QUANTITIES AND DIMENSIONS OF MATERIALS REQUIRED FOR DIFFERENT SIZES OF TERMINALS.

Size of Cable.	—Lead Sleeves— Length. inches.	Inside diameter. inches.	Sealing compound. pounds.	Solder. pounds.	Rubber Tape. pounds.
10	16	1⅝	2	½	½
25	20	2	3½	½	½
50	20	2½	4½	½	½
100	24	3	4½	1	¾
150	24	3½	6½	1	1
200	28	3¾	7½	1½	1
250	30	4	9	1½	1
300	32	4½	10	2	1½
350	34	4½	13	2	1½
400	36	4¾	15	2	2

SECTION 52.

52 Operation

Fig. 3 is a detail drawing showing the construction of a flexible terminal. The cable sheath shall be removed for 12 to 24 inches, depending on the size of cable. The cable core shall be thoroughly dried out, *without boiling in paraffine*. Slip lead sleeve over the cable, splice each cable wire to corresponding okonite wires by twisting the ends together and protecting with paper sleeve, as described in Specification B 1, Section 41, joining the colored wire of the cable to the red okonite of each pair. Keep all wire splices within a limit of from 10 to 20 inches from the end of the cable sheath. Remove all bits of paper or other debris; bind the cable wires at the sheath tightly with several layers of twine to prevent the compound entering the cable. Tape the okonite together tightly for two or three inches, depending upon size of cable, at such a point as will bring the taping at least ½-inch below the subsequent surface of the compound. Below the taping separate the wires to freely allow the compound to flow between them. Bind the brass tubing with twine lightly along the wires with the lower end opposite the end of the cable sheath. No binding twine shall be placed beyond the wire splices. Draw the lead sleeve over the splice until it laps the head of the cable 1½ inches, then wipe the sleeve into place. Place the splice upright, warm the sleeve until it can hardly be touched with the hand. Insert a funnel into the brass tube and pour in compound, previously heated to about 350° F., slowly until it fills the sleeve within ½-inch from the top. Before filling the sleeve, test the compound by immersing therein a piece of okonite wire for about two minutes. If the insulation of the wire is not so softened as to readily come off the compound is not too hot. After filling the sleeve allow the splice to become thoroughly cold. If any settlement appears refill with compound. If there is no settlement dress the top of the lead into contact with the okonite tape, as shown in Fig. 3. Mark the outside of the sleeve, where the brass tube ends, and cover the end of the thus completed joint with two layers of okonite extending from the first wrapping tape over the edges of the sleeve. *No paraffine or any similar substance shall be used in connection with terminals of rubber-covered wire. Cables must be dried by dry heat.*

SECTION 53.

53 Distributing Board Terminals

When terminals are made for distributing boards, to be used in reasonably dry locations, leaded or unleaded switchboard cable, or wool cable, may, at the option of the Company, be substituted for okonite.

SECTION 54.

54
Unleaded Switch-Board Cable

For this purpose, first-class quality of silk and cotton twenty-pair (20) switchboard cable shall be employed, and a sufficient number of switchboard cables used to match the wires in the paper cable. These cables shall be substituted for the okonite, specified in Section 50, and the pothead made up exactly in the same manner as if okonite was employed.

SECTION 55.

55
Lead Covered Switchboard Cable

If the distance from the potheads to the distributing frame is considerable, leaded switchboard cable shall be used to maintain good insulation. The lead sheath of the switchboard cable shall only be removed from the switchboard cable for such a distance as will expose a sufficient length to splice to the wires of the wire plant cable, thus allowing the lead sheath of each switchboard cable to extend not less than four (4) inches inside of the lead sleeve forming the pothead. When the switchboard cables are ready to splice to the wire plant cable a round lead disk shall be prepared ⅛-inch thick, of such a size as to closely fit into the lead sleeve of the pothead. This disk shall have such a number of holes bored in it as will accommodate the number of switchboard cables to be spliced into the pothead, the holes being $^1/_{64}$-inch larger than outside of the lead of the switchboard cables. This disk shall then be slipped on to the switchboard cables and the switchboard cables spliced to the wire plant cable. The lead sleeve of the pothead shall then be slipped into place and wiped on to the lead of the wire plant cable. The sleeve shall then be filled with dried sand, packed and rammed as closely as possible to within two (2) inches of the top of the lead. The lead disk above specified shall then be slipped along the switchboard cables and forced inside of the pothead sleeve down upon the top of the sand, so as to be about 1⅞-inches below the top of the pothead sleeve. The lead of the sleeve, the lead disk and the lead of the switchboard cables shall then be carefully cleaned and wiping solder shall be poured in on top of the lead disk and around the lead of the switchboard cables so as to make a soldered joint between the sleeve and the lead of the switchboard cables. After the joint has cooled the lead sleeve shall be trimmed off carefully and the whole joint finished in a neat and workmanlike manner.

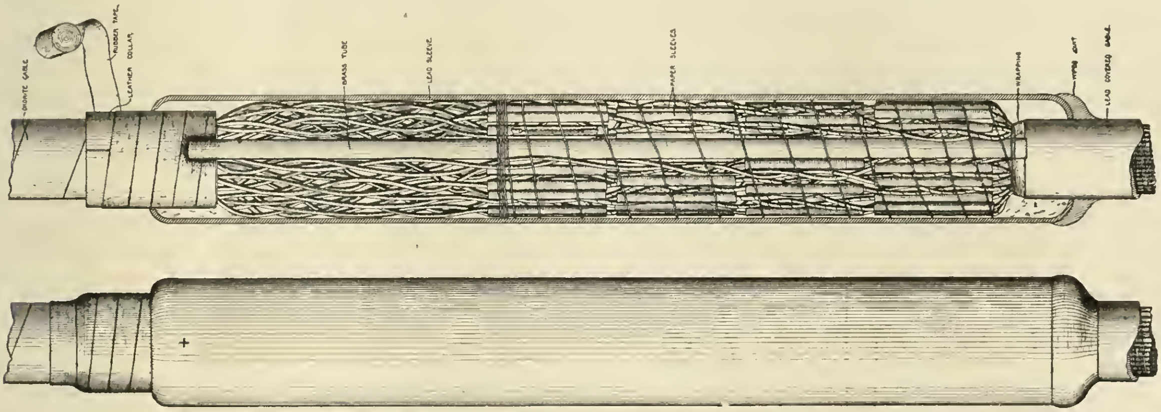

Fig. 3.

SECTION 56.

56
Wool Cable Terminals

Wire insulated with wool is to a considerable degree non-inflammable and non-hygroscopic, and may be used to join wire plant cables to distributing boards. Such wool cables shall be joined to the wire plant cables at some point where the splices can be conveniently laid up in a horizontal position. When connected to underground cables the best place is in the office manhole or in the basement run in of building, at the option of the Company. When joined to aerial cables the best place is the horizontal run of cable after entering the building. The length of wool cable for each incoming cable shall not be less than fifteen (15) feet. The wool cable shall be joined to the wire plant cable by means of a splice made according to Specification B 1. The lead covering of the wool cable shall be preserved on that cable up to the point where the first wires must branch away, and at this point the whole core shall be firmly bound with tape.

SECTION 57.

57
Terminal Forms

After the flexible cable is spliced to the wire plant cable, irrespective of the kind of material used for the purpose, the flexible end shall be carefully and neatly formed to match the terminal to which it is to be attached. The end of each wire shall be bared for half an inch and securely and substantially attached to the terminal designated by the Company for the purpose. The form shall be securely and neatly lashed in its place to the support provided and thoroughly shellacked or otherwise waterproofed, if so ordered by the Company. All potheads and cableheads shall be thoroughly secured to the supports provided in a neat and substantial manner satisfactory to the Company; all cable shall be laid neatly and compactly in the runs provided, and the entire work finished in a neat and workmanlike manner and to the satisfaction of the Company.

SECTION 58.

58
Supports

All the necessary racks and supports for holding any and all cable and all terminals shall be provided by......................

(D) SPECIFICATIONS FOR CABLE INSTALLATION.

1. UNDERGROUND CABLES.

SECTION 59.

59
Preparation of Manhole and Ducts

The ducts into which the cable is to be installed shall be designated by the Company. When the cable to be installed is delivered, the manholes into which the ducts open shall be cleaned and any cable in them carefully and neatly packed against the walls to give as good access as possible to the ducts into which the new cable is to be placed. Each duct shall then be cleaned by drawing through the duct a steel brush, as specified in *Specificotions for Underground Conduit, Section 26*. If a fish wire is already in the duct, it may be used to draw in the proper rope for the brush. If there is no fish wire the duct must be rodded, as described in *Specifications for Underground Conduit, Section 26*. The cable shall not be started into the duct till it is clean and far from obstruction. The mouth of each duct, while the cable is being drawn in, shall be protected by a shield of leather or guard so arranged as to prevent the edge of the duct from injuring the cable sheath.

SECTION 60.

60
Attachment of Pull Rope and Drawing

The pull rope shall be so attached to the cable with a swivel as to distribute the stress of drawing in uniformly over the entire cable without twist in such a manner that neither the sheath or core shall be strained or injured in the slightest degree. Power for drawing may be supplied in any desired way, either manually or by horsepower, or, preferably, with a hoisting engine, but it must be sufficient and adequate for the purpose and completely under control. When the cable has once started it shall be drawn slowly and steadily without stopping at the rate of from five to ten feet per minute, until it is completely in its final place.

SECTION 61.

61
Arrangement of Reel

The reel holding the cable shall be carefully transported without unboxing to the manholes at which drawing in is to begin. Here the reel shall be mounted on an axle of such a height as will cause it to clear the street about 6 inches and so that it shall easily and freely revolve. The reel shall be set close to the manhole, so that the cable can feed directly into the mouth of cover without dragging on the ground.

SECTION 62.

62
Feeding Cable

The cable shall be fed into the duct in such a manner as to produce the least strain in pulling and so as to absolutely avoid all kinks or other injuries to the sheath. As of necessity conduit manholes differ greatly in size, shape and accessibility, it is impossible to specify exactly the outfit needed for each case; but sufficient rollers, sheaves, guides, or other mechanical appliances or a sufficient force shall be provided to accomplish the result specified.

SECTION 63.

63 Splicing

When the cable is properly drawn into place the ends of the cable shall be coiled down into the manhole, ready for splicing. In case the cable is cut from a longer section, a sufficient amount shall be allowed for splicing and splicing shall be done immediately, or else the cut ends shall be boiled in paraffine and hermetically soldered. The reel, with any remaining cable, shall be carefully reboxed, removed at once from the street, and stored

(D) SPECIFICATIONS FOR CABLE INSTALLATION.

2. AERIAL CABLE.

SECTION 64

64 General Description

The work of installing aerial cable on existing pole lines may be divided into two parts:

First. The installation of the necessary messenger strands required to support the cable.

Second. The erection of the cable upon the messenger wire; the termination of the cable at each end by splicing to some other cable, or the installation of a cablehead or flexible terminal, set either in the office or in a pole box, with or without balcony.

SECTION 65.

65 Steel Strands

All wire used for strands shall be of steel, cylindrical in section, uniform in quality and free from all die marks, scales, sand splits, flaws or other imperfections. Each wire shall be double galvanized and shall fulfill the tests for galvanizing given in *Specifications for Aerial Lines.*

Each strand shall contain not less than seven wires laid up in a neat and uniform manner, showing no loose or imperfect places. The tensile strength of a section containing a wire that is spliced shall be as high as the tensile strength of a section containing no splice.

The properties of strands shall be as Table 8.

TABLE 8.

TENSILE STRENGTH OF STRANDS IN LBS.

Diameter		Bessemer		Siemens		High Steel		Extra High		Lay of
Strand.	Wire.	Working.	Ultimate.	Working.	Ultimate.	Working.	Ultimate.	Working.	Ultimate.	Strand.
¼ inch	.072	600	2500	762	3050	1275	5100	1900	7600	3 inches.
5/16 "	.109	1050	4200	1215	4860	2025	8100	3025	12100	3½ "
⅜ "	.120	1425	5700	1700	6800	2875	11500	4312	17250	3½ "
7/16 "	.134	1900	7600	1750	7000	3750	15000	5625	22500	4 "
½ "	.165	2450	9800	2750	11000	4500	18000	6750	27000	4½ "

SECTION 66.

66 Installation of Messenger Wire

Each messenger shall be made of wire rope, as specified in Section 65. The stress to which messengers shall be subjected is specified in Table 9, and the size of each messenger shall be selected from Table 8, in Section 65, from the column headed "Working Strength." When not more than two cables are to be erected on one line of poles each strand shall be supported by a messenger support similar to that shown at *A*, Fig. 4. For each strand one of these supports shall be bolted upon each pole, each about one foot below the lowest crossarm, and in such a manner that the axis of the groove *B* of the support is perpendicular to the crossarm. Upon each line of poles the supports shall be bolted relatively on the same side of the pole, so that the messenger may be strung in an essentially straight line. The messenger supports may be placed on the pole in advance, and the strands subsequently drawn in place, or the strands and supports erected simultaneously.

When the messenger supports are properly bolted to the pole the strand shall be erected by drawing it from its reel and placing it in the groove marked *B*, Fig. 4, and clamping it tightly in the support by means of the upper plate and bolts.

SECTION 67.

67 Angle Iron Cross Arms

Wherever more than two cables are to be erected upon one pole line an angle iron crossarm shall be used. This angle iron crossarm shall consist of a piece of 3 x 4 inch angle, weighing 30 to 36 pounds per yard, which shall be bolted to the pole in the place of the ordinary crossarm in the lowest gain. The method of securing this angle iron to the pole and of inserting therein the ordinary wooden crossarm is fully shown in Fig. 4 at *C*, *D* and *E*. From this drawing it is seen that the angle iron arm is placed underneath the regular crossarm, and the whole set in the lowest gain and bolted to the pole in the usual manner as specified for aerial lines. In addition, two 1-inch bolts are inserted in the angle iron, over which a band is placed encircling the pole, as shown in Fig. 4 at *C* and *E*. Further, the crossarm shall be stayed by four crossarm braces, two on the inside and two outside of the arm. For each cable which the line is to carry a Standard U-bolt, shown at *F*, Fig. 4, shall be placed in the angle iron arm in the manner shown at *G*. Each angle iron crossarm, when erected, shall be supplied with four standard U bolts, two on each end of the arm, as shown at *G*. When each messenger wire is erected the lower plate of this U bolt shall be removed, the messenger inserted between the arms of the U, and the plate replaced and bolted into place.

SECTION 68.

68 Tension for Messengers

After each messenger wire is erected in place all of the bolts of the supports, whether U bolts or standard messenger supports, shall be loosened and the tension of the strand adjusted, so as to bring a uniform strain at all the poles. This shall be accomplished by so loosening all the support fastenings that the strand is free to slide from span to span along the whole length of the pole line. The proper tension to which messenger strands shall be adjusted may be ascertained by the center deflection of the strand at the middle of each span. The proper center deflection to which messengers shall be adjusted for temperatures from 20° below zero, F., to 100° F., and for 80 ft., 100-ft., 120 ft., 150 ft. and 200-ft. spans, and for 50, 100 and 150-pair cable, is shown in Table 9.

As fast as the messenger wire is adjusted to the proper tension, all fastenings shall be screwed up solidly and substantially so as to hold the messenger firmly in place.

SECTION 69.

69 Anchoring

Wherever corners are turned, and at each end of each pole line, particular pains shall be taken to reinforce the line in a solid and substantial manner in order that the adequate strength may be secured to resist the strain introduced by the cables. The various methods that may be used for anchoring are given in detail in *Specifications for Aerial Lines.* Special methods applicable particularly to aerial cable construction are shown in Fig. 5, and each end of the line shall be guyed and anchored substantially in accordance therewith.

SECTION 70.

70 Erection of Cable

After the messenger wire is in its place and adjusted to proper sag and the various ends and corners of the lines guyed as hereinbefore specified, the aerial cable shall be erected. The reel carrying the cable shall be carefully transported and set about one span away from the pole upon which the cable is to terminate. The reel shall be mounted upon an axle so that it may freely revolve and so placed that it is about 6 inches above the ground and carefully unboxed. From the terminal pole to the reel a ⅜-inch or ½-inch guide wire strand shall be erected, serving to carry the cable from the reel to the terminal pole. At the terminal pole a large wooden sheave shall be placed immediately below the messenger over which the cable shall run. A sufficient length of rope shall be provided, supported on pulleys at each pole, to extend from the pulling apparatus, which shall be located beyond the other terminal pole, along the entire length of the span to the reel, so that the cable may be pulled into place at one operation. Power for pulling the cable may be supplied in any desired manner, either by a capston operated by manual or horsepower, or preferably a small hoisting engine. Whatever apparatus is used it shall be fully under control and capable of pulling the cable uniformly and steadily, after it is started, at the rate of from 10 to 20 feet per minute. The pulling rope shall be carried over the wooden sheave before specified down to the reel and attached to the cable by means of a swivel in such a manner as to distribute the pulling strain uniformly over the core and sheath of the cable, so that neither may be in any wise injured as the cable is drawn along.

SECTION 71.

71 Cable Supports

Such cable clips shall be used as shall be approved by the Company and sufficient hangers shall be employed, so that one may be placed every two feet throughout the entire length of each piece of cable. Actual erection of the cable shall be accomplished by placing one man at the reel to control the unwinding of the cable and sufficient force between the reel and the first pole to place upon the cable the hereinbefore specified hangers and to hook the same upon the guide wires; two men upon the first pole to guide cable over the guide sheave, and one man on each pole to unhook and hook hangers as the cable passes the messenger supports, and a sufficient force at the pulling engine to operate that portion of the apparatus. After drawing is commenced it shall proceed uniformly and steadily until the entire length of cable is erected. When the cable is in its place on the messenger wire a man shall be sent over the line to adjust all hooks in their proper position; he shall see that the hooks are properly attached to both the messenger wire and the cable and are so secured as to be safe against unhooking. When the attachment to the messenger wire as above specified is accomplished the tension on the cable and on

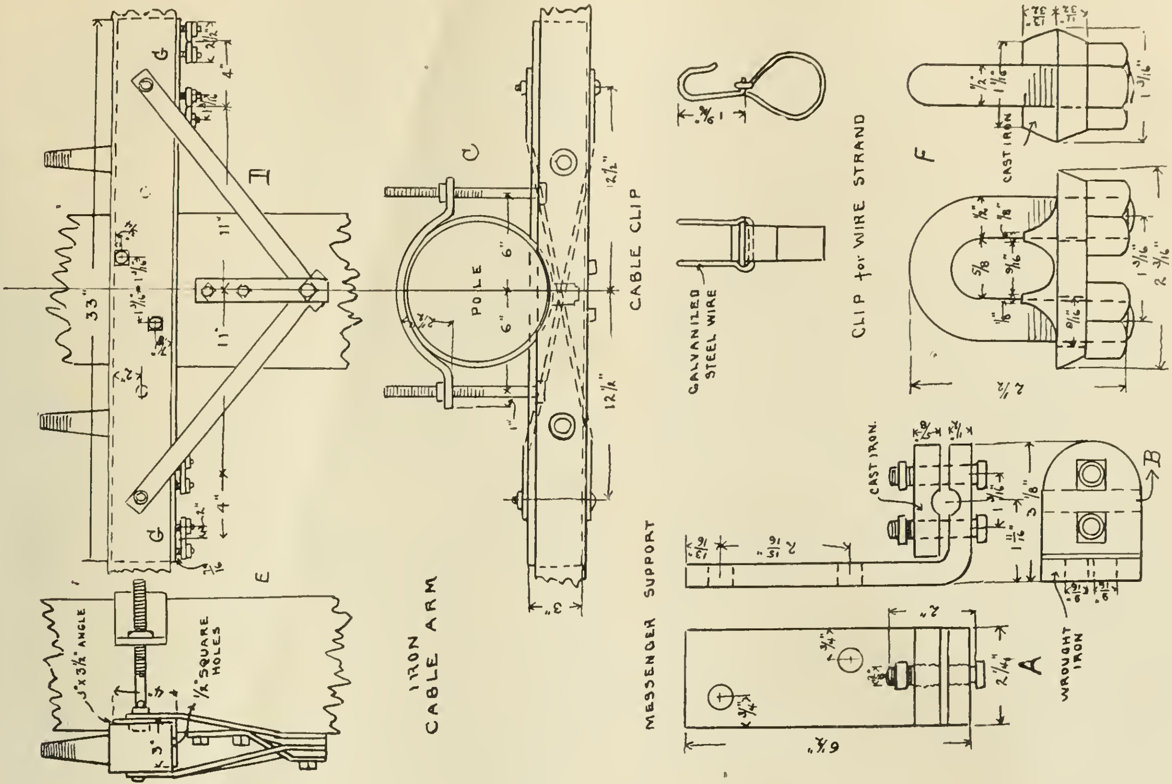
IRON CABLE ARM
CABLE CLIP
POLE
CLIP for WIRE STRAND
GALVANIZED STEEL WIRE
MESSENGER SUPPORT
CAST IRON
CAST IRON
WROUGHT IRON
1/2" SQUARE HOLES
3"x3 1/2" ANGLE
E
C
F
A
B
G
33"
11"
11"
4"
4"
6"
6"
12 1/2"
12 1/2"
3"
6 1/2"
2 1/4"
2"
2 1/2"

FIG. 4.

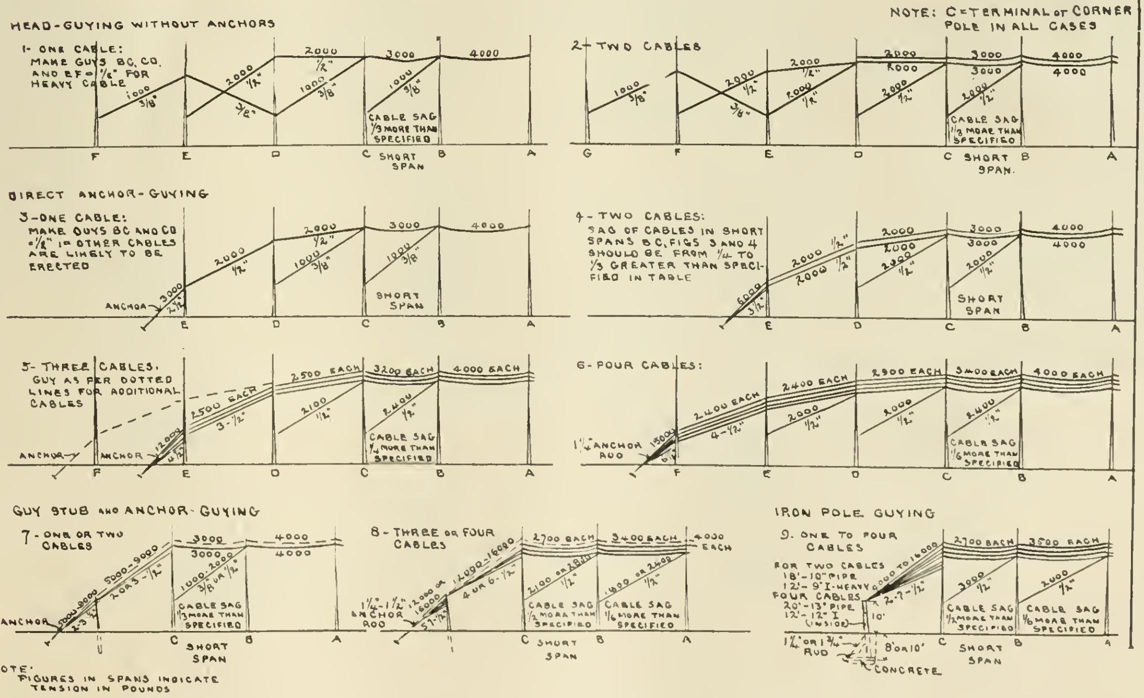
HEAD-GUYING WITHOUT ANCHORS
1- ONE CABLE: MAKE GUYS BC, CD, AND EF = 1/2" FOR HEAVY CABLE
2- TWO CABLES
NOTE: C=TERMINAL or CORNER POLE IN ALL CASES
DIRECT ANCHOR-GUYING
3-ONE CABLE: MAKE GUYS BC AND CD = 1/2" IF OTHER CABLES ARE LIKELY TO BE ERECTED
4- TWO CABLES: SAG OF CABLES IN SHORT SPANS BC, FIGS 3 AND 4 SHOULD BE FROM 1/4 TO 1/3 GREATER THAN SPECIFIED IN TABLE
5- THREE CABLES. GUY AS PER DOTTED LINES FOR ADDITIONAL CABLES
6- FOUR CABLES:
GUY STUB AND ANCHOR-GUYING
7- ONE OR TWO CABLES
8- THREE OR FOUR CABLES
IRON POLE GUYING
9. ONE TO FOUR CABLES
FOR TWO CABLES 18'-10" PIPE 12'-9" I-HEAVY
FOUR CABLES 20'-13" PIPE 12'-12" I (INSIDE)
1 1/4" OR 1 3/4" ROD
CONCRETE
8' OR 10'
10'
ANCHOR
1 1/4" ANCHOR ROD
1 1/4"-1 1/2" ANCHOR ROD
CABLE SAG 1/3 MORE THAN SPECIFIED
CABLE SAG 1/4 MORE THAN SPECIFIED
CABLE SAG 1/6 MORE THAN SPECIFIED
CABLE SAG 1/2 MORE THAN SPECIFIED
SHORT SPAN
2500 EACH
3200 EACH
4000 EACH
2400 EACH
2900 EACH
3400 EACH
2700 EACH
3500 EACH
G F E D C B A
NOTE: FIGURES IN SPANS INDICATE TENSION IN POUNDS

FIG. 5.

TABLE 9.

SAG OF CABLES AND TOTAL TENSION IN SUSPENSION STRANDS AT DIFFERENT TEMPERATURES.

50-PAIR CABLE.

Temp F. °	80 foot Span		100 foot Span		120 foot Span		150 foot Span		200 foot Span	
	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.
20	6	4,000	9½	4,000	13½	4,000	21	4,000	37	4,000
0	6½	3,650	10	3,700	14½	3,700	22	3,750	39	3,800
20	7	3,300	11	3,400	15½	3,450	23½	3,500	41	3,600
40	8	3,000	12	3,100	16½	3,200	25	3,300	43	3,450
60	8½	2,700	13	2,850	18	2,950	27	3,100	45	3,300
80	9½	2,450	14	2,600	19½	2,750	28½	2,900	47	3,150
100	10½	2,200	15½	2,400	21	2,550	30	2,750	49	3,000

100-PAIR CABLE.

Temp. F. °	80-foot Span		100 foot Span		120-foot Span		150-foot Span		200 foot Span	
	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.
20	8	4,000	13	4,000	18½	4,000	28½	4,000	51	4,000
0	9	3,700	13½	3,750	19½	3,800	30	3,800	53	3,900
20	9½	3,400	14½	3,500	20½	3,550	31½	3,650	54½	3,750
40	10½	3,150	15½	3,250	22	3,350	33	3,500	56½	3,600
60	11	2,900	16½	3,050	23	3,200	34½	3,300	58½	3,500
80	12	2,700	18	2,850	24½	3,000	36	3,200	60	3,400
100	13	2,500	19	2,700	26	2,850	37½	3,050	62	3,300

150-PAIR CABLE.

Temp. F. °	80-foot Span		100-foot Span		120-foot Span		150-foot Span		200-foot Span	
	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.	Sag in inches at center.	Tension in pounds.
20	9.0	4,000	14.5	4,000	20.5	4,000	31.5	4,000	56.0	4,000
0	10.0	3,700	15.0	3,750	21.5	3,800	33.0	3,800	58.0	3,900
20	10.5	3,400	16.0	3,500	22.5	3,550	34.5	3,650	60.0	3,750
40	11.5	3,150	17.0	3,250	24.0	3,350	36.0	3,500	62.0	3,600
60	12.0	2,900	17.5	3,050	25.5	3,200	38.0	3,300	64.0	3,500
80	13.0	2,700	19.5	2,850	27.0	3,000	39.0	3,200	66.0	3,400
100	14.5	2,500	21.0	2,700	28.5	2,850	41.0	3,050	68.0	3,300

the messenger wire shall, if necessary, be readjusted until it corresponds to the specifications of Table 9.

SECTION 72.

72
Method of Terminating

Three methods shall be used for terminating aerial cable.

1st. Connection to underground cable. Where aerial cable is to connect with an underground cable, the underground conduit, by means of an iron pipe 3 inches in diameter, shall be extended alongside of the terminal pole for a distance of at least 10 feet above the sidewalk. Either the aerial cable or the underground cable, as the Company may elect, shall be extended through this pipe. In case the Company shall elect to extend the underground cable, the splice between the aerial and the underground cable shall be made directly above the iron pipe extending along the pole. This splice shall be made as specified in B 1. In case the Company shall elect to extend the aerial cable into the manhole, the cable shall be run downwards through the iron pipe into the manhole and the splice and between the underground and aerial made in the manhole, as specified in B 1.

SECTION 73.

73
Connections to Open Wire Lines

At each point where the aerial cable shall terminate and enter an open wire line, a proper box and balcony shall be supplied and bolted to the pole, as shown in Fig. 6. The box and balcony shall be of such design as is approved by the Company, and shall be supplied by.................. .. .. and shall be erected in place substantially, shown in Fig. 6 by............................. The cable terminal shall be either a cable head, as specified in C 1, or a flexible terminal, as specified in C 2, as the Company may elect. After the cable is terminated it shall be secured to the pole and brought into the pole box as shown in Fig. 6. In all cases pains shall be taken to carry the cable to the pole with a long, round, easy bend, and in such a manner as not to kink, injure or hurt the cable in any way. A lead bushing shall be inserted in the base of the box through which the cable shall enter. All flexible terminals to aerial lines shall be made of Okonite wire, as specified in C 2. The Okonite shall be carefully formed, neatly lashed, and carefully secured to the back of the box, each wire being carried to its proper terminal and there soldered. If the cable head is to be used the cable shall be terminated in the head as specified in C 1. After the cable is spliced into the head the head shall be placed in the box and bolted to the back thereof. After the cable is erected in place and terminated it shall be inspected, as provided for in A 1. The Inspector shall test each wire from the terminal point at which the bridle wire is to be attached, to the other terminal of the cable wherever this may be situated, and each wire must fulfill each and all of the requirements specified under A 1.

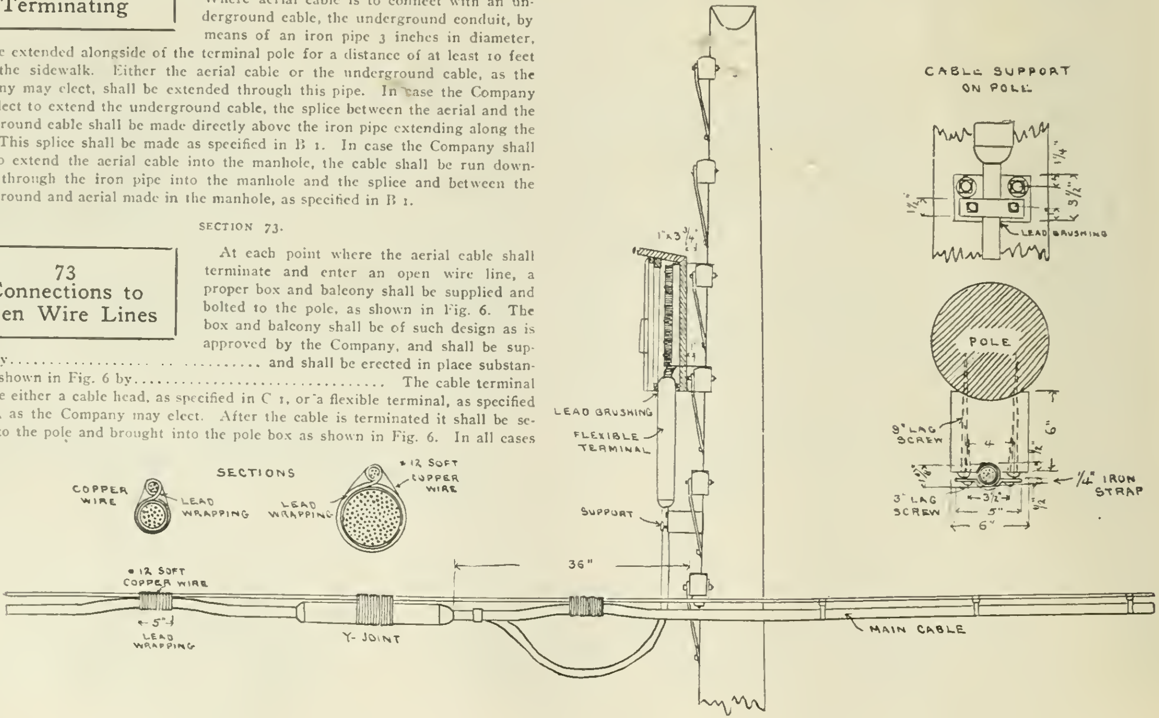

FIG. 6.

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CONTENTS.

Editorial 309
Meeting of the Pittsburg Branch of A. I. E. E. 312
Inauguration of Boston Chapter of the Institute 312
1,000-H.P. Water-Power Electric Plant in Manchester, Conn. 313
Alternating vs. Direct-Current as Applied to the Iron and Steel Industry. By C. H. Hines 315
The Mercury Arc. By Charles P. Steinmetz 316
Parallel Operation of Steam and Water Power Plants. By Charles Brandeis 318
Predetermination of Characteristics 318
The Speaking Arc 319
Some Recent Electrical Patents 319
The Construction of Aerial Telephone Lines—IV. By Arthur V. Abbott, C. E. 321
Cooper Hewitt Interrupter 323
New Telephone Patents 324
Ohio Independent Telephone Companies 324
Current News and Notes 325
Letter to the Editors:
  Line Poles. By W. F. Stevens 326
Digest of Current Electrical Literature 327
New Books 330
Power Required to Drive Machine Tools in a Locomotive Shop 331
Direct-Driven Machine Tools 333
Electric Power Equipment for a Japanese Arsenal 334
Small Generating Set 334
The Nernst Lamp in a New Bank 335
A New Telephone Receiver 335
Departments:
  Financial Intelligence 336
  Commercial Intelligence 337
  General News 339
  Trade Notes 343
  Record of Electrical Patents 343

COOPER HEWITT INTERRUPTER.

The latest result of Mr. Peter Cooper Hewitt's studies of the mercury vapor tube is described elsewhere in this issue. If a long list of present day desiderata were drawn up, it would perhaps contain no item of more immediate importance than an interrupter for an oscillating circuit which shall be efficient in transformation, maintain indefinitely oscillations of an exact predetermined character, be adjustable to the best conditions over a wide range of oscillations, and at the same time be inexpensive and simple of application. Such an apparatus appears to have been devised by Mr. Hewitt, and should the bright promise held out by the principles involved be realized in practical commercial operation, the art of wireless telegraphy will be enormously benefited. The electric arc as an interrupter by means of which to set up oscillations has proved far from satisfactory. Owing to the lack of a method of measuring the energy sent out by a Hertzian transmitting circuit, there are no data as to the efficiency of transformation in an oscillating circuit, but the loss at the arc is undoubtedly very great, and probably another great part of the energy supplied is dissipated in actions not contributing to setting up useful oscillations. Moreover, the action of the arc is not uniform, being subject to fluctuations and also dependent on the state of the electrodes as well as other local conditions. On the other hand, all of the factors entering into the interrupting action of the vapor tube would seem to be subject to exact control, and the discharge to possess a uniformity impossible in the use of the mobile arc. As in the case of the same inventor's apparatus for converting alternating to direct currents, the simplicity and inexpensiveness of the device is remarkable. An advance which substitutes for the paraphernalia of the disruptive gap a device as simple of connection and operation as the incandescent lamp, is indeed a most notable one.

THE MERCURY ARC.

We take great pleasure in presenting elsewhere an article by Mr. C. P. Steinmetz on this very interesting subject. As he very pertinently remarks, it is in the selective radiation of gases that one must seek for high efficiency in artificial illuminants, for the attempt to obtain it by the use of very high temperatures in solids is blocked by their physical incapacity to stay solid. Selective radiation in solids is not marked enough to lead to very striking results, and even the Welsbach mantle owes more to temperature and less to selective action than is generally supposed. With gases, however, the case is different, although as Mr. Steinmetz points out, it is perfectly possible to find a gas giving too much invisible radiation for good efficiency. The attempts at getting a good result from ordinary Geissler tubes have not led to decisive results, partly perhaps from the need of high frequency, but mainly because the mass of light-giving material in the highly exhausted tube is too inconsiderable to permit of attaining a reasonable intrinsic brilliancy under ordinary conditions. The mercury arc allows a considerable amount of energy to be transformed in a tube of reasonable size, and gives intrinsic brilliancy high enough to keep the dimensions of the apparatus moderate without producing, on the other hand, the painfully dazzling effect of high temperature illuminants in general. More than this, the mercury arc is particularly well adopted to the customary direct-current systems of distribution which makes it of immediate applicability.

In principle, the mercury arc is not new, having first been described in print nearly forty years ago, and it was studied by Dr. Arons more than ten years ago. Its present prominence, however, is due to the recent able work of Mr. Cooper Hewitt, who in the mercury vapor tube has developed the principle to a proximate commercial stage. The greater interest at present centers around the starting devices, on which much ingenuity is being expended. Dr. Weinstraub's plan, which we illustrate, is beautifully simple and effective, although open to the objection of requiring any given tube to be placed in a fixed position. The mercury arc is certainly highly efficient, requiring roughly about half a watt per candle power, can be regulated with comparative ease, can be conveniently worked in the series connection, is apparently of very long life, of convenient intrinsic brilliancy, rather insensitive to moderate variations of voltage and when properly arranged, remarkably steady. The light has very great actinic power, so that it has found a ready application in photography, and the lamp can be operated wherever direct current is attainable. Such a list of virtues cannot fail to be rather alluring, and we do not doubt that the mercury lamp when put out commercially will find sufficient encouragement in the use of incandescent gases to stimulate greatly all work in this interesting and, in our opinion, important field. We cannot believe that the mercury arc constitutes the last word on this topic, for with all its good points it has a fault that must bar it from the field of general illumination—its truly disagreeable color.

It is with respect to this latter point that we have to express total disagreement with the views of Mr. Steinmetz, and we fancy that he will find precious little support in his physiological and æsthetic theories regarding blue lights. There is certainly no sound basis for supposing that the red component of any light in practical use has any effect whatever that is deleterious to the eye. That the red component is not one to which the eye is sensitive has long been known, but for that matter neither is the blue, the yellow and green component, being those which are most effective for visual purposes. In fact, Crova proved years ago that the visual effectiveness of lights is practically proportional to their yellow components. The mercury arc lacks almost completely the red and orange components of white light. Hence by it the normal eye becomes as if red blind, and, as Prof. Boys recently put it, the color sense seems to go crazy. There is no relation between this total lack of one of the primary colors and such mild idiosyncracies as are found in other commercial illuminants. The net result is a light ghastly to a degree unapproached even by a Welsbach mantle at its worst. This failing must inevitably limit the usefulness of the present mercury arc to places in which color is without importance and appearances are scorned.

Boston Local A. I. E. E. Meeting.

There have been meetings of the Institute at Boston in the past, but they were meetings of the membership as a whole. Last Wednesday, however, witnessed the first meeting of the Boston local branch of the Institute. There were no fewer than three past presidents of the Institute in attendance, besides President Scott, several vice-presidents, the secretary and other officers. The meeting was well attended and the speaker, Mr. Lockwood, was in the best and wittiest of moods. Several local branches of the Institute are now in full swing, including the very flourishing one at Pittsburg, an account of the recent meeting of which is reported elsewhere in this issue. The success of this excellent movement is largely owing to the untiring industry of President Scott, and it is to be hoped that these local meetings will continue to flourish and do good work by discussing papers, developing subjects of interest and introducing new members.

The Photometry of Electric Lamps.

A paper on this subject has recently been read by Dr. Fleming before the British Institution of Electrical Engineers. The author lays considerable stress upon the pentane flame standard as a primary standard, placing it in the same class with the Violle molten platinum standard; whereas the Hefner-Alteneck amyl-acetate lamp is relegated by him to the class of secondary standards. We should have supposed that the pentane and amyl-acetate flame standards would have been associated in the same category. But the more one reflects upon the Violle standard, the more hopeless its use appears, except, perhaps, in National Standard Laboratories. The pentane 10-candle lamp seems to have driven the parliamentary candle out of its stronghold—Great Britain—except in name. The apparatus employed by Dr. Fleming in his preferred form of photometer has certain interesting peculiarities. Electrically, he rejects all measuring instruments save the potentiometer. The standard lamp has an extra large bulb, to diminish the rate of blackening, and a filament which has been suitably aged in a separate lamp-chamber. The lamp tested is not rotated about a vertical axis, as is usual with us, in order to arrive at the mean horizontal intensity; but the maximum and minimum horizontal intensity are respectively noted, and in addition thereto, the "end on" intensity is also observed. The rating recommended by Dr. Fleming involves, therefore, three coordinates. This does not seem nearly so desirable as a single coordinate, such as the mean horizontal intensity or else the total flux of light. If accuracy of rating is aimed at, the mean spherical intensity, or the total flux of light, is much better. If convenience with commercial accuracy is desired, the mean horizontal intensity is better.

Characteristics of Electric Earth-Current Disturbances and Their Origin.

A paper on this subject has recently been written by Mr. J. E. Taylor and communicated to the Royal Society by Sir Oliver Lodge. It contains a number of interesting suggestions. Everyone who has listened to the babblings of a telephone inserted in a ground-return circuit knows of the boiling and frying sounds that are always detectable by the ear. Mr. Taylor has been experimenting on a British Post Office wireless telegraph scheme, in which a telephone receiver is connected in a low-resistance circuit "earthed in the sea" at both ends. The noises heard in this telephone receiver at times when no wireless telegraph signals were being sent are divided into four characteristic classes, substantially as follows: Rushing water, boiling water, crackling and rocket disturbances. The latter are described as commencing with a shrill whistle and as dying away in from 2 to 4 seconds, with a note of diminishing pitch. These rocket noises are described as being heard freely by night, but rarely by day.

The ingenious suggestion is offered that the rocket noises are due to celestial rockets, or meteors. The sound suggests them, and their duration corresponds to the visible duration of meteors. The meteors are supposed to produce an electrical disturbance high up in the air, inductively influencing the ground or ocean, and thus leading to detection in the telephone. This is a hypothesis that seems readily capable of being tested. According to it, all that has to be done is to take up a telephone in a ground-return circuit at night, when no one is talking over the circuit, listen for rocket sounds, and watch for meteors. Since many meteors per hour are ordinarily visible on a fine night, when pains are taken to watch for them, the coincidence of visible and audible rockets should be capable of determination. Moreover, Leonid nights should give especially choice rocket disturbances in the telephone. The experiment is not likely to be capable of trial in a large city, or near a trolley system, or near a large telephone exchange. We recommend it to our country friends far from the madding crowd. Mr. Taylor thinks that the reason why rockets are heard much more frequently by night than by day is not because there are fewer meteors when the sun is looking on, but because the sun's rays ionize the atmosphere to some extent and make it very feebly conducting. Consequently, the earth and the telephones thereof are electrically shielded at such times from the inductive disturbances of shooting stars, by the thin veil of aerial conducting matter. This suggestion also conforms with the generally accepted belief that long-distance wireless telegrams carry considerably further by night than by day. A feeble daily conductivity of the air owing to the work of our grand luminary, would be capable of explaining the greater diurnal than nocturnal attenuation in wireless electric impulses.

If this suggestion for the origin of telephonic rocket disturbances can be actually substantiated, the result will be important in various ways. It would be worth something to know that we can hear the flight of a falling star. Moreover, these celestial high-flyers move and have their brief but brilliant existence at a great elevation above the earth's surface, where no balloon is ever likely to take us. We can move nearly all over the surface of our planet; but five miles upwards and one mile downwards are the approximate limits of our travel in these less favored directions. It goes without saying that any electrical communications capable of being detected from these lofty visitors should be able to yield valuable information after appropriate study. A similar suggested explanation is offered for the diurnal variation of the magnetic needle. The impact of the higher frequency solar radiations on the molecules of the atmosphere disrupts a few of them, so as to knock off chips, or electrons, from these, thereby producing a feebly electrified and conducting atmosphere, the currents in which, reaching their maximum intensity early in the afternoon, influence the earth's magnetic field, and affect the alignment of suspended magnetic needles on the earth's surface.

THE ELECTRONIC THEORY.

A recent and valuable paper, presented by Sir Oliver Lodge to the British Institution of Electrical Engineers, discusses matters at the base of matter itself. It starts with the supposition that since the inertia of electrified matter is capable of being explained electromagnetically the simplest way to explain the phenomenon of inertia is to assume that all matter is electricity. Up to the present time, the electronic theory of J. J. Thomson and his school has postulated the existence of material corpuscles, or chips of atoms. Each chip that can be detached from an atom is negatively electrified, or constitutes a negative electron. The chip has been regarded as a piece of matter, although an exceedingly small piece, and as carrying an electric charge. In the paper under consideration, however, the electronic charge carried by the corpuscle is regarded as the corpuscle itself. That is to say, instead of assuming a nucleus or core of matter to carry the electronic charge, the charge, as a sort of magnified point-charge, is regarded as the corpuscle. All matter is assumed to be built up of these electronic charges or electrons, which are both negative and positive. A hydrogen atom is supposed to contain about 700 of these electrons. A mercury atom is reckoned to have 200 x 700 or 140,000 electrons all stowed away inside. The atom itself is taken as a sphere of one-tenth of a bicron in diameter, or 10^{-10} metre, so if there are 140,000 electrons stowed away into this little space, one might suppose that they are tightly packed. But, on the contrary, since the diameter of the electron, to account for its inertia, has to be 10^{-15} metre, or the millionth of a bicron, there is so much elbow-room for the 140,000 supposed inhabitants of the mercury atom, that they are roughly as distant from each other, relatively to their size, as are the planets in our solar system.

This speculation opens to our minds the conception of a complete solar system all shut up within the space of one-tenth of a bicron. The electrons perform orbits inside these little spheres, but the place which our sun occupies in our visible planetary system seems to be vacant in these atomic systems. According to the hypothesis, the electrons do not swing about a grand central electron, but about one another. The difference between one kind of matter and another lies in the physical and chemical properties of the atoms; but the difference between the atoms is merely due to the difference in groupings of electrons. A heavy atom like mercury would have a relatively large number; while a light atom, like hydrogen, would have but a relatively small number. Every atom is composed of positive and negative electrons, or vagrant electric charges, in space. Just how such a charge exists in space or what its mechanism is, does not yet appear. We can merely regard it as an electric point-source. The same hypothesis suggests to the mind the analogy that our visible planetary system may only be an atom in material aggregation on a sufficiently enlarged scale.

All chemical affinity is traced to aggregations of electrons, or atoms, with odd or unbalanced electrons either positive or negative. Chemical union is the result of the attraction of such unsatisfied electric charges on different atoms for one another. Cohesion is a less locally powerful, but more extended, electric attraction of groups of electrons in mutual linkage or satisfaction. Cohesion, in the electric sense, as in wireless telegraphy, is the artificially enhanced molecular attraction due to electric stimulus and the momentary inductive displacement of groups of electrons. Lenard rays and cathode rays are regarded as moving electrons, that is, trains of minute negative electric charges flying with great velocity. Röntgen rays are trains of solitary waves of radiated energy emitted at the impact of flying electrons with stationary groups of electrons, *i. e.*, solid matter. While, therefore, a cathode ray or Lenard ray consists essentially of electric charges, Röntgen rays do not contain charges but electric disturbances in ether radiated off or shed from the moving electrons, on being arrested.

The free path of a free electron moving into a solid body as dense as platinum is given as about a micron. This is about a billion times the electron's radius. The relatively great length of probable free path, before encountering other electrons is, of course, due to the large elbow-room or spacing between electrons even in dense matter. In matter of lower density such as aluminum or wood, the mean free path becomes correspondingly magnified. When collision does occur, it is suggested that it is rarely a clean encounter like that of two opposed locomotives on one and the same track, but nearly always such a sharp swing as a comet makes around the sun at perihelion, the two sides of the hyperbolic path leading to and from the sun being virtually straight lines, and the return virtually a rebound of the comet from the sun as viewed by a very distant observer. The power required to stop a single electron moving at a velocity of one-thirtieth that of light, within the thickness of a single molecule, is set at about ten watts.

The Lodge theory of the electron appears to differ then from the Thomson theory mainly in postulating that there is no matter in an electron or corpuscle, and that this little fundamental unit is all electric. Thomson's theory means that negative electricity is matter. Lodge's theory means that all matter down to the ultimate corpuscle is electricity. The difference in thought between the two theories is quite appreciable; but there is so little matter in an electron that it matters little to which we pin our faith.

Meeting of Pittsburg Branch of A. I. E. E.

A meeting was held February 5 of the Pittsburg local branch of the American Institute of Electrical Engineers, at the Electric Club. The papers presented at the New York meeting, together with President Scott's introductory remarks, were read by Secretary John S. Peck. The discussion which followed was participated in by Messrs. Grace, Bradley, Lincoln, Gallagher and Hommel. As a part of the discussion, Mr. Grace read a communication in which he commented on the papers of Messrs. Hammer and Lockwood, and Mr. Bradley presented a communication discussing the installations of switchboards and a general system of standardizing apparatus. A communication from Mr. Sidney Hand Browne on Mr. Lockwood's paper was received after the meeting adjourned.

Mr. Bradley sketched the progress of telephone installation engineering from the day when all of the work except building the switchboard proper and distributing frames was done by the foreman at the time of installation. The multicolored insulation scheme was later introduced, the cables cut and soldered to the multiple jacks at the factory and elaborate specifications prepared and plans furnished showing the location of the switchboard, power plant, conduit, etc. When the common battery board was planned the work increased greatly owing to the number of cable runs, more apparatus and power plants of larger capacity. It was found that by locating exactly each piece of apparatus, the racks for carrying the cables could be designed accurately and built in the shop, conduit plans be prepared and, in fact, innumerable details that were formerly left to the installer were now figured out by the engineer before the installation actually started. Particular attention was paid to the arrangement and location of apparatus on the switchboard proper so that the cable work could be done in such a way that all apparatus would be accessible and easy to maintain. To-day practically all cables are cut and formed from plans made by the engineer and are soldered to their respective terminals or jacks before they leave the factory.

The communication by Mr. Browne referred to improvements in switchboard details whereby the cable required in wiring multiple jacks is reduced two-thirds, the use of a shunt to put out the supervisory lamp is avoided, the use of a repeating coil in the cord circuit is dispensed with and also the third contact in multiple jacks. Figs. 1 and 2 show two telephones connected through a telephone exchange system, whose operation is as follows:

The operation of removing the receiver from the hook of the sub-station instrument closes the circuit and energizes the line signal relay, *X*, in the usual manner. The operator, by inserting the plug in the answering jack, allows current to flow over the ring of the plug through a relay, *Y*, of high impedance, to the ground; this relay being energized attracts its armature, *Z*, and disconnects the line signal apparatus, consisting of relay, *X*, and lamp, and also "puts current" on the sleeve of the jack which will give the busy test through a relay, *T*, placed in the operator's circuit. The advantage of this relay controlling the busy test is that by its use the operator only gets the signal without conveying it to the subscriber who has made the call. The insertion of the plug also causes current to flow through relay, *P*, closing the local contact at *L*, and allows current to flow through the lamp to the local contact at *L* on relay, *R*, to ground. These relays are of low resistance and are placed on each side of the cord circuit. When the subscriber answers his call by taking the telephone from its hook, it allows the current to pass back over the tip of the cord to relay, *R*, to ground and opens the local contact at *L*, thus cutting out the supervisory lamp. It will be noticed that there is a straight through circuit from the tip and sleeve of the answering cord to the tip and sleeve of the calling cord, with the condensers, C^1 and C^2, inserted. These condensers permit the flow of voice currents and prevent the steady flow of current from the battery, which simply simplifies current for the sub-station transmitter.

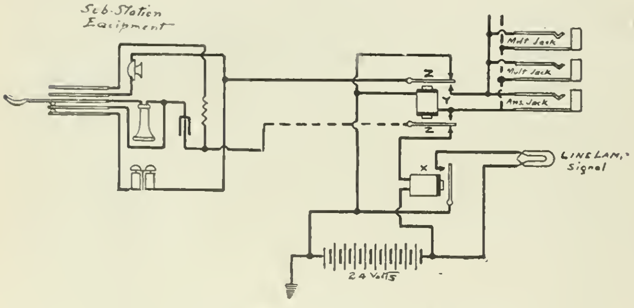


FIG. 1.—TELEPHONE SWITCHBOARD CONNECTIONS.

The system described eliminates undesirable features, and while it is true that the relays, *R* and *P*, and R^1 and P^1 are introduced, these relays are wound to a high impedance and are not connected directly in the talking circuit, but are bridged across it. The circuit is perfectly balanced and instead of shunting the lamp and allowing current to flow through the lamp circuit, the lamp circuit is opened and a drain on the batteries thus avoided. The amount of wire necessary in a large multiple switchboard and the consequent greatly increased cost of manufacture renders obvious the immense saving can be made by the elimination of one-third of the amount of multiple switchboard cables, by the use of two-contact jacks instead of three-contact, by the use of two-conductor cords instead of three-conductor; while at the same time obtaining a much more direct and better talking circuit.

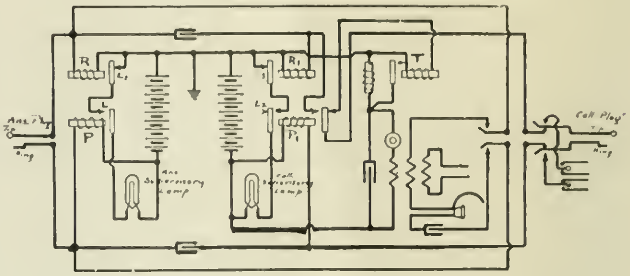


FIG. 2.—TELEPHONE SWITCHBOARD CONNECTIONS.

At the same meeting Mr. R. A. L. Snyder presented a communication on the speaking arc, which is reprinted elsewhere.

Inauguration of Boston Chapter of the Institute.

One of the most representative assemblages of electrical engineers that has ever convened in Boston met on the evening of February 13 to take part in the opening meeting of the Boston Chapter of the American Institute of Electrical Engineers. Men of note in their profession from all over the eastern section of the country were present and from New York a special delegation came on to attend the affair. Everything combined to make the Boston meeting successful and full of promise for the future.

Prof. Elihu Thomson presided. In his opening address he spoke of the place that the electrical engineer holds in the world to-day, of the tremendous growth of the science in the past and of the brilliant future that stands before it. He touched on the position which the American Institute occupies in connection with this, and then introduced President Scott to elaborate on that subject.

President Scott went into details of the Institute, its work, aims and the way they were being carried out. On the same subject and in discussion of the paper of the evening, Secretary Ralph W. Pope, Dr. Samuel Sheldon, Dr. A. E. Kennelly and Mr. Louis A. Ferguson, president of the Chicago Edison Company, also spoke. The paper read was Mr. Thomas D. Lockwood's "Evolution of the Telephone Switchboard." Mr. Lockwood himself presented it and gave a most interesting talk to the two hundred men present.

These meetings, of which this was the first, are to be held monthly in one of the buildings of the Massachusetts Institute of Technology. The Tech students in electrical engineering, who have an organized society of their own of nearly one hundred members, also attend them jointly with the older men. It is the hope and expectation, as President Scott remarked, that the young blood infused into these affairs will carry the Boston organization on to a prosperous, worthy place among the professional societies of the city.

1,000-H.P. Water-Power Electric Plant at Manchester, Conn.

About nine miles east of Hartford, Conn., is situated the thriving village of South Manchester. Here is located one of the most important industries Connecticut boasts of, namely, the immense silk mills of Cheney Brothers. This establishment is the largest of its kind in New England, if not in the United States, and has been under the direct management of the Cheneys for several generations. Their silks are well known to every merchant in the country, for fine quality and finish.

As in the case of most manufacturing establishments, steam, until recently, has furnished all the power for these silk mills. The great success for the past three years of the Hartford Electric Light Company in utilizing the falls of Farmington River, at Tariffville, Conn., and transmitting the product of the water wheel and generator fourteen miles to light the city of Hartford and furnish power to customers there, has opened the eyes of alert manufacturing and business men of that section to the possibilities of the various water powers in their neighborhood, and, of course, their great economy over coal. Though the first cost is considerable, the operating expenses, repairs and incomes are usually greatly in favor of the hydro-electrical plant over those of the steam plant, though with the high-efficiency engines, to say nothing of the steam turbine, the latter is a good investment in the city of Hartford.

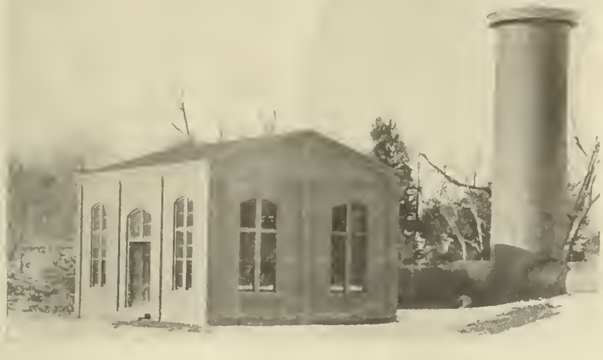


FIG. 1.—POWER HOUSE.

The water plant of the Hartford Electric Light Company, running continuously every hour since its start three years ago, has called upon the auxiliary steam plant in Hartford but very little, and for the past year scarcely at all, while for this period of time the amount expended for repairs was too small to take into account. So it was not a surprise that the progressive spirit of the Cheney Brothers, near by, should manifest itself by the purchase, early in 1901, of three dilapidated powers of eight, ten and twenty-two feet fall on the Hockanum River at Manchester, Conn. They engaged Mr. A. C. Rice, of Worcester, Mass., the designer and engineer of the above-mentioned hydro-electrical power plant of the Hartford Electric Light Company and many other large developments, to take these three water privileges and deliver their power to their mills in South Manchester, about three miles distant. Mr. Rice accordingly made plans to consolidate these falls into one and control the water supply in one pond.

To accomplish this it was necessary to raise the elevation of one of the old dams and conduct the water by a steel feeder pipe to the site of the power house on the fall farthest downstream. The old dam was a stone structure erected a great many years ago and crowning upstream in the shape of a slight arch. It was found necessary to remove a few of the top courses and to thoroughly clean the exposed faces and joints of the old masonry before applying the new concrete. Thus a concrete dam was constructed thirty feet high, with an ogee face, by using the old masonry as a core wall and adding a new concrete apron and rollway, and sealing the back by a thick layer of concrete.

The dam runs across the river for a distance of 130 feet and then turning an angle runs parallel to the river for 210 feet to the waste gate abutments and gate house. From the gate house a dike ten feet high runs back 160 feet to the natural level. The gate house covers the entire forebay and racks, as well as housing the gate irons. A steel bulkhead, with three wooden head gates, shuts out the water from the portion of the forebay leading into the penstock. Slat flooring in the gate house admits air to this chamber and thus relieves the pipe when the head gates are closed.

The waste gates on the dam are operated by an ingenious mechanism, designed by Mr. Rice, by which one man can with ease operate them. The gate stem, instead of having a rack and pinion, consists of a single rod threaded to run through a nut resting on ball bearings in the head of the apparatus, which is operated by a pair of bevel gears and crank, the working parts being encased and protected from the weather.

From the gate house the feeder pipe nine feet in diameter, built of 5/16-in. steel and single riveted with inside and outside sheets, runs downstream along the river bank for a distance of 2,700 feet to the power house. Two lap expansion joints were provided to take care of the expansion and contraction, as a large part of the pipe lies half exposed above ground. For the first few hundred feet the pipe lies on the bottom of the old canal that supplied water to the abandoned mills along the river, and has been entirely buried. Just before the water reaches the wheels it passes through a stand pipe twelve feet in diameter and fifty feet high, which stands near one corner of the power house. It is built of 5/16 and ¼-in. steel. The stand pipe was necessary to relieve the feeder pipe, which is so long that the sudden changes of load upon the water wheels would otherwise produce great strains upon the pipe caused by water hammer.

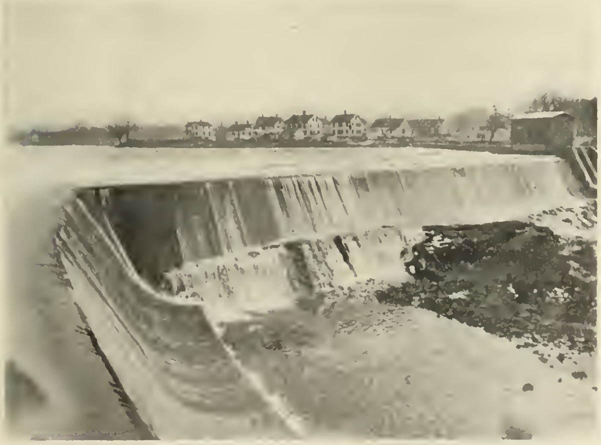


FIG. 2.—DAM AND GATE HOUSE.

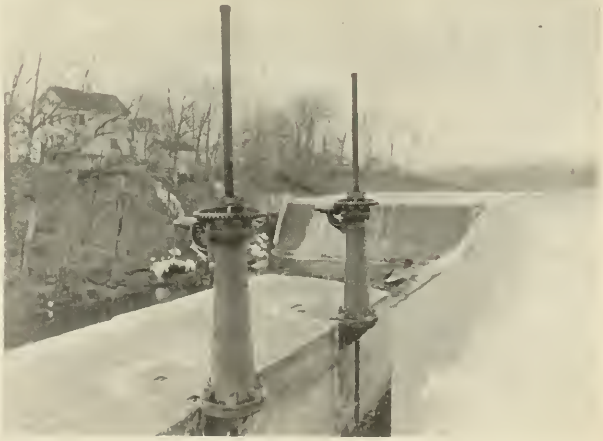


FIG. 3.—DAM AND WASTE GATE IRONS.

From the stand pipe the water passes into the flumes of the two wheel units, which are erected on steel beams and concrete piers in the rear of the power house directly over the tail race, so only the flume head projects into the power house.

The power house is a neatly constructed brick structure 32 feet wide by 48 feet long. The roof is covered with standing seam steel roofing laid on two-inch planking planed and beaded on the under side. The purlins supporting this planking are also finished, and are carried by two steel trusses, the bottom chord of which is twenty feet clear of the floor.

Two tall, broad windows on every side of the building furnish abundance of light, while the large double doors will admit the largest piece of machinery easily. The window sills and underpinning are rock faced cut red sandstone. The floor consists of six inches of concrete dressed on top with a finish coat of neat cement. The generator foundations are large blocks of concrete and the tail-race walls are also concrete.

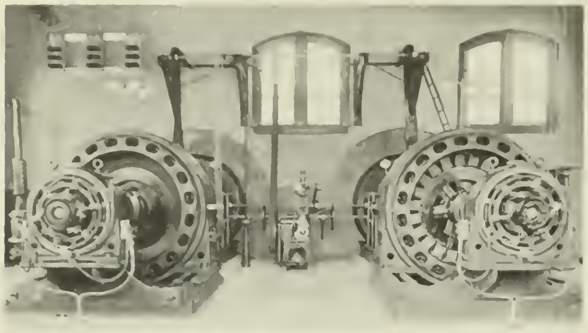


FIG. 4.—TWO UNITS WITH SINGLE GOVERNOR.

The water wheels, designed specially by Mr. Rice, consist of two pairs of 24-in. horizontal turbines, rated at 510 hp each, with a speed of 327 revolutions under a head of 36 feet. Although the total head is 40.5 feet, an allowance is made to draw the storage pond 4.5 feet. On the shaft of each wheel is a momentum wheel six feet in diameter, weighing 5,250 pounds and running with a peripheral speed of 6,164 feet per minute. It is built of steel plates riveted together, and is guarded by a brass railing.

In the governing apparatus of the water wheels a very novel feature has been introduced. One Lombard governor is used to govern the two wheels, whether only one of the two or both are running together. The governor is placed centrally between the two wheels. An overhead shaft with specially designed friction clutch pulley at each end, is driven by a quarter twist belt from each wheel. This shaft drives the pump of the governor, and as the friction pulleys are connected to the same shifter, which is operated by a hand wheel on a vertical rod standing near the governor, the shaft is driven by merely throwing out the friction pulley driven by the wheel that may happen to be not running. A smaller shaft on a level with the wheel shafts and behind the governor is used to drive the speed balls of the governor. This shaft is divided in the middle and each part is driven by a small belt from the shaft of each wheel in a similar way to the pump shaft. The governor balls are driven by a belt that can be shifted from one part of this shaft to the other. It was found necessary to have these two separate shafts, as the jerking of the pump interfered with the driving of the sensitive speed balls by the same shaft.

The gate shaft passes through the governor to the racks of each wheel and has a special lock coupling to disconnect the part operating the gates of the idle wheel. A hand wheel on each part of the gate shaft is used to open the gates of each wheel if one or the other should not be running; then if more power is required and the second unit is to be started, the gates of the idle wheel are opened by means of the hand wheel to the same opening of the first wheel, and the gate shafts connected by means of the lock coupling, when the governor immediately takes hold and regulates the gates to the required load. It is, of course, understood that the generators are then connected on the switchboard when they are in synchronism and run in parallel to carry the whole load. Each wheel is supplied with tachometer and pressure and vacuum gauges.

The generators are direct-coupled to the water wheels. They are Westinghouse make, 300-kw, 6,600-volt, 3-phase, revolving-field, self-exciting type. As shown in the photograph, the exciter is mounted on the free end of the generator shaft, and thus driven at the same speed as the generator. These are 25-kw, 125-volt machines. One exciter is capable of exciting both generators if the other exciter is disabled.

A four-paneled switchboard stands at one end of the building, with which the generators are connected by simple, neat overhead wiring. The lightning arresters are grounded to the penstock.

The transmission line is about three miles long and consists of three strands of copper wire and runs to the Cheney Brothers' mills in South Manchester. Here the 6,600 volts alternating current is transformed to 440 volts direct current and is used to light the entire plant and drive the machine shop, carpenter shop and velvet mills. As fast as they can make the changes to install motors in other departments, the water power plant will be called upon to furnish power to the last drop of water in the river, while the present steam plant will be kept as an auxiliary to furnish power during periods of low water and heavy loads.

Contractor David Waite, of Holyoke, Mass., executed the work of building the concrete dam, the gate house, dike and power house. The American Bridge Company built the steel bulkhead and racks. The Riter-Conley Manufacturing Company, of Pittsburg, Pa., erected the feeder pipe and stand pipe. The Eastern Bridge & Construction Company, of Worcester, Mass., furnished the structural steel work for the power house. The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, built the water wheels with the draft tubes and momentum wheels complete to the generator coupling. The Lombard Governor Company, of Boston, Mass., furnished the water wheel governor. The Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., furnished the entire electrical equipment. Mr. A. C. Rice, consulting engineer, of Worcester, Mass., was designing engineer, and G. R. Stattlemann, of Dayton, Ohio, was resident engineer.

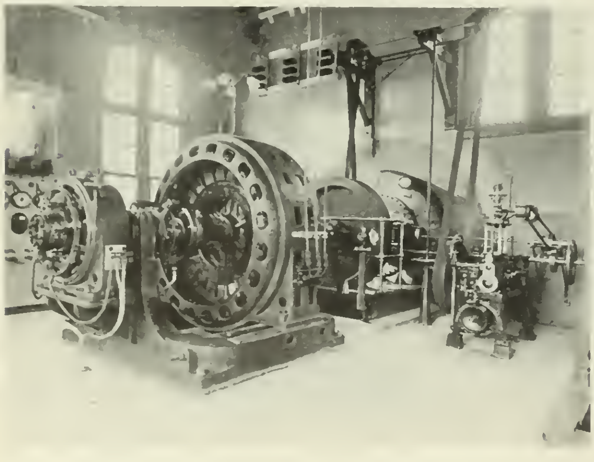


FIG. 5.—SINGLE UNIT WITH GOVERNOR.

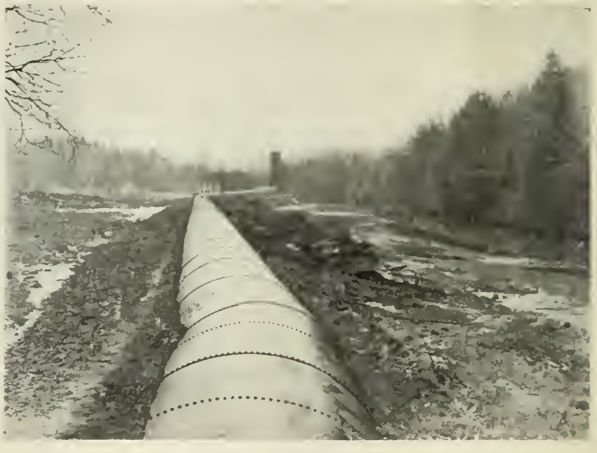


FIG. 6.—PIPE LINE.

Alternating vs Direct Current, as Applied to the Iron and Steel Industry.

By C. H. Hines.

The question of the relative merits of direct and alternating-current in the operation of the varied mechanisms of the great iron and steel mills of the country, is an open one, and while both systems have their ardent advocates the champions of the alternating system are at the present time handicapped somewhat by the fact that there is at present no large mill in this country so equipped, although on the continent of Europe there are several which give the utmost satisfaction. This condition of things is, however, rather owing to the conservatism of the mill managers and to the fact that most of the large installations took place at a time when the alternating current was passing through the experimental stage, than from any actual reason against the same; and at the present one of the largest mills in the country is being equipped throughout with the alternating current.

The conditions to be met with in equipping a steel or iron mill are peculiar, as they present certain characteristics not found elsewhere. In view of the large initial outlay, and the absolute necessity of continuous and efficient service under the most unfavorable conditions, too much care cannot be taken in deciding on what is best suited for the case.

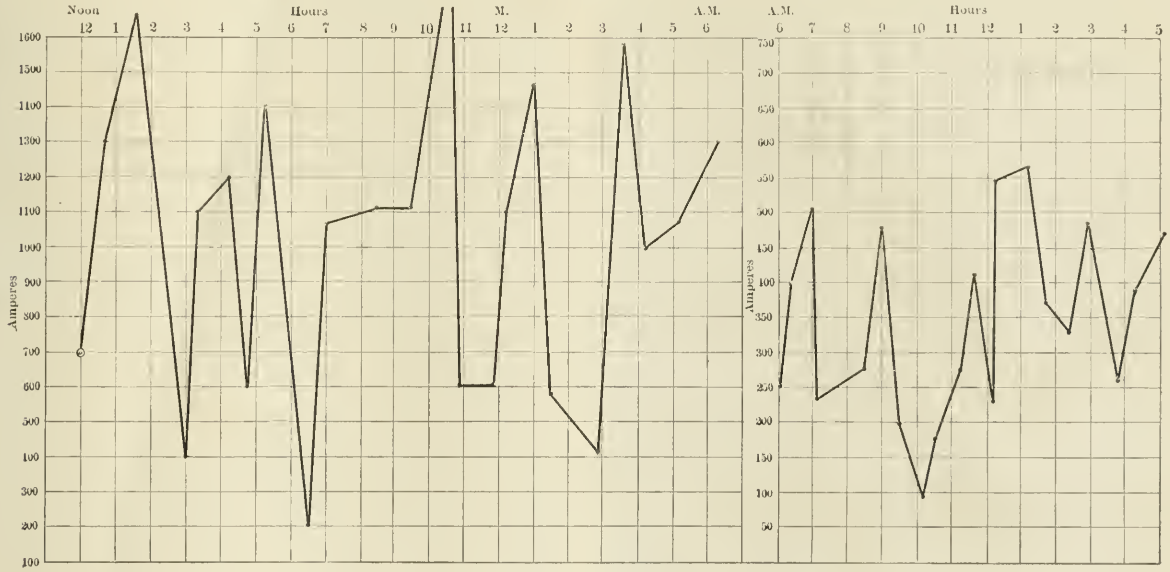
The three principal things to be considered in regard to this class of work are, first, durability; second, efficiency; and last, but by no means least, simplicity. I mean by this that the apparatus must be such as can be intrusted to unskilled labor for manipulation without injury, or the chance of such injury must be reduced to the narrowest possible margin. With these factors always before us, let us now proceed to investigate the especial claims of the two systems.

A large proportion of the motor load in these places will consist of motors requiring a high starting torque and variable speed, and these conditions are more nearly met by the direct series-wound motor. It is right here that the advocates of the direct current base their strongest claim; for while it is quite possible to install an alternating-current motor which will give the desired effects, yet we then introduce a costly and complicated piece of mechanism in the system of control, which runs up the initial cost and adds more apparatus to get out of repair still, when the question of maintenance is brought into the question, then even this costly affair will more than hold its own with the direct-current motor. Now, could we have a series-wound alternating motor there could be no comparison between the two, and when we compare the shunt-wound, direct-current motor and the induction alternating motor, the advantage all lies with the latter. The shunt-wound, direct-current motor is an essentially electrical piece of machinery and its commutator is always a constant source of trouble and expense, while the induction motor is really a mechanical piece of machinery and is the simplest form of a machine devised to perform work known, which will do its work faithfully day after day with little or no attention save oiling. This is a most important fact to be considered, as spare armatures, commutators and the expense of hiring competent men to keep them in condition will run up a high bill for repairs per year, and each spare armature and part represents the lost interest on the money so invested in addition to the money lost caused by delays while repairing or changing armatures. As this affects directly production, the cost may run up into large figures. So we may say as regarding series motors, the alternating current at least holds its own, and as regards direct-current shunt motors, it is by far superior.

Now we come to the question of voltage to be carried. The present practice in such places limits the voltage carried to from 250 to 550 volts, with the preponderance largely in favor of the small figure. This is very necessary, as the wires are exposed to intense extremes of heat and cold, flying iron and steel dust, graphite, and grease, which will quickly deteriorate the best insulation that can be installed; and despite the most careful attention "grounds" are a never-failing source of trouble. Thus it is easily seen that on account of danger to life and property the lower the voltage the better. With this necessary low voltage and the large units of power that are required, the question of copper comes to the front, even though the distance to which power is required to be transmitted is not great. Even in a distance of three or four thousand feet, when as many thousands of kilowatts of power are to be transmitted the cost of copper leaps into the thousands, leaving aside the question of increased expenditure for the pole line, which to be secure will necessarily have to be built of structural iron set in masonry, thus still further running up the bill of costs. There may be thus forty or fifty thousand dollars' worth of copper cables which represents more idle money, not only drawing no interest, but requiring an annual "writing off" for depreciation.

Now we will consider the question of the alternating current at the same low voltage. Although we can in this case dispense with transformers and run our motors direct from our generator, still the same question of copper confronts us. Let us now consider a voltage of 2,200 for our primary line, and the cost of copper drops at once to three or four thousand dollars and the difficulties of the pole line to nothing; and even with the cost of transformers added, the total cost is below that of the lower voltage, the initial voltage on the primary lines is entirely safe and by judicious grouping of transformer banks you have here the perfect system.

I append here the figures of a hypothetical plant embracing both features based on transmitting 3,000 kw of power 5,000 ft., using



Charts of Load Variations.

alternating three-phase currents at 600 volts, a power-factor of 85 per cent., frequency, 25, and using iron poles.

Copper required	18,377,000 circular mils
347,025 lbs. of copper at 14 cts. per lb.	$48,583.50
125 iron poles at $46.20 each	5,775.00
375 iron cross arms at $2.24 each	840.00
65 bbls. of cement at $2.20 per bbl.	143.00
Labor on poles, concreting, etc.	375.00
2250 insulators at 6¼ cts. each	140.62
2250 locust pins, at $14.00 per thousand	31.50
Labor, sundries, spikes, ties, etc	625.00
Total	$56,513.62

Cost of transmitting same power and distance at 2200 volts	$56,513.62
Copper required	1,500,000 circ. mils
28,275 lbs. of copper at 14 cts. per lb.	$3,998.50
100 poles at $4.50 per pole	450.00
100 cross arms at 20 cts.	20.00
300 insulators at 10 cts. each	30.00
300 locust pins at $4.50	4.50
3000-K.W. of transformers at $11.00 per K.W.	33,000.00
Labor, sundries, etc.	150.00
Total	$37,653.00

Cost of transmitting at 600 volts	56,513.62
Cost of transmitting at 2200 volts	37,653.00
Difference in favor of higher voltage	$18,860.62

The above figures may vary slightly in different localities, and with different makers of apparatus, but the saving in cost of the higher voltage over the lower will remain about the same. The figures given for the lower voltage of alternating current may also serve for comparison with the direct current at 500 volts, but in that case the cost would be still greater, so that one can see at a glance the immense superiority of the high voltage alternating over any other form of transmission.

Now, having settled on the question of current and voltage, the next question that arises is what style transmission is best suited to the requirements of the case—whether three-phase or two-phase. The accompanying curves show the load variations taken from a typical plant and from a large number of readings; also a chart of readings from one motor of the type I have described. Here is seen a wider range and more abrupt peaks than even street railway service, and the question of balancing the phases becomes a not very easy task. From a study of these charts it would seem to indicate that a two-phase, four-wire system would be the easiest solution of the difficulty, even though it involve the cost of an extra feeder, as the greater facility of balancing the phases will render it more desirable than the three-phase system.

The above arguments, I think, cover the ground thoroughly as to the respective merits of the two systems, and I am confident that the large plants that may be erected in the future will find that the alternating current will be the equal of the direct in all things and its superior in most of them.

Moving Sidewalk Scheme for New York.

The proposal made by Mr. Max Schmidt, of the Multiple Speed & Traction Company, to Bridge Commissioner Lindenthal is that the city should build the subway under the city from Bowling Green to the new East River Bridge at an estimated cost of $3,200,000, and lease it to the Multiple Company at a nominal rent, the company agreeing to operate a moving platform transit system on the basis of a one cent fare. This proposition is now under consideration by the rapid transit commissioner and pending his report no other proposition will be made.

Since the above proposition was made a law has been pointed out by the rapid transit commissioner, prohibiting the city from making any investment that does not guarantee a return of at least 4 per cent. This will doubtless cause a modification of the company's proposal as to the terms of the lease, but not as to who shall build the subway.

The company has full confidence in the success of the moving platform system of transit, pointing to its success in other cities, and says it is willing to guarantee the city a return of 4 per cent. on its investment, but that it cannot do so on a one cent fare basis.

The Mercury Arc.

By Charles P. Steinmetz.

While the electric motor is rapidly replacing all other methods of power transmission and distribution, due to its greater economy, electric power when used as a source of light is still at a disadvantage regarding economy. That is, as a rule electric power is more expensive than gas or kerosene, and the extensive use of electric light is due rather to its greater convenience, reliability and cleanliness than to its economy. This follows from the fact that the efficiency of producing light from electric power is extremely low, below 10 per cent. in the most efficient carbon arc lamp, and something like 3 per cent. in the incandescent lamp and the Nernst lamp.

It is obvious, then, that if the efficiency of light production could be raised to figures even half as high as that of power production, the electric light would sweep every other illuminant out of existence by its greater economy. These considerations led me some years ago to undertake a systematic research into the method of conversion of electric power into electric light.

The cause of the low efficiency of the present method of electric lighting is the use of heat as intermediary form of energy, which always involves an excessively low efficiency. The efficiency of production of light from heat by incandescence rises with the increase of temperature. But at the highest available temperature—the boiling point of the most refractory substance, carbon—the efficiency is still very low, probably about 10 per cent. for the crater light of the carbon arc.

The attempt to utilize selective radiation; that is the property of some substances to produce an abnormally large percentage of visible rays at apparently moderate temperature, has been successful in gas lighting and has given us in the Welsbach mantel a more efficient gas light But this increase of efficiency was due rather to the very low inherent efficiency of the ordinary gas flame. In electric lighting this principle in the Nernst lamp gives only about the same flux of light as in the incandescent lamp of the same power—one-quarter mean spherical candle per watt. The good feature of the Nernst lamp is the distribution of light rather than the efficiency.

The Geissler tube and the arc were investigated, since none of them follows the temperature law of radiation, but both give selective radiation.

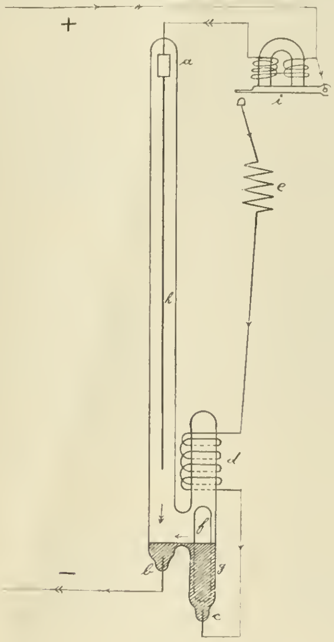
The Geissler tube reaches reasonable efficiencies only at very high frequencies and so appears of no practical value as illuminant.

The spectrum given by luminous gases, as the arc flame, does not vary in wave length and consequently color, with the temperature as that of incandescent solids, but every gas or vapor gives light of certain definite wave lengths, the spectrum of the substance. The substance of which the spectrum is entirely or mostly within the range of visible wave length, would give a very efficient illuminant, while a substance as silicon, the spectrum of which is largely beyond the visible range. is inefficient as an illuminant. Here, then, high temperature of the light-giving substance is not instrumental in increasing the efficiency; but, if anything, higher temperature rather leads to lower efficiency, due to the greater loss of power by heat conduction and convection, etc.

This led to an investigation of arcs and arc spectra, which, while still continuing, has already given results of considerable practical value and great scientific interest regarding the constitution of matter and the phenomena of the arc and arc conduction. A short review only of the work relating to the mercury arc can be given here.

Owing to the poisonous character of mercury vapors, the mercury arc is preferably operated in a vacuum tube. Mercury arcs in a vacuum have been investigated by Dr Arons and others. The great difficulty in their use was found in starting. The common method of starting an arc by bringing the terminals into contact with each other and then withdrawing them, is rather impracticable with an arc several feet in length. Arons and later investigators started the mercury arc by sending a high-voltage discharge of several thousand volts through the vacuum tube, thereby breaking down the vacuum. This method appeared to me impracticable for general use since it practically precludes the use of the mercury arc in series connection, for which it is eminently suitable, owing to its low voltage. On a constant-potential circuit of, say, 110 volts, a mercury arc to consume 80 to 90 volts, would have a length of four to five feet, which makes it rather awkward for use and gives a unit of light greater than desirable for most cases, while in a series circuit tubes of 12 to 18 inches length can be operated efficiently.

This difficulty was overcome by a very ingenious device developed by Dr. Weintraub, of the Research Laboratory of the General Electric Company, which permits starting the mercury arc by means of a small auxiliary arc without any increase of voltage over that at which it operates normally. One of the arrangements of the starting device is illustrated by the mercury arc shown as vertical tube in Fig. 1. It contains a positive terminal, *a*, for which graphite was found the most suitable material, and two mercury terminals, *b* and *c*, closely adjacent and on the same level with each other; *b* is connected to the negative *c* through the solenoid, *d*, and the resistance, *e*, to the positive. At open circuit the mercury overflows and connects *b* and *c*. When the circuit is closed the current first passes through the circuit shown by single arrows. The solenoid, *d*, lifts the iron core, *f*, out of the mercury cup, *g*, and thereby lowers the mercury level so that the circuit between *b* and *c* breaks and a small arc starts in this side branch. This arc in a vacuum instantly flashes up to terminal, *a*, and so establishes the arc in the main tube, *a b*, however long it may be. A carbon filament, *h*, extending from the positive terminal a part of the way down the tube, greatly assists in starting. A cut-out magnet, *i*, in the circuit, *a b*, of the main tube shown by double arrows, may now either cut out the side branch, *b c*, or cut resistance into the circuit, leaving a small arc between *b* and *c*, which greatly increases the stability of the main arc.



STARTING DEVICE FOR MERCURY VAPOR LAMP.

It was found that of all the arcs the mercury arc probably is the most stable. While in the carbon arc with constant arc length the voltage consumed by the arc decreases with increase of current, in the mercury arc the voltage is constant irrespective of the current, so that in constant potential operation the amount of steadying resistance required for the mercury arc is less. The mercury arc is very little sensitive to even wide variation of voltage and current. For instance, since last summer I am lighting my laboratory and conservatory with a number of mercury arcs in series connection, which derive the power from the trolley circuit at the end of a long branch line, where the voltage varies excessively during the time of heavy traffic, between 5 and 7 P. M., fluctuating between 280 volts and 600 volts, while the current varies between 2.5 and 8 amp in the mercury arcs, without causing serious difficulties.

The efficiency of the mercury arc is about two to three times as high as that of the carbon arc lamp and four to six times as high as that of the incandescent or Nernst lamp, and does not vary materially with the current, so that the mercury arc offers an electric light which can be turned up or down without loss of efficiency.

The most prominent feature of the mercury arc is its bluish-green color. This is due to the deficiency of the mercury spectrum in red and orange rays. This feature is objectionable in some cases and advantageous in others, and will probably give the mercury arc a distinctive field of its own. Extended investigation showed that the harmful physiological effects of light, as observed when working for a long time with artificial illumination, are not due to the lower intensity of artificial illumination compared with daylight, but rather to the red and orange rays which predominate in the artificial illuminants. These harmful effects disappear by excluding the red and orange rays. The mercury arc, therefore, is the only known artificial illuminant which is perfectly harmless, and thus especially suited for use where accurate work has to be done by artificial illumination, as in drafting rooms, offices, factories, etc. In this respect it differs from the Welsbach gas light in which the greenish color is due to an excess of green rays superposed upon an excess of red and orange rays, and which, therefore, does not have the same harmless feature.

A strongly noticeable feature of the mercury arc is its penetrating power regarding distance. While the intensity of radiation obviously decreases for all colors proportional to the square of the distance, the sensitivity of the eye with decreasing intensity decreases much faster for red than for green and blue rays, so that the apparent physiological intensity of bluish-green light decreases with the distance much slower than that of red light; that is, of a red and green light of equal intensity the red light will appear much more intense and glaring at a short distance, while the green light will appear much more intense at a greater distance.

For color matching, however, the light of the mercury arc is unsuitable, as is also that of the gas or kerosene flame, only that with the latter the blue appears blackened, while with the former the red appears brown and the blue retains its full brilliancy.

The mercury arc gives specially brilliant effects wherever green is the preponderating color and is thus best suited for suburban street lighting, lighting of country seats, greenhouses, etc. The suppression of the red color gives all vegetation an especially vivid and fresh appearance, and the strong actinic character of the light gives a fluorescent sheen to many substances usually not recognized as fluorescent, such as glass, snow, etc. For indoor illumination in private residences, the mercury arc is, owing to its color, not well suited except when there is added to it the red and orange rays. This, however, lowers the efficiency owing to the inherently lower efficiency of red and orange light.

The mercury arc can be operated on alternating-current as well as on direct-current circuits, though thus far most of the development has been done in the line of direct current. In an alternating-current circuit the current passing through the mercury arc is unidirectional, passing only in one direction, so that any apparatus connected into an alternating circuit through a mercury arc receives a unidirectional current and the mercury arc acts as a rectifier. This feature is of interest in connection with the problem of conversion of alternating into direct-current power.

Stricter Wiring Rules in Chicago.

Since February 1 the Electrical Department of the City of Chicago has ceased to approve of the installation of concealed wires on insulating supports, commonly known as concealed knob and tube work. In all new buildings and in alteration work on old buildings, all new concealed wires must be encased in approved metal conduits. In wiring or re-wiring old buildings not liable to dampness, an approved metallic or non-metallic conduit may be used, provided that the department receives notice before contract is made for such wiring, so that it can ascertain that such portions of buildings are not liable to dampness. The new rule came as a surprise to many electrical contractors, and was based on the lessons taught by reports of electrical fires. There are rumors that even more stringent requirements will soon be made. A committee appointed by the board of underwriters is now preparing new rules for non-metallic flexible conduits, and there is a possibility that such conduits will be required to be fire-proof. Although the new rule at first thought seems to be rather stringent, it is in the line of progress and good work, and will make all wiring safe. There is no doubt that mechanical protection of wiring will go a long ways toward preventing fires caused by defects in the wiring itself.

Parallel Operation of Steam and Water Power Plants.

By Charles Brandeis.

AN interesting parallel operation recently took place in Montreal, Canada, between two and three phase system steam and water power plants, which may be worthy of note.

This event was caused by an unfortunate break in the main dam of the Chambly Power Company, 250 feet of the dam being carried away, causing a complete shut-down of the power house for several months. The Chambly Power Company, situated on the Richelieu River, about 17 miles from Montreal, supplies power to the Montreal Street Railway Company and to the company formerly known as the Royal Electric Company. Two years ago the Chambly Power Company, the Royal Electric Company and the Montreal Gas Works amalgamated under the name of the Montreal Light, Heat & Power Company.

The occurrence of this above-mentioned disaster on November 30th of last year, which deprived, at the season of maximum demand, the City of Montreal of some 20,000 hp, caused a virtual famine of electric power and required the united assistance of all available steam and other water power plants in the neighborhood of Montreal to prevent the necessity of shutting down some of the large and important factories and to give satisfactory service during the peak of the load.

The situation was interesting in that there were no less than 10 steam and water power plants, all situated at considerable distance apart working in multiple, as shown in the diagram. As will be seen, these plants, equally divided, are under the control of two powerful competitors, the Montreal Light, Heat & Power Company, and the Lachine Rapids Hydraulic & Land Company, one company operating on the two-phase, the other on the three-phase system, the Lachine Rapids Company supplying to its competitor 3,500 hp.

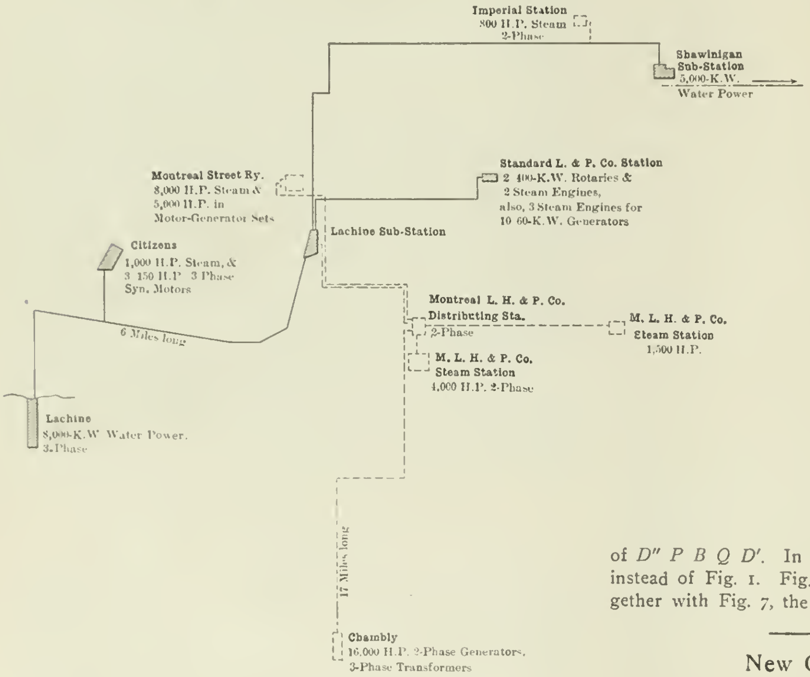


DIAGRAM SHOWING INTERCONNECTION OF THE VARIOUS STATIONS.

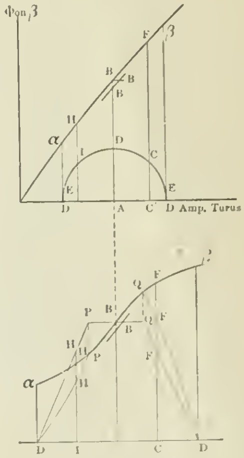
Under normal conditions two-phase current is generated at the Chambly works, which is transmitted three-phase at 25,000 volts and distributed in the city on the two-phase system, using the Scott two-phase three-phase system of connections. The Montreal Street Railway Company receives its power from the sub-station of the Montreal Light, Heat & Power Company, operating five induction and one synchronous two-phase motors, which are direct connected to 500-volt, direct-current generators. During the failure of the Chambly dam the 8,000-hp steam power was used entirely and the direct-current generators operating as motors drove the synchronous as well as the induction motors as generators and thus assisted the Montreal Light, Heat & Power Company.

The Lachine Company generate, transmit and distribute their power entirely on the three-phase system. While assisting their competitor the current was transformed from three-phase to two-phase in the sub-station of the latter and connected in multiple with their system. The latest addition of water power supply for the Lachine Company is that from Shawinigan Falls, which is transmitted at 50,000 volts, three-phase, over a distance of 85 miles. The Lachine Company have the control over this power supply for the Island of Montreal, having leased it from the Shawinigan Power Company, and it is expected that inside a few years 25,000 hp will be taken from this source. The Standard Light & Power Company supplies its customers with direct current, receiving its power through two 400-kw rotary converters from the Lachine Company. These rotaries, however, can be also driven by steam engines supplying power to their customers and at the same time assisting the Lachine Company as was the case during the failure of the Chambly dam. Similarly, the Citizens' Light & Power Company, another plant operated by the Lachine Company, assisted by running their synchronous motors as generators driven by steam engines. The whole system worked admirably together without the slightest disturbance.

* * *

Predetermination of Characteristics.

In the section of the article by Prof. C. F. Guilbert on the above subject which appeared in the issue of December 20, there are several errors. On page 1003, first column, eighth line, read Fig. 8 instead of Fig. 2. In the fourth line read *D″ H″ B F″ D′* instead of *D″ P B Q D′*. In the second column, twelfth line, read Fig. 7 instead of Fig. 1. Fig. 8 was omitted and is printed herewith, together with Fig. 7, the two figures having a common axis.



FIGS. 7 AND 8.

* * *

New German Cable Steamers.

Vice-Consul Harder reports from Stettin: The steamship *Stephan*, recently launched at the Vulcan yards in Stettin for the North German Sea Cable Works at Nordenhamm, is the first vessel built at a German shipyard exclusively for the purpose of cable laying. In the early part of 1903 she will lay out the new transatlantic cable now in construction at the cable works at Nordenhamm. The main dimensions of the ship are: Length over all, 412 ft. 9 in.; beam, 47 ft. 11 in.; depth, 32 ft. 8 in.; draft, 24 ft. 7 in.; tonnage, 4,600 register tons. The whole capacity of the steamer will be 6,050 tons, and she will be able to take 5,000 tons of deep sea and coast cable in four water-tight cylindrical tanks, of which the largest is 43 ft. 4 in. and the smallest 36 ft. in diameter. Two cable engines are fixed on the ship, one for taking in or for repairing a cable already in use and the other for laying the cable.

The Speaking Arc.*

At the meeting February 5 of the Pittsburg local branch of the American Institute of Electrical Engineers, Mr. R. A. L. Snyder presented a communication entitled, "Archophone," and dealing with the speaking arc. The discovery of this property of the electric arc to reproduce speech was first made by Dr. Simon at the University of Erlangen. In the fall of 1897 he found that by making and breaking the current in a circuit paralleling an arc circuit, sounds corresponding to the make and break were reproduced by the arc. Since that time Dudell and Ruhmer have taken up the subject, to which they have added very materially. Dudell shunted the arc with inductance and capacity, and produced the whistling arc. By varying the amount of capacity and inductance he could produce a note of any desired pitch. Ruhmer, following Bell's photophone principle, used a searchlight for transmitting the light waves from an arc lamp to a selenium cell, a telephone receiver and battery being placed in series with the selenium cell. By this arrangement speech can be transmitted for a considerable distance by means of the light waves. The Electrical World and Engineer of December 20, 1902, contained an article by Mr. A. Frederick Collins describing how Herr Ruhmer transmitted speech by means of light waves to a distance of 12 miles and in a very satisfactory manner. Dr. K. E. Guthe, at the University of Michigan, gave an exhibition of a speaking arc before the University Engineering Society, March 28th, 1902. He claims to have discovered that the sound continues a short time after the arc is blown out.

The lamp exhibited by Mr. Snyder was an ordinary Schuster hot wire arc lamp, working on 110 volts, direct current. In series with the lamp was an impedance coil shunted by an ordinary solid-back transmitter. The lamp and coil were shunted by a condenser. The positive carbon is a special kind, being impregnated with foreign substances to produce a longer and more uniform arc. In the arc formed between ordinary carbons there is a great fall of potential close up to the positive carbon. In the arc formed between impregnated carbons there is a more uniform drop of potential all the way across the arc. Fig. 1 shows a diagram of the circuit.

A number of arrangements have been suggested for the speaking arc circuit, but none with a condenser-shunt, which adds very materially to the results. An attempt has been made to make an alternating-current arc reproduce speech, and though the results were reasonably good, it sounded as if the speech were confused with the notes of a jew's harp.

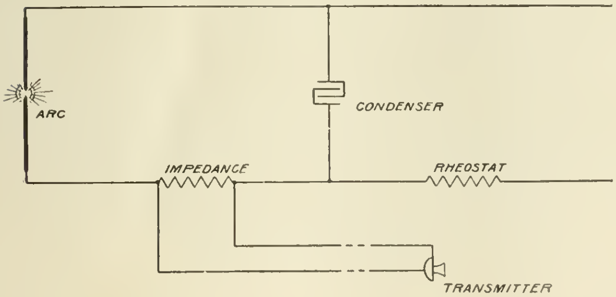


DIAGRAM OF CIRCUIT.

Several theories have been advanced as to what causes these sound waves to issue from the arc. The most logical explanation appears to be the one assigning the cause to the sudden expansion and contraction of air due to variations in the temperature of the arc. In speaking into the transmitter the sound waves strike the diaphragm, causing the current to pulsate in the transmitter circuit, and this pulsating current sets up similar pulsations in the arc circuit. The temperature of the arc varies as the square of the current passing through it. As the arc is composed principally of carbon-vapor in a high state of molecular vibration, it has a very low specific heat. The temperature of this vapor varies almost instantly with the current. When the current is pulsating, the temperature of the arc is raised or lowered correspondingly, and the volume of vapor is increased or diminished in accordance with its temperature. Hence the volume of the vapor increasing and diminishing sets up sound waves in the surrounding air.

This discovery may be utilized in the near future to enable a speaker to address great audiences with but little effort. This can be done by the speech waves from a transmitter circuit being impressed upon the field of an arc light generator. All the lamps supplied by this machine will reproduce the speech. Besides being of use in addressing large audiences and transmitting wireless telephone messages, the value of the archophone as an advertiser is obvious. Thunder, one of the loudest known sounds, is produced by the electric arc.

Some Recent Electrical Patents.

During the past several months ten patents have been issued to Albert G. Davis covering a considerable range of invention. Six of the patents relate to phase transformation, the applications having been filed June 25 and September 28, 1897. The other four have as subjects a rotary transforming device, a variable-speed, direct-current motor, a frequency compensating means for electric meters and a regenerative system for electric traction, the dates of application being respectively May 26, 1900; March 29, 1902; March 29, 1902, and May 21, 1900.

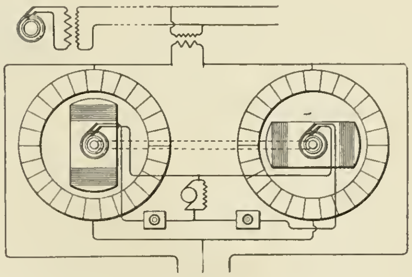


FIG. 1.—CONVERTING SINGLE-PHASE CURRENTS TO POLYPHASE CURRENTS.

In one of the methods described for converting from single to polyphase, two synchronous motors (Fig. 1) have their direct-current members, which are the revolvable parts, connected together rigidly at an electrical angle of 90°. The two legs from a single-phase circuit form the outer sides of a two-phase circuit. Connection with one of these legs is made to the primary of one motor and with the other leg to the primary of the second motor; opposite these connections, both motor windings are tapped and a common connection made to the conductor forming the third conductor of the two-phase circuit. Another method is illustrated in Fig. 2, where B_2, B_3 are two angularly displaced windings on a single core, connected in series as shown. C is the secondary member, consisting of a short-circuited rotor. When once started the device will run as a single-phase induction motor, but as the two windings are dephased, they will form part of a polyphase system. The condenser, K, is used in starting.

Still another form is shown in Fig. 3. E is the exciter of the field, F, which is driven at synchronous speed or by the action of the resultant field of B, C. B and C are two coils at right angles connected as shown with the single-phase source and the polyphase circuit. A modification of the latter (Fig. 4) consists of a stationary member with a short-circuited winding, and a revolvable member with four salient poles. The four coils on these poles are interconnected and also connected to four collector rings; two of the latter are connected to brushes from which two sides of the polyphase circuit proceed, the other pair of brushes being connected to the single-phase source. Another patent shows a still further modification in which there is a common short-circuited member and two separate structures carrying the phase-displacing windings, and a third structure carrying the inducing windings. The patents describe details of starting. The advantage claimed for this method of phase transformation is that any change in the load of the secondary system will, at most, produce a corresponding change in each of the secondary circuits and will not affect their relative phase angles. An adjustment of the phase relation of the e.m.fs induced in the secondary system is provided.

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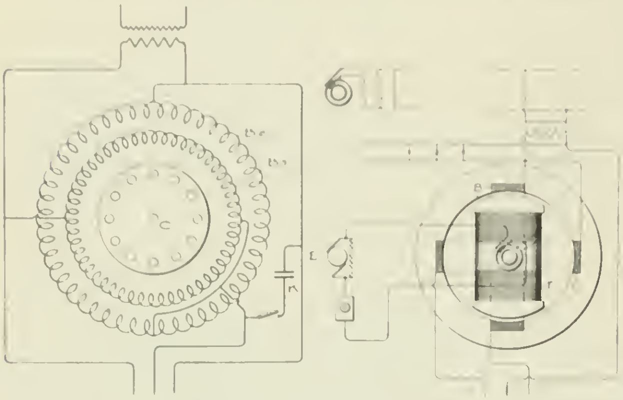
* A paper read at the 4th meeting of the Local Branch of the American Institute of Electrical Engineers, held at Pittsburg, Pa.

The patent entitled "Rotary Transforming Apparatus" relates to a rotary converter which admits of any desired ratio of conversion. Referring to Fig. 4, which shows a converter with a revolvable field, the essential features are the double magnetic elements of the stationary part, one carrying a primary winding connected with the polyphase source, and the other a secondary winding connected with the commutator. Means are provided for varying the length in circuit of the primary coils, thereby varying the direct-current voltage. The patent describes the principle applied to a stationary field and rotating primary and secondary coils.

The variable speed electric motor, which forms the subject of a patent, is of the class for driving machine tools, printing presses, etc. A small motor-generator is employed of about one-tenth the capacity of the working motor. The latter is of the ordinary direct-current type and by means of its controller first takes current from the motor-generator; after a predetermined speed is reached the motor is connected directly to the line and the motor-generator stops running. The controller gives 13 speeds, of which five are with the motor-generator in circuit—the control of the main motor being through armature and field rheostats.



FIGS. 2 AND 3.—CONVERTING SINGLE-PHASE CURRENTS TO POLYPHASE CURRENTS.

The patent on frequency-compensating means for electric meters relates to the use of a circuit containing capacity and inductance whereby changes in frequency are compensated for. For the normal frequency the capacity and inductance have such a relation that there is no compensating effect. If, however, the frequency changes either above or below normal, their relative effect is altered, the inductance preponderating upon rise of frequency and the capacity upon fall of frequency. This circuit is shunted about one of the meter current coils, and the difference of phase which it may produce with respect to its companion coil results in a correcting torque on the damping disc.

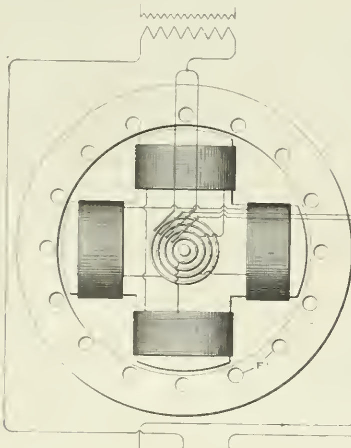


FIG. 4.—ANOTHER FORM OF ROTARY CONVERTER.

The regenerative system patented is particularly adapted for use with modern high speed motor cars or trains employing a number of motors. Its principal object is to return to the supply line energy when the car or train is being retarded. Another application is in starting a car or train from a station without the resistance ordinarily carried for the purpose of varying the e.m.f. impressed on the motor circuit. Three additional contact rails are required on the track, and certain apparatus located at one or more points along the line. In one modification this consists of an alternating-current motor-generator set, the field of the direct-current generator being varied by electrically-operated means at the fixed point and controlled from the moving vehicle. To maintain a constant feed for the car-motors when acting as generators, a shunt-wound generator is mechanically coupled to the motor-generator. A storage battery might be substituted for the latter. This combination permits of the transformation of the constantly-diminishing e.m.f. generated by the motors of the vehicle, acting as generators, into a practically constant e.m.f. counter to and greater than that of the line, so that a current will continue to flow from the generators on the cars to the line until the car is brought almost to a full stop. The function of the shunt-wound generator or storage battery is to keep the fields of the car motors practically constant, independent of the line voltage, while the motors are acting as generators. The trolley or third rail is required to be divided into sections, an advantage of which is that with the present arrangement there can be no collision with a car standing still at a station.

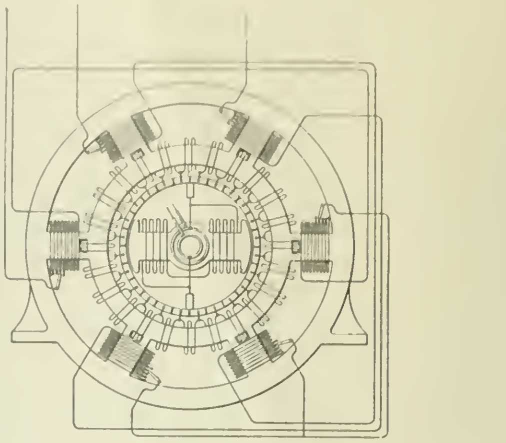


FIG. 5.—CONVERTER WITH REVOLVABLE FIELD.

New Telegraph Competition.

News from the West states that immediate competition with the Western Union and Postal Telegraph Companies in commercial business, and ultimately competition with both of those companies in general telegraph business is the purpose of a new telegraph company which has been organized quietly in the interest of St. Louis and Chicago capitalists.

Absorption of all leased lines which may be released at lower rates, the use of their lines for telephone purposes, which it is declared will bring all of the independent lines in the territory covered by the new company into Chicago, and an attempt to control all the Board of Trade and stock exchange business in the West, are further intentions of the concern.

The work of the new company has progressed so far that the promoters have already secured options on the Chicago & Milwaukee Telegraph Company, operating between Chicago and Milwaukee, the National News Telegraph Company, an Illinois corporation, and a short line which now enters St. Louis.

The Orthwein family of St. Louis is credited in dispatches from that city with the promotion of the deal, and they, with their associates in Chicago, whose names have not yet been given out, will endeavor to furnish a complete commercial service between Milwaukee, St. Louis, Chicago and Kansas City.

The Construction of Aerial Telephone Lines—IV.

By Arthur V. Abbott, C. E.

COST OF OPEN WIRE LINES.

The cost of constructing open wire telephone lines is probably the most difficult item to estimate of all the various parts of the telephone plant. This is partly owing to the absence of any real and definite standard type of construction and partly to variation in prices that obtain in different parts of the country for the various materials used. The city line must be built to carry a greater number of wires than is usually necessary in cross-country lines, and must be designed with the view, ultimately, of carrying perhaps several aerial cables. In addition to greater strength, city lines must present a much better appearance than is demanded in country work. Wages and price of materials in cities are often considerably higher than in country districts. Rights of way are more expensive and more difficult to obtain, and greater delays are frequent during construction. For such reasons the city line is considerably more expensive than that constructed in the country. The chief items composing open wire line cost are poles, cross arms with pins and insulators, wire and labor of erection. To aid in the estimation of open wire costs six tables in graphical form are prepared. Table 2 gives the cost of single poles, and the cost per wire mile of various sizes of copper wire (at various prices of copper per pound) erected in place including cross arms, hardware, pins, insulators and labor of erection. Holding this table with the point *A* in the lower right-hand corner, a scale marked "Pole Cost in Dollars" is found on the left hand. On the bottom there are two scales reading from 25 to 65 in both directions denominated "Height of Poles in Feet." In the body of the table there are nine curves, *A, B, C, D, E, F, G, H* and *I*, by means of which the cost per pole of various kinds, sizes and lengths can be calculated. The kinds of poles to which these curves apply are as follows:

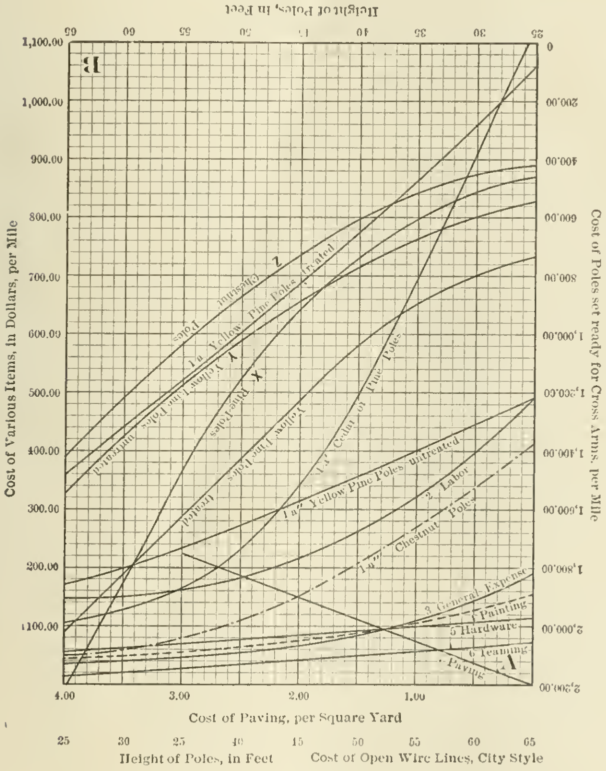


FIG. I.—TABLE OF DATA FOR ESTIMATING COST OF POLE SETTING.

A Southern cedar, delivered in Northern States, 7-in. top, best quality.

B Northern pine or cedar, 8-in. tops, delivered in Middle Western States.

C Southern cedar, 7-in. tops, delivered in Northern States, ordinary quality.

D Chestnut, 7-in. tops, delivered within wagon haul of point of cutting.

E Southern cedar, 6-in. tops, delivered in Southern States.

F Yellow pine, 7-in. tops, delivered in Northern States, untreated.

G Yellow pine, 8-in. tops, delivered in Northern States, untreated.

H Yellow pine, 7-in. tops, delivered in Northern States, creosoted.

I Yellow pine, 8-in. tops, delivered in Northern States, creosoted.

Example: To find the cost of a chestnut pole 40 feet high, 7-in. top, a vertical from 40 on the lower scale to Curve *D*, thence a horizontal to the left-hand scale finding $3.40. The "Height of Poles," scales should be read from left to right for Curves *A* to *E* inclusive, and from right to left per curves *F* to *I* inclusive.

By turning the sheet around so that the point *B* is in the lower right-hand corner, the curve per cost of wire can be read. The lower horizontal scale is "Price of Copper per Pound," and should include delivery at nearest railway stations. The left-hand scale is "Cost per Wire Mile for Wire, Pins, Glass and Cross Arms erected." Carriage bolts, lag screws, braces, etc., are included and labor of stringing, putting up and tieing. Two sets of curves are given, one set for copper wire and from No. 6 to 14 inclusive B & S gauge, indicated by full lines, and one set in dotted lines for Nos. 7, 8 and 9 B. W. G. The best quality of standard ten-pin yellow pine cross arms (untreated, but painted) is assumed. If common pine arms are used, deduct $3.75 from the cost of any mile of wire. Thus the cost of a mile of No. 8 B. & S. wire at 14 cents per pound is found by following a vertical from 14 on the lower scale to the curve headed No. 8, B. & S., thence a horizontal to the left-hand finding $43.80. If common arms are used deduct $3.75, giving $40.05 per mile.

Tables 1 and 3 contain the data for estimating cost of poles set, ready for cross arms and wire. Table 1 is calculated for city lines and Table 3 for country lines. Holding Table 2 with *A* in the lower right-hand corner, the lower scale is "Height of Poles in Feet," while the left-hand scale gives the expense of the various items comprised in the cost of a mile of poles ready for arms. These curves are based on wages at $1.75 per day, and $3.25 per day for teaming. The expense of poles set, ready for arms, is divided into 7 parts.

1st. The Cost of Poles.
2nd. Labor.
3rd. General Expense.
4th. Painting.
5th. Hardware.
6th. Teaming.
7th. Paving.

Curves 1*A'*, 1*A''* and 1*A'''* give the total cost per mile for poles only. Curve 1*A* shows the cost of creosoted yellow pine poles, 1*A'* northern pine or cedar, 1*A''* yellow pine poles uncreosoted and 1*A'''* chestnut poles. Curve 2 gives the labor expense. This includes pole inspection at point of delivery, shaving, framing and other carpenter work to prepare the pole for setting; labor of loading and unloading from teams; the removal of pavement and digging the necessary holes; the refillment of the hole and tamping of the pole after setting and the temporary replacement of the pavement. Curve 3, "General Expense," includes all items which cannot be properly classified under any of the other headings, such as cost of supervision, car fares for workmen employed, office expenses, etc. Curve 4 is devoted to painting, giving the cost of painting the poles two coats of lead in linseed oil with a coat of black paint, 6 feet high from the ground. Curve 5, headed "Hardware," is the cost of pole steps, protection strips, butt guards, wheel guards, etc., etc. Curve 6, headed "Teaming," is the cost of all teaming, including hauling of poles, tools, machinery, etc., to and from the line location. Curve 7, headed "Paving," gives the cost of necessary repaving around the excavation made in which to place the pole. As the cost of paving is itself variable, this curve must be read by aid of the supplementary horizontal scale, headed "Cost of Paving per Square Yard." The prices on this scale run to $3, and the cost of repaving per mile of poles is found by taking the cost of paving per yard on the lower scale, following a vertical to Curve 7 and thence a horizontal to the left-hand scale. For example, at $2 per yard the cost of paving for one mile of poles is found by following a vertical from $2 on the lower horizontal scale to the Curve 7 and thence a horizontal to the left-hand scale, finding $150. By inverting Table 2 so that *B* appears in the lower right-hand curve a set of four summation curves are found showing the complete cost of all the preceding items per mile of poles set ready for arms. Four curves are given—*W X Y* and *Z*—respectively, applying to yellow pine poles treated, northern pine or cedar, yellow pine poles untreated and chestnut poles. For example, to find the cost of a mile of poles, ready for cross arms, select the height of the pole on the lower horizontal scale, follow a vertical till the curve of the kind of pole to be used is found, and thence a horizontal to the left-hand scale. Thus a mile of 50-ft. poles of

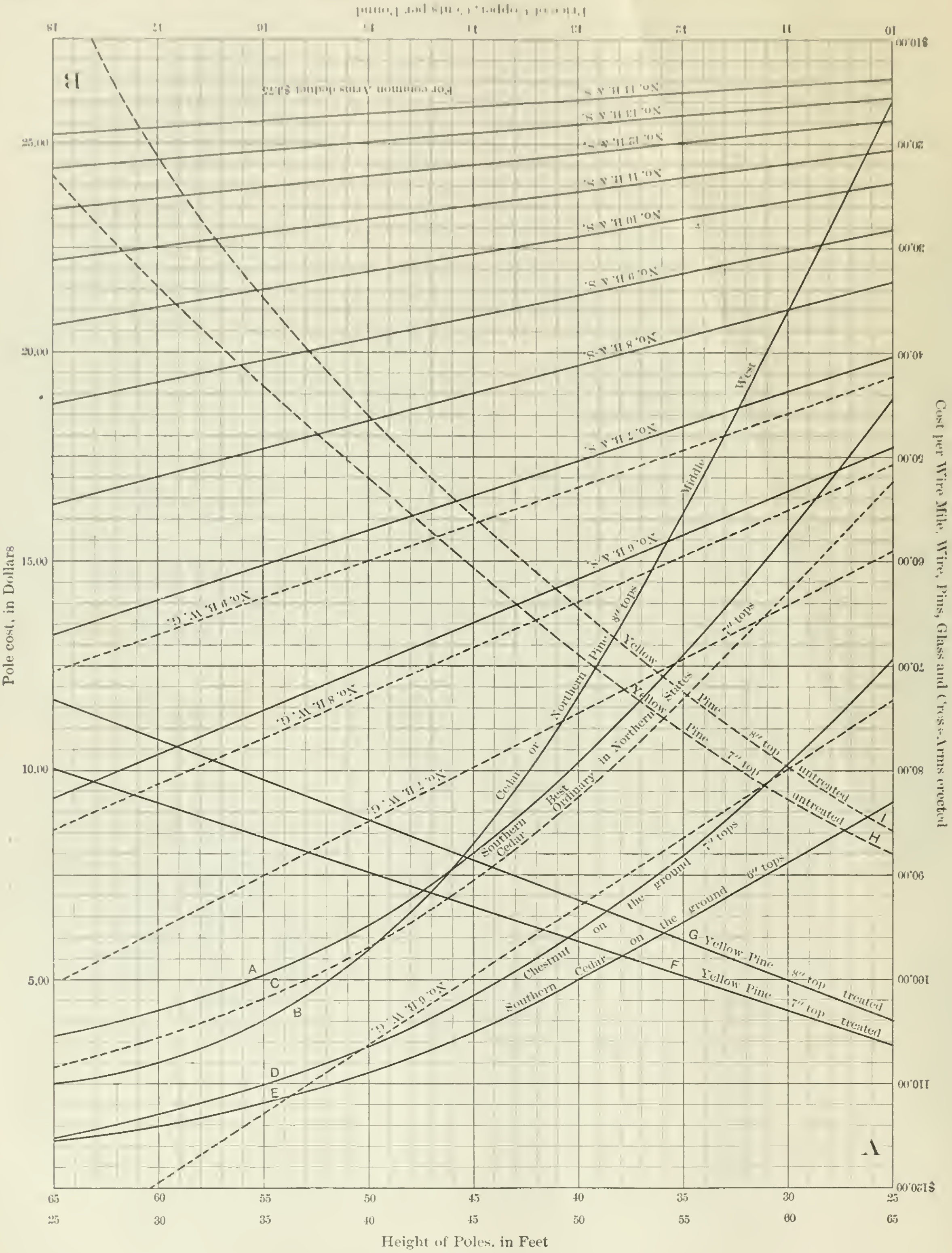


Fig. 2.—Table Showing Cost of Poles, Wires, Etc.

yellow pine, creosoted, will cost $1,412; of northern pine, $1,148; of yellow pine, untreated, $1,024; of chestnut, $868.

Table 3 is arranged in precisely the same manner but applies to country style pole lines. Holding this table with *A* in the lower right-hand corner, the lower scale is "Height of Poles in Feet" and the left-hand scale "Cost of various items in dollars per mile." For country lines there are only four items:

1. Poles.
2. Labor.
3. Teaming.
4. General expense.

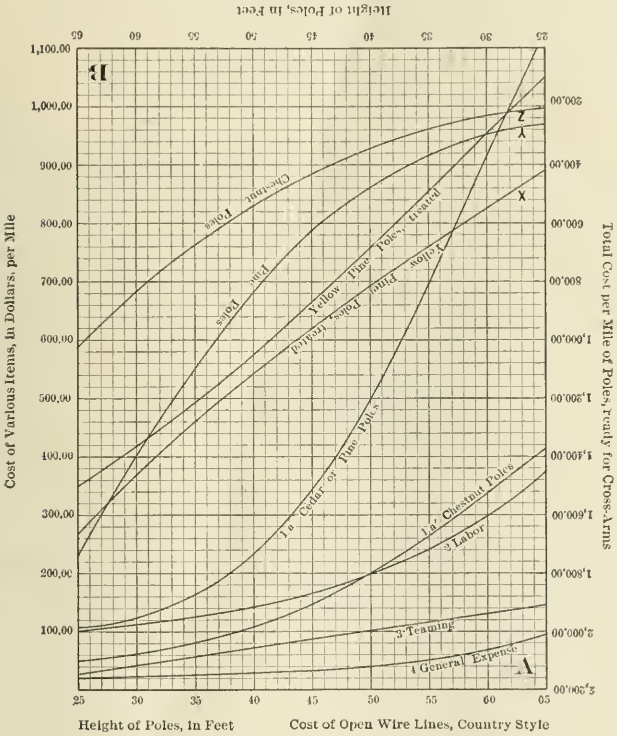


FIG. 3.—DATA FOR ESTIMATING COST OF POLES SET FOR CROSS ARMS, ETC.

Curves for two varieties of poles, 1*A* northern pine or cedar poles and 1*A′* chestnut poles are given. Curve 3 gives the labor cost, Curve 3 that for teaming and Curve 4 the general expense, and for these the same explanations apply as have been already given for Table 1. By inverting Table 3, so that *B* is in the lower right-hand corner, the total cost per mile of poles, ready for cross arms, is found. Three curves are here given—*X*, *Y* and *Z*—applying respectively to lines constructed of yellow pine treated, northern pine or cedar and chestnut poles. Thus a mile of 45′ chestnut poles is seen to cost $428, a mile of 45′ pine poles $628, and a mile of treated yellow pine $960.

The information thus presented in Tables (Figs.) 1, 2 and 3 will enable the reader by selecting such items as may be desired to calculate with great rapidity and by means of a few simple additions the cost of almost any kind of open wire line in any location.

Nebraska Independent Telephone Interests.

The managers and superintendents of the independent telephone exchanges in the southeastern part of Nebraska held a meeting in Nebraska City on February 7 and organized the Southeastern Nebraska Telephone Association. The object of the association is to bring about a system of uniform rates over all of the independent lines in that part of the State. The following officers were elected: A. E. Gantt, Falls City, president; T. H. Pollock, Plattsmouth, vice-president; A. M. Munn, Nebraska City, secretary. The three officers, with J. C. Killarney, of Auburn, and C. N. Kadus, of Stella, will compose the Executive Committee. The next meeting of the association will be held at Falls City.

Cooper Hewitt Interrupter.

Each advance of wireless telegraphy has emphasized the inefficiency of the spark-gap interrupter, and this element has threatened to be the weak factor in the commercial development of aerial transmission. In the Marconi transatlantic experiments the power required at the disruptive gap was enormous in comparison with the presumable quantity of energy radiated from the antennæ, and a serious incident of the great local disturbance thereby set up has been the adverse effect on telephonic service over a wide range, which forecast trouble for the exploiters of commercial wireless telegraphy. It is, therefore, a matter of unusual interest to learn that an interrupter for an oscillating circuit has recently been devised which not only very greatly reduces the draft on the source of electrical energy but possesses most valuable properties with respect to exact control, and at the same time is extremely simple in form and application.

In wireless telegraphy the spark-gap oscillating circuit has heretofore been employed, either in connection with the simple induction coil or the disruptive gap. In his studies on the mercury vapor tube, it occurred to Mr. Peter Cooper Hewitt that the "electric valve" property of the vapor tube, which property he has employed in his static converter, could be applied to the oscillating circuit. This application he has succeeded in carrying out in a most successful manner.

Briefly stated, the spark-gap of the oscillating circuit is replaced by a mercury vapor tube in parallel with a condenser. Assuming that the immediate source of electrical energy is a transformer, in the transformer secondary in series are a condenser and the primary of the antennæ-ground circuit, the condenser being shunted by a vapor tube. The tube does not differ in principle from the usual Cooper Hewitt vapor tube, though naturally of a somewhat different form, owing to its different application, and the nature of the work to be performed. The transformer secondary voltage may range between 10,000 and 20,000 volts.

The fundamental advantage of this interrupter is the enormous speed of interruption that may be attained, and the absolute control of this speed. Moreover, by proper design and adjustment, any given rate of interruption can be secured. With the disruptive spark there is a limit to the efficient rate of interruption fixed by the time required for the condenser to clear itself, and this rate, as well as the total effect, is variable, owing to the mobility of the arc, the condition of the knobs with respect to polish, etc. This latter consideration does not apply to the mercury electrode surface, and the vacuum discharge is not subject to similar fluctuations. It follows that with this new type of interrupter it is possible to create and maintain continuously oscillations of an absolutely definite character, the great importance of which consideration with respect to wireless telegraphy is obvious.

The practical advantages of the interrupter are no less evident. The efficiency is very high, the loss being about proportional to the drop of about 14 volts in the tube, and in a circuit of 10,000 volts this amounts to a but small fraction of one per cent. The device, consisting merely of a glass tube or bulb with sealed-in electrodes, is inexpensive, and in case of breakage can be immediately replaced by another in the same manner as an incandescent lamp.

Telephony in Washington, D. C.

The long-standing trouble between the Bell telephone system and the local subscribers in Washington, D. C., has been satisfactorily settled by General Manager Bethell, whose régime has been marked by a noteworthy improvement all along the line. The Subscribers' Association will drop all its 100 suits against the Chesapeake & Potomac Company as to rates and grades of service and will receive $10,000 to offset its claims. The company agrees also to rebate half of the suspense accounts, making another $10,000, and the question of new rates is left for the future development to determine. Mr. Bethell has announced that the plans of improvement for the next two years involve the expenditure of about $1,000,000. Out of the 2,000 subscribers in Washington, the burden of the fight had been borne at last by only 200, and all the commercial interests of the District have recorded their support of the arrangement and of the progressive attitude of the company.

New Telephone Patents.

If the necessity for an article may be judged by the number of patents providing for it, then surely the need for some antiseptic screen, gas or solid, for telephone instruments is very great. Indeed, with the patent issues as a criterion, by this time a large proportion of the population should be suffering from some disease "transmitted by telephone." Fortunately, this telephone infection seems to be largely an output of the imagination; nevertheless, the inventors of antiseptic appliances go right on with their work, the latest production being a form of the "sheet-of-paper" type of protector embodied in a patent issued to S. G. Ballard. This device is a holder for sheets of paper arranged to clamp upon the transmitter so that a fresh sheet may be dropped in front of the mouth piece before each conversation. The patent is chiefly concerned with details of construction, but it is rather interesting to note in the specification that the inventor lays almost as much weight upon the value of the sheets of paper as advertising space as upon their antiseptic value.

In two patents issued to Mr. Edward E. Clement, of Philadelphia, there is an interesting application of the coherer to "wire" telegraphy and other long-distance signaling, such as telephone calling signals. In this system a coherer of large current-carrying capacity and of a very high normal or decohered resistance is so related to the line that it serves directly as the controlling switch or contact of the local signal apparatus, when acted upon by a high potential discharge, received either directly or indirectly from the distant station by means of the main line wires. In one patent the use of such a system at common battery subscribers' stations in lieu of the usual condenser, is described, while the other patent deals with the general application of this method of signaling.

Considering the latter patent first, Fig. 1 will illustrate the general principle, this showing one of the many ways of using the system which have been devised by the inventor. Here C^1 represents the coherer, preferably a glass tube containing rather large-sized iron and nickel filings, mixed. The wires of the main line are represented by 1 and 2, while the local circuit is 25, *b' L*, 24, *V*. When the key, *K*, is depressed a current flows through the local and line circuits in series, thereby magnetizing the core in *U*. When the key is released the discharge of the electromagnet is sufficient to cohere the particles of *C*, when battery, *b'* operates the local signal. When this local signal is a telegraph sounder, the decoherence will be accomplished by the sounder. When, however, the signal is a telephone switchboard line lamp, Mr. Clement proposes to operate a tapper in connection with the switchboard jack, mounting his coherer, for this purpose, immediately below the jack in such a manner that the insertion of a plug will operate the tapper.

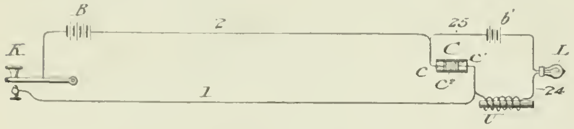


FIG. 1.—CLEMENT SIGNAL SYSTEM.

In the use of the coherer in lieu of the subscribers' station condenser, the former is associated either directly or indirectly with the hook switch, or is mounted upon the magneto bell frame. It is wired directly in series with the ringer, the two being then bridged across the line. The normal twenty-odd volts direct current of common battery practice is not sufficient to cohere the filings, and decohered their resistance is said to be about one-tenth megohm. When, however, the alternating ringing current of seventy volts is applied to the line, the resistance of the coherer is reduced to forty ohms and the bells ring. The act of removing the receiver from the hook switch or the operation of the ringer armature, according to arrangement, shakes the coherer and decoheres it.

It is difficult to state with certainty the future of such a novel system, but it may be said with safety that a great deal of refining will be necessary before the coherer will be applicable to telephone working with even a small fraction of the reliability of the relays and condenser it attempts to supersede.

As a means of reducing the mutual capacity of the wires of a telephone line run in cable, Mr. R. F. Hall has devised a paper spacer to be wound with the wires of a telephone cable, having twisted pairs according to usual telephone cable practice. In this cable the paper spacing strip is corrugated transversely so that it forms a connected series of U's. The bottoms of these are cemented to a paper backing strip, somewhat wider than the U strip. When the paper-insulated wires are to be twisted in pairs, they are placed one on each side of the corrugated strip, lying in the corners between it and the backing strip. By this means the backing strip serves, after twisting, to hold the several parts together, while the spacing strip holds the wires apart. Mr. Hall has assigned his patent to the Western Electric Company.

In a patent granted to C. H. Thordarson, of Chicago, an improvement in telephone magneto bells is described. This improvement consists in making the polarizing magnet of two parts, held together by a clamping screw passing through an elongated hole or slot in one of its portions. By this means the length of the polarizing magnet may be varied, this in turn varying the air-gap between the free pole and the armature, and thus facilitating adjustment of the polarizing field.

A "Telephone Transmitter" is the subject of a patent issued to Frank S. Tucker, of Boston, and assigned to the Electric Gas Lighting Company. The improvements described are mechanical in nature and may be best described by reference to Fig. 2. The bridge piece which supports both the diaphragm and button has upon its ends projections, *d*, which are adapted to engage in a groove, *c*, in the transmitter front. In assembling one end of the bridge piece is inserted in the groove, when the other is pressed in position through a slot provided for that purpose. The case is then given a part revolution, thereby locking the whole in position.

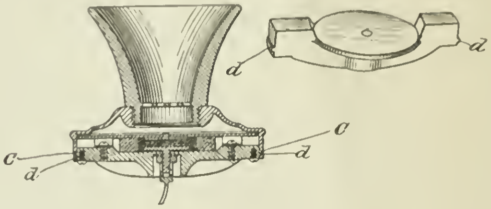


FIG. 2.—TUCKER TRANSMITTER.

The last patent of the issue of February 10, relating to telephony, is entitled "Telephone-Protecting Device," and has been granted to G. R. Bonham. This apparatus consists of the equivalent of a knife switch to be inserted in a telephone line just before the subscriber's premises is reached. This switch has no hinge, and the blades are so shaped that when locked together manually the main line wire pulling one way, and the subscriber's wire pulling the other, will be insufficient to cause the switch to open. A cord is, however, extended through the house wall to the telephone instrument and in case of a storm coming up the blades may be separated by an additional pull put upon the cord. This device will certainly open the circuit wide enough, as the wires will fall to the nearest support; but after the storm—"Who will put them up again?"

Ohio Independent Telephone Companies.

A meeting of representatives of independent telephone companies of Ohio was held in Cleveland on February 7 for the purpose of establishing a more potent "Community of Interests" among themselves. An organization was effected under the name of the Independent Telephone Traffic Company of Ohio. Membership will be limited to the heads of independent telephone companies, and no member will be permitted to own more than ten shares.

It is explained by one of the most active promoters of the new concern that it will be a straight business enterprise. The company will, among other things, purchase for its members supplies of various kinds, and although this branch of the business has not yet been fully organized, it is not intended that it shall interfere with the business of manufacturers of telephone apparatus or construction material. Among other advantages offered by the association will be the employment of engineers for the purpose of working out uniformity of practice and construction. There will be a central clearing house for toll business, and each company will receive its pro rata of the receipts for the business passing over its lines. A department will be maintained for the distribution of information to members, and a "bad debt exchange" will also be established.

There were present at the meeting representatives of 47 companies. It is thought that a large majority of the independent companies in the State will become members of the association. The first meeting will be held in Cincinnati some time during May next. A press committee will be formed for the purpose of giving out such information relative to the meetings as shall be deemed advisable by the officers.

The following officers were elected at the organization meeting: President, W. Gilbert Thompson, Lebanon, Ohio; first vice-president, Judge Crissinger, Marion; second vice-president, H. C. Devin; treasurer, A. V. Hageman, Lorain. The directors are G. P. Thorpe, F. L. Beam, Carl Curtiss, R. E. Hamblin and H. H. Robinson.

CURRENT NEWS AND NOTES.

CHICAGO ELECTRICAL ASSOCIATION.—At the meeting of the Chicago Electrical Association on February 20, in the Monadnock Building, Mr. H. H. Brinckerhoff, general manager of the Metropolitan West Side Elevated Railway Company, of that city, is to discuss third-rail methods, with illustrations.

OFFICIAL WIRELESS TELEGRAPHY IN FRANCE.—A special cable dispatch from Paris of February 9 says: The *Journal Officiel* publishes a Presidential decree stating that the Department of Posts and Telegraphs alone is authorized to work the wireless system of telegraphy. Individuals desirous of working such a system must obtain permission from that department.

OERLIKON INDUCTION MOTOR WITH FOUR SPEED VARIATIONS.—In the article with the above caption, which appeared in the issue of January 17 several errors occur. The author of the article is Dr. Hans Behn-Eschenburg, not Hans Behr. On page 113, first column, second line, the normal speed of the motor should be 1,450 r.p.m., not 450 r.p.m., as printed. Finally the table at the foot of the first column, page 113, refers not to the induction motor described, but to a direct-current motor.

A REDWOOD WATER TUNNEL.—The Niagara Falls Power Company has contracted for 3,000,000 feet of redwood timber, to be delivered at Buffalo, N. Y., next July. The redwood is to be used instead of steel for a large tunnel to be constructed next summer. The reason given for the preference of the California wood is that water passing over it continuously forms a surface of a soapy and pasty nature, which is proof against corrosion, whereas the particles of sand and matter carried with great velocity from the Niagara River cut into and destroy steel in an incredibly short space of time.

CLEVELAND GAS PLANT.—At Cleveland, Ohio, on February 9, at the meeting of the Board of Control, the first step toward the establishment of a municipal lighting plant was taken by Mayor Johnson. The ordinance was approved providing for a Division of Lighting and the appointment of a superintendent, inspectors and men to care for the lamps. Places for about 200 men are provided. When the present lighting contracts expire the city will own all the street lamps and natural gas may be substituted for artificial gas. It is admitted that this is a movement toward municipal control

HENRY A. ROWLAND MEMORIAL LIBRARY.—In order to establish a permanent memorial of the late Prof. Rowland, and to promote the efficiency of the physical laboratory of the Johns Hopkins University, one of its former students has given a most generous sum of money with which to found a special collection of books, pamphlets and other publications in the field of radiation and spectroscopy. This is to be called the "Henry A. Rowland Memorial Library," and is to be placed in the physical laboratory of the University. To make the collection complete and to maintain its usefulness, the co-operation of observatories, laboratories and investigators is necessary. It is hoped that sets of official publications, books, reprints of papers on spectroscopy or allied subjects, and photographs of spectra and of apparatus will be contributed to the library, both now and in the future. They may be addressed to the care of Prof. Joseph S. Ames, at the University.

AMERICAN ELECTROCHEMICAL SOCIETY.—The following gentlemen were elected to membership in the American Electrochemical Society at the February meeting of the council: L. Seeger, New York; Dr. Rudolf de Neufville, Frankfurt-on-Main, Germany; Dr. Hans Landolt, Turgi, Switzerland; J. M. Morehead, Chicago, Ill.; W. Smith Horry, Niagara Falls, N. Y.; C. I. Zimmerman, Madison, Wis.; John W. Schlegel, New York; Craig R. Arnold, Sharon Hill, Pa.; A. J. Rodgers, Milwaukee, Wis.; O. M. Thowless, Newark, N. J.; Godfrey L. Cabot, Boston, Mass.; Joseph B. Hall, Chicago, Ill.; Francis W. Higgins, Niagara Falls, N. Y.; Robert S. Allyn, New York; Ralph McNeill, New York; Takakichi Nakayama, Kochi, Japan.

NOVEL ISOLATED PLANT ENTERPRISE FOR PITTSBURG.—An extension of the usual scope of office building power plants is to be tried in Pittsburg under the direction of Henry Phipps. A group of office buildings will be erected in lower Pittsburg in the neighborhood of Fifth Street and Duquesne Way, and one plant will furnish light, heat and power for the entire group of five or six buildings, including the Bessemer Building, corner Sixth Street and Duquesne Way. The power equipment has already been partly contracted for and will include two 1,500-hp Westinghouse-Corliss engines, which are now under construction, and will be ready for delivery in about six months. These engines are of the horizontal, cross-compound type, and will operate non-condensing, the exhaust steam being used for heating purposes. On account of the difficulty of high river water, universally experienced in Pittsburg, the engines will be placed upon the ground floor instead of the basement, while the boilers will be located on the second floor of the plant and supplemented by suitable coal and ash-handling appliances. The machinery will be installed by Westinghouse, Church, Kerr & Co.

PARCEL ELECTRIC RAILWAY.—A patent issued February 10 to Thomas E. Murray and John Van Vleck describes an interesting automatic electric railway system for the conveyance of parcels, mail, etc. There may be any number of stations disposed at intervals along the main track, a given car being automatically side-tracked at a desired station. Very complete provision is made to insure the continuity of the general service in case of any derangement of action of a car, switch or other detail. The construction and arrangement is such that, first, a car starting from a principal depot or any given station will automatically proceed to and stop at any other given station; second, prior to reaching the predetermined station said car will automatically close a switch for leading it upon the station siding; third, prior to reaching the predetermined station the strength of the current actuating the car will be automatically reduced; fourth, prior to reaching the predetermined station an electric brake mechanism will be automatically applied to retard the motion of the car; fifth, the line conductors in proximity to the track are disposed in block sections, and by means of suitable automatic mechanism the section next to and immediately succeeding that upon which the car is advancing is rendered dead, so protecting the car from rear collisions; sixth, the car mechanism being adjusted for a predetermined or normal speed any excess speed will result in the automatic operating of mechanism to reduce the speed to normal; seventh, in event of the automatic switch-controlling mechanism not properly setting the switch the car is automatically arrested before the switch is reached and cannot proceed until the failure is corrected; eighth, the track is double and stations are located on loops extending from one track to the other, but in a different plane—that is to say, the loop may preferably rise over the tracks or descend below them—the stations being located on said loops; ninth, in case a car passing from a loop to main track comes in danger of rear collision with a car on the main track the first-named car is automatically stopped; tenth, in case a car on main track comes in danger of rear collision with a car coming to main track from a loop the first-named car is automatically stopped; eleventh, a reversing gear is provided on each car, whereby from a distant point the motion of the car may be reversed; twelfth, an indicating mechanism is provided located at stations, whereby the speed of cars in proximity to the station is indicated and also their position at one side or the other of said station; thirteenth, a continuous sheet-steel hood may be provided when the tracks are above ground to protect the track, cars, and conductors and prevent derailment.

A LONG ELECTRIC ROAD.—Secretary of State Cook, of Missouri, has issued a charter to the Central Missouri Electric Railroad, with a capital of $4,000,000. The road is to extend from Brookfield to Glasgow and thence to St. Louis, a distance of 194 miles. Colonel W. H. Chase, of New York, is the principal financier of the road. The line is to be completed in time for the St. Louis Exposition.

INDEPENDENT TELEPHONY.—It is reported that there is a movement to consolidate the independent telephone companies in Vermont, Massachusetts, New Hampshire, etc., including part of New York State, and reaching out to Ohio and Indiana. The statement is made that toll line agreements have already been effected and that the People's Telephone Company, incorporated under the laws of Maine with a capital of $5,000,000, is organized to push the movement.

TROLLEY PROFIT SHARING.—The Street Railway Company, of Vancouver, B. C., has voluntarily decided that the regular employees shall receive as their share of its profits one-third of the amount available for dividends after the ordinary shareholders have received 4 per cent. This means, as estimated, that at the end of the first year each employee will receive about $30, at the end of the second year the share will be about $50, and in five years it will be $100. The men will receive the standard union wages. The plan is expected to do more than pay for itself.

A. I. E. E. PRESIDENCY.—Nomination forms have been issued for the Institute annual election, which is, as usual, exciting considerable interest. Mr. Scott's active year gives a much larger electorate to be polled. There are two distinctly leading presidential candidates. Mr. C. O. Mailloux, who has served the Institute with great credit in various capacities for years past and has been a generous giver to the Library, is being advocated vigorously by his numerous friends. The other candidate put forward is Mr. Bion J. Arnold, of Chicago, also well known in the profession and a large contributor to the Library funds. The West has never had a representative in the presidential chair, and Mr. Arnold's cause, aside from his rank as an able professional man, has been enthusiastically taken up out West, as well as by many in the East, on the ground of a better territorial distribution of offices and recognition in Institute work.

MESSENGER BOYS are not altogether angels, but it may be doubted whether they are as bad as the Child Labor Committee makes out. Unquestionably, there is a good deal of boy in them. According to the report of Miss Helen Marot, there are employed at one time, in the Boroughs of Manhattan and Brooklyn, by one telegraph company alone, about 1,000 youngsters. During the entire year some 6,000 lads are given employment by this company. In addition to this army of uniformed children there are hundreds of other boys employed by other somewhat similar companies, and of the whole number of urchins so employed it is probable that one-half started to work when they should still have been in school. One requirement of the telegraph companies is that the boys shall have reached the age of fourteen. To secure employment under that age boys declare themselves fourteen, when, as common observation indicates, and investigation proves, they are much less than that age. In one day twenty-six messenger boys assured an investigator that they were fifteen years of age, but it was learned from school records and other sources that twenty of them were only twelve or thirteen years old.

NEW YORK TRANSPORTATION is the subject of a report by the State Railroad Commissioners dealing with surface railway operation on Manhattan Island. The report is a virtual endorsement of the claim of the Metropolitan Street Railway that it has done everything possible under the circumstances, and the attitude of the city authorities in previous years is vigorously attacked. The Commissioners say: "Every attempt to lay a new track or make a new connection was denounced as "a grab"; the city has paid the full cost of the widening of Fifty-ninth Street, between Fifth Avenue and Eighth Avenue, as it will also do for the widening of Eighth Avenue, on Central Park West, and for the widening of Fifty-ninth Street east of Fifth Avenue, notwithstanding the street railway company was ready and offered to pay the whole expense. And it should be borne in mind that the company did not seek to lay down any new tracks in these widened thoroughfares, but only to help a freer car movement by giving greater room for all other vehicles. The board might multiply examples and give some very specific instances to show that there has been a petty, demagogic policy persistently pursued against all interurban railway enterprises in New York City, probably instigated by and dating, of course, from the Broadway Railroad scandal of 1884, and that the tendency has been to treat the corporations as the public enemy. To this very combination of circumstances is in some degree due the difficulties and the backwardness and the incapacity of the service to-day." It is recommended that the Interurban system add 250 closed cars as well as the 175 open cars now under contract.

STORAGE BATTERY CONTROL PATENTS.—Three patents issued February 10 to A. S. Hubbard cover systems of electric distribution in which the use and control of storage batteries are provided for. The first of these relates to a system in which two groups of batteries are used connected in parallel, one group being charged while the other is discharged into the external circuit. The battery which is under charge is connected directly to the generator, while a resistance is interposed between the generator and the load; a resistance being also inserted between the discharging battery and the load. A sliding switch is provided, which, when moved in one direction, increases the resistance between the generator and the load, while it decreases the resistance between the discharging battery and the load. A movement in the opposite direction gives a reverse effect. This allows an adjustment between the generator and the discharging battery, of the relative proportions of current to the external load supplied by each. A reversing switch throws the discharging battery directly on to the generator for recharging, while the charging battery is connected on to the discharge side. If the sliding switch be motor-driven and actuated to run backwards or forwards by voltmeter contacts as the voltage of the mains rises or falls, the adjustment is effected automatically. The second patent relates to modifications of the above. The third patent covers an automatic booster system in which the machine is of the separately excited class and is a modification of Mr. Hubbard's previous patent on boosters. The booster armature is in series with the battery and these connected across the mains. The booster field is in series with the armature of a small exciting dynamo and these are also connected across the mains. The exciting dynamo derives its field from the main current, which passes from the generator to the line, so that the voltage of this dynamo at any given speed is proportional to the main generator output. The voltage of this exciter dynamo opposes the impressed e.m.f. of the mains and its winding is such that when normal generator output is passing into the line—and through its field—its voltage is just equal to that of the line, and consequently no current flows through the booster field. The latter machine has under this condition zero voltage and the battery neither is charged nor discharges. The motor which drives the exciter has, in addition to the regular shunt field, a series field—which is also in series with the exciter dynamo field, and through which the current from the main generator passes. This series field opposes the shunt field, so that any increase in current from the main generator will cause a decrease in the field strength of the motor, with a corresponding increase in speed, and *vice versa*. Increase of generator current. therefore, causes the voltage of the exciter dynamo to increase, due to increase both of field strength and speed of driving motor, which voltage, exceeding that of the line, sends a current through the booster field, causing an e.m.f. to assist battery discharge. A reverse set of conditions causes the battery to charge when the generator current decreases.

LETTER TO THE EDITORS.

Line Poles.

To the Editors of Electrical World and Engineer:

Sirs: I should be glad to receive from your readers some information on the subject of hard pine poles suitable for electric light purposes. We have had occasion to use a large number of these poles, and we find that while some last as long as twelve years, others must be renewed in from five to six years. It seems to me that the subject of the selection of suitable poles and treatment which would be practicable as well as efficient, is one that would be of interest to a large number of people in this country who are coming to believe that hard pine is a very inferior material for street poles. W. F. Stevens.

Allston, Mass.

[A paper read by Mr. W. E. Moore at the Cincinnati meeting last year of the National Electric Light Association discusses the relative value for line poles of different woods, and gives an account of a method of treatment with creosote. An abstract of this paper appears in our issue of May 24, 1902. The subjects of the selection and treatment of line poles are considered in this week's installment of Mr. A. V. Abbott's series of articles on "The Construction of Aerial Telephone Lines."—Eds.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

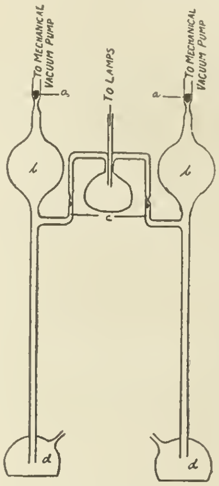
DYNAMOS, MOTORS AND TRANSFORMERS.

Design of Electrical Machinery.—Esson and E. K. Scott.—An illustrated abstract of two papers read before the (Brit.) Inst. Elec. Eng. Esson's paper deals mainly with Continental European practice. He shows that it is easier to design machines of large output to run at low speed than at high speed; at the same time, high-speed machines of large output have proved to be quite practicable. As the speed of a machine is increased, the hysteresis and eddy-current losses increase at a greater rate, while the temperature-coefficient may or may not decrease in the same ratio. If the armature is so designed that the curve of watts lost corresponds approximately to the temperaturec-coefficient curve, the heating of the armature may be practically constant over a wide range of speed. If this is not so, it may happen, as in a case cited by the author, that an increase of 50 per cent. of speed may admit of an increase in the output of only 25 to 35 per cent. The want of agreement in the values of the output coefficient of machines by different makers is due, to some degree, to variations in the methods adopted for ventilation, but more still to the divergency in practice as regards the proposition adopted for the prevention of sparking; different designers follow different principles concerning the last point; the former method was to provide sufficient forward induction to neutralize the self-induction of each armature coil during its period of short circuit, while at present the custom is to so proportion the armature that the e.m.f. generated in each coil during this period does not exceed the amount which has been found by experiment to give sparkless commutation with carbon brushes. The author's experience with laminated poles for direct-current machines, has not been altogether satisfactory. The advantages claimed for such poles are that it is possible to use wide armature slots and a smaller proportion of insulation in the active belt, thereby leaving more for a greater area of copper, and by cutting the alternate plates to a different slope it is possible to obtain a gradually fringed field, which lessens the armature hum and also lessens the tendency to spark. An important novelty in alternator construction is the tie-rod construction of the armature adopted by the General Electric Company, of Berlin; Dobrowolsky asserts that as compared with the usual design, this construction effects a saving of about 20 per cent. in weight of materials required in respect to a given output, and the saving in cost of construction is about 10 per cent. The object of this design is to do away with the heavy castings heretofore used to keep the armature true in its shape, and in their place to surround the armature with tie-rods having struts so disposed as to give the maximum resistance to distortion. Scott's paper deals chiefly with details of construction.—Lond. *Elec. Rev.*, January 23.

Heyland Motor.—Heyland.—A continuation of his long illustrated article, the first part of which was abstracted in the Digest last week. He first discusses the use of a direct-current winding with short-circuited commutator; its main disadvantage is the increase of the losses, due to the shunting by the connections between the segments. He then discusses the three-phase winding with a commutator, short-circuited in itself, and finally the three-phase winding with branches in parallel. The latter winding is the best one; it is always short-circuited through the brushes so that even without connections between the segments it has all the properties of a short-circuited winding. To accomplish this, each phase winding consists of two parts connected in parallel. The arrangement is explained by various diagrams.—*Elek. Zeit.*, January 29.

LIGHTS AND LIGHTING.

Pump for Incandescent Lamp Manufacture.—In an illustrated article on the Premier Lamp Works near Liverpool, the Reinmann mercury pump is described which is in use there. The design is based on the principle of the old lift pump; that is, the mercury alternating rises and falls in a glass vessel, which is connected at the top through a mercury sealed valve to a mechanical vacuum pump, and at the bottom through another valve to the lamps. The arrangement is seen in the adjoining diagram. When the mercury falls the top valve, *a*, seals so that a high vacuum is produced in the glass vessel, *b*. At the bottom of its stroke the mercury uncovers the connection, *c*, to the lamps, allowing the air in them to expand into the vessel, *b*. On its up-stroke the mercury closes the valve, *c*, and on rising drives the air before it through the top valve, *a*, into the pipe connected with the mechanical exhaust. The rise and fall of the mercury is obtained by connecting the bottom reservoir, *d*, alternately to the atmosphere and to a mechanical vacuum pump. One of the chief features of the arrangement is that each batch of lamps, usually a dozen, which are being pumped simultaneously, is connected to a pair of these pumps, the mercury rising in one and falling in the other. As the mercury rises more than it falls, the pumps are almost continuously in connection with one or other of the vacuum vessels, *b b*, into which the air from the lamps has time to expand while the up-stroke is being completed. Moisture is removed in the usual way by placing phosphoric anhydride between the lamps and the pumps. The whole of the pumps are worked from one point by an arrangement of stop-cocks. A movement of the controlling lever causes the mercury to rise on one side of the double pump and to fall on the other; on the completion of the stroke the lever reverses and so reverses the motion of the mercury. An extremely high degree of vacuum is said to be obtained with this pump.—Lond. *Elec. Times*, January 29.



MERCURY PUMP.

POWER.

Driving Boiler Feed Pumps.—James.—A short article dealing with the various methods of driving boiler feed pumps. For an electrically-driven boiler feed pump, the author suggests that a triplex pump be used, the motor being run at constant speed. In order to cover the requirements for variations in the rate of pumping, the suction to the exhaust of one or two of the pump cylinders of the triplex pump is fitted with a by-pass valve of large capacity, so that to vary the rate of pumping it is only necessary to open the by-pass valve more or less. With the valves completely closed, the pump would work at its maximum output. If there are by-pass valves for two of the cylinders in the pump, the opening of two of the valves to the fullest extent would cut down the rate of pumping two-thirds. Such a pump would, of course, be more economical when driven from one of the large main engines. In point of fuel consumption, the next best arrangement would probably be to drive the pump by means of an electric motor. If the pump were driven by a small independent steam engine, which could operate on 60 pounds of steam per indicated horse power, as against 200 or 300 pounds for a direct-acting steam pump, there would still be considerable economy realized from a direct-acting steam pump.—*Am. Elec.*, February.

Refuse Destructor.—Broadbent.—An article in which he replies to some criticisms of De Legundo on the "fuel value" of town refuse. Whether or not it pays to burn refuse instead of coal is principally a matter of local conditions, in very many cases it certainly does. If refuse must be burned—and it should be for sanitary reasons—it is folly to waste the heat if it can be utilized in any way. It is absolutely wrong to contend that refuse has no "fuel" value.—Lond. *Elec. Rev.*, January 23.

REFERENCES.

Development of Mountain Water Powers.—Letheule.—A long and well illustrated article on water power developments in the French Alps, with reference to the recent "White Coal" congress.—*Eng. Mag.*, February.

Oil and Compound Feeders for Boilers.—Hobart.—An illustrated article describing the various makes of oil and compound feeders for boilers. The author also illustrates and describes various pieces of home-made apparatus.—*Am. Elec.*, February.

TRACTION.

Management of Tramways.—Wordingham.—An article on the commercial management of electric tramways. Great possibilities exist for tramways beyond the mere carrying of passengers. He discusses the traffic of express packages, etc. Concerning combined light and traction stations he makes the following remarks: The average cost of production in a combined station will be more than the cost in a station for traction only, and less than in one for lighting only, but the average cost in a combined station will be substantially less than the average of the cost in a traction station and in a lighting station serving the same loads, and there will be a considerable saving to both undertakings. In other words, the cost of producing the traction energy in a combined station will be substantially less than if it were produced in one solely devoted to traction, and the cost of producing energy for lighting will be less than in a station solely for lighting. The idea is wrong that a traction load provides a steady demand on the station for some 16 hours out of 24; a traction load is not much, if at all, better than a factory motor load, and is far inferior to that arising from street lighting.—Lond. *Elec. Rev.*, January 30.

Relation of Interurban Electric Railways to Steam Roads.—Wyly.—An article in which the rapid development of the interurban electric railway and the improved facilities which it offers are considered, as well as the influence which its development has had in increasing the public travel. It is contended that the electric interurban extensions have materially benefited the steam railways in spite of the fact that much of the suburban traffic of the old lines has been taken by the new electric system. It is pointed out that this is not an unmixed evil, as the steam trains are ill adapted to this class of service. This is now recognized by many steam railway managers who are encouraging the development of the electric lines as feeders to the steam trunk lines, and in some instances have substituted electricity as a motive power for suburban and branch roads.—*St. R'y Jour.*, January 31.

REFERENCE.

Pavement Plow Car in Chicago.—A description of this plow, which is drawn behind one or two motor cars, and will dig macadam pavement preparatory to track repairs. If necessary, the plow car can be loaded down with pig-iron. There are ten digging bars carried directly in the rear of the front wheels, and scrapers in the front of the rear wheels to scrape the débris from the rails.—*St. R'y Jour.*, January 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Rectifiers.—A long editorial on the Hewitt and Nodon rectifiers. As is well known, the former is an outgrowth of the Cooper-Hewitt vapor lamp, while the latter is an electrolytic cell with an aluminium electrode; the property common to both devices is that they allow the current to pass only in one direction. Concerning the Hewitt rectifier, reference is made to the statement that the apparatus will work up to 1,000 volts with a constant loss of only 14 volts, throughout its whole range "obviously then—if this statement is correct—the resistance undergoes some curious change, and the efficiency increases in direct proportion to the applied pressure." It is doubted whether the laboratory figure of 1,000 volts will be confirmed in actual practice. It is claimed that the difficulty of starting the converter, although not serious, cannot be overcome without making the apparatus complicated; and, as a consequence, it is more likely to break down. The resistance of the converter must first be broken down, before it will start, and this might be accomplished by means of a small step-up transformer. In single-phase working this transformer would have to be permanently connected to the terminals, or the resistance of the negative electrode would reassert itself and allow the rectifier to cease its functions. The presence of the transformer would entail a slight loss of energy, but a further and considerably greater disadvantage would be introduced by the continued increase of voltage, which might eventually result in the fracture of the bulb and admission of air. Having been taken up by the Westinghouse Company, the apparatus is in good hands, and we look forward to its emerging triumphantly from the exptrimental stage and becoming a practical adjunct to the plant of an alternating-current electricity works. Some notes are then given on the various theories of the electrolytic rectifier. It is said that if the apparatus can take the place of the motor-generator or synchronous converter, it has a great future, but in its present state the large space taken up is a great disadvantage. For instance, a 5-kw Nodon "electric valve" occupies over 12 cubic feet, and when working continuously must be kept cool artificially. The mere fact that it is liable to get overheated is a disadvantage, but with proper supervision there should be no difficulty in making it work quite smoothly and efficiently; there is also the question of cost. In the present state, both apparatus may be excellent devices for charging small batteries of accumulators, or even for working lifts and for the numerous minor operations which it is not possible or convenient to perform with alternating current, but improvements must be made before they can be successfully applied on a larger scale.—Lond. *Elec.*, January 23.

Pulsating Currents.—Holden.—An article giving "suggestions for the use of intermittent currents for electric lighting." By intermittent or pulsating currents he means that an alternating current is superposed on a direct current. He appears to advocate the simultaneous use of both pulsating current and direct current. "For instance, if continuous current were supplied during the day and pulsatory current during the night, it would be quite possible to arrange that certain lamps (say street lamps) were only lighted up when the current became pulsating; or that certain motors were only able to run during one or the other period." Another use to which the possibility of varying the character of the supply might be put would be in fixing the charge to be made for current supplied at different hours of the day.—Lond. *Elec. Rev.*, January 23.

WIRES, WIRING AND CONDUITS.

Wiring of Buildings.—Falconar.—A long abstract and discussion of a paper read before the Newcastle section of the (Brit.) Inst. Elec. Eng. He distinguishes exposed positions, ordinary positions, and unexpected positions. In discussing exposed positions, as in shipyards, in boiler shops, etc., he admits only the possibility of using gas barrel or welded steel tubing, although he puts in a plea for armored cable. As regards the first, he has experienced rough interiors, condensed moisture and deteriorated insulation, and there is waste of time in screwing and making special bends. In dealing with screwing, attention is drawn to the harmful effects of oil on the rubber, if it is not wiped off the threads, or if allowed to creep in from outside sources. Internal moisture is generally produced by condensation; this can be proved by observing the low insulation test obtained whenever there is a sudden fall of temperature. He advocates armored cables for exposed positions, and his tables of costs show that these are both cheaper to buy and to erect, than insulated cables and iron or steel pipes together. (Editorially it is here remarked that the cables should not be used for this purpose, unless they are first lead-sheathed and then armored.) He then discusses "ordinary positions" where there are such factors as general dampness, in moist plaster, etc. He appears to favor welded steel tubing, but makes it an important condition that the cables should be drawn in after the tubing has been fixed completely. Braze steel tubing is dismissed as unsatisfactory. He says that wood casing may be used with success if it is water-proofed, but not otherwise. (Editorially it is here remarked that wood casing has done good service in the past, yet there is no reason for its use now, either on the score of economy, protection, or safety.) Concerning nonmetallic tubing, he thinks it strange that this has not made much headway, and he suggests earthenware ducts let into walls of new buildings. (Editorially this is not recommended, as it would condense moisture equally with, or more than, metal tubes; moreover the sodium in the glazing might tend to become separated by the electrolytic action of any leakage currents.) Bitumenized fibre tubing has been found wanting in many qualifications. The author advocates running insulated cables on insulators, both for large buildings such as workshops, and for private houses. In discussing "unexpected positions" he deals with wood casing, split tubing (close joint), lead-covered wire and flexible. He does not seem to condemn wood casing, if used in dry places. (Editorially it is said that the possibility of becoming damp should be allowed for.) He dismisses split tubing as unsatisfactory. He recommends the lead-covered wire system (by which it is assumed he means paper-insulated). As regards flexible wires, he advocates some form of armority. The author's conclusion is that there should be fused armored cable for "exposed positions"; water-proofed casing and screwed welded tubing for surface and concealed work respectively, for "ordinary positions"; and cleat-insulators or lead-covered wire for "unexposed positions." The editorial critic, while reserving his opinion regarding the armored cable—unless it can be shown to be water-tight, when its use should prove of advantage—would drop wood casing altogether and only rely on the welded screwed tubing, the lead-covered wire, and the cleat system for use in all ordinary positions, according to the amount of money required to be spent.—Lond. *Elec. Rev.*, January 23. The paper itself is reprinted in Lond. *Elec. Eng.*, January 30.

Metallic Protection of Conductors.—Prentice.—An article in which he says that metallic tube systems, as usually installed, are utterly untrustworthy from the standpoint of safety. He admits that if properly installed, and if no future extensions are to be provided for—except from distribution boxes—are required, a screwed metallic barrel system is difficult to excel. But he says it is not often found "properly installed." He thinks that "to employ metallic tube as a protection is, under ordinary circumstances, to court disaster." An insulating tube of the nature of hard fibre rendered impervious to moisture and as nearly nail proof as possible, with joints on the same principle as ordinary unscrewed Simplex, seems to the writer to afford the most promising solution of the difficulty.—Lond. *Elec. Rev.*, January 27.

Electro-Physics and Magnetism.

Magnetic Effect of Electric Convection.—Cremieu.—A paper on the present state of the question of electric convection, in which he endeavors to defend his position against the positive results obtained by Pender. The experimental problem, which was already surrounded by numerous difficulties, is said to be further complicated by a new cause of disturbance. He found that besides the theoretical effect of the convection of charges, an astatic magnetic system contained in a closed electric screen may, under certain conditions, be subject to a magnetic action which strongly deflects the needle and can even demagnetize it. This action may be produced by placing the astatic system in its screen above a horizontal metallic plate attached to a conductor of low resistance and no inductance, whose other terminal is put to earth. If now a condenser is discharged anywhere along the conductor, the needle receives a violent shock which displaces its zero. This effect can be stopped by introducing a high liquid resistance or a larger metallic screen. He points out that a disturbing magnetic effect may be produced by a loss of charge of the body conveying the electricity. He thinks that the final decision of the question will still involve much time and trouble.—*Jour. de Phys.*, December. Abstracted in Lond. *Elec.*, January 30.

Current Bridges.—Sundorph.—An account of experiments made in continuance of his work on the coherer and the Schaefer anti-coherer. When a current from two storage cells is passed between any two metals, and they are then slowly separated by means of a micrometer screw, a "bridge" about 0.01 mm thick and about 1 mm long is found between them. This bridge, which is seen under the microscope to consist of countless thin wires, accounts for the persistence of the current after contact has been apparently broken. No bridge is formed between platinum conductors. Between platinum and zinc a bridge is formed, especially if the platinum is cathode. Both aluminum and zinc are good bridging metals, but no bridge can be formed between one and the other.—*Ann. d. Phys.*, 1903, No. 1; abstracted in Lond. *Elec.*, January 23.

Luminous Electric Wind.—Warburg.—A paper on phenomena accompanying the discharge of an influence machine. The positive and negative poles are easily distinguished by the fact that long brushes proceed from the positive pole, while a minute star is attached to the negative pole. This star represents the negative glow light of the vacuum tube reduced to small dimensions by the pressure of the atmosphere. He shows that under certain conditions an electric wind can also proceed from the negative pole; this happens when the gas surrounding that pole is dry nitrogen at atmospheric pressure. If the pole is charged to a negative potential of some 2,500 volts, not only the star is seen, but a fine pencil of light, which at first sight resembles the positive brush discharge remarkably closely; as a matter of fact, it is luminous negative electric wind.—*Ann. d. Phys.*, No. 1; abstracted in Lond. *Elec.*, January 23.

Velocity of Röntgen Rays.—Blondlot.—An account of an investigation the results of which confirm the prevailing theory that Röntgen rays are but an irregular series of single-wave pulses, making up what might be called, by an acoustic analogy, an optical "noise." He tested whether the different varieties of X-rays, which we know to have very different powers of penetration, differ in their velocities, as do the rays given out by the different radioactive bodies. He found that whatever kind of vacuum tube from which X-rays might be obtained, their velocities were always equal to the velocity of light in air. The experiments were made by the method already described. Indeed the previous experiments made it probable that the rays had a fixed velocity, as otherwise the maximum could not well have been a decided one, however the tube might be working. The author also found the natural conclusion verified that the velocity is independent of the medium through which the rays are propagated, since there is no refraction. He verified this for wood, paraffin, vaseline, oil and essence of turpentine.—*Comptes Rendus*, December 29; abstracted in Lond. *Elec.*, January 30.

Capillarity of Solutions.—A short note on an investigation by Mathieu. When a dried pig's bladder is placed in a salt solution, the concentration of the solution absorbed is less than that of the original. The introduction of suitable electrodes allows the system to be regarded as a concentration cell, and the e.m.f. of this cell is a measure of the difference between the concentration of the solution and that of the portion absorbed by the bladder. Qualitatively, porous cells and tiles, parchment paper and capillary tubes exhibit the same phenomenon. In the last case it is found that the smaller the radius of the tube the greater is the difference of concentration produced; hence it is not permissible to determine the surface tension of electrolytic solutions by measuring the heights to which they will rise in a capillary tube.—Lond. *Elec. Eng.*, January 9.

Electro-Chemistry and Batteries.

Disassociation of Electrolytes.—Liebenow.—A theoretical article in which the author discusses the reasons why Ostwald's well-known formula for the electrolytic conductivity as a function of the concentration, does not agree with the facts in the case of the highly ionized solutions of ordinary inorganic salts and acids. He develops a new formula which is more general than Ostwald's, as it contains two empirical constants, while Ostwald's contains only one. In the case of potassium chloride the formula is shown to be a good representation of the change of conductivity over a wide range of concentration.—*Zeit. f. Elektrochemie*, December 25.

REFERENCES.

Edison Battery.—Hibbert.—An article with the title "Edison contra Jungner," and quoting some statements from a Stockholm paper. Some notes are given on runs made by automobiles provided with Jungner alkaline cells in 1900 and 1901; and it is claimed that Jungner's invention was prior to Edison's.—Lond. *Elec. Rev.*, January 30.

Phase Rule.—Van't Hoff.—A long abstract, illustrated by diagrams, of a lecture on Gibbs' phase rule, its application to different cases, and on graphical methods for representing such chemical problems.—*Zeit. f. Elektrochemie*, December 25.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring High Temperatures.—Fery.—A description of a new method for measuring high temperatures, based upon the law of Stephen, the conditions of which are fulfilled for bodies enclosed from all sides, which is the case in the electric furnace. In the author's apparatus the radiation is concentrated by means of a lens upon a thermocell and its e.m.f. is measured. A comparison of this apparatus with the pyrometer of Le Chatelier gave differences of less than 1 per cent. between 1,000 and 1,500° C., while below 900° the differences were greater on account of the small deflections. The author in this way found the temperature of the positive carbon of an electric arc lamp to be 3,490°. For very high temperatures, this method appears to be very suitable.—*Comptes Rendus*, v. 134, p. 977; abstracted in *Zeit. f. Elektrochemie*, November 20.

Capillary Electrometer.—Boley.—The electrometer in which only a drop of mercury is used is very advantageous for null methods, but maxima cannot be observed by its means, and the drop is liable to slip out of the tube. Boley describes two new types which lend themselves to all kind of measurements. Since the sensitiveness depends upon the mobility of the meniscus and the power of the microscope, each of these two factors should be made a maximum. The mobility of the meniscus would be infinitely great for a form of the electrometer in which the mercury would be in a state of indifferent equilibrium. Such a state could be realized by putting the capillary tube into the shape of a hyperboloid of revolution; but most capillary tubes approximate to this shape more or less, and have a region of indifferent equilibrium slightly below their thinnest bore. By choosing a tube of nearly hyperboloidal shape, the author is enabled to measure an e.m.f. of 0.00001 volt with an enlargement of 840 and a water manometer. The bore is 0.25 mm and the mercury thread is only 2.75 cm long. Another form of tube resembles Lippmann's reversed pattern, and has a bore as large as 1 mm. It measures 0.0001 volt.—*Jour. de Phys.*, December; abstracted in Lond. *Elec.*, January 30.

REFERENCE.

Measurement of E.M.F's by Means of the Telephone as Zero Instrument.—Fischer.—A description of a method of using the telephone as a zero instrument for the measurement of e.m.f's and currents. It has been used for a long time in Kohlrausch's method of measuring the conductivity of electrolytes. The present one is based upon Poggendorf's compensation method, or the potentiometer method, and differs from it only in that a telephone is used in place of the usual galvanoscope, and that there is a make and break in the telephone circuit, operated from an independent source of current; there are also two high resistances in the telephone circuit, the lesser one of which is used only for the finer adjustments. A diagram of the connections is given and a measurement is described.—*Zeit. f. Elektrochemie*, January 1.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Telephone Engineering.—Dommerque.—A short article in which the author deals with the preservation of timber by processes other than the one of creosoting.—*Am. Elec.*, February.

Independent Telephone.—Clausen and Hubbell.—Two articles on the progress of independent telephony.—*Tel. Mag.*, January.

Toll Lines.—Wegner.—An article in which he gives a series of diagrams showing the connections for toll lines and interurban circuits.—*Tel. Mag.*, January.

MISCELLANEOUS.

Visibility of Ultra-Microscopic Particles.—Siedentopf and Zisigmondy.—A description of a method of making small particles visible, which considerably extends the range of microscopic vision, and brings us within a short distance of molecular dimensions. The method is a form of "dark field illumination" with sunlight filtered through a narrow slit. The particles specially examined are gold particles in ruby glass; these are exceedingly small, and although they cannot be seen as they actually are, they appear as diffraction discs about 1 mm in apparent diameter; this means an enlargement of 50,000. The objection that the disc does not show the real object, also applies to the fixed stars, which appear in the most powerful telescope only as diffraction discs. The limit of the method is about 10 times the diameter of a molecule, and the authors prove that some of the gold particles are smaller than that limit. By counting the number of particles in a certain volume and estimating the total amount of gold present, they arrive at the size and weight of the particles. Molecules themselves could be seen only if the microscope could be made much more sensitive.—*Ann. d. Physik*, No. 1; abstracted Lond. *Elec.*, January 30.

The method is discussed in an editorial note. It is said to be simply an extension of well-known microscopic principles. What hitherto blocked the way was diffraction, which becomes very troublesome as the diameter of the particles to be observed decreases. Now this difficulty has been overcome by rigidly excluding the illuminating beam from the field of vision; hence the numerous reflecting and refracting surfaces employed in its transmission are no longer able to disturb the pure diffraction cone by which an ultra microscopic object makes its presence evident. Therefore something is seen in the microscope, provided the objects are not so closely crowded that their diffraction cones overlap; what is seen is of course only a diffraction disc.—Lond. *Elec.*, January 30.

Magnetic Separators.—Danneel.—In this continuation of his long illustrated serial on the Dusseldorf exhibition, he discusses a number of metallurgical apparatus; most of them are purely mechanical, but among them are some magnetic separators, including a diagram of the well-known Wetherill separator. The Heberle separator employs a wet process; the particles of ore fall through a rising stream of water while exposed to the action of a magnetic field; the chief advantage of this construction is said to be that the adhesion between the single particles of ore is so completely removed that those which are magnetic are absolutely free from the non-magnetic ones.—*Zeit. f. Elektrochemie*, January 8.

Röntgen Rays in Practice.—Lowe.—A note on a paper read before the Röntgen Society in London in which he gives an account of his experiences of the use of X-rays in the treatment of cancerous growths, lupus rodent and other ulcers. In cases of new growths he found exposure to X-rays to be of very great benefit, and many diseases formerly supposed to be incurable now yield to this treatment. In one case of a malignant growth on the breast, he had given an exposure of 25 minutes; here an operation had been advised, but this was rendered unnecessary by the therapeutic action of the rays. Turning to radiography, he described cases in which this had been of the greatest service in his practice. It is of the highest importance in radiography to have the anode adjusted immediately above the line of fracture in order to secure good results. The reason for the slow advance seemed to lie in the want of definite lines of treatment and of suitable apparatus, which should be readily available.—Lond. *Elec. Eng.*, January 9.

New Books.

Leitfaden zur Konstruktion von Dynamomaschinen. Und zur Berechnung von Elektrischen Leitungen. Von Dr. Max Corsepius. Berlin: Julius Springer. 269 pages, 108 illustrations. Price, 5 marks.

This is a compact little work intended as an exposition of the principles of practical dynamo construction. In many respects it somewhat resembles the English text-book of Wiener on dynamo machinery, but is very much less pretentious, much more condensed and destitute of the extensive tabular information given by Wiener. The first 50 pages are occupied with the discussion of the magnetic qualities of the various irons employed in dynamo machinery. The principles of frame design succeed and then a few pages upon the various kinds of windings. The remainder of the work is chiefly devoted to working out in detail a number of designs for dynamo machinery, and in this respect the book is of value, giving practical illustrations of the method of calculations.

Der Elektrische Betrieb von Fernschnellbahnen. By Gustav W. Meyer. Halle a. S.: Wilhelm Knapp. 63 pages.

This little book investigates the general problem of high-speed electric railroad traction. The application of the three-phase, high-tension system is analyzed in the simplest manner and with various assumptions of engineering data. A comparison is made of the system of alternating-current motors supplied by step-down transformers carried with the cars, and the system in which the transformers are stationary and supply secondary conductors along the track. A particular case is outlined on both plans, and the first-named is indicated to be preferable. This is the method which has already been initiated in Germany and Switzerland. The pamphlet is directed to technical students of electric railroad engineering.

Electrical Engineer's Pocket Book. A Handbook of Useful Data for Electricians and Electrical Engineers. By Horatio A. Foster. New York: D. Van Nostrand Company. 987 pages, illustrated. Price, $5.00.

The crying need which this useful book supplied is indicated by the fact that it has in a short period entered a third edition and more than 5,000 copies have been sold. A number of corrections were made on the plates previous to the printing of this edition.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Electrical Contractors' Association of New York State, Secretary, Wm. J. Davis, Ithaca, N. Y.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Interstate Independent Telephone Association, Secretary, E. M. Coleman, Louisville, Ky.

Kentucky Independent Telephone Association, Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York. Next meeting, February 18, American Institute. Illustrated Lecture by Dr. A. E. Kennelly, "Submarine Cables."

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

Power Required to Drive Machine Tools in a Locomotive Shop.

We record here some power tests made recently in the locomotive shops of the Buffalo, Rochester & Pittsburg Railway, at Du Bois, Pa. The plant consists of five buildings, viz.: the power house, a building containing the locomotive erecting, boiler and machine shops, the round house, the blacksmith house, and the storehouse and offices. These buildings are located on a plot of ground 32 acres in extent and the equipment is intended to handle the repairs of about 150 locomotives, with provision for an increase of 75 engines, which is expected to cover about five years, making an estimated ultimate total of 17 engines per month. The machine, boiler and tank shops are under one roof, covering an area of 134 x 524 ft. The blacksmith shop is 80 x 140 ft., the power house 63 x 93 ft., the office and storehouse 60 x 120 ft., and in addition to these there is an oil house 30 x 60 ft., a 16-stall round house, and a 26 x 140-ft. coal, coke and iron storage building.

The power plant is located in a separate building and is designed for the transmission of power by electricity and compressed air, and furnishes all power needed for driving the machinery, lighting the shops, grounds, a large car-building plant and neighboring stations, and the further supply of steam for heating the buildings. All pipes and wires pass from the power house to the several buildings through underground galleries. The boiler equipment comprises four 200-hp water tube boilers, the furnaces of which are hand-fired. The engine room contains the following Westinghouse machinery: A 200-hp compound engine, direct-connected to a 125-kw, direct-current, main compound-wound generator, operating at 250 volts, and 280 r.p.m. This main generator carries the day load and supplies power for machine tools, cranes, lighting, etc. A 100-hp, simple engine, belt-connected to a 75-kw, direct-current, compound-wound generator, operating at 250 volts and 750 r.p.m. This generator carries the night load and supplies power for lighting, motor driving for special night work and the turntable. The night and day load generators are interchangeable at the switchboard.

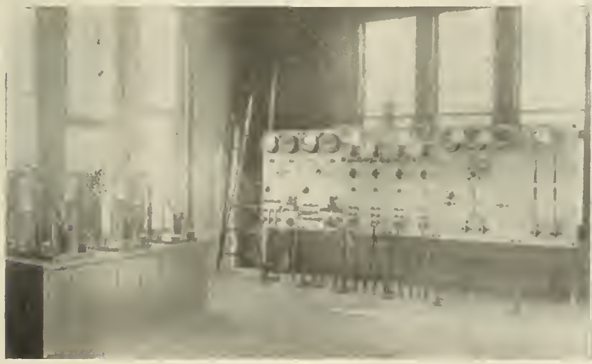


Fig. 1.—Switchboard.

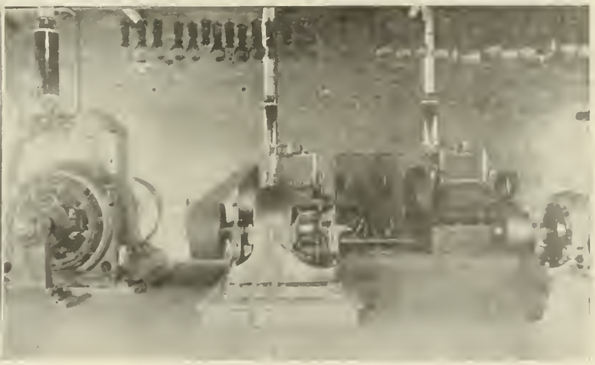


Fig. 2.—Interior of Power House.

There is a Westinghouse 100-hp, simple engine, belt connected to a 60-kw, 2-phase, alternating-current generator, operating at 2,200 volts, 7,200 alternations and 900 r.p.m. This generator furnishes power for lighting the yards, the Falls Creek Station, the passenger and freight stations at Du Bois and the Du Bois car shops. A 2½-hp exciter, operating at 125 volts and 180 r.p.m. An Ingersoll-Sergeant, steam-driven compressor, furnishing compressed air for the plant.

The tests made, in addition to furnishing accurate data relating to the power required for various tools when starting, running light and cutting, also make possible some estimation of the merits of roller bearings for shaft hangers. The line shafts are cold-rolled steel and are carried on roller bearings and a shaft 200 ft. long without belts could be turned by hand. But in spite of the unusual efficiency of the bearings, it was noted that the power consumed by the tool is often less than that lost in transmission. Nevertheless, the capacity in motors required for the group drive is two to two and a half times smaller than it would have been had each tool been provided with an individual motor. It is a question as to how for the low average power taken by large groups of tools in operation may be due to the fly wheel action of the shafts and pulleys.

The locomotive erecting, boiler and machine shop consists of a middle aisle for erecting and two shed bays equipped with shafting for driving the machine tools. Two 50-ton electric traveling cranes have a runway in the middle aisle. There are five lines of shafting driven by five shunt motors in the shed bays and the sections are designated as wheel section and boiler section in one bay, and lathe, tool and flue sections in the opposite bays.

Wheel Section.—Shafting driven by a 40-hp, shunt-wound motor and operating 42-in. car wheel boring mill, 48-in. car wheel lathe, 2 79-in. wheel lathes, quartering machine, 60-in. x 60-in. x 18-in. planer, 84-in. boring mill, single axle lathe, 6-ft. radial drill, 18-in. slotter, band saw, No. 7 grinder, water tool grinder. The line shaft is 200 ft. long, 2½ in. in diameter, and has 20 hangers. It was inconvenient in this instance to obtain a test of the line shaft alone. A test of the line shaft and counters only gave 1.5 hp. A 15-minute test was made of a group of machines comprising a 72-in. and a 66-in. wheel lathe each with two cuts, a wheel press operated at 50 tons, and an 84-in. Niles boring mill, a band saw belt, an emery wheel, a Pond radial drill and a 60-in. planer with one tool cutting cast iron, with an average result of 4.6 hp, a minimum of .88 hp and a maximum of 10.43 hp. The speed of the line shaft was 160 r.p.m.

Two machines were then thrown in, a 42-in. wheel lathe cutting with one tool and an 84-in. boring mill—with the wheel lathe cutting, the boring mill on starting up took 6.9 hp, and cutting 3 hp. To the above two machines were added, a tool grinder and a 79-in. wheel lathe cutting, which starting up took 6.3 hp, and running steadily 3.95 hp. To the above was added a 60-in. planer, cutting a cast-iron cylinder, which at starting took 10.3 hp, and running steadily 4.2 to 7 hp, or an average of 6.1 hp during the whole time. To the above were added another tool grinder and an 18-in. slotter. The maximum reversals of the planer and the slotter at the same instant gave 15.5 hp, and steady running showed 5.2 hp. The planer interfered somewhat with the reading. To the above was added a band saw cutting 4-in. oak, which took 5.6 hp. Whether the saw was cutting or not seemed to make no difference in the reading.

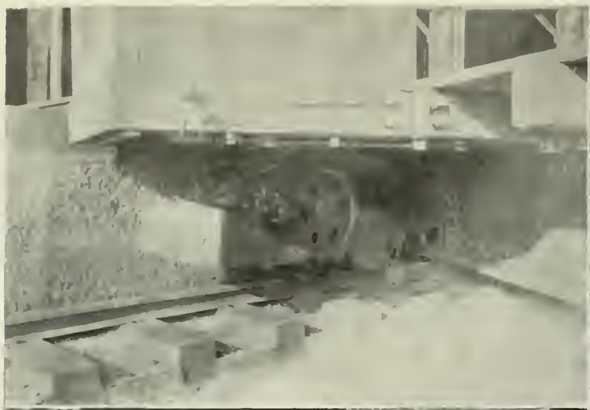


FIG. 3.—TURNTABLE DONKEY.

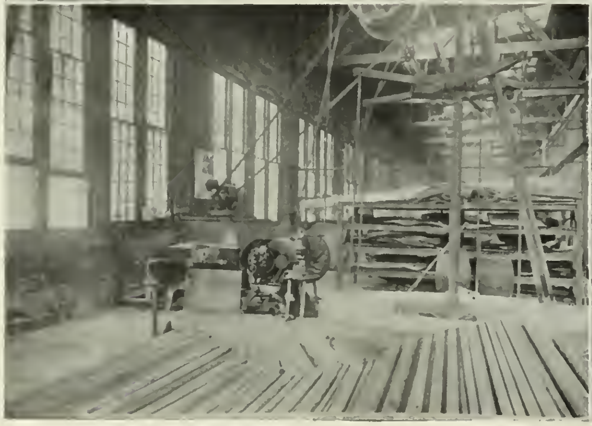


FIG. 4.—FLUE SECTION OF MACHINE SHOP.

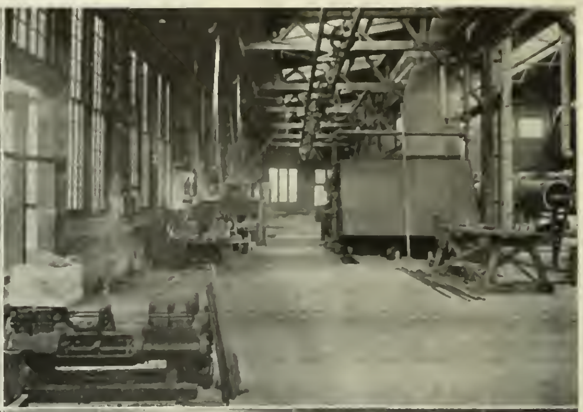


FIG. 5.—BOILER SECTION OF SHOP.

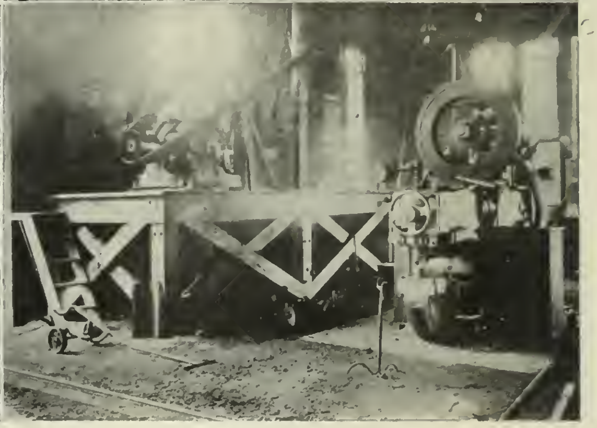


FIG. 6.—BLACKSMITH SHOP.

ELECTRIC POWER FOR MACHINE TOOLS IN LOCOMOTIVE SHOP.

Tests of single machines were then made; that is, of the power consumed by the one machine tool thrown in at a time. A 42-in. wheel lathe with one tool cutting took on starting up 4.6 hp, and on steady running 5 hp. An emery wheel took .7 hp. A 79-in. wheel lathe with two tools making roughing cuts on a pair of drivers took 4 hp. An 84-in. boring mill boring an 8-in. cylinder took 2 hp. A 60-in. planer cutting a cast-iron cylinder took 2 hp, and a maximum at reversal of 8.5 hp. An 18-in. slotter with tools of ¼-in. face cutting steel took .3 hp, and a maximum at reversal of 1.2 hp. A band saw starting up took 6.3 hp and running light or cutting 4-in. oak 4 hp.

A group run of an 84-in. boring mill, a 79-in. wheel lathe, a 6-ft. radial drill, a 60-in. planer and an 18-in. slotter gave at steady running 6.9 hp, and with the planer at reversal took 14 hp.

Boiler Section.—Shafting driven by a 30-hp, shunt-wound motor and operating 12-ft. bending rolls, bolt cutter, stay bolt cutter, drill press, tool grinder, Brooks plate planer, horizontal punch, shear and punch, 6-ft. bending rolls, 6-ft. straightening rolls, 6-ft. radial drill. All the counter belts were thrown off and the line shaft tested alone, with a result of .3 hp. This line shaft is 170 ft. long, 2½ in. in diameter and has 19 hangers. The speed of the line shaft was 158 r.p.m. A test of the line shaft and counter shafts only gave an average of 2 hp. The machines comprising the first group tested were a stay-bolt cutter and a bolt cutter, a No. 4 Hilles & Jones punch and shear. The No. 4 punch and shear was punching 13/32-in. holes in 3/16-in. steel plate. A 15-minute test showed an average of 1 hp, with a minimum of .2 hp and a maximum of 3.5 hp.

A single tool, the No. 4 Hilles & Jones 48-in. punch and shear was then thrown in, and starting up light took 6.9 hp, settling down to .4 hp. Shearing 5/16-in. steel plate, it required 3 hp.

A 6-ft. radial drill was then added, and at starting up light took

3.6 hp, settling down to 1.1 hp. A 1½-in. drill cutting in steel gave 1.5 hp. A 6-ft. radial drill and bolt cutter required 1.1 hp. The 12-ft. rolls were then added, and starting up light showed 7.3 hp, settling down to 4.75 hp. Rolling steel plates, ½-in. x 8-in. required 5.3 hp. A test of line shaft and counters with the 6-ft. radial drill cutting steel with 1½-in. drill, and a punch and shear running light showed 2 hp. A 1-in. stay bolt cutter added to the above took on starting up 4.5 hp, and cutting 12 threads per inch gave 2.1 hp.

Lathe Section. Shafting driven by a 30-hp, shunt-wound motor and operating 24-in. crank planer, 36-in. x 36-in. x 20 ft. planer, 51-in. boring mill, 16-in. shaping machine, 24-in. lathe, 24-in. drill press, 37-in. boring mill, two 22-in. lathes, three 16-in. lathes, two 18-in. lathes, 28-in. lathe, 43-in. lathe, 2-in. x 24-in. flat turret lathe, two 26-in. x 26-in. x 10-ft. planers, 60-in. horizontal boring machine, water tool grinder, centering machine. The line shaft and counters gave 4.1 hp. A test of the line shaft with counterbelts off gave .7 hp. The speed of the line shaft was 155 r.p.m. The line shaft is 180 ft. long, 2½ in. in diameter and has 22 hangers. A 15-minute test was made of a group of machines comprising two 26-in. planers and one 36-in. planer, cutting steel with one tool each, a turret lathe, an emery wheel, three 16-in. lathes, two 22-in. lathes, a 36-in. boring mill, drill press and a shaper, all in operation. The readings gave an average result of 6.9 hp, a minimum of 4.74 hp and a maximum of 15 hp. A group run of a 26-in. planer, three 16-in. lathes, an 18-in. lathe, a 24-in. lathe, a 16-in. shaper, a 24-in. drill press and a centering machine in operation required at steady running 2.4 hp, and at reversal of the planer 7.6 hp.

A single 26-in. planer cutting cast iron took 1 hp, and at reversal 3.5 hp. A 16-in. shaper cutting 1/32-in. steel at 12-in. stroke took .9 hp, with a minimum of .2 hp and a maximum of 1.4 hp. A 24-in. turret lathe cutting required .3 hp. A 24-in. lathe boring brass took .03 hp.

Tool Section.—Shafting driven by a 20-hp, shunt-wound motor and operating tool grinder, drill grinder, 21-in. drill press, 16-in. lathe, milling machine, grinding machine, three 18-in. turret lathes, 24-in. drill press, 28-in. lathe, No. 10 vertical milling machine, 2-spindle rod drills, 14-in. pillar shaper, 16-in. lathe, 26-in. x 26-in. x 6-ft. planer, 32-in. drill press, surface grinding machine, water tool grinder. The line shaft and counters required 2.8 hp. The line shaft is 140 ft. long, 2½ in. in diameter, and has 20 hangers. It was not convenient to obtain a test of the line shaft alone. The speed of the line shaft was 155 r.p.m. The line shafts of the lathe and tool sections can be connected by a clutch coupling and the whole operated from either motor. A group test was made of a 16-in. lathe, a drill press and a grinder, all in operation, with a result of 1.9 hp.

A single grinder took in starting up 9.7 hp, and grinding 1.95 hp. A 28-in. lathe took on starting 4.7 hp and cutting steel 2.5 hp. A group run of two 16-in. lathes, a shaper and two grinders in operation showed 2.5 hp.

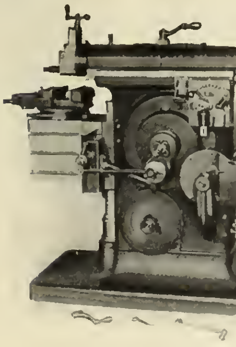


FIG. 1.—SHAPER.

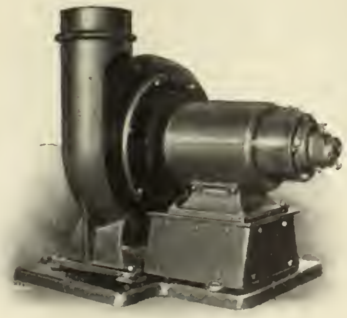


FIG. 2.—BLOWER.

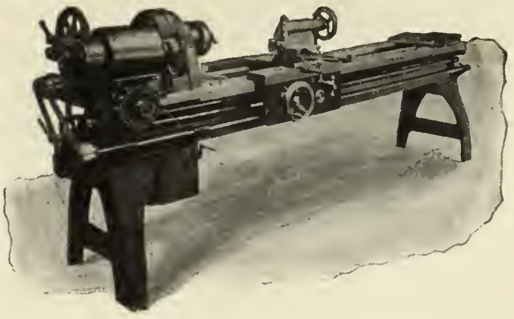


FIG. 3.—"REED" LATHE.

Flue Section.—Shafting driven by 10-hp, shunt-wound motor and operating flue welder, flue cleaner, two No. 7 Jarecki pipe-threading machines, two pipe cutters. A test of the line shaft with all counters gave .6 hp. A test of the line shaft gave .035 hp. The line shaft is 90 feet long, 2½ in. in diameter, and has 12 hangers.

A single flue welder with blowing fan attached required on starting up 7.1 hp. Running light it took 3.4 hp. The pipe cutter cutting 2½-in. pipe took .06 hp. The auto-flue cleaner, cleaning 2-in. flue, took .2 hp.

Flue Rattler.—Outside at the end of the machine shop is a flue rattler operated by a 7½-hp, shunt-wound motor.

Blacksmith Shop.—The blacksmith shop is driven by a 40-hp, shunt-wound motor, which is belted to 75 ft. of 2½-in. line shafting with 12 hangers. The apparatus driven comprises a bolt header, a 25-in. punch and shear, a cutting-off saw, a tool grinder, a 40-in. planer, a drill press, a 50-lb. hammer, a blower, and an exhaust fan. A test of the line shaft and counters with grindstone and two blowers constantly in operation gave 14.5 hp. The bolt header added to the above gave on starting 7.8 hp, running light .5 hp, and heading 1-in. bolts 3.5 hp. A No. 2 Hilles & Jones punch and shear added to the above, first condition, gave on starting up 5.5 hp, running light .5 hp, and shearing 1½-in. round bar 4.3 hp.

Turntable.—The turntable is 70 ft. long and is operated by a 10-hp, direct-current motor of the street railway type geared to an independent traction wheel, the driving combination being supported in a pivoted frame, or "donkey," which rests with all its weight upon the turntable track, even when the table is tipped by a locomotive. The power is led to the motor through a sliding contact placed on the bridge above the center of the turntable. With the table running light and the controller on full, a test gave 4.45 hp. In throwing on the controller and accelerating up to full speed 5 hp was attained, which dropped to a constant of 4.45 hp.

With a locomotive on the table, weighing with tender approximately 286,000 lbs., a test gave 7.35 hp when accelerating to full speed. When full speed was attained, the test showed 5.43 hp.

Power House.—Switchboard readings of the ammeter and voltmeter were taken every five minutes, from 1 : 00 P. M. to 5 : 30 P. M., with averages of 220 volts and 250.7 amperes, or 73.8 hp. The minimum current was 200 amp, or 59 hp, and maximum current 300 amp, or 88.5 hp, the average of which is 250 amp, or 73.75 hp.

These tests were carried out by Messrs. H. M. Palmer and George H. Gibson, of the Westinghouse Electric & Manufacturing Company, and were made possible by the courtesy and permission of Mr. F. T. Hyndman, master mechanic, and the kind assistance of Mr. C. D. McArthur, chief draftsman of the Buffalo, Rochester & Pittsburg Railway Company.

Direct Driven Machine Tools.

The accompanying illustrations show several machine tools equipped with Storey motors. Fig. 1 represents a shaper fitted with a motor, and the arrangement is such that the speed of cutting may be readily adjusted to suit the conditions of service, to do which requires a speed variation of about 3 to 1, with a low speed of about 500 r.p.m., and from 1 to 3 hp, depending upon the work to be done.

Fig. 2 represents a blower that is compact, dust-proof and so constructed that the speed can be adjusted in 50 increments, from 400 to 2,400 r.p.m., with a very satisfactory economy if it is considered that the speed changes do not involve an armature resistance. The makers state that motor is dust and moisture-proof, runs well within "Navy" specifications, and is sparkless in point of commutation at all load changes.

Fig. 3 represents a "Reed" lathe, arranged with a variable-speed Storey motor, which forms an integral part of the lathe, with every facility for giving all the speed changes that can be desired in any service.

Fig. 4 represents a Prentice lathe with still another style of attachment of the motor, no less compact. The power required depends, not upon the "swing" of the lathe in any given case, but rather upon the kind of material being removed, and the amount of that material removed in a given time. It is a fact, nevertheless, that large swing, heavy lathes, are used as a rule for heavy cuts at high speeds and rapid feeds, hence it is desirable to employ motors in proportion.

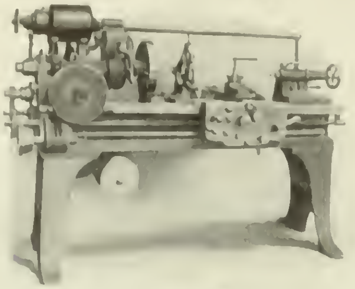


FIG. 4—PRENTICE LATHE.

Not considering special service, it is generally safe to allow motors for lathes about as follows:

Swing of Lathes	12"	16"	20"	24"	28"	32"	36"
H.P. rating of motor	1	1½	2½	3¾	5	7½	10
Speed changes in per cent.	500	450	400	350	300	250	200
Lowest speed, r.p.m......	550	500	475	450	400	350	300

Speed changes—From 20 to 60, depending upon service.

The above data are no more absolute than is the fact that the material to be cut is fixed; to illustrate this point it may be said that a 36-in. lathe turning gun barrels with ¾-in. x ¼-in. "blue" turnings, will require the large size motor, whereas the same lathe on brass castings might be all right using a motor of one-half that size.

Electric Power Equipment for a Japanese Arsenal.

One of the most complete and up-to-date electric power plants recently installed in Japan is located at the Osaka Military Arsenal. This installation was made for the purpose of operating the electric cranes; and blowers for the cupolas in the new foundry just completed. The foundry is built of red brick, with a corrugated iron roof, the inside dimensions being 86 m 300 x 33 m 400. It is equipped with four 10-ton, one 25-ton and one 20-ton Morgan cranes; also four 4-ton and six 7-ton cupolas, two being made by the Whiting Foundry Equipment Company and the others in the Arsenal itself. Four Root blowers, each driven by a Westinghouse 40-hp induction motor, supply the blast for these cupolas.

The power house is equipped as follows: In the boiler room are two Sulzer-Frere Cornish shell boilers, center-fired, each having heating surface of 62 square meters and a grate surface of 1.8 square meters. Each boiler is complete with its own heater, consisting of two plain cylinders each of 600 mm diameter and of the same length as the boilers. These heaters are mounted over the boiler shells and suspended from the angle irons supporting the brick work. One Worthington duplex pump and one restarting injector are provided for supplying feed water to the boilers.

In the engine room there are two Sulzer-Frere vertical, tandem-compound, single, balanced-crank engines with high-pressure cylinders 325 mm in diameter, low-pressure cylinders 475 mm in diameter and stroke 300 mm, operating under a steam pressure of 8 atmospheres at 257 r.p.m. The low-pressure cylinders have a fixed cut-off and the high-pressure cylinders a variable cut-off. Each engine is provided with a heavy fly-wheel by means of which the angular variation of the engine speed is reduced to a minimum. The condensers are a part of each engine, operating from the crank-shaft by eccentrics.

Direct coupled to each engine is a Westinghouse 100-kw, 220-volt, 3-phase, 3,600 alternations, composite-wound generator of the two-bearing, revolving-armature type and standard construction. The armatures are of the slotted drum type, the cores being built up of laminated sheets of steel, pressed on the cast-iron spider and held in place between two end plates. The armature windings consist of strap-wound coils formed and insulated before being placed in the slots, the coils being held in the slots by retaining wedges of hard fibre, thus requiring no bands. Two 11¼ kw, 125 volt, multipolar exciters, driven by belt from the main engines, furnish field current for the separate field of the generators, each exciter having sufficient capacity for two generators. The switchboard, to which the two generators are connected in parallel, is of the Westinghouse standard type "8" construction. There are two 3 phase feeders, of 0000 B. & S. gauge, each leading out from the power house to a distribution panel located at a convenient point in the foundry, from which the circuits of the various cranes and blowers are supplied. Before any load was put on the generators they were synchronized and it was noted from the ammeters and tachometers that there was no perceptible angular variation in the engine speeds and no cross currents flowing between the armatures. As it was not possible to get a steady motor load, the generators were given a trial run on a non-inductive load. This load was obtained by rigging up three water barrels with iron plate terminals, three plates being fastened at the bottom of the barrels and the other three lowered into the water by pulleys overhead. The artificial load thus secured provided an excellent means for properly adjusting the compensating field for perfect parallel operation and for taking care of the full range of the machines. After this test a full load run of two hours was made with the cranes and blowers working.

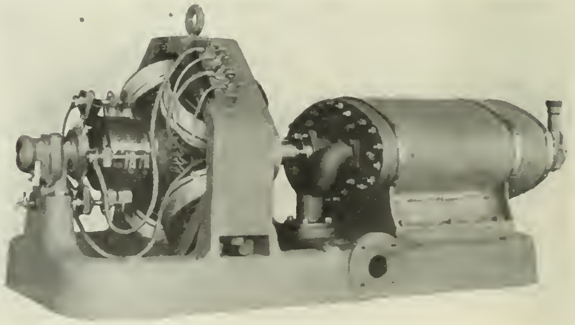
The cranes are all equipped with Westinghouse standard variable speed induction motors and Westinghouse crane controllers. The very close regulation of the motors and the perfect control of the cranes were subjects of much comment by the directors of the Arsenal.

The design of the power house and foundry, together with the lay-out of all machines in the latter, came directly under the supervision of Mr. G. Kuwada, the mechanical engineer of the Arsenal. The foundry is a model of completeness in every detail and reflects great credit upon Mr. Kuwada, who is one of the most clever engineers in Japan. All of the electrical apparatus, as well as the cranes, blowers and two cupolas were supplied by Messrs. Takata & Co., who are the sole agents in Japan for Westinghouse electric apparatus.

Small Generating Set.

The accompanying illustration shows a small generating set which was installed in the power plant of the Keystone Telephone Company, of Philadelphia, some four months ago, and has been in continuous operation there ever since, contributing its share to lighting the building. The novel feature of this set is not the generator, but the engine, which is one of nine of its type built and installed by the inventor, Mr. E. C. Warren.

As is apparent from the illustration, the Warren engine is of the rotary type, but beyond this general classification it has nothing in common with the numerous other rotary engines which have appeared from time to time, mostly experimental rather than practical.



GENERATING SET DRIVEN BY ROTARY ENGINE.

The advantages of the rotary type of engine have long been recognized, but a stumbling block in arriving at satisfactory results has been the uniform failure to secure steam-tight joints. Chief among the advantages of the type is high piston speed, because the condensation losses due to low piston speed are thereby diminished; but when higher speeds were tried it was invariably found that friction packing was unsatisfactory.

The Warren engine does away with friction packing entirely. In its place is substituted a condition which the inventor describes as "contact without pressure" and hence without friction. A convenient illustration of this principle is afforded by the operation of an ordinary rotary surface grinder. As soon as it ceases to be fed downward or pressure ceases to be applied abrasion ceases; but the wheel continues to revolve smoothly and without friction at such an infinitesimal distance from the object, that, speaking in general terms, it may be said to "touch" it. At any rate, this inappreciable interval provides a joint through which no foreign substance can pass even though that substance might be a gas or vapor under high tension. Furthermore, it is obvious that this condition may be maintained indefinitely, any settling of the wheel due to the gradual wear of the bearings being compensated by a corresponding wearing away of the object with which it is in contact.

If this condition of contact without friction, heat or perceptible wear can be maintained in the case of a rough wheel of abrasive material, the condition will naturally be vastly bettered when hard-polished metal is substituted. That this may be done in the case of a rotary engine is the claim of Mr. Warren, and the details of the mechanism will later be made public.

The Warren engine will be built by the Rotary Engine Company, of Philadelphia, of which Mr. C. E. Wilson, general manager of the Keystone Telephone Company, of Philadelphia, is president. Mr. E. C. Warren, the inventor, is vice-president and Mr. W P. Tarrant secretary and treasurer. Among the other directors is Dr. Louis Duncan, of the Massachusetts Institute of Technology.

The Nernst Lamp in a New Bank.

The Farmers' National Bank Building, which is to be the largest structure in Pittsburg and one of the tallest office buildings in the world, is nearing completion and will be occupied early in March. Contracts for the electrical apparatus have been signed and most of the apparatus is already in place. The generating plant, consisting of three 150-kw and one 75-kw machines, has been furnished by the Westinghouse Electric & Manufacturing Company, and the building has been wired by Clark & McMullen, of New York. The lighting contract was the most hotly contested of any in the building, and the outcome is that the entire building is to be lighted with Nernst lamps made by the Nernst Lamp Company, of Pittsburg, and supplied by the Doubleday-Hill Electric Company of the same city.

Alden & Harlow, the achitects for the building, decided on the lamp because of the beautiful quality and steadiness of the light, the absence of shadow and the high efficiency. There are to be installed 1,000 55-kw single glower, 1,250 88-kw single glower, 20 2-glower and 20 6-glower lamps, and although different units will prevail in the building, the quality of light will be the same throughout, this being one of the features of Nernst lamp illumination in distinction from the combination of arc and incandescent lights ordinarily found in large interiors.

A New Telephone Receiver.

A new telephone receiver has recently been put on the market by the International Telephone Manufacturing Company, Chicago. The accompanying cuts show the instrument as used, and its working parts. It has a horseshoe magnet constructed in one piece of the very best magnet steel obtainable for the purpose and of sufficient length and weight to secure the strongest magnet possible for an instrument of its kind. The magnet is fitted at its pole ends into the adjusting block and firmly clamped to the bobbins and block by a heavy binding bolt and nut.

The diaphragm is firmly clamped to a metal head by a threaded metal ring, to give it the greatest possible freedom to vibrate, and so it does not depend on the rubber cap for its permanency. Its double-pole pieces are made of a special grade of soft Norway iron, thoroughly insulated and wound with silk-covered magnet wire.

The cores are swaged under heavy pressure in a special die to make them absolutely uniform in width and provide positive stops for the spool heads. The ends are milled perfectly square in a special jig, making them all of one length. The spool heads are mounted and set to the cores by machine in a special tool, to give the bobbins all the same spacing. The spools all being absolutely of one shape and size in every way, makes them interchangeable at all times. The cores fit tightly into the adjusting block, making it impossible for the receiver accidentally getting out of adjustment.

It is adjustable, so that the diaphragm and pole pieces of every instrument may be placed in their exact, proper relations with each other, to secure the best possible results for the service desired. The spools being practically the only working part of a receiver that are subject to being destroyed or naturally becoming defective, the International Receiver is made adjustable so this part may be conveniently and readily replaced and the receiver accurately and permanently adjusted without returning the entire instrument to the factory. It has all working parts self-contained and has no part depending on the shell or cap for being held in place. Its magnet is fastened at its pole end only, so that the receiver is not affected by any difference between the contraction and expansion of the rubber shell and of the magnet steel, from extreme variations in temperature.

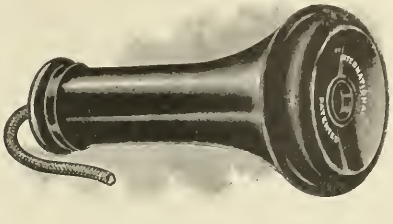


FIG. 1.—RECEIVER COMPLETE.

The magnet, together with the spools, are securely fastened into a strong cast brass threaded adjusting-block, which is fastened into a metal cup. The diaphragm is clamped firmly to the edge of this cup by a finely threaded metal rim. The adjustment is locked by two binding screws passing through slots in the cup, firmly clamping it to the adjusting block. All working parts being of metal and securely held in position near the diaphragm, make the adjustment absolutely unchangeable.

Every detail part is made strong and durable. The shell which in itself is of extra thickness, has no strain or weight to hold. The shell is only a cover to the working parts. The receiver can be used without its shell. The cap of the receiver is provided with a small ridge around the hole, so that perspiration, due to long use of the instrument in hot weather, will not enter and rust the diaphragm. The shell and cap are constructed of polished hard rubber. The coil wires are of silk-covered magnet wire and lead through sleeving direct to the cord terminals, avoiding chance of loose connections or open circuit in the receiver head.

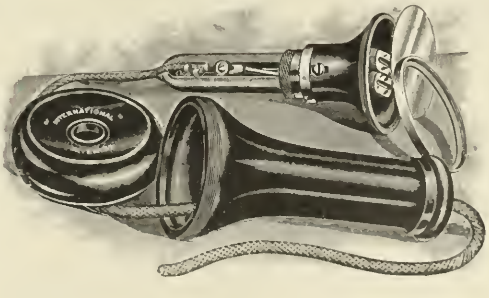


FIG. 2.—DETAILS OF RECEIVER.

The cord terminals are mounted upon an insulating block, placed between the magnet bars. They are provided with a special cord clip to hold the cord by its braid and relieve the conductors of all strain. The outer ends of the cord are regularly furnished with a loop to fasten under a binding screw. They are provided with the ordinary cord tips if desired, and so ordered.

This receiver has all metal parts and cord terminals entirely concealed within its rubber shell and cap. There is positively no danger of getting an electrical shock from the receiver while using the instrument, in case of lightning or trolley crosses on the outside lines.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered liberally and there was a fair demand. The closing rates were 4¼ per cent. for 60 to 90 days, and 4¼ a 4½ for 4, 5 and 6 months. The stock market showed less activity, as a result of the holiday Thursday. The volume of business, however, was fairly large and the general tone was strong. A great deal of attention was paid to large increases which have continued to be shown in railway earnings and also to the general favorable condition of business and of manufacturing industries, which latter is reflected by the increased attention paid to the various securities on the industrial list. More or less effect was produced by the continued indication of improvement in the copper market and the inception of active manipulation, not only in Amalgamated Copper, but in the various other copper stocks traded in either at New York or Boston. Amalgamated Copper rose from 68¾, to 71. Among the tractions, Brooklyn Rapid Transit became conspicuous upon talk about improved earnings under the new management. This stock closed at 69¼ after having reached 70½, the sales aggregating 53,060 shares. The closing price represents a net gain of ⅜ of a point. Metropolitan Street Railway closed at 138, being a net gain of 1 point, this quotation being ½ point below the highest price of the week. General Electric scored another sharp advance in connection with the expected "rights" to be issued against new stock used for the purchase of the Stanley Electric Company. It closed at 202⅜, being a net gain of 8⅝ points. The sales were 15,600 shares, the range of prices being 193¾, the lowest, and 204 the highest. Westinghouse, both issues, showed gains, common closing at 218, being 4¼ points higher than last quotation, and preferred 202, being a net gain of 2 points. Western Union was steady throughout the week, closing at 90, which is practically unchanged from last week. American District Telegraph closed at 38½ and American Telegraph and Cable at 84¾. Following are the closing quotations of February 17:

NEW YORK.

	Feb. 10.	Feb. 17		Feb. 10.	Feb. 17
American Tel. & Cable......	85	84	General Electric.	195⅛	200
American Tel. & Tel........	164	165	Hudson River Tel...........	..	..
American Dist. Tel	37	37	Metropolitan St. Ry.........	137¾	139⅛
Brooklyn Rapid Transit ..	69¼	70¼	N. E. Elec. Veh. Trns........	3/16	..
Commercial Cable.	..	.	N. Y. & N. J. Tel............	162	..
Electric Boat	20	20	N. Y. E. V. T. Co....	10	10
Electric Boat pfd	37	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	3	3	Western Union Tel....... ...	89⅞	90
Electric Vehicle...	6	6⅛	Westinghouse com....	210	217*
Electric Vehicle pfd........	11¼	11½	Westinghouse pfd...........	210	220*

BOSTON.

	Feb. 10	Feb. 17		Feb. 10.	Feb. 17
American Tel. & Tel	164¾	165⅛	Western Tel. & Tel. pfd....	89	..
Cumberland Telephone....	..	..	Mexican Telephone.........	2¼	2¼
Edison Elec. Illum...	..	305	New England Telephone ...	135	..
General Electric............	194¼	200¼	Westinghouse	105	104
Western Tel. & Tel	24	25¼	Westinghouse pfd...... . .	105	105

PHILADELPHIA.

	Feb. 10.			Feb. 10.	
American Railways.........	..	Election Day.	Phila. Traction..	98	Election Day.
Elec. Storage Battery.. ...	.		Phila. Electric	8	
Elec. Storage Battery pfd..	..		Pa. Electric Vehicle...	..	
Elec. Co. of America.	9⅛		Pa. Electric Vehicle pfd ...	..	

CHICAGO.

	Feb. 10.	Feb. 17		Feb. 10.	Feb. 17
Central Union Tel	.	..	National Carbon pfd........	98	98
Chicago Edison.......... ..	160	162	Northwest Elev. com........	..	..
Chicago City Ry....	225	220	Union Traction	10¾	10
Chicago Tel. Co	..	157	Union Traction pfd.........	35	45
National Carbon	24	25			

*Asked.

CONSOLIDATION AT LOUISVILLE.—A merger of the Louisville Railway Company, the Louisville Gas Company, and the Louisville Electric Light Company and the Citizens' General Electric Company, is said to be on foot. A conference was held last week. There were present J. B. Speed, vice-president of the Louisville Railway Company, with large interests in this corporation and the Louisville Gas Company; Udolpho Snead, president of the Louisville Gas Company; A. Hite Barret, president of the Louisville Electric Light Company, and Harry Bishop, vice-president; J. J. Harbeson, president of the Citizens' General Electric Company, and A. M. Worthington, secretaries; W. T. Sheehan, New York; Thomas E. Murray, Brooklyn, and John Hourigan and R. B. Lewis, of Albany. The Louisville Railway Company, the Louisville Electric Light Company, and the Citizens' General Electric Company are now maintaining separate power plants, and under a merger of interests these would be combined, thereby effecting a big saving of operating expenses.

NEW ENGLAND TELEPHONE.—At the meeting of the directors of the New England Telephone & Telegraph Company the statement of the business of the company for the year 1902 was presented. It shows gross revenue of $6,024,609, against $5,177,412 in 1901 and $4,518,306 in 1900; operating expenses of $4,855,840, against $4,139,929 in 1901 and $3,621,644 in 1900, making the net revenue in 1902 $1,168,769, against $1,037,482 in 1901 and $896,752 in 1900. The dividends (6 per cent.) in 1902 were $1,108,726, against $947,406 in 1901 and $838,635 in 1900. The surplus for 1902 was $60,042, against $90,076 in 1901 and $58,117 in 1900. The capital stock sold during 1902 amounted to $3,593,200 and the total stock outstanding at the end of 1902 was $21,616,700. The number of exchange stations open was 111,774; increase in stations during year, 17,952.

DIVIDENDS.—The directors of Niles-Bement-Pond have declared the usual semi-annual dividend of 4 per cent. on the common stock, one-half (2 per cent.) payable March 20, and one-half payable June 20. The directors have also declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable February 14. A 2 per cent. semi-annual dividend has been paid on the $100,000 of preferred stock of the New Albany (Ky.) Street Railway, the first dividend since reorganization. The Metropolitan Elevated, Chicago, has declared the semi-annual dividend of 1½ per cent., making 3 per cent. for the year, payable February 28th. The American Railways directors have declared the quarterly dividend of 1½ per cent., payable March 16, to stock of record February 28.

GENERAL ELECTRIC-STANLEY.—The much-discussed deal between the General Electric and Stanley interests has, it is said, been closed, but does not include the Electric Storage Battery Company, as was expected by some people, and even announced in the daily papers. The price for the Stanley shares is understood to be somewhere in the vicinity of $120—$125. The large factory at Pittsfield will be carried on as usual and the Stanley Company will continue to devote its energies chiefly to high-voltage polyphase apparatus for which it has won a deservedly high reputation. For the present also no change, it is said, is to be made in the personnel of the management or the technical and selling organization.

NORTHWESTERN ELEVATED, of Chicago, reports for the year ended December 31 as follows:

	1902.	1901.	Changes.
Gross	$1,410,998	$978,766	Inc. $432,232
Expenses	464,401	322,645	Inc. 141,756
Net	$946,597	$656,121	Inc. $290,476
Charges and tax	757,173	400,693	Inc. 356,480
Surplus	$189,424	$255,428	Dec. $66,004
Previous surplus	282,305	......	....
Total surplus	$471,729	......	....

CLEVELAND INDEPENDENT TELEPHONE.—The Cuyahoga Telephone Company, of Cleveland, Ohio, reports as follows for the year ended December 31, 1902: Gross, $385,852; expenses and taxes, $229,709; net, $156,143; charges, $155,600; surplus, $543. The general balance sheet as of December 31 shows: Assets—Property and plant, $5,714,243; material and supplies, $60,616; current assets, $101,724; deferred assets, $1,756; deficit, $29,143; total, $5,907,482. Liabilities—Capital stock, $3,000,000; bonded debt, $2,233,000; current liabilities, $196,046; Federal Telephone Company, $475,393; deferred liabilities, $3,043; total, $5,907,482.

SOUTH JERSEY ELECTRICS.—The stockholders of the South Jersey Gas, Electric & Traction Company will vote on February 28 on a proposition authorizing the issue of $15,000,000 of bonds of which $8,200,000 will be used to retire existing bonds at maturity. The stockholders of the company, which is supposed to be dominated by United Gas Improvement interests, will also vote on merging eight companies into its organization.

COLORADO TROLLEYS.—According to Denver dispatches the Florence and Kenton City Electric Street Railway has filed a mortgage to secure $2,700,000 5 per cent. twenty-five-year gold bonds, and will build 125 miles of electric railway throughout the region.

MINNEAPOLIS GENERAL ELECTRIC.—The Minneapolis General Electric Company will hold a stockholders' meeting February 20 for the purpose of increasing the preferred stock by $250,000, making the total issue $1,000,000.

PITTSBURG BELL TELEPHONE.—The capital stock of the Central District Printing & Telegraph Company has been increased from $1,250,000 to $10,000,000.

BOSTON EDISON BRANCHING OUT.—The Edison Electric Illuminating Co., of Boston, will shortly petition the gas commissioners for authority to issue new stock to capitalize recent purchases of suburban electric properties. Five companies have already been absorbed, and others will probably be gathered in before the filing of the petition. The companies already acquired, the capitalization and the floating debts follow:

	Capital stock.	Bonds & notes.	Floating debt.
Dedham Electric	$60,000	$93,000	$21,000
Blue Hill Electric	30,000	......	63,000
Milton Light & Power	42,000	69,000	12,000
Natick Gas & Electric	62,000	62,000	98,000
Framingham Electric	80,000	50,000	56,000
Total	$274,000	$274,000	$250,000

The extent of the new stock issue will depend upon the appraised valuation of the several plants purchased.

ALBANY & HUDSON.—At the Court House at Hudson, N.Y. on February 11, the property of the Albany & Hudson Railway and Power Company was offered for sale and was bid in by Charles H. Warner, representing Sheehan & Collins, attorneys for the Colonial Trust Company of New York, holders of the mortgage of $2,500,000. There was only one bid—$1,250,000—just one-half the amount of the mortgage. This sale includes all of the company's property in Columbia and Rensselaer Counties, the gas plant in Hudson, the electric power house at Stuyvesant Falls, Electric Park, and the Hudson Railway. The company has been unable to pay interest since the serious accident two years ago, in which several lives were lost. The road will be reorganized and continued under new management. It is a splendid property and will rapidly recuperate from the disasters inflicted upon it by careless motormen.

NORTH AMERICAN.—The Board of Directors of the North American Co. has declared a dividend of 4 per cent. upon the capital stock of the company, payable 1 per cent. quarterly on the first days of March, June, September and December of the current year. The dividend thus declared is derived solely from the interest and dividends received by the company from its permanent investments in electric lighting companies, irrespective of the earnings derived from its general operations and business. This is the first dividend in 20 years, and is entirely due to the policy of going into sound electrical enterprises. The original scheme was a branch of the Villard Northern Pacific deals.

STARK ELECTRIC MORTGAGE.—A Youngstown, Ohio, dispatch states that the Stark Electric Company has filed a mortgage for $1,000,000 in favor of the Savings and Trust Company of Cleveland.

Commercial Intelligence.

THE WEEK IN TRADE.—The trade situation throughout the country is summed up by *Bradstreet's* as follows: "Distributive trade and productive industry feel the influence of spring-like weather, slightly better collections, steady and even strong prices for staples, some improvement in the railway transportation situation and cheaper and better supplies of coal at the east." The mild weather has stimulated building operations generally, and highly satisfactory reports are made from the different sections of the country. The prosperity of railways does not seem to have yet culminated, since increased freight rates, based upon higher wages, have brought larger receipts. The net returns for December will turn out better than was expected, while the gross receipts for January this year will prove to be by far the best ever reported in that month. It is pointed out in connection with the industrial situation that present high prices do not seem to check consumption. In the strongest situated industries of all those of cotton manufacturing and of iron and steel production, insistent demand, culminating in large sales, gives testimony to the increased purchasing power of the country at large. In iron and steel the car congestion continues to be the chief obstacle to freedom of trade, the supplies of coke for the furnaces being limited thereby. There is an increased demand for structural material, steel plates, merchant bars and rails. The distribution of hardware is increasing and building operations promise to be very active. The logging output in Maine is very large and an unprecedented activity is noted on the Pacific coast, but the Northwest reports that lack of snow is limiting the output. In the South and Southwest the output of lumber is enormous. In the metal market, copper exhibited great strength and a large business was done for home trade as well as for export. Manufacturers continue very busy. Prices have again advanced, the closing quotations being 12¾ a 12⅞c. for Lake, 12⅝ a 12¾c. for electrolytic in cakes, wire bars and ingots, and 12⅜ a 12½c. for cathodes and casting stock. The number of business failures for the week ending February 12, as reported by *Bradstreet's*, numbered 214 as against 208 the week previous and 265 the corresponding week last year.

THE NEW YORK EDISON COMPANY has recently placed a contract with Westinghouse, Church, Kerr & Co. for another 6,500 hp Westinghouse vertical three-cylinder compound engine of the same size and construction as the eight already in operation and being installed at its 39th Street Waterside Station. This contract includes an independent steam driven air and circulating pump condenser equipment and is the third order received from the New York Edison Company for these engines, the first covering eight units, the second two, and the third one, a total of eleven units, aggregating 71,000 hp normal, or 100,000 hp maximum capacity. The engines are of the vertical type, with a middle high pressure cylinder 43½ inches diameter, and two outside low pressure cylinders each 75½ inches diameter, the stroke being 60 inches. The engines are approximately 40 feet over all in height. They are direct connected to 4,000 kw revolving field generators, supplying high tension polyphase current to the various local sub-stations throughout Manhattan. Steam is supplied at 175 lbs. and a vacuum of 27 inches is maintained by the condensing system. The air and circulating pumps are mounted upon a common bed-plate, together with the actuating Corliss cylinder, forming a pumping unit of great compactness.

WATERWORKS FOR PORTO RICO.—The Stilwell-Bierce & Smith-Vaile Company, through Mr. George W. Neff, Washington Life Building, have secured a contract from Vicente Usera, of Ponce, Porto Rico, for a complete waterworks system. There will be two compound pumping engines having a combined capacity of 5,000,000 gallons. The boiler plant will consist of three 150-hp units. Four hundred tons of cast-iron water pipe, varying from 6 inches to 14 inches in diameter, have also been requisitioned for. The value of the contract exceeds $60,000.

LARGE POWER PLANT FOR PERU.—A large plant is to be constructed in Peru for the purpose of operating the smelter works —not yet built—at the Cerro de Pasco copper mines, which are controlled by American interests in which J. B. Haggin, Mills Building, is one of the leading spirits. The capacity of the power plant will be 5,000 hp. Mr. Frank Klepetko, consulting engineer, whose offices are in the Maritime Building, Bridge Street, is now in Peru regarding the matter. He is expected to return in about three weeks.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company's instrument statement for the month ended January 20, shows:

	1903.	1902.	Changes.
Gross output	129,837	87,412	Inc. 42,425
Returned	43,286	34,796	Inc. 8,490
Total output	86,551	52,616	Inc. 33,935
Total outstanding	3,236,871	2,578,626	Inc. 658,245

MEXICAN HYDRAULIC PROJECT.—Lauro Barra, of Mexico City, has been granted a concession by the Mexican authorities for the purpose of constructing an hydraulic plant on the Del Valle River, located in the State of Mexico, at a point called Salitrillo, about 45 miles west from the City of Toluca. The franchise permits of the use of 8,000 liters of water per second. The power is to be used for furnishing electric energy in the vicinity.

BIG BUENOS AYRES TRAMWAYS TO BE ELECTRIFIED. —The Tranvia Cuidad de Buenos Aires—the Buenos Ayres Tramway Company—which concern at present operates 36 miles of animal lines in the Argentine capital, is about to seek permission from the municipality for converting the system over to electric traction. The company is a British one, with head offices at 1 Great Winchester Street, London, E. C.

THE DRAVO CONTRACTING CO., Pittsburg, Pa., is building for Mr. Harry Oliver at Pittsburg, a large and complete electric plant for furnishing electric light and power for the Lewis Block and surrounding buildings. The plant is to consist of three 400 hp vertical cross compound engines, direct connected to Westinghouse generators. The engines are built by the Ball Engine Company, Erie, Pa.

LARGE RIO LIGHTING PLANT.—The Rio de Janeiro Gas Company is primarily interested in a project to establish an extensive electric light plant in that Brazilian city. Mr. J. B. Orr, of the electrical engineering and contracting firm of James Mitchell & Co., Rio Janeiro, is expected to bring further data with him when he visits New York shortly.

ELECTRIC LIGHTING AND TRACTION FOR CORDOBA. —An electric light plant is to be built in the City of Cordoba, Argentine Republic. The construction of an electric traction system is also projected. A Mr. Ross is primarily interested in the schemes.

ST LOUIS FAIR BOILER PLANT.—The contract for erecting the great boiler plant of the World's Fair has been awarded to the American Bridge Company, of St Louis, for $100,000 The structure will be constructed of steel frame. It will stand just west of Machinery Hall and the main approach to the Midway. Between twenty and thirty boilers will be housed there. They will consist of boilers of various capacity, to be furnished as exhibits by boiler-making firms in every part of the world. The first exhibit boiler, one sent by a firm at Duesseldorf, Germany, is already on the grounds awaiting the completion of the plant. Power furnished by the boilers will be supplied to the generators and dynamos in the western end of the Machinery Building. These electrical engines will be placed in the building as live exhibits by their makers and will supply at least two-fifths of the electric power used on the site. The current will be carried to various parts of the grounds by the electric subway, already constructed. Three-fifths of the total power will be furnished by the Citizens' Electric Light Company.

MORE STEAM TURBINES FOR HARTFORD.—The steam turbine equipment of the Hartford Electric Light Company, Hartford, Conn., is to be duplicated in the near future by machines manufactured by the builders of the original installation, the Westinghouse Machine Company, Pittsburg, Pa. The present Corliss engine equipment will be replaced by two 1,000-hp turbines, direct connected to revolving-field polyphase generators. These units will operate in parallel with the 1,500-kw unit installed one year ago, and were chosen for the purpose of securing the utmost flexibility and economy in the operation of the plant. The turbine plant will operate upon superheated steam, with 150 pounds pressure and a high vacuum. The original installation created much interest among engineers and power users, and it is interesting that the first American turbine of large size has given such satisfaction as to warrant an extension of the turbine equipment and the relegation of the steam engine, after one year's operation.

ELECTRIC CRANES FOR CANADIAN LOCOMOTIVE SHOPS.—The Montreal Locomotive & Machine Company's new plant about to be constructed in Montreal, Canada, is to be equipped with electric traveling cranes, to be built by the Whiting Foundry Equipment Company, of Harvey, Ill. Edward J. Etting, of 26 Cortlandt Street, who represents the Whiting interests in New York State, outside of Buffalo, and in Eastern and Central Pennsylvania, has just taken a contract for a 20-ton crane to be installed in the Paxtang Electric Company's plant at Harrisburg, Pa. The Mishawaka (Ind.) power station is also to be equipped with a Whiting crane of similar capacity. This order was taken through the engineering and contracting firm of Sanderson & Porter. A 60-ton crane, to be operated by Westinghouse motors, has been ordered by the Southern Electric Company, of Philadelphia.

NEW YORK CENTRAL IMPROVEMENTS.—The New York Central & Hudson River Railroad has recently placed an order with Westinghouse, Church, Kerr & Co. for four Westinghouse-Corliss engines of the horizontal cross compound type. These engines will form the main power equipment of a new power station in process of erection on the company's property at Weehawken, N. J., which will supply power to the grain elevators and shops there located. Two of the engines are 1,200 hp normal capacity and the remaining two of 700 hp, each pair being direct connected respectively to 750 and 400 kw polyphase generators of the revolving field type. They will operate with 140 lbs. of steam, superheated to 500 degrees Fahrenheit, and with high vacuum. The equipment also includes a small exciter engine of the Westinghouse vertical compound type.

EQUIPMENT FOR NORTH BEACH PLANT.—The Bowery Bay Electric Light & Power Company, of North Beach, L. I., whose president is Walter C. Foster, of the law firm of Foster & Foster, 132 Nassau Street, New York, has placed a contract with Thayer & Company, Incorporated, 39-41 Cortlandt Street, for four Cahall boiler units of 266 hp each. The electric plant consists of Stanley generators operated by engines built by the Buffalo Forge Company and Armington & Sims. The plant which generates power for the purpose of lighting North Beach and operating the steam circuses at that seaside resort will very shortly be extended. The present capacity of the plant is 1,000 hp.

THE A. A. McCREARY COMPANY, 136 Liberty Street, New York, manufacturer of the well-known McCreary half shades, reflectors, desk lamps, etc., and the oldest electrical specialty house, has been reorganized as the McCreary Electric Company, as already noted. The new company has increased facilities for the prompt manufacture and delivery of electrical goods, and will materially enlarge its line. It will be represented in Chicago, London and the Continent. A. A. McCreary, who has been identified with the electrical business for the past twenty years, will be retained as president. Henry W. Brooks, Jr., of 44 Pine Street, New York, is treasurer.

POWER DAM FOR ST. CROIX RIVER.—Plans for a proposed dam in the St. Croix River, between Taylor's Falls and St. Croix Falls, which are before the War Department for consideration, have been endorsed by Major R. L. Hoxie, government engineer, stationed there. Major Hoxie has been in consultation with engineers representing St. Croix River interests, and has found that they have no objection to the proposed dam. The water is to be used for the purpose of generating electric power.

THE PHILADELPHIA TAPESTRY MILLS, manufacturers of tapestries and light carpeting, two years ago decided to operate their plant throughout by electric power and for that purpose purchased (on recommendation of their consulting engineer, Dr. Drysdale), a 150 kw Westinghouse two-phase engine type alternator, together with some 12 to 15 induction motors. This plant has given such satisfaction that they have now decided to duplicate it and have recently contracted with the Westinghouse Company for another alternator of the same size.

POWER TRANSMISSION PLANT FOR INDIA.—The Federal Electric Company, 141 Broadway, New York, has taken a contract for the complete electrical equipment of a transmission plant to be constructed in India for the purpose of generating energy to be conveyed a distance of about 20 miles for both light and power use. There will be two 150-kw, 3-phase generators. The contract for the steam equipment has been awarded to a British concern on the plea of better prices and deliveries being obtained there at present.

POWER PLANT DEVELOPMENT.—Mr. J. H. Robeling has completed the plans for the development of a water-power electrical plant at old Limekiln Falls in the town of Stockbridge, N. Y. The plans provide for two plants, one above the other, thus using the water twice, and the combined plants will furnish 2,000 hp. It is proposed to use the upper power house for supply for Syracuse and the one on the flats for the use of Oneida and Canastota. Mr. Dewitt Hadcock, of Oneida, owns the water rights.

BALL ENGINE ORDERS.—The Woman's College, Baltimore, Md., has recently purchased from the Ball Engine Company, Erie, Pa., a 160-hp self-oiling engine, arranged for direct connection to a 100-kw General Electric generator. Strauss, Eisendrath & Co., Clinton and Quincy Streets, Chicago, have recently installed a 175-hp direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine and the Western Electric Company the generator.

WHITEHEAD MACHINERY COMPANY, of Davenport, Ia., has purchased some 1,500-hp Babcock & Wilcox water tube boilers, from Benedict & Burnham Manufacturing Company, of Waterbury, Conn., and has also purchased 1,000-hp Heine water tube boilers from the L. Hoster Brewing Company, of Columbus, Ohio. Both plants will be dismantled at once. The changes, in both instances, are due to radical alterations and enlargements.

DE FOREST WIRELESS.—Since the adoption of the De Forest system by the United States Navy negotiations have been instituted which will probably result, it is claimed, in its adoption by the Clyde, Mallory and Ward Line of steamships, and by the line running from New York to Porto Rico. The United Fruit Company announces that it has made an agreement with the De Forest Company respecting two stations to be established.

THE DODGE COLD STORAGE COMPANY, of Philadelphia, is building a large coal handling crane to be installed at the Maryland Steel Company's plant at Sparrow's Point. This crane will be driven by electric motors, and the Dodge Company has recently purchased for this purpose one 50-hp and two 30-hp direct-current motors with controllers from the Westinghouse Electric & Manufacturing Company.

THE ALLIS-CHALMERS COMPANY, amongst other large orders for January, reports the sale to the St. Louis & Suburban Railway Company, of St. Louis, Mo., of one 30 x 50 x 60 cross-compound Reynolds-Corliss engine and two 32 x 60. The United Engineering & Contracting Company, of New York City, has ordered two 18 x 42 horizontal Reynolds-Corliss engines.

BULLOCK CONTRACT FOR TROLLEY PLANT.—The Scioto Traction Company, of Columbus, Ohio, has awarded the contract for all the heavy electrical machinery for its power house and sub-stations to the Bullock Electric Manufacturing Company, of Cincinnati. The work will cost about $100,000.

MACHINE TOOLS FOR JAPANESE GOVERNMENT RAILWAY.—Frazar & Co., of Japan, at 63-65 Wall Street, have secured a contract for double-axle lathes, treble-geared turret lathes and other American machine tools for installation in the Japanese Government railway shops.

ORDERS PENDING FOR SMALL BRAZILIAN PLANT.—The Brazilian export house of Blytton Brothers is after contracts for several small plants, which are to be erected for lighting villages along the upper section of the Amazon River and in other parts of South Brazil.

General News.

THE TELEPHONE.

BATESVILLE, ARK.—The Newark Telephone Company, of Batesville, Ark., has filed articles of incorporation. The capital stock is $10,000, of which $5,000 has been subscribed. C. J. Magness is president, J. S. Hanford, vice-president and treasurer, and J. C. Yancy, secretary.

SAN FRANCISCO, CALIF.—The Mission Long Distance Telephone Company has been incorporated with a capital stock of $1,000,000. The directors are G. K. Brown, J. J. Scrivner and others.

DENVER, COL.—The Rifle Creek Telephone Company has been incorporated by C. J. Hoover, R. Parris, G. E. Clarkson and others. Capital $60,000.

WASHINGTON, D. C.—The Chesapeake and Potomac Telephone Company has awarded a contract for the construction of a $200,000 telephone exchange building to be erected in Twelfth Street. C. L. W. Eidlitz and Andrew McKenzie are the architects.

ROCHELLE, ILL.—The Ogle County Telephone Company has increased its capital stock from $60,000 to $100,000.

CALEDONIA, ILL.—The Boone County Co-operative Telephone Company has increased its capital stock from $7,500 to $15,000.

MOUNT VERNON, ILL.—A new telephone company was formed a few days ago at Idlewood. Its line will run from Mount Vernon via Idlewood to Range. There will be twenty stockholders in the company and each one will have a telephone.

ALTON, ILL.—The Kinloch Telephone Company has completed a 664-mile stretch of wire, which gives direct connection with Terre Haute and Indianapolis, Ind., from Alton. Another line from St. Charles to Kansas City has been completed recently.

SPARTA, ILL.—A representative of the Mutual Telephone and Telegraph Company will appear before the City Council of Sparta, the first Monday in March and ask for a general telephone franchise. There is also a representative of a private corporation in St. Louis who will appear before the City Council at the March meeting and ask for a general franchise

EDWARDSVILLE, ILL.—Another rural telephone company has been organized by prominent farmers of the bottom south of this city, officers being elected as follows: President, John Feldman; vice-president, William Dickman; secretary, J. F. Dickman; treasurer, August Brockmeier; directors, Edward Brockman, Henry Viere, Chris Rathert, August Klingeman, Ed Kramer and August Stegmeier. Contract for poles, wires, etc., will be let at an early day.

LAFAYETTE, IND.—The Salem Co-operative Telephone Company has been incorporated at Lafayette, with a capital of $600.

GREENCASTLE, IND.—An ordinance was passed granting the Putnam County Co-operative Telephone Company a franchise for a telephone system in this place.

THOMAS, I. T.—A local telephone system was put in operation here Feb. 1 with 75 telephones. The owners of the system are Riley, Mitchell & Co., of Clay City, Mo. Five months ago Thomas was a wheatfield and to-day it is a booming town on the new Frisco extension from O'Keene to Vernon, Tex.

NEVADA, IA.—The Short Line Telephone Company has been incorporated with a capital of $5,000. F. M. Boardman is president.

WATERLOO, IA.—The Commonwealth Telephone Company, a new corporation, has acquired the lines of the Cedar Valley Telephone Company, the County Telephone and Telegraph system, the Waverly Telephone Company, Hardin County Company, Parkersburg and La Porte systems, all of which have been closely affiliated with the Cedar Valley system. The capital of the company is $900,000, and its principal place of business will be Waterloo.

MT. STERLING, KY.—The Eastern Kentucky Telephone Company, of Montgomery County, has filed incorporations at Frankfort. The capital is $25,000 and the incorporators are R. D. Wilson, Henry Watson and Dr. J. A. Shirley.

SALISBURY, MD.—At the annual meeting of the stockholders of the Maryland and Delaware Telegraph and Telephone Company the expenditure of $150,000 for building of the lines in Virginia was passed upon favorably.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, Grand Rapids, Mich., has recently purchased a 160-capacity, 100 equipped generator call switchboard for Traverse City, Mich., from the Stromberg-Carlson Telephone Mfg. Co.

HUTCHINSON, MINN.—The stockholders of the Hutchinson Telephone Exchange Company have elected the following named officers and directors: President, W. E. Harrington; vice-president, W. S. Clay; secretary, H. L. Merrill; treasurer, Wm. Davidson. Directors: W. E. Harrington, W. S. Clay, H. L. Merrill, Wm. Davidson, D. S. Sivright, W. E. Sivwright and C. G. Odquist.

SAVANNAH, MO.—The Haynie Telephone and Manufacturing Company of this city has been incorporated with a capital of $15,000. one-half paid. The incorporators are George A. Haynie, James Huston and Leslie N. Fry.

DARIEN, N. Y.—The Rural Telephone Company of this place has decided to extend its line.

BERGEN, N. Y.—The Bergen Telephone Company has applied for a franchise. M. Gillette is president.

PENN YAN, N. Y.—The Pulteney-Branchport Telephone Company has been incorporated. The capital stock of the company amounts to $1,000. The line has been in operation for some time.

CANAAN, N. Y.—The Canaan & Chatham Co-operative Telephone Co., of Canaan, Columbia County, has been incorporated; capital, $1,000. Directors: A. B. Howes, F. C. Goodrich, Sr., and O. D. Bartlett, of East Chatham.

ALBANY, N. Y.—The Edmeston and Winfield Telephone Company, of West Exter, Otsego County, has been incorporated, capital $2,000. The directors are D. J. Wood, E. L. Morris and J. B. Wolcott, of West Exter.

HOOSICK FALLS, N. Y.—The Eastern New York Telegraph and Telephone Company, of Hoosick Falls, N. Y., has made a five years' contract with the Rensselaer Telephone Company, of Troy, for the interchange of toll business.

NEW YORK, N. Y.—Plans have been filed with the Building Bureau for the enlargement of the three-story and basement telephone exchange at 30 East Twenty-ninth Street by the addition of a four-story and basement annex on the adjoining lot, doubling the present size of the exchange. The improvement is to cost $80,000.

CLEVELAND, OHIO.—The Empire Telephone Company, of Cleveland, has increased its capital stock from $200,000 to $500,000.

WELLINGTON, OHIO.—The Wellington Telephone Company has 360 telephones, a gain of 120 within a year. The company will connect up a number of farmers and will build a line to New London the coming summer.

HANNIBAL, OHIO.—The Hannibal & Roundbottom Telephone Company has been incorporated, with $10,000 capital stock, by J. A. Fraley, J. W. Fraley, S. W. Fraley, John Ruby and G. Youssy. It will build a system at Hannibal, Monroe County .

DELAWARE, OHIO.—The Citizens' Telephone Company has just completed the installation of a Stromberg-Carlson multiple central energy board of 3,200 lines capacity. The company is extending its system into the surrounding farming districts. Guy Kingsbury is manager.

COLUMBUS, OHIO.—The Franklin County Telephone Company has over 1,200 subscribers in Franklin County, outside of the city of Columbus. It is planning to erect a new exchange in the only town in the county not covered at present. The farmers' system is to be extended during the coming summer.

MARION, OHIO.—The Marion County Telephone Company has 1,075 subscribers in this county. It is installing a new 50-line board at Green Camp, a 100-line board at La Rue and a 50-line board at Agosta. It is planning to build two additional exchanges in other towns and will also build a large number of farmers' lines during the summer.

SANDUSKY, OHIO.—The Sandusky Telephone Company has elected the following named directors: L. Duennisch, J. Kuebler, J. C. Hauser, J. A. Geideman, C. C. Curtiss, J. A. Beihl, C. H. Cramer, L. L. Curtis, C. L. Engel, J. W. Holland, Sidney Kilbourne, C. A. Rittman, John Sinerson and John Whitworth. The company will make a number of improvements during the coming summer.

TOLEDO, OHIO.—The Toledo Home Telephone Company has made application to Probate Judge Miller for a modification of its franchise so as to permit the company to increase its rates. It is claimed the company expected only to secure about 3,500 subscriptions whereas it now has 6,500 subscribers, with many more on a waiting list. At present all contracts are being made on a basis of three years at existing rates.

LEBANON, OHIO.—The Valley Telephone Company has 450 subscribers, a gain of 134 within a year. It is installing a new American Electric board which connects up 350 farmers' lines outside the main exchange. During the coming summer it will erect 8,500 feet of cable and will build branch exchanges at Franklin and Middletown. The board for the former will have 300 lines and for the latter 1,000 lines. None of this material has been purchased.

ALTOONA, PA.—The United Telephone and Telegraph Company, of Philadelphia, has planned to spend $250,000 in this vicinity this spring and summer.

PHILADELPHIA, PA.—The Keystone Telephone Company, of Chester, has joined with the United Telephone Company, and will have service in Pennsylvania, Maryland, Virginia and West Virginia.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, is said to have made a 60 per cent. increase in the number of telephones in the year 1902, the list of stations in service in Philadelphia increasing from about 25,000 to 40,000.

McKINNEY, TEX.—The McKinney Telephone Company has sold its property to the Southwestern Telegraph & Telephone Company.

AMARILLO, TEX.—The Amarillo Telephone Company has been incorporated. Incorporators: R. G. Steyman, R. L. Stringfellow and J. C. Smith, all of Amarillo.

MARSHALL, TEX.—The city council granted a franchise to an independent telephone company. The franchise is forfeited if ever sold to the Bell Telephone Company.

GAINESVILLE, TEX.—The Gainesville Telephone Company, of this city, has been incorporated with a capital stock of $100,000. The incorporators are F. B. McElroy, Sidney L. Samuels and Geo. D. Winters.

COUPEVILLE, WASH.—The Eclipse Telephone Company has elected directors for the ensuing year. The officers are F. A. LeSourd, president; C. T. Terry, vice-president; O. S. Van Olinda, secretary; A. W. Cook, treasurer.

APPLETON, WIS.—The Appleton & Freedom Telephone Company has been organized with a capital of $1,200 to build a telephone line between Appleton and North Freedom.

MADISON, WIS.—The Badger Telegraph & Telephone Company, of Milwaukee, has been incorporated with a capital stock of $150,000 by Charles A. Russell, H. J. Droppers and E. L. Richardson.

FOND DU LAC, WIS.—The Little Wolf Telephone Company has under consideration a proposition from a party of Wisconsin capitalists looking to the extension of its lines throughout the State. The plan is to enter into an agreement with the independent companies of the State whereby connections may be made through the Little Wolf, thus forming one of the most complete telephone systems in Wisconsin. It is proposed to make the line a complete copper circuit.

ELECTRIC LIGHT AND POWER.

CLAYTON, ALA.—The town will soon receive bids for putting in electric lights and water works. It has just finished an artesian well, and when this is put into operation it will proceed to attend to the light question.

WASHINGTON, D. C.—The Potomac River Power Company is reported organized, with J. F. McLaughlin, of Toronto, Ont., as president, to erect buildings necessary for the establishment of a large water power plant near Washington.

SMYRNA, DEL.—The Town Council will borrow $6,000 for improvements of the electric light and water plants.

MONROE, GA.—An electric light plant will probably be constructed this year, but no definite arrangements have yet been made. L. S. Radford is city clerk.

ATLANTA, GA.—O. H. Sheffield & Co., Atlanta, have purchased water rights on Savannah River in Elbert County. About 5,000-hp will be developed and transmitted to factories in the vicinity. The improvements are estimated to cost about $300,000.

DECATUR, ILL.—R. F. Pratt and others have been granted the right to establish an electric light plant in Decatur.

AURORA, ILL.—Plans are being prepared for an electric light plant to be erected by the Fox River Light, Heat & Power Company.

CERROGORDO, ILL.—A company composed of M. N. Mikels and W. M. Rader, will construct an electric light plant at a probable cost of $8,000.

CHICAGO, ILL.—The Chicago Street Lighting Company has been incorporated with a capital stock of $25,000 by A. J. Hirsch, F. W. Bigelow and A. J. C. Timm.

NEWPORT, KY.—It is proposed to establish a municipal electric light plant here, the City Council having provided a fund of $10,000 per year for the purpose.

NEW ORLEANS, LA.—The Consumers' Electric Company has applied for an electric light franchise in this city.

FRYEBURG, ME.—The Fryeburg Electric Light Company has been incorporated with a capital of $10,000. Henry B. Cotton, Conway, N. H., and A. R. Jenness, of Fryeburg, are among the incorporators.

AUGUSTA, ME.—The Columbus Electric Company has been organized at Portland with a capital stock of $1,250,000. The promoters are Gardner Rogers, Brookline; Henry R. Hayes, Dedham; John W. Hallowell, Medford; Ardon W. Coombs, Charles H. Tolman, Portland. Ardon W. Coombs is president, and Gardner Rogers is treasurer.

MANSFIELD, MASS.—It is proposed to organize the Mansfield Gas & Electric Company. F. M. Cobb and Chas. C. Hagerty are reported interested.

MIDDLEBORO, MASS.—The report of Manager George A. Philbrook of the town municipal lighting plant shows sales for the past year of $13,102.33, receipts of $23,958.76 and expenditures of $23,943.05, cash on hand, $15.71. The increase of sales for the year were $415.48. The sales of electric light were $8,233.91; gas, $3,091.99; jobbing, $1,776.43. This makes the cost of the street lighting $10,840.62.

MORRICE, MICH.—The Shiawassee Light & Power Company contemplates extending its service to Morrice, a distance of nine miles.

PLYMOUTH, MICH.—At the spring election the citizens will vote on the question of issuing $12,000 bonds for an electric light plant.

BENTON HARBOR, MICH.—The City Council has appointed a committee to investigate the question of constructing a municipal electric light plant.

BESSEMER, MICH.—E. D. Nelson, president of the Ironwood & Hurley Electric Railway, is said to be interested in a movement to harness the water power on Black River and construct an electric plant.

FERTILE, MINN.—The citizens have voted to construct an electric light plant, to be operated in connection with the water works.

SARDIS, MISS.—The council has granted D. L. Rush, of Batesville, Miss., an electric light franchise here.

NATCHEZ, MISS.—T. McClelland, president of the Jackson Bank, is reported interested in the construction of an electric light plant in Jackson, to cost about $20,000.

SPRINGFIELD, MO.—It is reported that the Springfield Lighting Company will expend about $150,000 in improvements during the year.

ST. JOSEPH, MO.—About $25,000 will be expended this spring by the St. Joseph Railway, Light & Power Co. in improving its lighting system.

BIG TIMBER, MONT.—The Council has granted a franchise to the Big Timber Electric Company.

BROCKPORT, N. Y.—It is reported that the Brockport Electric Company will be purchased by the Albion Power Company.

PLATTSBURGH, N. Y.—It is stated the Delaware & Hudson Railway Company is to install an electric light plant at Plattsburgh.

LUMBERTON, N. C.—The Council is reported to have under consideration the question of establishing an electric light plant.

HIGH POINT, N. C.—The High Point Electric Power Company has been incorporated with a capital of $20,000 by A. N. Richardson and W. S. Thomas.

SPRINGFIELD, OHIO.—The Citizens' Light, Heat & Power Company has been granted a franchise in Springfield.

LOUISVILLE, OHIO.—It is proposed to have the town lighted with electricity by some corporation. Canton, which is about seven miles distant, will likely get the contract.

CAMBRIDGE SPRINGS, PA.—The Council has granted W. B. Ross a franchise to establish an electric light plant.

LAWRENCEBURG, TENN.—It is reported that an electric light plant and water works will be constructed here.

NASHVILLE, TENN.—The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, is reported to have secured the contract for an engine and generator for the electric light plant, at $5,615.

DENISON, TEX.—The Denison Light & Power Company will erect an electric plant to cost about $40,000.

BROWNWOOD, TEX.—The Bayson Light & Power Company has been incorporated with a capital of $30,000.

FT. WORTH, TEX.—The Traders' Investment Company has secured a franchise for an electric light and power plant.

PILOT POINT, TEX.—A company has been organized here, to construct an electric light plant and ice factory. J. E. Light, president; A. W. Walker, secretary.

BRIGHAM, UTAH.—The Council is reported to have placed contracts with the General Electric Company, of Schenectady, N. Y., for a 450-hp dynamo, and with the Pelton Water Wheel Company for an 800-hp water wheel.

RENSENS, VA.—Geo. O. Tenny is stated to have secured the contract for an electric power plant at Renseus, for the Lynchburg Water Power Company, of Lynchburg. The contract price is reported to be about $100,000. This does not include the electrical equipment, which will cost an additional $75,000.

OROVILLE, WASH.—J. M. Hagerty is examining the water power on Similkameen River, six miles from Oroville, which he proposes developing for electrical purposes.

ORTING, WASH.—The Pierce Improvement Company has placed an order for machinery of a capacity of 30,000 horse-power for its electric plant to be built on the Puyallup River.

ABERDEEN, WASH.—The Gray's Harbor Power & Light Company has been organized, with a capital of $250,000, by John L. Wilson and E. C. Finch, of Aberdeen. Power for running the plant will be obtained from Little North River Falls.

MADISON, WIS.—Plans are being prepared for the municipal central power and lighting plant.

KENOSHA, WIS.—Fire in the power house of the Kenosha Gas and Power plant recently destroyed the building. The damage to machinery, etc., will be from $8,000 to $10,000.

DE PERE, WIS.—The directors of the De Pere Electric Light & Power Company have elected the following named officers: president, J. P. Dousman; vice-president, R. J. McGeehan; secretary and treasurer, L. Minich; manager, C. G. Wilcox.

HAMILTON, ONT.—The Hamilton Cataract, Power, Light & Traction Company has been incorporated with a capital of $5,000,000 by J. M. Gibson and J. R. Moodie, of Hamilton, and J. A. Kammerer, of Toronto.

THE ELECTRIC RAILWAY.

ST. AUGUSTINE, FLA.—The St. Augustine & South Beach Railway has been sold under foreclosure to Judge J. W. Henderson and Dr. Horace Lindsley. It is said that the new owners plan to reconstruct the property and equip the line with electricity.

NEW HARMONY, IND.—The Mt. Vernon, New Harmony & Northeastern Traction Company is to be incorporated. Harry Kurtz is interested.

INDIANAPOLIS, IND.—The Indianapolis & Cincinnati Traction Company has been incorporated with a capital of $1,500,000 by Chas. L. Henry, W. L. Taylor and others.

WABASH, IND.—It is announced that the Wabash River Traction Company has sold its line from Wabash to Logansport to the Union Traction Company, of Indiana. The consideration is reported to be almost $1,000,000.

FT. WAYNE, IND.—The International Construction Company, of New York, is preparing for the construction of the Goshen & Indiana Railway. The project has financed and many of the contracts for material placed.

WARSAW, IND.—The Huntington & Winona Traction Company has secured nearly all the right of way for its line from Huntington to Winona by way of South Whitely. Construction work will start in the spring.

LOUISVILLE, KY.—The Louisville & Interurban Railroad Company has been organized with $500,000 capital stock by the officials of the Louisville Railway Company. It is the intention to build a road from Louisville through the counties of Jefferson, Oldham, Shelby, Spencer, Nelson and Bullitt.

ROCKLAND, ME.—The State Railroad Commissioners have approved the location of the Rockland, South Thomaston & Owl's Head Street Railway. The proposed line will be about 8 miles in length.

CUMBERLAND, MD.—The Cumberland Narrows Electric Railway Company has been incorporated with a capital of $20,000. Judge R. H. Koch, of Pottsville, Pa., is one of the incorporators.

SHARON, MASS.—The Norwood, Canton & Sharon Street Railway Company has petitioned the Sharon, Mass., Board of Selectmen for an extension of its track to the Foxboro, Mass., line, and the selectmen have designated Saturday, Feb. 21, for a hearing.

JACKSON, MICH.—The power house of the Jackson Electric Light & Power Company was obliged to close down recently through inability to secure fuel of any kind. The service was resumed after several interruptions.

LANSING, MICH.—The city council has revoked the franchise of the Lansing City Railway Company and the police stopped the running of the cars. The company will go into court to regain possession of its franchise rights.

OMAHA, NEB.—The Omaha, Decatur & Northern Railway Company, capital $1,000,000, has filed articles of incorporation with the Secretary of State. The company intends to build an electric railway through the counties of Douglas, Washington, Burt, Thurston and Dakota.

ALBANY, N. Y.—The Hudson Valley Railway Company has changed its principal office from Waterford to Glens Falls.

JOHNSTOWN, N. Y.—The Fonda, Johnstown and Gloversville Railroad Company has increased its capital from $1,950,000 to $2,500,000.

NEW YORK, N. Y.—New York and Long Island Traction Company (formerly Mineola, Hempstead and Freeport Traction Company) has increased its capital from $125,000 to $1,000,000.

OSWEGO, N. Y.—The Rapid Transit Railway Company, of Syracuse, is reported to be considering the proposition to develop the water power at High Dam. C. F. Stenly is chief engineer.

NEW YORK, N. Y.—In accordance with the request of the State Railroad Commission the Manhattan Railway Company has added several trains to its service on the elevated roads. The new schedule calls for 97 more trips on the Sixth Ave. line and 76 on the Ninth Ave. line. Five new express trains were added to the Ninth Ave. service.

NEW YORK, N. Y.—Two experimental cars, one of which has been built by the General Electric Company and the other by the Westinghouse Company, are being tested nightly on the Ninth Avenue elevated railroad by the officers of the Interborough Rapid Transit Company. Each car is supplied with two motors of 200-hp and the tests already made show that an average speed of 45 miles an hour can be maintained.

NEW YORK, N. Y.—A franchise has been granted to the New York Interborough Railway Company by the Board of Estimate and Apportionment for the operation of a trolley road in the Bronx. The franchise is for a term of fifty years and gives the railroad company the right to run cars across Macomb's Dam Bridge and other Harlem River structures and contains the provision that at the expiration of the franchise the city can purchase the plant necessary for the operation of the road at a fair price, to be fixed by the Board of Estimate and Apportionment.

NEW YORK, N. Y.—The Metropolitan Street Railway Company will make several changes in the motive power of various branches before Nov. 1 next. Three cross-town lines are to have the electric underground system. The first change is to be on the Grand Street cross-town line. The change of the motive power is to be begun on March 20. The next change is to be on the Fourteenth Street cross-town line, which is to have the electric system. The third is to be on the Eighty-sixth Street cross-town line. It is the purpose of the company to install electricity as far as Central Park West, with the idea of running the cars through West Eighty-sixth Street some time in the future. The opposition on the part of the residents of West Eighty-sixth Street at present prevents the continuation of the line on that street.

LANCASTER, OHIO.—The Lancaster Traction Company will double track its road on Main Street and make other improvements. F. E. Ginn, Lancaster, is superintendent.

DAYTON, OHIO.—The Covington, Bradford & Versailles Traction Company has been incorporated by Dennis Dwyer, Albert Emanuel, B. M. Hopkins, E. C. Spring and T. H. Robinson.

CINCINNATI, OHIO.—J. G. Schmidtlapp, B. W. Campbell and H. A. Perkins, prominent business men of this city, are at the head of a project to build an electric railway from Decatur to Springfield, Ill.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway will erect three new sub-stations; one near Urbana, one at Springfield and the third at Dayton. The Columbus, London & Springfield Railway is also planning to increase its power facilities by erecting additional sub-stations.

MANSFIELD, OHIO.—The Citizens' Electric Railway, Light & Power Company has elected these officers: N. S. Ford, president; C. F. Ackerman, vice-president; S. G. Cummings, secretary, and Reid Carpenter, treasurer. These with T. R. Barnes, Rush Taggert, Fred R. Bristor, C. H. Voegele and Robert Hancock are directors.

ASHLAND, OHIO.—H. B. Camp, chief owner of the Ashland & Wooster Railway, a short steam road operating in Ashland and Champaign Counties, announces that the road is to be extended to Lake Erie, terminating at Huron or Vermillion. It is the intention to operate freight trains by steam and equip the line for electric passenger service.

CINCINNATI, OHIO.—Senator Roudebush, promoter of the Cincinnati, Milford & Eastern Railway Company, announces that the financing of the project has been arranged for. It is stated that the deal was put through entirely by Cincinnati and Cleveland capitalists. F. L. Fuller & Company, Cleveland bankers, are interested in the enterprise.

DAYTON, OHIO.—The Dayton & Kenton Traction Company has elected officers as follows: E. M. Hopkins, New York, president; W. W. Chambers, Dayton, vice-president; H. S. Forgy, New Carlisle, secretary; C. H. Pomeroy, Saginaw, Mich., treasurer. W. E. Harris, of De Graff, with the officers, are the directors. The power house will be located at De Graff.

DAYTON, OHIO.—Dr. Samuel F. George, president and chief promoter of the Cincinnati, Dayton & Ft. Wayne Traction Company, announces that his project has been financed and that actual construction work is to start early in the spring. The project contemplates the building of a system of electric lines touching Cincinnati, Dayton, Ft. Wayne, Toledo and other cities.

TOLEDO, OHIO.—At the recent annual meeting of the Toledo Railways & Light Company the following named directors were elected: H. A. Everett, L. E. Beilstein, Albion E. Lang, E. W. Moore, Robert Van Courtlandt, of New York; Herbert S. Holt, of Montreal, and Barton Smith, of Toledo. Mr. Lang was chosen chairman of the board, Mr. Everett president, Mr. Beilstein vice-president and general manager, E. O. Reed secretary, and S. D. Carr treasurer.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Electric Railway Company has elected officers as follows: P. McCrary, president; F. E. Flory, vice-president; D. H. James, secretary; H. R. Klauser, treasurer; A. E. Klauser, Hugh Schunk, Theodore Schmidt and H. S. Landis directors. The company increased its capital stock from $10,000 to $1,800,000. It also let the contract for building the road to the Cooper Construction Company, of Toledo.

CLEVELAND, OHIO.—The incorporation of the Mansfield, Crestline & Galion Railway, with a nominal capital of $10,000, was the preliminary step of the merging of the new line between Mansfield, Crestline and Galion with the Ohio Central Traction Company. Nominally it has been a part of that line since it was completed some weeks ago. The new company will continue the name of the Ohio Central Traction Company and will have a capital stock of $700,000. When the Wellington-Mansfield line is completed, the whole will be absorbed by the Cleveland & Southwestern Traction Company. All the roads mentioned are Pomeroy-Mandelbaum properties.

WHEELING, W. VA.—The Wheeling Traction Company has secured the necessary consents for the construction of a line over an entirely new route into this city. The route will provide a favorable entry for the proposed interurban line to Steubenville.

SOUTH PARKERSBURG, W. VA.—The promoters of the South Parkersburg Electric Railway Company, which will build a line in Wood County, have also incorporated the South Parkersburg Light, Power & Water Company, capital stock. The plan is to build a large plant to supply the railway as well as to furnish city lighting and other utilities. W. G. Peterkin, John Moss, H. P. Camden and G. L. Fries are interested.

MILWAUKEE, WIS.—For a consideration of $3,400,000, subject to a bond issue of $1,500,000, the Chicago & Milwaukee Electric Railway Company has transferred its right of way and property to the Chicago & Milwaukee Electric Railroad Company. The ultimate completion of the electric line between Milwaukee and Chicago will warrant the bond issue.

TORONTO, ONT.—The shareholders of the Toronto Street Railway Company have re-elected the former officers. The gross earnings of the railway for the year were $1,834,908, an increase of $173,890 over last year. The net profit was $506,442. There were 44,437,678 passengers carried, being an increase of 4,589,591 over last year.

ST. JOHN, N. B.—The St. John Street Railway Company is preparing to greatly improve and extend its street car service in the city. The company carries on not only the street railway, but also all gas and electric lighting business of St. John, and has a very valuable franchise. Large improvements are to be made to the power houses, and heavy generators are to be installed.

NEW INDUSTRIAL COMPANIES.

THE O'BRIEN ELECTRICAL COMPANY, of Monterey, Calif., has been incorporated, with a capital stock of $25,000, to deal in electrical appliances.

THE NEW JERSEY ELECTRO-THERAPEUTIC SANATORIUM COMPANY has been incorporated with a capital of $100,000 by Dr. F. K. Irving, C. H. Bunn and John J. Berry.

THE EASTERN ELECTRIC CONTRACT COMPANY, of Jersey City, N. J., has been incorporated. Capital, $100,000. Incorporators: Chas. N. King, W. H. Greene and Le Grand Bouker.

THE CARROLLTON ELECTRIC COMPANY, domiciled at Carrollton, La., has been incorporated by C. B. Clower, J. M. Phillips and John Martin. Capital stock, $10,000.

THE RAILWAY ELECTRICAL IMPROVEMENT COMPANY has been incorporated in Jersey City, N. J., by Ernest P. Haas, Jesse K. Whittaker and Kenneth K. McLaren. The capital is $50,000.

THE PEERLESS TELEPHONE MFG. COMPANY has been incorporated at Rio, Wis., with a capital stock of $10,000. The incorporators are J. L. Farington, Chas. Caldwell and David Robertson.

THE STAR DYNAMO COMPANY, of Jefferson City, Mo., has been incorporated, with a capital stock of $5,000, all paid. The incorporators are Wm. A. Magee, John M. Dutro and Samuel T. Rowley.

S. EDWARD EATON & CO., have organized at Nyack, N. Y., to do electrical and mechanical engineering. The capital stock is $50,000 and the directors are W. A. Eaton and J. S. Eaton, of Nyack, and E. B. Statt, of Brooklyn.

THE WARREN SELECTIVE TELEPHONE SWITCH COMPANY, of Sheldon, Mo., has been incorporated to manufacture telephone apparatus; capital stock, $10,000. Incorporators: John A. Warrick, A. J. Warrick and Semer Cobb.

THE TAYLOR ELECTRIC TRUCK COMPANY, of Troy, N. Y., has been incorporated to manufacture railway and steel car trucks, wheels and car brakes; capital, $75,000. Directors: William F. Gurley, John Taylor and A. Louise Gurley, of Troy.

THE MISSOURI AMERICAN ELECTRIC COMPANY, of St. Louis, has incorporated with a capital stock of $20,000. The shareholders are R. F. Plochman, O. E. Plochman, A. W. W. Miller, George P. McDonnell, L. V. Reach, Ernest Mueller, E. E. Dougherty, Harold R. Small, Harry C. Barker.

THE SHEFFIELD COMPANY, of Tuscumbia, Ala., has been incorporated in New Jersey with a capital of $425,000. The company will acquire the electric light franchise and franchises for a trolley line in Tuscumbia and Florence and the water works of Sheffield. Geo. Parsons, of New York, N. Y., and Col. A. B. Andrews, of Raleigh, N. C., are reported interested.

THE WILLYOUNG & GIBSON COMPANY was incorporated Feb. 6 with the following officers: Elmer G. Willyoung, president and general manager; C. R. Gibson, secretary and treasurer, under the laws of the State of New York, with a paid-up capital of $25,000. The corporation has taken over the business formerly conducted under the title of Elmer G. Willyoung, and will immediately expand the facilities. It is the intention to cover the entire field of high-class scientific instruments and also to make a separate department for electro-therapeutic and allied surgical appliances for the medical profession. The prospects of this combination are very bright; the business last year having exceeded by considerably over fifty per cent. that done during the preceding year. Mr. Willyoung is already well known to the electrical profession. It is Mr. Gibson's first connection with the electrical industry.

THE AUTOMOBILE.

INDIANAPOLIS AUTOMOBILE SHOW.—The annual automobile show will be held in Indianapolis, Ind., the first week in April. Interesting events are being arranged and the entries are very promising.

LEGAL.

TELEPHONE COMPANY ENJOINED.—Judge Windes, at Chicago, on behalf of the Appellate Court, has affirmed the order entered in Judge Tuley's court a year ago granting a temporary injunction to restrain the Chicago Telephone Company from charging more than the franchise rate of $125 a year for its business service. The restraining order also enjoined the company from removing the telephone appliances from the complainants' places of business and from cutting off their service. The suit was brought by the Illinois Manufacturers' Association, and several hundred business men and firms joined in the bill as co-complainants.

PERSONAL.

COL. H. G. PROUT.

COL. HENRY G. PROUT has been appointed vice-president of the Union Switch & Signal Company, of Swissvale, Pa., and the Westinghouse industrial forces thus enjoy the accession of a notable leader. He is of English-Devonshire descent, fought at the front as a youth in one of the Massachusetts regiments during the Civil War, and then completed his education at the University of Michigan, where he graduated with the degree of civil engineer. After engaging in the practice of his profession in railroad surveys through the Rockies, he entered the service of the Khedive of Egypt as a major of engineers, and soon became an intimate associate and friend of General "Chinese" Gordon. Major Prout was sent to the head of the Nile as Governor-General of the Province of the Equator, where he had 3,000 soldiers under him and was supreme in finance, civil and military affairs. When he retired as Baroud Bey he was offered the rank of Pasha and the governorship of either of two Egyptian provinces to stay. Had the Suakim-Nile railroad that he recommended been built, Gordon would not have perished, and the Soudan would not have been lost. Returning to America, Col. Prout became signal engineer for the Union Switch and Signal Company, and in 1887 he was made editor of the *Railroad Gazette*. He remained with that admirable engineering publication for 15 years and has left a deep imprint on its pages and policy. This editorial work has been supplemented by a great variety of professional engagements. He has given lectures in nearly all of the engineering schools from Boston to the Mississippi, is departmental editor for the railroad division of the new volumes of the Encyclopedia Britannica, and he has done a good deal of writing for the magazines and the daily press. Few editors of class journals have become more widely known personally, and in 1902 his work as an editor was recognized by Yale University in the honorary degree of Master of Arts. He has been a member of the American Society of Civil Engineers for many years, has served that society as a director and on several special committees, and is now on the committee to consider the question of a revision of the standard rail sections. He is serving his third term as vice-president of the Engineers' Club of New York, and is one of the governors. He is a member of the American Railway Engineers and Maintenance of Way Association, of the Master Car Builders' Association, of several Railroad Clubs, a Corresponding Member of the American Geographical Society and a member of the Century Club, of New York, being now on its Admissions Committee. His most recent notable appearance was as presiding officer at the banquet to signalize the foundation of the John Fritz gold medal by the four national engineering societies.

MR. G. MARCONI had the honor of being received by King Edward at Buckingham Palace on February 13.

DYER & DYER is the new name of the well-known patent law firm of Dyer, Edmonds & Dyer, of New York City.

MR. W. B. RANKINE, of the Niagara Falls electric power interests, has been elected a director in the Equitable Trust Company of New York City.

MR. R. E. GALLAHER, the general manager of the New York Insulated Wire Company, is mitigating the terrors of the winter by a sojourn at St. Augustine, Fla.

MR. ALAN D. KENYON, of the law firm of Kenyon & Kenyon, actively engaged in so many electrical litigations, has returned to New York from a trip taken to Bermuda in successful search for health.

MR. DANIEL SKELTON has been appointed superintendent of the American District Telegraph Co., of New York. He has risen by merit, having entered the service of the company as a messenger in 1876.

MR. GARDINER C. SIMS has been appointed a police commissioner for Providence, R. I. This will give him a splendid chance to try in a new field his proved expertness in governing engines and dynamos.

MR. M. H. GERRY, JR., of Helena, Mont., has become associated with the Great Northern Power Company, of Duluth, Minn., in the capacity of consulting electrical engineer during the construction of the company's power plant.

MR. CHARLES DAY, of the firm of Dodge & Day, modernizing engineers of Philadelphia, read a paper before the last meeting of the Westinghouse Electric Club, of Pittsburgh, on "Recent Developments in Machine Tool Equipment."

MR. MAX LOEWENTHAL, who has done some excellent electrical engineering work for the Prometheus Electric Company has been appointed secretary of that concern, in which other important progressive changes have been made lately.

MR. CALVIN W. RICE was, last month, elected a member of the Institution of Electrical Engineers of London, having been proposed by Lord Kelvin. At the last meeting of the M. I. T. Alumni Association of Western Pennslyvania, Mr. Rice was made president.

PROF. A. B. PORTER.—The editors of this journal would like to get the address of this gentleman, for whom they hold a volume of Prof. S. P. Thompson's translation of Gilbert's "De Magnete." The copy has been sent to the Armour Institute, Chicago, and one other address without success.

MR. GEORGE H. MORGENSTERN resigned his position recently as manager of the sales department of the pay station consolidation, controlled by the Baird Manufacturing Company, and has accepted a position as manager of the sales department of the Vought-Berger Company, La Crosse, Wis.

MR. T. A. EDISON, according to a New York *Sun* reporter, says he is going to take a two years' vacation from industrial work and devote the holiday to the scientific investigation of recondite phenomena of which he has been making copious notes for years past in a big volume of 400 pages.

MR. CHARLES WIRT has been granted the John Scott medal of the Franklin Institute of Philadelphia for his improvements in electrical apparatus of the rheostat type, and particularly that the essential feature of which comprises a flat, jointless ribbon winding made usually with a continuous taper or graduation in ampere capacity.

MR. P. M. TAYLOR has been elected manager of the Dickinson Hard Rubber Company, Springfield, Mass., succeeding Carl F. Siemon. The concern is now turning out a high grade of insulating material in the shape of cross bars, bushings, keys, telephone receiver shells, plugs, mouthpieces, etc. Mr. Taylor remains the treasurer of the company.

MR. CESARE PIO, of Milan, Italy, has recently been appointed agent in that country for the American electrical apparatus, the sale of which is controlled there by the Goudey-McLean Co., of New York, including Milwaukee electric apparatus, Keystone instruments, Garton-Daniels lightning arresters, Pittsburgh transformers and Fostoria incandescent lamps.

MR. W. D. SARGENT, vice-president and general manager of the New York & New Jersey Telephone Company, was given a dinner at the Hamilton Club, Brooklyn, last Saturday, February 14, by a number of personal friends and associates to celebrate his forthcoming marriage during the present week. The menu took the appropriate form of a valentine, and an original poem was read by Treasurer Snow, of the company.

MR. C. C. HINES, lately electrical engineer with the Loraine steel interests has become associated with the Canadian Pacific Railway in charge of important electric motive power work in their shops, etc., and will make his residence in the Dominion. He has great possibilities with that progressive corporation and should prove fully equal to them. Mr. Hines is a valued contributor to these pages.

MR. EDWIN H. SMYTHE, of the patent department of the Western Electric Company, Chicago, one of the early and most successful American workers in the field of wireless telegraphy, has been visiting New York the past week in regard to his interests in that field. Mr. Smythe has already patented some of his work and is still very active in seeking to promote the practicability and perfection of this promising industry.

MR. F. S. PEARSON, one of the prime movers in the Mexican Light & Power Company, 29 Broadway, is expected back from Mexico next week. It will be recalled that the Mexican company has been organized with a capital of $12,000,000 for the purpose of constructing a huge power transmission plant—initial capacity to be 40,000-hp—to furnish Mexico City and vicinity with electric energy for lighting, manufacturng and traction.

MR. A. A. CARY, the well-known mechanical engineer, has just had the great misfortune to lose his wife, the daughter of the late Capt. Stone, of Cincinnati, leader in the telephone and street railway interests of that city. Mrs. Cary, who had been in poor health for some time past, was a young woman of most charming and sympathetic personality and had a large circle of acquaintances in electrical circles. It may be noted that it was after her that her father named his famous trotter "Maud S."

PROF. A. E. DOLBEAR, of Tuft's College, at a recent dinner of the Boston Schoolmaster's Club, discussed space telegraphy, and stated that a recent message to England, sent by the Marconi system, was received at several stations in that country when it was intended for only one. He asserted that until space telegraphy is so perfected that a message can be received selectively only by the station for which it is intended, the greater part of its commercial value is missing. He also expressed his conviction that the space-telegraph experiments would teach something about the ether.

MR. W. J. WILGUS, fifth vice-president of the New York Central, made the announcement last week that the electrification of certain portions of the various routes of the company in New York City and vicinity is in charge of a commission consisting of Mr. Wilgus, Bion J. Arnold, Frank J. Sprague, George Gibbs and Arthur M. Waitt. The electrical and mechanical corps reporting to the commission is under the general charge of Edwin B. Katte, electrical engineer. The above action has already been noted briefly in these columns. Arthur J. Slade is appointed mechanical engineer, with office in New York, in charge of the designing and construction of heat, light and power plants, water and fuel supply stations, vice Edwin B. Katte.

Trade Notes.

MR. WM. ROCHE, 42 Vesey St., New York, has just issued a new catalogue wherein is set forth all the merits claimed for his various products—new Standard dry batteries, flash lights, gaslighters, spark coils, etc.

THE OSBURN FLEXIBLE CONDUIT COMPANY, 21 Park Row, New York, is sending out to the trade a very unique and attractive folder calling attention to the merits of "Flexduct." It is handsomely gotten up and is the first of a series.

THE NEW YORK SAFETY STEAM POWER COMPANY has closed a contract for two 120-hp Worthington water-tube boilers for the Majestic Hotel, New York, and a 100-hp, 11x12 engine, to be direct-connected to a 37½-kw Westinghouse generator, for J. W. Beardsley's Sons.

ELECTRIC LIGHTING OF RAILWAY CARS.—Bulletin No. 75 of the Electric Storage Battery Company, Philadelphia, is devoted to the use of storage batteries in railway car lighting. The text points out the advantages of this use of storage batteries, and five illustrations show views of railway cars electrically lighted by their means.

THE STANDARD ELECTRIC CONSTRUCTION COMPANY and the California Incandescent Lamp Company, R. J. Davis, president, have opened extensive show rooms and offices occupying the entire ground floor of one wing of the new Rialto Building on New Montgomery St., near Mission, San Francisco. The Elblight Company will have quarters at the same location.

INNER GLOBES.—The Shelby Electric Company, Shelby, Ohio, has issued a catalogue giving illustrations and dimensions of Shelby inner globes for enclosed arc lamps of all makes. Eighty-eight styles of globes are shown. The company pays particular attention to perfect grinding of its globes, which are made of the highest grade of glass.

THE KELLOGG SWITCHBOARD & SUPPLY COMPANY has issued a calendar for 1903 in which the illustration exemplifies the satisfaction that comes from using Kellogg telephones. The cut is that of a girl holding a receiver to the ear of a dog, and by the expression of delight on the animal's face it is evident a familiar voice is speaking. The calendar is attractive and very serviceable.

THE CENTRAL ELECTRIC CO., of Chicago, has recently published a new telephone catalogue dated February, 1903. It contains a complete line of the products manufactured by the Williams-Abbott Elec. Co., for whom the Central is sales-agent. In addition to the Williams-Abbott material, the catalogue contains a list of wires, insulators, tools, batteries and all other supplies used by telephone companies. A copy will be sent upon request.

THE NERNST LAMP COMPANY reports its western business increasing to such an extent that it is obliged now to open a Chicago office in addition to its other offices in New York, Philadelphia and Boston. The management of the office will be in the hands of Mr. A. E. Fleming, whose face is very familiar to all those who visited the Pan-American Exposition and saw the wonderful display of Nernst lamps there under the direction of Mr. Fleming.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has just issued for immediate distribution a handsome conduit catalogue. It is well arranged and is probably the most complete little catalogue of its kind ever issued by a supply house. Besides illustrating the complete line of Toler system of conduit boxes it furnishes a number of working diagrams, and is full of valuable information along that line. A copy will be mailed upon application.

CROSELMIRE & ACKOR, platinum refiners, Newark, N. J., report business exceptionally brisk. This new concern is constantly increasing its business, especially in the electrical trade, although it has been in existence only a little over a year. Mr. F. A. Croselmire, the junior member of the firm, is well known to the electrical trade. This concern is sending out a very neat and attractive letter opener to its friends in the electrical trade, which will be much appreciated.

THE THOS. E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, Detroit, Mich., has secured a factory site and is now arranging for the erection of a factory for the manufacturing of wireless telegraph and telephones, and parts, as it has secured many large orders from educational institutions and others which runs into many thousands of dollars. It is also distributing among those interested, illustrated pamphlets showing some of the types of instruments that this company is manufacturing.

STORIES OF SUCCESS.—Under the title "One Thousand and One Stories of Success," the International Correspondence Schools, Scranton, Pa., have issued a booklet containing a list of names of more than one thousand students who have advanced either in salary or in position as a result of the International Correspondence Schools' training by mail. The list gives, besides the names, the place of residence of the students and particulars as to how they were benefited. The list is classified by States. The work of the schools is not limited by national boundaries; it is carried on in all civilized countries on the face of the globe, as this booklet shows.

W. M. SHEEHAN & CO., 136 Liberty St., New York, are now mailing the second issue of their descriptive catalogue and price list of Nernst lamps. The catalogue has been gotten up with considerable care and not only gives a very good description of the lamp in general, but also gives wattage tests, the distribution of light economy, as compared with standard incandescent lamps, and explains the operation of the Nernst lamp in a very concise way. Messrs. Sheehan & Co., as general distributing agents for the Nernst Lamp Co., carry a heavy stock of lamps and parts and report a steadily increasing demand for this deservedly popular form of illuminant.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has recently issued two new bulletins, Nos. 3037 and 3039. The former is devoted to the use of alternating current motors to the driving of positive pressure blowers, and the second relates to automatic start induction motors. Both subjects are comprehensively discussed and illustrated. The company has also issued three slips giving some points on the subject of Emerson motors (1) in the press room, (2) to run sewing machines and (3) in doctors' offices. The slips are intended principally for the use of agents and dealers who desire to bring to the attention of the public the convenience and advantages of using these motors in various lines of work. They are made to go into the ordinary size envelope.

MR. J. FRANCIS SHERIDAN, 1717 S. Chadwick St., Philadelphia, Pa., is about to incorporate the Anglo-American Underground Telegraph and Telephone Cable Syndicate with offices in New York and London. He has, it is said, perfected a cheap and reliable system of underground cables, with accessories, using compounds of his own invention and specially treated paper. He desires the co-operation of a reputable manufacturing concern or a few responsible investors to assist him in the incorporation of the company. Mr. Sheridan has just returned from a 4-years' sojourn in Europe where he studied the requirements of underground telephone and telegraph service.

THE AARON ELEC. CO., of Chicago, now makes a very neat line of motors from ½ to 25-hp. For the past two years the greater part of this company's energy has been devoted to manufacturing these motors to meet the unprecedented demand which has arisen during these prosperous times. These motors are the semi-enclosed type, multipolar. The frames are of cast iron, holding cast steel pole pieces. The field coils are form wound and thoroughly insulated, and are interchangeable. The brushes are the radial carbon type, with an adjustable tension on each brush, but the carbons are of such number and cross section that the full load current is about half the carrying capacity of the brush. The bearings are self-oiling, lined with phosphor bronze sleeves. The commutators are made of pure drop forged copper, with mica insulated segments. The bases are arranged so that the motor can be mounted in almost any position on either the wall, floor or ceiling.

ELECTRIC HEATING.—Under the ingenious title of "The Wireless Electric Heating System," the Prometheus Electric Company, of 60 Reade Street, New York City, has issued a handsome pamphlet describing its heating and cooking apparatus and resistances. These are beautifully illustrated with half tone cuts and the features of each piece are set forth in detail. As is known, the Prometheus heating element consists of a strip of mica on which a layer of metal has been deposited, or fired. This conducting strip is protected by another piece of mica and the whole is enclosed in a metallic casting. This unit can be painted to any desired resistance. The paint is an alloy composed of non-oxidizable metals, insuring the element's life. The element may be either straight or circular according to its usage and may be inserted into or removed from a piece of apparatus with the greatest ease in case of a break-down, thus lending itself freely to a great variety of applications large and small, industrial or domestic, etc.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 10, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

719,983. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. A storage battery on each car is charged by the main current and the current from the battery is used to operate the electro-magnetic switching devices.

719,984. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. A magnet of sufficient length to bridge two of the switching devices in the branch circuits to the working conductor, is energized by a battery on the car.

719,987. GUARD FOR SPEECH RECEIVERS OR TRANSMITTERS; S. J. Ballard, Los Angeles, Cal. App. filed July 2, 1901. (See page 324.)

719,991. ELECTRIC CONTROLLER; R. W. Brown, Chicago, Ill. App. filed Aug. 30, 1902. A series of resistance shunting switches can be operated successively or all simultaneously.

719,998. TELEPHONE SYSTEM; E. E. Clement, Philadelphia, Pa. App. filed June 4, 1901. (See page 324.)

719,999. SIGNALING APPARATUS AND SYSTEM; E. E. Clement, Philadelphia, Pa. App. filed June 13, 1901. (See page 324.)

720,004. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed March 18, 1901. When the primary impulse of a signal is transmitted, it initiates a record on a chemically prepared receiving tape; the transmitting generator is then disconnected and the formation of the record is continued by the capacity effects of the circuit.

720,020. MEDICAL BATTERY; F. Grimshaw, Northeast, Pa. App. filed July 10, 1901. Details.

720,023. ELECTRIC CABLE; R. F. Hall, New York, N. Y. App. filed March 10, 1902. A cable comprising a core made up of pairs of twisted wires, the wires forming the different pairs being held in position by a paper strip consisting of a backing and a looped separating piece.

720,024. ELECTRIC FURNACE; J. F. Hammond, New York, N. Y. App. filed Feb. 1, 1902. A furnace for the use of dentists arranged so that the work can be easily examined while being heated.

720,029. CONTROLLER FOR ELECTRIC MOTORS; O. Holz, Schenectady, N. Y. App. filed Oct. 4, 1901. A movable member for supporting the blow-out coil in close proximity to the contact finger.

720,073. ELECTRICAL FUSE HEAD AND FUSE; N. Schmitt, Kupperstey, and Johann Kranoichtolt, Cologne, Germany. App. filed Sept. 10, 1900. A mine exploder. A strip of celluloid or other non-conducting material is coated on each face with foil or other conducting material and a priming compound molded on the end connecting the two conducting faces. The patent deals mainly with manufacturing details whereby the cost of the fuses may be made small.

720,082. MAGNETO BELL; C. H. Thordarson, Chicago, Ill. App. filed March 8, 1902. Details.

720,08[illegible]. TELEPHONE TRANSMITTER; J. S. Tucker, Boston, Mass. App. filed July 5, 1902. (See page 324.)

720,087. ELECTRIC FUSE BOX; T. Van Aller, Schenectady, N. Y. App. filed May 1, 1901. The fuse is inclosed in a chamber whose walls come in contact with parts of the fuse to keep them cool, the other parts being thus more rapidly heated. An open channel connects the parts least protected with a section of the fuse lying across a discharge opening in the path of which is a body of gravel which chills the gases and prevents the discharge of flame from the fuse box.

720,092. APPARATUS FOR MAKING COILS FOR ELECTRICAL APPARATUS, E. L. Aiken, of Schenectady, N. Y. App. filed Dec. 5, 1898. A process for making spiral coils of small number of turns, but large cross section. A rod, strip or bar is wound about a mandrel while at a temperature below that of the softening point of the metal, the pitch being determined by a guide.

720,093. COIL FOR ELECTRICAL APPARATUS; E. L. Aiken, Schenectady, N. Y. App. filed Dec. 5, 1898. A conductor of large cross section is wound into a few turns which are separated by the slightest possible air space.

720,095. AUTOMATIC REGULATOR FOR X-RAY TUBES; W. S. Andrews, Schenectady, N. Y. App. filed June 5, 1897. An electric heater for vacuum tubes comprising a number of conductors in series, insulated from each other and supported by an electrical insulator adapted to transmit heat to the tube.

720,103. TELEPHONE-PROTECTING DEVICE; G. R. Bonham, Empire Prairie, Mo. App. filed May 6, 1902. (See page 324.)

720,307. ARMATURE BAND, J. J. Wood, Fort Wayne, Ind. App. filed Feb. 26, 1902. An improved fastening device for the meeting ends of the strap.

720,312. ELECTRIC ARC LAMP; H. Baggett, London, Eng. App. filed Nov. 22, 1902. Details.

720,321. SECONDARY BATTERY; F. Buchanan, Dayton, Ohio. App. filed March 18, 1901. The outer containing cell constitutes the negative electrode; an inner cell is both a positive and a negative electrode, while a positive electrode occupies the central position, thus giving a substantially four volt battery.

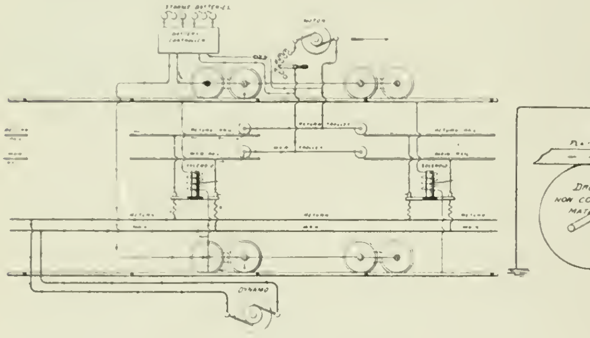
720,326. PROCESS OF PREPARING STORAGE BATTERY PLATES; R. N. Chamberlain, New York, N. Y. App. filed March 3, 1899. The plates are exposed successively to electrolytic action as anodes in a solution capable of dissolving lead, thereby cleaning and roughening the plate.

720,327. ELECTRIC SWITCH; R. N. Chamberlain, Depew, N. Y. App. filed April 16, 1902. A dynamo electric counter-electromotive force generator is included in shunt with the end-cell of a storage battery at the moment the latter is being cut in or out, to prevent short-circuiting of the end cell.

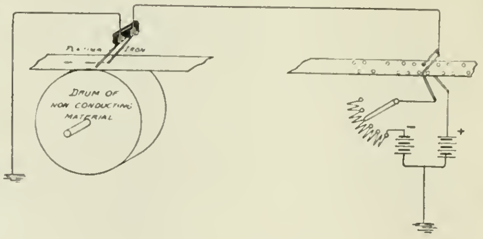
720,333. TROLLEY AND BRAKE FOR AERIAL RAILWAYS; M. J. Doner, St. Louis, Mo. App. filed Aug. 18, 1902. A rod is connected to both the trolley arm and a brake lever, so that the brakes are applied when the arm is lowered.

720,335. MEANS FOR MEASURING ELECTRIC CURRENTS; G. N. Eastman, Chicago, Ill. App. filed June 20, 1902. A high resistance shunt conductor is wound non-inductively around the conductor carrying the current to be measured and includes a potential-indicating instrument.

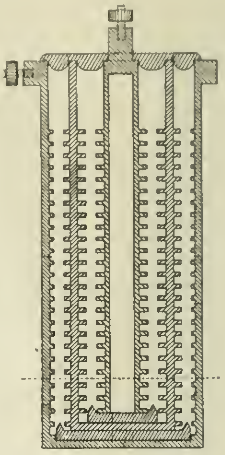
720,347. FIRE AND POLICE ALARM CALL SYSTEM; W. J. Hofstatter, Toledo, Ohio. App. filed Jan. 31, 1902. Details.



719,983. Electric Railway



720,004.—Telegraphy.



720,321.—Secondary Battery.

720,152. COMMUTATOR METER; J. F. Kelly, Pittsfield, Mass. App. filed Oct. 19, 1901. Means for preventing sparking or burning at the commutator.

720,156. MAGNETIC SEPARATOR; J. Kirschweng, Butte, Mont. App. filed Aug. 17, 1901. An automatic alarm to indicate the choking of the ore-chute.

720,184. INSULATOR; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 28, 1900. An insulator adapted to be set into the web of an iron beam and provided with means for locking it in place.

720,186. APPARATUS FOR ELECTRO-ENDOSMOTICALLY FREEING MATERIALS FROM FLUIDS; B. Schwerin, Berlin, Germany. App. filed April 24, 1902. The body of liquid undergoing treatment is divided up into a number of thin layers to facilitate the process.

720,226. LIGHTNING ARRESTER; J. P. Coleman, Edgewood Park, Pa. App. filed Feb. 1, 1902. The discharge plates are arranged so that the discharges are permitted to occur between any two plates of a group representing two circuits, while only one air gap is presented to the path of rupture.

720,233. RECEIVING TAPE FOR CHEMICAL TELEGRAPHS; P. B. Delany, South Orange, N. J. App. filed May 29, 1902. The tape is corrugated before it is rolled into a coil, so that it may be rolled under tension and will absorb the sensitizing chemical without bursting.

720,235. PROCESS OF RECOVERING AND SEPARATING METALS FROM THEIR ORES; H. A. Frasch, Hamilton, Canada. App. filed Nov. 2, 1900. The body containing the metals to be extracted is utilized as the anode in the bath.

720,273. ELECTRIC RAILWAY; T. E. Murray and J. Van Vleck, New York, N. Y. App. filed Nov. 22, 1901. An automatic railway in which the cars switch themselves onto their proper sidings at stations, the current being cut off and the brakes applied at the proper time.

720,305. CURRENT REGULATOR; J. J. Wood, Fort Wayne, Ind. App. filed Dec. 14, 1901. Consists of a coil and a core, one movable relative to the other, the core having approaching poles to reduce and localize the air gap.

720,350. SYSTEM OF DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. App. filed Dec. 17, 1901. (See Current News and Notes.)

720,351. SYSTEM OF DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. App. filed Jan. 14, 1902. (See Current News and Notes.)

720,352. SELF-REGULATED SYSTEM OF ELECTRICAL DISTRIBUTION; Albert S. Hubbard, Greenwich, Conn. (See Current News and Notes.)

720,369. MANDREL FOR CONDUIT SECTIONS; R. W. Lyle, New York, N. Y. App. filed Oct. 17, 1902. The mandrel has a spiral scraping wing and is adapted to be drawn through the conduit as the sections thereof are laid, to line them up and clean them of mortar, etc.

720,454. GUIDE WHEEL AND GUIDE; A. H. Mathesius, Brooklyn, N. Y. App. filed March 26, 1900. The wheel has a tread capable of revolving independent of its flanges, so that wear upon the cable will not be caused by unequal peripheral speeds.

720,475. CLIP FOR ELECTRICAL KNIFE SWITCHES; C. D. Platt, Bridgeport, Conn. App. filed Dec. 9, 1902. A pair of plates riveted together at their middle and having at one end parts to receive the knife blade and at the other end angular jaws to embrace an angular block for the wire connection.

720,483. ELECTROMEDICAL APPARATUS; G. S. Rider, New York, N. Y. App. filed April 17, 1902. Details.

720,508. ELECTRICAL SHIP'S-LOG APPARATUS; T. F. Walker and T. S. Walker, Birmingham, England. App. filed Jan. 25, 1902. A registering taffrail log which by means of electrical contacts may control one or more distant registers. The motion of the rotator in the water rotates a pinion in the register geared with an arbor having a tensional spring. Each revolution this latter is tripped, and in course of returning to its initial position a momentary electrical contact is made.

720,511. DRUM ARMATURE; H. A. Balcome, Jamaica Plain, Mass. App. filed April 23, 1902. The winding consists of flexible coils of equal length stretched over the core in the same direction, the ends of each coil passing over a number of coils and under an equal number of coils and being stretched taut to lie snugly against the core and underlying coils.

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CONTENTS.

Editorial 345
Congresses for the St. Louis Exposition 348
New Telegraph Competition 348
Wisconsin Independent Telephone Interests 348
The Largest Power Plant in New Hampshire 349
Some Engineering Features of the Bedell System of Composite Transmission. By A. S. McAllister 351
Radiant Efficiency of the Mercury Arc 353
Analysis of the Seventh Annual Report of the Public Lighting Commission, Detroit, Mich. 354
The Construction of Aerial Telephone Lines—V. By Arthur V. Abbott, C. E. 359
A Unique Electric Light Plant. By L. B. Cherry 361
The Mercury Vapor Lamp 362
Telephone Cables and a Suggestion as to Unreasonable Specifications. By Frederick J. Hall 362
A Discussion of Electric Automobiles 363
Laying of a Submarine Cable 363
New Telephone Patents 364
Extraction of Moisture by Electricity. By Clinton Paul Townsend 365
Chicago Electrical Association Meetings 365
Current News and Notes 365
LETTERS TO THE EDITORS:
  Mr. Hewitt and the Mercury Arc. By Peter Cooper Hewitt 366
  Arrangement of Power Stations for Operating Steam Railways Electrically. By C. J. Spencer 366
  Recuperating Exhausted Dry Batteries. By W. A. Sherlock 367
Digest of Current Electrical Literature 367
New Books 370
High-Power Horizontal Gas Engines 372
Perambulating Wireless Telegraph Plant 374
Electrical Gold Dredge in the Klondike 374
St. Louis Fair Boiler Plant 375
Handling Newspapers by Motor-Driven Conveyor 375
DEPARTMENTS:
  Financial Intelligence 376
  Commercial Intelligence 377
  General News 379
  Trade Notes 383
  Record of Electrical Patents 383

BOOK-KEEPING AS A FINE ART.

Again we have the pleasure of presenting to our readers a searching analysis of the Detroit municipal lighting report. It is a valuable lesson in applied statistics. We have not the least prejudice against municipal lighting, because it is municipal, but we object most strenuously to claims made in behalf of municipal lighting which cannot be substantiated. In the present instance the faults in the report are the same old faults to which we have before called attention. They are common faults in central station bookkeeping, public and private, but cannot for this reason be used legitimately in a comparison of public and private plants. Our exposure of the facts in this case may seem merciless, but it is better for the public that they should come out without reserve, for many a municipality has been tempted by the example of Detroit. We have investigated many reported successes in municipal lighting and have found as a rule the same kind of statistical dodging and shuffling that characterizes the report in hand. Now the art of electric lighting is an established success, and it needs no apologies. Nothing permanent is to be gained in it by concealing the facts as to its real cost, by whomsoever produced.

The first serious flaw in the Detroit report is the entirely inadequate treatment of depreciation. We have many times gone upon record on this topic and propose to make use of every fresh opportunity. Depreciation is generally entirely neglected in reports on the cost of lighting from both public and private plants, and we suppose some credit should be given for even partial recognition of its existence. The amount charged this year is 3 per cent. on the total investment, which figure is built up from partial depreciations varying from 7 per cent. to nothing on various items. There are very varying opinions as to depreciation, but we do not see how annyone familiar with the art and both sane and honest, can assign to it so small a value, even if it could be treated as a sinking fund which it cannot. For a plant does not go to pieces through depreciation like the famous "one-hoss shay," "all together and nothing first," at the end of a fixed period, but requires replacements at uncertain intervals, thus breaking the continuity of any sinking fund scheme. As an annual depreciation, 3 per cent. is absurd. To be sure, we have known alleged experts to go upon the stand, and, having been duly sworn, to affirm the sufficiency of even smaller rates than this on electric lighting property. The utter failure of a 3 per cent. depreciation rate to maintain the value of the assets is in the main due to complete neglect of depreciation caused by changes in the art. The records of the central station industry in this country show beyond the shadow of a doubt that electric light plants have been turned upside down at intervals of ten years or less, merely by changes in the art, and quite irrespective of the physical depreciation of the several items replaced. It may be true that an arc dynamo of twenty years ago may be as fit for producing current as it ever was, but it has ceased to be desirable for the ordinary uses of a central station and only escapes the scrap heap through sentiment or lack of funds or credit for the purchase of modern apparatus.

Depreciation is very rarely properly taken into account even in plants under private ownership. It has usually been placed at a nominal figure to make a brave showing at the annual meeting.

When the inevitable day of reckoning has come, the result has been a reorganization of the company or a large increase of capital stock for "improvements" in municipal plants. Leaving depreciation to be taken care of by a future increase in investment is squarely dishonest whenever and wherever done. Moreover, it is foolish, for it has come to be evident even to a tyro in the wiles of high finance. In the Detroit scheme of salvation by bookkeeping a similar interesting process seems to have been applied to the operating expenses. It is an old and transparent scheme to charge up labor and material to construction instead of to maintenance and operation. It works well for a time, but murder will out, and in a term of years a fraud of this kind will become evident unless it, like depreciation, can be pushed over into the "improvemennt" account and lost in the shuffle. Another well-worn dodge comes to light in the "saving" of $1,200 annually by work previously paid for and now done by the city electrician. We have no doubt that this gentleman earns his salary, but if he does not find his present duties strenuous the office must have been a sinecure previously. This illustrates one of the greatest advantages of municipal ownership—the ability to play hunt-the-slipper with expenses between several departments. It reminds us of the double-shuffle in securities sometimes performed by banks under the same roof when the examiner calls, or still more of the interesting game that is played with three shells and a pea. It is instructive, too, to see the cost of energy computed from the switchboard readings. Does the municipality reckon the losses in distribution as an asset? Taken as a whole this report is thoroughly typical of municipal business methods—it is the same cheerful old humbug with which we have regaled our readers in former years. It is no worse, perhaps, than some reports of corporations—to damn it with faint praise—but it can hardly be termed scrupulous.

THE MEASUREMENT OF HIGH TEMPERATURES.

A paper by Lummer and Pringsbeim, abstracted in the Digest this week, is of particular importance in view of the extent to which high temperature operations have been recently developed. All the older methods of measuring high temperatures have proved rather unsatisfactory, even at the moderate limit of 1,000 C., as a glance at a list of melting points will show. The results even for well-known substances like gold and silver, are by no means precise, and when one enters the field of modern research with the electric furnace, even the thermoelectric couple is of small avail and pyrometers of the usual kinds are a delusion and a snare. The bolometric method, on the contrary, seems to have shown great capabilities in this direction, and should come into extensive use. Of course, there may be in certain cases some doubt as to the complete absence of selective radiation, but the method has the very great advantage of offering the fourth power of the thing to be determined as the quantity to be measured, thereby lessening the experimental errors of the process. There is one disadvantage, however, in the bolometric method, which is that the formulæ may lead to trouble in case of a change of state, as when a substance boils and wraps itself in a vaporous envelope; but nevertheless it gives a most promising line of attack on high-temperature problems in general, and the experimental difficulties will doubtless be greatly reduced by experience. Few people have an adequate idea of the difficulties of thermometry even at ordinary temperatures, and the relief offered by the newer plan of apparatus will be felt in more than one branch of industry.

SAFE ELECTRIC RAILROADING.

The recent horrible accident at Newark again directs attention to the grave dangers which have come with the development of electric traction. The heavy and fast-running cars now in common use cannot be treated in the matter of safety precautions like the old-fashioned horse car. As we had occasion to point out recently, in connection with a couple of Institute papers on braking, the modern electric car has a long, dangerous space ahead of it even when on a clean and level track, and when the car is on a grade and the track is slippery, this space is very greatly increased. Under these conditions a grade crossing becomes intrinsically dangerous and doubly so when it is approached on a down grade. We are not disposed to go so far as to say that crossing a steam road at grade should never be permitted in electric railroading, but it should certainly be forbidden unless there is at least a hundred yards of clear and level track on the side of approach, and the car should come to a full stop at least a hundred feet from the crossing and then proceed slowly and under full control. Most collisions on electric lines have come from underestimating the distance required for stopping the cars, and in the present state of our knowledge there is no excuse for this error. Electric roads should heed the lessons that have been learned by the steam railroads and not go blundering along imperilling the lives of their passengers. When the schedule is quickened or a new type of heavy car is introduced, the capabilities of the brakes should be fully tested on good track and bad before entering upon the new conditions in service.

More than this, we think that power brakes should be required on all lines having grade crossings or operated with a maximum speed of more than, say, ten miles per hour. Power brakes for electric cars are now thoroughly reliable and are vastly more effective than hand brakes. When public safety is at stake the extra expense should be thrown out of consideration. When the power brake question has come up there have too often been representatives of the railways to arise and throw discredit on power brakes and to raise all sorts of hypothetical objections in order to avert the expense of a change. The whole question of power brakes *vs.* hand brakes was threshed over years ago on the steam roads, and then as now the corporations often tried to shirk the responsibility. The question of stoves in railway cars was similarly treated, and the deliberate misstatements made about the difficulties of steam heating ought to have secured numerous indictments for perjury. The penitentiary is a good place for those who imperil the public to save expense. The present tendency is to abolish grade crossings entirely, and it is a sound principle to follow, although it may bear heavily upon certain roads. By rigorous regulation of equipment and operation, the majority of grade crossings can be made secure, and common sense rather than an inflexible rule is the best guide in determining whether grade crossings should be permitted. The question of safety should be taken up on its merits in each particular case, and there will generally be little difficulty in reaching a reasonable result. But at whatever cost and inconvenience, disasters like the Newark horror should be made impossible, and those responsible for them should be held mercilessly to account.

THE CONSTRUCTION OF SENSITIVE GALVANOMETERS.

An interesting paper on this subject was read by Mr. C. G. Abbott before the American Association for the Advancement of Science in Washington. When the sensitiveness of a galvanometer is being discussed on paper, the figures are frequently deceptive. In order to arrive at the greatest possible sensitiveness, the instability of magnetic control may be so great that the zero of the instrument is constantly shifting. This represents a greatly increased uncertainty in the use of the galvanometer as an instrument of precision. The ordinary method by which the sensitiveness of a galvanometer is determined is to find the deflection corresponding to a known current of fairly considerable strength, and thence compute the small current strength which would give one millimetre deflection of the light-spot at a range of one metre. As to whether this small deflection could actually be used with precision, for current measurement in the then existing magnetic condition of the apparatus, is not adverted to. Moreover, the millimetre deflection at a metre may be an unduly large deflection that could be greatly magnified by extending the range to several metres. Some instruments will permit of this range being extended, while with other instruments, no benefit may thereby result. Consequently, the only precise way of defining the sensitiveness of a galvanometer is to obtain the most sensitive magnetic and optical condition by trial, and then to determine the actual small strength of current which can be detected with certainty. It does not much matter just what the angular magnitude of this minimum current may be, so long as its presence or absence can be detected. The value of this minimum current is usually the true measure of the sensitiveness of the instrument.

In the instrument described by Mr. Abbott there are eight sets of magnets and 16 coils. The period of oscillation being about ten seconds, the minimum detectable current is about 10^{-12} ampere or the millionth of a micro-ampere. The resistance of the whole apparatus is, however, only 1.6 ohm. If, therefore, the coils were wound with very fine wire, so as to produce a high-resistance galvanometer of about 20,000 ohms resistance, the number of turns in the coils would be increased about 100 times, and the minimum detectable current with the otherwise unchanged instrument would be about one-hundredth less. In the above sense the order of ideas in connection with the terms "current-detector" and "galvanometer" is reversed. It is customary to regard a "current-detector" or galvanoscope, as a relatively crude device as compared with the more sensitive instrument for measuring the current called the "galvanometer." But in many departments of research the question asked is whether, under certain conditions, a measurable electric current does or does not flow, and what is the limiting feeblest current that can be observed. Such a current-detector is thus the highest and most sensitive type of galvanometer.

Composite Transmission.

Mr. McAllister's article on page 351 of this issue relates to an electrical system which contains various novel and interesting features. The principle of superposing alternating and continuous currents on one and the same circuit has already been used in telephony, and also in simultaneous telephony and telegraphy. It has likewise been proposed by M. Leblanc to superpose direct and alternating currents in a power transmission circuit, but not in the particular arrangement of circuits here represented. The latter contemplates split transformers, one of the methods by which direct and alternating currents are simultaneously used in telephony. This is another illustration of the constantly-increasing bond of union between the methods of electric power-transmission and electric signaling or electric telephony. The more closely these various originally distinct systems are united, and regarded alike, the more benefit each is likely to derive from the development of the other.

The fundamental principle of the system described by Mr. McAllister is the remarkable well-known fact that if two equal co-phase alternating current strengths of the same frequency are simultaneously impressed upon a conductor, the power wasted in heating the conductor is not twice but four times as great as when either current flows alone. But if the two equal alternating-current strengths differ in frequency, then the power wasted in heat is only double that due to either alone. A continuous current comes within the scope of this proposition as a particular case, namely, as a current of frequency zero. The physical peculiarity of the method described lies in its special adaptability to the two-phase system. Two-phase machinery is commonly connected with a two-to-three-phase transformer before reaching the transmission line, in order to make the saving of copper available that belongs to the three-phase system over and above the two-phase or single-phase system. But in the case now under consideration we should expect to reverse this order, and use a three-to-two-phase transformer between three-phase machinery and the line, in order to employ the two-phase line transmission which this composite method prefers.

The article claims that the composite system will transmit 12½ per cent. more power for the same loss of power in conductors; so that 11 per cent. of copper can be saved over the three-phase system for the same pressure load and loss of power. This, however, does not adequately represent the merit of the system. It would often hardly be worth while changing from three-wire to four-wire transmission merely for the sake of 11 per cent. of saving of conductor. The point is that in order to keep the regulation of the distribution system within the limits required for good incandescent lighting, when the motor load on the same main is subject to rapid fluctuation, it is necessary to have a much smaller total drop of pressure, and more copper in the system than would be necessary if the motors were replaced by lamps. In the composite system the motor drop and the lamp drop are divorced, and consequently the copper can be much reduced. Fifteen per cent. drop to the lamps may now be tolerated without unsteadiness, whereas five per cent. might be necessary when every elevator motor sings its song of grief at starting to every incandescent lamp within a mile. There can be no doubt that there are advantages in keeping the motor load and the lamp loads on separate circuits, and the system here discussed does this virtually, although not literally.

A more purely theoretical point of interest in the article is the method by which the voltages may be quantitatively determined in the case of multi-frequency circuits. In the ordinary single-frequency circuits, the effects of phase difference upon the magnitudes of voltages and currents is made simple by the use of plane vectors, and the computation of polyphase circuits finds natural expression in complex quantities. If we take a certain standard phase, and the phase in quadrature with this be denoted by the symbol j, then all or any phases whatsoever may be made to fall within the expression $a \pm j b$. But when we come to a bi-frequency circuit, j is not enough. We are obliged to use three-dimensional space, and to reckon in terms of the unit mutually-perpendicular vectors, i, j and k. Thus a pair of adjoining wires in the composite transmission system of Fig. 1 in Mr. McAllister's article comprise between them a voltage of $\left(\frac{i}{2} + \frac{j}{2} + \frac{k}{\sqrt{2}}\right)$ the numerical value, or "tensor," of which is unity. Consequently, just as complex quantities are the natural and simplest language of the single-frequency circuit with difference of phase, so quaternions with their three-unit vectors seem to be the natural language of the bi-frequency circuit. It looks as though the tri-frequency circuit would drive us into four-dimensional space, so we beg inventors to content themselves with bi-frequency circuits for a while, until we can overtake them with adequate mathematical machinery, imagery, and stage setting.

Congresses for the St. Louis Exposition.

The board of directors of the St Louis Exposition voted on February 10 to organize an International Congress of Arts and Science in connection with the Exposition, in accordance with the recommendations of the Administrative Board appointed in January to formulate a plan. The sum of $200,000 was set aside for the Department of Congresses. This sum will cover the expenses of the International Congress of Arts and Science and the publication of the proceedings thereof, and all other expenses connected with the promotion of other congresses and conventions. The administrative board of the International Congress of Arts and Science now consists of President Butler, of Columbia University; President Harper, of Chicago University; President Pritchett, of the Massachusetts Institute of Technology, Boston; President Jesse, of the University of Missouri; Mr. F. J. V. Skiff, director of the Field Columbian Museum, Chicago; Mr. Herbert Putnam, Librarian of Congress, Washington; Mr. Frederick W. Holls, New York, member of the Hague Tribunal. The appointment of Professor Simon Newcomb, of Washington, the eminent astronomer, as president of the International Congress of Arts and Science, was confirmed, as was that of Professor Hugo Muensterberg, of Harvard University, and that of Professor Albion W. Small, of the University of Chicago, as vice-presidents of the congress. The president and vice-presidents were created a scientific committee to make detailed arrangments for the congress, subject to the general control of the Administrative Board and the director of congresses. The plan recommended by the Administrative Board was adopted by the directors of the Exposition, viz.:

There will be one general Congress of Arts and Science, to begin September 19, 1904. The congress will have one definite task, namely, to bring out the unity of knowledge and thus to bring harmony and inter-relation into the scattered scientific work of the day. Leading scholars from the whole world will be invited to discuss every theoretical and practical science in its definite position, to trace the development of each science during the last century, and to state the open problems of to-day. An honorarium and a sum for traveling expenses will be allowed to all who submit a paper in response to an invitation and who contribute a definite piece of work to the uniform plan. The plan also provides for the active participation of men of affairs. For example, the group on commerce, or on finance, or on labor, will attract business men. Groups on colonial policy, or arbitration, or municipal government, will attract politicians. The plan further provides for the participation of independent assocations, national or international congresses of specialists, and scientific or popular meetings.

The provision for the publication of the proceedings of the International Congress of Arts and Science which is made in the appropriation above mentioned, will form a lasting contribution to the scientific literature of the country, and be a permanent memorial to the work of the St. Louis Exposition.

The action of the board of directors inaugurates the first attempt ever made at an international exposition to hold a series of related congresses, all of which should tend towards the development of one central idea. The congresses hitherto held in connection with expositions have been entirely independent, and forced to rely upon the convenience and pleasure of persons interested for their attendance. It is the first time, also, that a definite sum of money has been set aside to obtain the presence of men distinguished in the various fields of art, literature and science. The American Institute of Electrical Engineers is already taking steps to arrange if possible for an electrical congress that shall fit into the general scheme.

The New Telegraph Competition.

Details have already been given in these pages of the new competition that has sprung up in the telegraph field, with St. Louis as its center. It is now stated that active work will be begun within a week upon the new telegraph line which will connect Milwaukee and Chicago with St. Louis and Kansas City. Contracts have been let and the construction will be started just as soon as the necessary material can be secured. The work will start from the Chicago end and extend south and west as rapidly as circumstances will permit. The capital necessary to carry out the project has been secured. Right of way has also been secured over the greater part of the contemplated route, which will take in the principal cities and towns between Chicago and St. Louis and St. Louis and Kansas City. The new company will be capitalized for $2,000,000 and about $1,250,000 bonds will be issued. No name as yet has been selected, but it will be either the Midland Telegraph Company or the Continental Telegraph Company.

At a meeting held in the offices of the National Telegraph News Company, Chicago, between St. Louis capitalists and officers of the Chicago & Milwaukee Telegraph Company, the National Telegraph News Company and the Sempire Clock Company, final arrangements were perfected whereby the new telegraph line becomes a reality. Mr. Orthwein, vice-president Germania Trust Company, St. Louis; R. H. Orthwein, capitalist, St. Louis; B. E. Ryan, representing the Sempire Clock Company, St. Louis; W. R. Stewart, president National Telegraph News Company, Chicago; L. M. Martin, formerly general manager Iowa Central Railroad Company, and F. E. Crawford, secretary and treasurer Chicago & Milwaukee Telegraph Company, are among those interested.

The Chicago & Milwaukee Telegraph Company operates a ten-wire line between Chicago and Milwaukee and, it is claimed, controls about 90 per cent. of the commercial messages between these points. The line has been in operation for more than twenty years. It is capitalized for $100,000 and has a bonded indebtedness of $50,000. The National Telegraph News Company is an Illinois corporation and controls the majority of the page printing tickers operated in Chicago in the interest of the commercial and financial boards.

The Sempire Clock Company, of St. Louis, manufactures electric clocks and electric appliances. It has about 1,000 electric synchronized clocks in Chicago and a greater number in St. Louis. It is the intention of the new company to enter into active competition with the other telegraph companies for commercial messages, leased wires, etc., at the beginning, but later it expects to enlarge the scope of its operations and do a general telegraph business between the points reached by its wires. It will also endeavor to bring into Chicago by means of the Chicago-St. Louis line all of the independent telephone companies now operated in the territory covered by this line.

Apparently telephone competition has sprung up also, as a special dispatch from Chicago of February 20 says: Contracts have been let for the partial construction of a new telegraph and telephone company's line to operate between Chicago and other Western cities, to be called the Continental Telegraph Company. The contract calls for the laying of ten copper wires under the superstructure of the South Side Elevated Railways from the business district to the end of the road. From that point the line will run on poles to the largest cities in Illinois, including Bloomington, Peoria, Springfield, Decatur and East St. Louis. It will enter St. Louis through a conduit. This distance is 410 miles, and the building cost is estimated at $400,000. A line will also be built to Kansas City, and one to complete the circuit through to Sioux City, and to St. Paul, Minneapolis and Duluth. The Kansas City line will cost $600,000.

Wisconsin Independent Telephone Interests.

The Wisconsin Independent Telephone Association held its annual convention in Milwaukee on February 11 and 12, President Richard Valentine, of Janesville, being in the chair. Members were present representing between 40 and 50 indpendent companies doing business in the State. There was a large number of exhibits of telephone apparatus. According to a statement made at the meeting the number of independent telephones in use in the State is five times more than those controlled by the Bell or Wisconsin Telephone Company.

Papers were read as follows: "Competition," by M. L. Berger, of La Crosse; "The Necessity of Uniformity," by A. L. Hutchinson, of Weyauwega; "Generation and Generators," by C. W. Farr, of Chicago; "Prospective Telephone Legislation," by J. C. Harper, of Madison; "Comparative Merits of the Central Energy and the Magneto Systems," by W. A. Taylor, of Madison. and "New and Old Telephone Problems," by J. E. Keelyn, of Chicago. A general discussion followed the reading of these papers.

The Largest Power Plant in New Hampshire.

STEAM engines and water wheels of 24,125 hp aggregate capacity are employed to operate the mills of the Amoskeag Manufacturing Company, at Manchester, New Hampshire. This great plant occupies a space on both sides of the Merrimack River extending about 5,000 feet down stream from the dam and about 2,000 feet wide including the river, which has a width of approximately 400 feet for the greater part of the distance. In this space are located about one dozen large mills for spinning and weaving cotton cloth, also a larger number of smaller auxiliary buildings such as a machine shop, dye house, foundry, cloth and cotton storehouses. During the year ending June 30, 1900, these mills operated more than 300,000 spindles, employed upwards of 7,000 persons, and produced 116,990,523 yards, or 29,877,626 pounds of cotton cloth, and 1,809,663 bags. To drive the machinery for these operations, spread over nearly one-half square mile of territory, involves no mean problem in power distribution. Before the advent of the electric drive, steam and water were the agents relied on exclusively to accomplish the work of power distribution, and they performed their task effectively though at some disadvantage. The dam previously mentioned at the up-stream end of the site occupied by the Amoskeag Mills, gives a fall of somewhat more than forty feet for the entire flow of the Merrimack River. Two canals at different levels are fed with water from a basin which draws its supply from the river behind the dam. The lower of these canals may receive water either through wheels connected with the upper canal or directly from the basin. These canals extend on lines approximately parallel with the river to points below the mills of the Amoskeag Company. Between the two canals and between the lower one and the river a part of the Amoskeag Mills is located and is driven by water wheels. The remaining mills, on the opposite side of the Merrimack, derive their power entirely from steam.

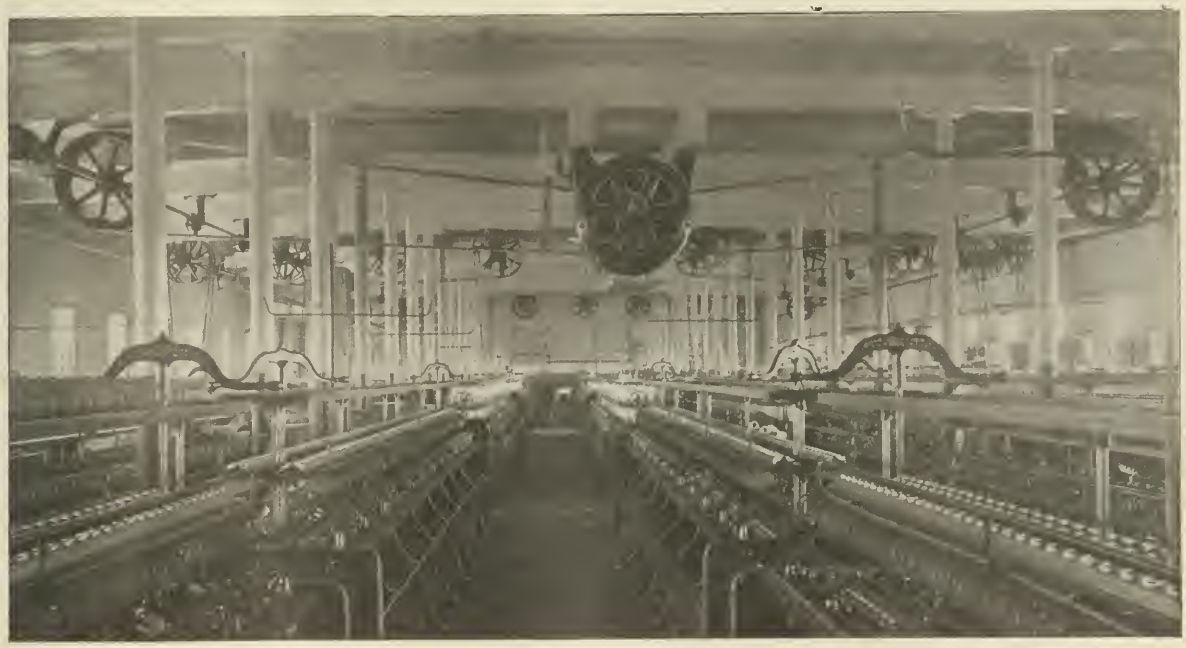


Fig. 1.—General View of an Interior in Amoskeag Mills.

In the way just named 23 water wheels or pairs of wheels are employed with an aggregate capacity of 9,500 hp. The majority of these wheels are vertical, but five are horizontal. Some wheels are geared to main lines of mill shafting, and other wheels are direct-connected to main shafts. Steam power is utilized to drive some of the mills at all times of year, and other mills only at times of low water. Prior to the introduction of the present equipment of electric motors for driving some of the mills, the number of steam engines employed at different points in the plant was seventeen. At present the number of these engines has been reduced to ten, with an aggregate rating of 14,625 hp. A part of these engines are direct connected to main shafting, while others have a belt connection. Some engines are connected to the same shafting with water wheels, some operate only when the supply of water is low, and some are in use every working day of the year. In individual capacity, the seventeen engines formerly employed ranged from 20 to 2,000 hp. The ten engines now in use are rated between 75 hp for the smallest and 4,500 hp for the largest. The seven engines that have been displaced, which had capacities of 20 to 60 hp each, were all of the simple type and non-condensing. Of the ten engines now in use, one of 75 hp, one of 150 and one pair of 1,800 hp are simple non-condensing. The simple engines that operate condensing include one of 250 hp, one of 2,000 hp, and one pair of 1,000 hp. Compound engines operating condensing include one of 1,200 hp, one of 1,500 hp, and one of 4,500 hp capacity. There is one triple-expansion condensing engine rated at 2,150 hp. Gravity condensers are used with all engines that operate condensing. Steam for these ten engines is generated in three boiler plants composed of Manning upright tubular boilers. One plant of ten boilers rated at 150 hp each, located up-stream from the larger group of mills, supplies steam for the 2,150-hp and the 150-hp engines nearby. Further down stream and on the opposite side of the river, is a battery of 12 boilers rated at 150 hp each and devoted to the operation of the 4,500-hp engine in an adjoining building. Close to this last-named building is the main boiler plant, which generates steam for the remaining engines and for other purposes about the mills. This main plant contains 57 boilers at 150 hp each. The other engines are numbered as follows:

Number.	H.P.	Number.	H.P.
1	1,000	5	1,800
2	2,000	6	1,500
3	250	8	4,500
4	1,200		

The 2,150-hp engine with its boiler plant is located about 1,500 feet up stream from No. 9 mill, which is partly driven by power from this engine. As the main boiler plant is on one side of the Merrimack River and a great part of the engines it supplies are on the other side, an extended system of steam pipe is necessary. A main element in this system is a loop of 20-in. pipe carrying steam at high pressure. This loop is about 2,700 ft. long and crosses the river in two places. An exhaust pipe of 15 in. diameter also crosses the river.

Under the conditions thus far outlined it was decided to replace a part of the steam distribution of power, and to provide for some extensions by the introduction of electric motors. The first step in this direction was to install a 500-kw. 600-volt, 3-phase, 60-cycle generator on the shaft of the 2,150-hp engine, which shaft also carries three horizontal water wheels of 1,537 hp total capacity. Power from this generator is used to operate four induction motors of 550 hp combined capacity in No. 9 mill, some 1,500 ft. down stream. The generator has been in operation several years, and quite recently a much larger one has been added to extend the electric drive. This latest generator is rated at 2,500 kw, 600 volts, 60 cycles, 3 phase and 120 r.p.m., is of the internal revolving magnet type, and this magnet is mounted directly on the shaft of a cross-compound, vertical engine. The external frame of this generator is 18 ft. 4 in. in diameter and the shaft on which the revolving magnets are mounted has a diameter of 2.5 ft. The engine cylinders measure 33 x 66 x 48 in., steam enters the high-pressure cylinder at 160 pounds pressure and the rated capacity is 4,500 hp. There is little doubt that this connected generator and engine form respectively the largest electric and steam unit in the State of New Hampshire. Besides driving the electric generator with which it is directly connected, the 4,500-hp engine has a belt connection with a shaft that drives four arc light dynamos. Each of these arc dynamos is arranged for four circuits of 2,500 volts and 6.6 amp each, giving the dynamo a capacity of 125 enclosed arc lamps. The main purpose to which this 2,500-kw generator is to be devoted is the operation of 3-phase, 60-cycle motors. Incidentally some arc lamps are supplied through constant-current transformers. One group of three such transformers, each rated at 4,000 volts and 7.5 amp, has already been installed. At present the load of motors is not complete, but 19 motors of 150 hp each, three motors of 100 hp each, and one motor of 500 hp are either in position or are being added. This gives a total thus far of 3,650 hp capacity, in motors, but as 550 hp capacity is supplied by the 500-kw generator, only 3,100 hp in motors is connected to the 2,500-kw generator. All of the 150-hp and the 100-hp motors are of the induction type, and rated to operate at 585 r.p.m. under full load, and at 600 r.p.m. under no load. These 150-hp and 100-hp motors are all belted to line shafting in the mills, the usual arrangement being to hang a motor from the ceiling and belt it to shafting beneath the looms of the floor above. All belts are thus avoided between looms and ceiling.

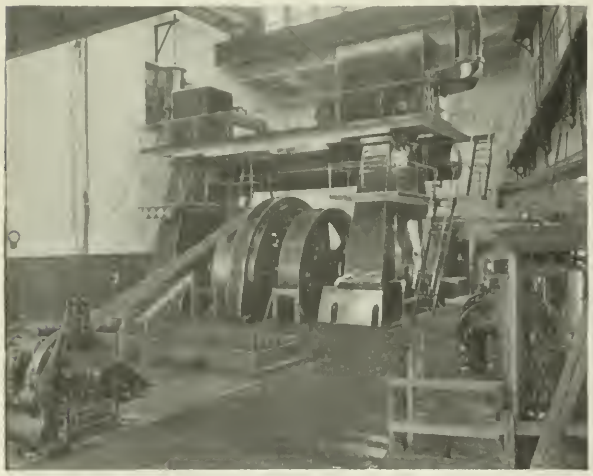


FIG. 2.—AN ENGINE ROOM, AMOSKEAG MILLS.

The above generators and motors were built by the General Electric Company, and the 4,500-hp engine by McIntosh & Seymour. The 500-hp motor above mentioned is of the three-phase, synchronous type and will be direct connected to the driven shaft. A part of the foregoing motors have been installed in new mills, where they constitute the only source of power. Other motors, however, have been erected in mills where an equipment of water wheels and steam engines already existed. In such mills the engines have had to carry the load of the water wheels, or at least a part of it, at times of low water. Now, the electric motors will be utilized to make up any deficiency in the amount of work done by the water wheels. The tendency thus is to shift loads from some engines distant from the boiler plant to the 4,500-hp unit, which is close to it.

The introduction of electric drive for spinning and weaving operations has rendered the measurement of the power consumed in these lines of work an easy matter. In one test made with a 150-hp induction motor at the Amoskeag Mills, 462 box looms at work on staple ginghams were driven and the rate of consumption of electrical energy by the motor was 140.67 hp, so that the average rate per loom was .319 hp. In another similar test, a 150-hp induction motor drove 557 box looms, also working on staple ginghams, and drew 180.50 electrical hp from the line. In this case the average consumption per loom was .324 hp. It should be noted that each of these tests gives the power consumed by the motor, so that all motor and shafting losses are included in the figures given per loom. The second test shows how a motor may be overloaded with no material falling off in efficiency. A test of 44 spinning frames and 13 spoolers, driven by a motor rated at 150 hp, showed a consumption by the motor of 156.52 hp. It was found by an independent test that the 13 spoolers, containing 1,300 spools, required 6 hp, so that 150.52 hp was consumed to operate the spinning frames. These frames contained 9,312 spindles and the number of spindles operated per horse power was, therefore, 62.

After passing to its switchboard, the 600-volt, 3-phase current from the 2,500-kw generator is distributed to the motors by four circuits of three cables each. Each of these cables has a cross-section of 1,000,000 cm and a weight with insulation of 3.5 pounds per foot. Three circuits, each 1,000 ft. in length, extend from the switchboard in the generator room to motors across the river, passing through an enclosed footway over the river and then through a tunnel to the mills. One circuit 800 ft. long feeds motors on that side of the river where the 2,500-kw generator is located.

Besides the electrical equipment already noted, the mills of the Amoskeag Company contain the following smaller dynamos used for lighting purposes. Three arc dynamos with capacity of 75 enclosed arc lamps each, there being four 1,520-volt, 6.6-amp circuits to each dynamo. Five arc dynamos with capacity of 50 open arcs each, or 2,500 volts and 10 amp. Two arc dynamos with capacity of 60 open arcs each, or 3,000 volts and 9.6 amp. Two arc dynamos rated at 30 open arcs each, or 1,500 volts and 9.6 amp. Two 125-volt dynamos for incandescent lighting, one with capacity of 150 amp and the other for 250 amp. Including the four 125-lamp arc dynamos and the three 50-lamp, constant-current transformers, previously mentioned, the total capacity at these mills for the operation of enclosed arcs amounts to 875 lamps. In open arcs the capacity amounts to 430 lamps, making the total rating of arc lamp equipments 1,305 arcs. There are in use throughout the mills 1,387 open and enclosed arcs, also 577 incandescent lamps. As may be seen from these figures, most of the lighting is done with arc lamps, and one of the weave rooms in Nos. 4 and 5 mill presents a typical example of their arrangement. This room is 467 ft. 8 in. long, 95 ft. 4 in. wide, and contains 840 looms. Lighting is done by 58 arc lamps arranged in two rows of 15 lamps each, and two rows of 14 lamps each, along the room in the direction of its greater dimension. The rows of lamps are 24 ft. apart, and the lamps in each row are 32 ft. apart. Each arc lamp thus supplies light for about 14 looms.

An interesting test of the power required to drive an engine and shafting connected by belts to the loose pulleys for about 3,000 looms, also a dress room, was recently made. The total length of shafting in this test was 11,353 ft., ranging in diameter from 5 in. down to 2⅛ in. To drive the engine, shafting, belts and loose pulleys, required 378 hp, the looms not being in operation.

These interesting facts concerning the largest power plant in New Hampshire have been collected through the courtesy and with the aid of the engineers of the Amoskeag Manufacturing Company.

Paris-Brussels Electric Road.

A Paris dispatch says: Some French and Belgian engineers are working on a scheme to reduce the time of the journey by rail between Paris and Brussels, 191 miles, from six to two hours by electric trains, so that Parisians may lunch at home, take a train to Brussels, transact business there and return to Paris for dinner. The cost each way is to be $4. The system will be double track, with the accumulators of the cars united with each other by cables. All cars are to be first class. The termini will be in the center of business in each city. The trip will be made at the speed of ninety-four miles an hour, including stops.

Some Engineering Features of the Bedell System of Composite Transmission.

By A. S. McAllister.

It is well recognized that, for the transmission of mechanical power, polyphase currents are required and a low frequency is desirable, while, for the lighting service, a high frequency is required and, as concerns the receiver, the equivalent of single-phase circuits must be used. When power is transmitted to both motors and lamps, there is made a compromise selection of polyphase currents, and a high frequency, that is, a frequency higher than is best suited to motor service. By a method, in the application of which complications are conspicuous by their absence, there may be obtained the simultaneous combination and separation within the same conductors of low-frequency polyphase currents for mechanical power and high-frequency single-phase currents for illumination. Upon the fact that superposed asynchronous currents and e.m.fs add as though in quadrature, depends the complete solution of the problem which confronts every engineer when determining the selection of equipments adapted to the requirements of both lamp and motor service.

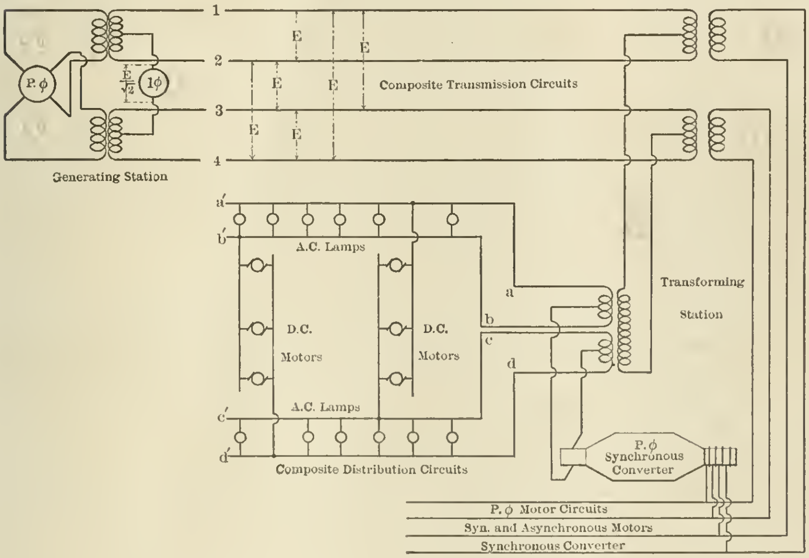


FIG. I.—COMPOSITE TRANSMISSION AND DISTRIBUTION CIRCUITS.

Before discussing some of the practical applications of the simultaneous transmission of differing currents, it is well to establish the fact concerning the non-interference of asynchronous currents. If two currents, I and I_1, of different frequencies, pass simultaneously through a conductor, the effective line current will be $\sqrt{I^2 + I_1^2}$, and the line loss, for a resistance R, will be $I^2R + I_1^2R$, or the same as though each current acted alone. Any change in the value of either current has no effect upon the loss occasioned by the other. The importance of this result will be appreciated when it is remembered that, for direct or alternating currents of one frequency, the loss would be $I^2R + 2I\,I_1R + I_1^2R$, and hence there is not the same independence. This characteristic of asynchronous currents allows of the independent regulation of the e.m.f. impressed upon the receivers of the component systems supplied with power transmitted conjointly over the same conductors, for, with line losses independent, line drop must likewise be independent.

The Bedell system provides various methods for the joint transmission of direct and alternating currents, or of alternating currents of two frequencies, some of which will now be described in detail.

Fig. 1 represents circuits so interconnected as to obtain the advantages of joint transmission both in the high-tension primary mains and in the low-potential secondary distributing circuits. In the main power station are installed low-frequency polyphase generators of any convenient size, designed for any e.m.f. or number of phases, arranged to be operated in parallel according to the demands upon the polyphase system. The station contains also single-phase high frequency lighting generators, built for a high e.m.f. to feed directly to the line, or for a lower e.m.f. to be connected to the primary coils of step-up transformers. These latter generators may conveniently be so constructed as to maintain automatically the e.m.f. at the distant station at any constant value chosen for the lighting service. With a lagging current and especially with a current which changes its angle of lag with the ratio of the demands of the motors and the lights, the reactive drop would render perfect regulation by automatic compounding somewhat difficult to obtain. Since, however, the lighting load alone is to a large extent non-inductive, this result can easily be secured.

Current from the single-phase generator passes differentially through each half of each of the high-potential line transformer coils. The magnetizing effect of each half, therefore, neutralizes that of the other and the core is, consequently, unaffected by the flow of the single-phase current. The low-frequency power current does not interfere with the asynchronous current in the transmission line. Hence, the single-phase power is transmitted over the four conductors in all respects as though the polyphase generating and receiving apparatus were idle. At the receiving station the single-phase current is delivered at the two neutral points of the separate line transformers and passes into the lowering transformer where, being converted to the proper e.m.f., it supplies energy to the network of feeders for the lamp service. Thus the power for illuminating purposes in its travel from the generators to the receivers encounters only such circuits as are ordinarily provided for the transmission of single-phase current.

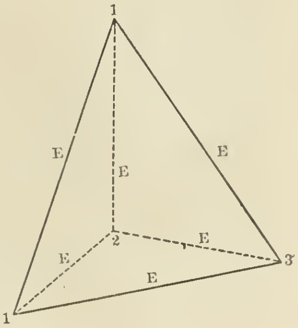


FIG. 2.—TETRAHEDRON OF E.M.FS.

Consider now the polyphase equipment. The only change from standard high-tension transmission practice is in the use of two-phase rather than three-phase circuits; all apparatus intended to be operated by the low-frequency current being of standard accepted design and no change whatever being needed in its connection to the polyphase circuits. Motors of the synchronous or asynchronous type, or synchronous converters, are operated by methods too well known to need comment. A decided advantage is gained, however, over equipments now in use, due to the fact that the low frequency of the polyphase circuit is conducive to the satisfactory performance of all synchronous machinery and is accompanied with a low line inductance and improved regulation of the circuit e.m.f.; while the elimination of all unbalance of loads on the separate phases is a result, the desire to obtain which has led to the introduction into equipments now installed, of such complications in connections, switching devices, potential regulators, etc., that an adequate description thereof would require more space than that allotted to this article.

Mention has been made of the substitution of the two-phase for the now universally employed three-phase system, and it is obviously true that, to transmit a certain amount of power over two-phase circuits, requires one-third more conducting material than when three-phase circuits are used, the e.m.f. and the line loss remaining the same, and it is also true that the loss due to any current in the two-phase system is not lessened by the flow of the superposed single-phase current. The question then arises as to any source of gain to be derived sufficient to offset the seeming additional cost of line material. The fact is, that, without raising the effective line e.m.f., and at the former percentage of line loss, the composite system will transmit 150 per cent. as much power as the single-phase, or the two-phase system alone, or one and one-eighth times as much as the three-phase system, the amount of conducting material being the same in each case, so that the change from the popular three-phase system, in addition to securing the very desirable results of independence of regulation of the e.m.f. for lamps and motors and equality of division of loads on the polyphase system and permitting of the selection of frequencies adapted to the best operation of each type of machine, allows of an actual decrease in the cost of line conductors.

It will be recalled that the e.m.f. between opposite phase lines in a two-phase system, with interconnected neutral points, is only $\sqrt{\frac{1}{2}}\ E$, where E is the e.m.f. measured between wires of the same phase. When the neutral points of the two phases are separated by an interposed asynchronous e.m.f. of value $\sqrt{\frac{1}{2}}\ E$, the e.m.f. measured between opposite phase lines becomes E, since e.m.fs of different frequencies add as though in quadrature. By giving to the single-phase circuit (Fig. 1) this value of e.m.f., there is produced a novel condition of connections due to having four conductors, each of which is at the same measurable difference of potential from the other three. In attempting to represent this result graphically, one is confronted by the fact that in a single plane only three points can lie equally distant one from the other, and that a fourth point to be thus located must be out in space; in fact, the four points occupy the vertices of an equilateral tetrahedron (see Fig. 2).

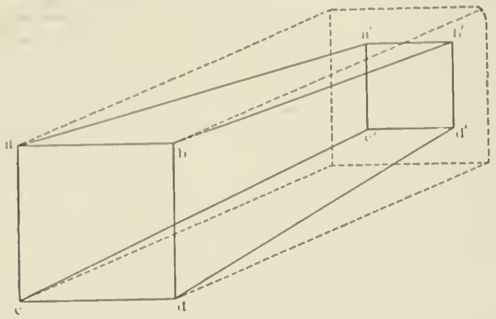


FIG. 3.—ALTERNATING-CURRENT AND DIRECT-CURRENT LINE DROPS.

The single-phase circuit has a line resistance, one-half of that of each circuit of the two-phase system. Hence, for the same percentage of line loss for the two systems, at an e.m.f. of $\sqrt{\frac{1}{2}}\ E$ for the former and E for the latter, the single-phase current must be $\sqrt{2}\ I$, where I is the current per phase of the low-frequency circuit, so that the lighting load may be $\frac{\sqrt{\frac{1}{2}}\ E\sqrt{2}\ I}{2\ I\ E} = \frac{1}{2}$ of the polyphase load. From this fact are obtained the values given above for the relative economies of the composite and other transmission systems.

An advantage possessed by the composite system over any other now in use is found in the fact that the motor loads may fluctuate through any range whatsoever and become so excessive in value as to cause the circuit-opening devices to remove all connections between the polyphase generators and the transmission lines, yet the lamps will be entirely unaffected. In consequence of the independence of the regulation of the component systems, each may be given a load much in excess of what would be considered admissible with circuits operated according to present-day practice. Thus, the line drop due to the almost non-inductive lighting load can conveniently be compensated for by accurate compounding at the generating station, while the load on the polyphase system is not limited in value to that amount which would interfere with the brilliancy of the lamps, and, moreover, due to the lower circuit frequency, a larger value of current may be transmitted in order to cause the former percentage of line drop allowed with the higher frequency.

The foregoing description has referred particularly to the differential system of primary transmission of asynchronous alternating currents, of which it is a good illustration. For low-tension secondary distribution, the common conductor system of superposed direct and alternating currents is admirably adapted. An application of this method is shown in Fig. 1, the direct current obtained from the direct-current side of a two-phase synchronous converter being introduced at the neutral points of the two distributing-circuit coils of the lowering transformer on the single-phase lighting system. A little consideration will show that thus connecting the converter terminals will tend to separate the potentials of similar sides of each transformer coil by an e.m.f. equal to that between the direct-current leads. When no direct current flows, this difference of potential will, obviously, be maintained between similar conductors throughout the alternating-current circuits. If a direct-current receiver be connected between these conductors the current which will flow will pass through one-half of one transformer coil in one direction and return in a reversed direction through an equal number of turns of another coil wound upon the same core. With regards to the core magnetism, therefore, no effect is produced by the direct current and, since within the conductors the dissimilar currents do not interfere one with the other, the e.m.fs impressed upon the alternating and upon the direct-current receivers are unaffected the one by the load on the other. Thus loads on the separate alternating-current circuits cause the e.m.fs of those circuits to be less at the distant end than at the transformer station, but only direct-current loads can decrease the difference of potential between similarly disposed alternating-current conductors.

An idea of the relative decrease of the individual e.m.fs at the distant end of the circuits when direct and alternating currents are flowing can be gained from a study of Fig. 3. Here *a b* and *c d* are the alternating e.m.fs at the station, while *a' b'* and *c' d'* are the corresponding receiver e.m.fs; *a c* and *b d* are the initial direct e.m.fs, while *a' c'* and *b' d'* are the final terminal e.m.fs. The drop in e.m.f. on each circuit is determined by the load on that circuit alone.

In the common conductor system of distribution, it is convenient to operate motors by direct and lamps by alternating current. The illumination will thus be unaffected by the fluctuations in the motor loads, while the lighting circuits may be given a low e.m.f. independent of the requirements of the motors.

It is worthy of note that no additional circuits whatever are needed for the common conductor system of distribution. Each lighting circuit is erected along a separate route, as is customary at present, and the circuits are interconnected only where there is a demand for power for the operation of motors. When a single consumer desires both motors and lights, as in office buildings, stores, etc., only three wires are taken to his premises.

For heavy factory work and where large amounts of mechanical power are used, the characteristics of the polyphase motor render its installation desirable, and there should be available for its operation polyphase current derived by transformation directly from the high-potential circuits. Such motor circuits are indicated in Fig. 1. The low-tension polyphase circuits needed for this purpose are well adapted to the requirements of synchronous converters for supplying power to direct-current traction motors.

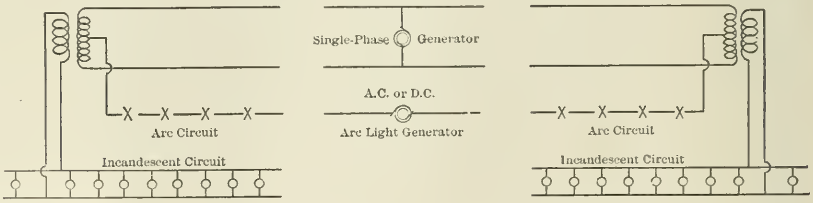


FIG. 4.—COMPOSITE LIGHTING CIRCUITS.

It is interesting to observe that the differential system is applicable not only to the effective separation of the lamp and motor loads on long-distance transmission circuits; it may be applied equally as well to the simultaneous transmission of differing currents for the operation of arc and incandescent lamps from relatively local circuits. Fig. 4 represents a high-tension circuit for supplying single-phase current to lowering transformers for the incandescent lamp service. Without complications, this circuit is used as the return conductor for the arc light circuit, for which current is obtained from a proper generator installed in the main station. Where a single series of arc lamps is desired, this method allows of a saving of fifty per cent. in the amount of conducting material for the arc light circuit.

It scarcely need be stated that the composite system is applicable to numerous interconnections of circuits, of which the above are but isolated examples, and that in each case the inherent characteristics of independence of regulation and economy of operation are preserved.

Radiant Efficiency of the Mercury Arc.

The February issue of the *Physical Review* contains a paper by Prof. William C. Geer giving the result of investigations on the radiant efficiency of the mercury arc. The opening paragraphs give references to the work of those who have experimented with the mercury arc, but neglects that of Jamin about 1882. The investigations by Hittorf, Righi, Skinner and others on the phenomena of electrodes in exhausted tubes are not touched upon. We give below a condensation of the paper:

In the year 1860 Way observed that an intense light was produced when an electric current was allowed to flow through a fine thread of mercury which was falling from an upper reservoir to a lower one. He had this "mercurial electric light" on the mast of a yacht off the Isle of Wight, where its brilliant radiation was observed from a distance of many miles. The newspapers of the day commented upon its intensity and suggested it as a means of artificial illumination.

The interest thus aroused in the discovery naturally stimulated investigation and as a result many patents have been issued, in this and other countries, whose main specifications describe a lamp for obtaining an arc between mercury terminals. Rapieff, in 1879, took out a British patent for an inverted U-tube having the ends dipping into mercury, and the arc playing either in air or in a vacuum. Rizet, in 1880, obtained a French patent. The design was similar to the above, while the U-tube is filled with nitrogen. Langhans, in 1887, obtained a German patent for a U-tube with legs filled with any metal or metalloid. By far the most interesting and thorough attempt to render this principle of commercial value has been made by Cooper Hewitt with what he calls a mercury "vapor lamp." He has patented a large number of designs.

None of these mercury vacuum tubes has proved to be practicable as a means of artificial lighting and consequently they have failed of commercial success. However, the mercury arc has rendered valuable service to pure science. The green lines, produced by this means are employed in spectrometric work as a source of monochromatic light of high intensity which can be maintained for a long time, when properly cared for, and which is comparatively easy to produce. The device commonly used in the production of the arc is some form of the tube, or "lamp," described by Arons in 1892 and in 1896. Many slightly different designs have been made by Lummer and others. These lamps all embody the same principles, viz., a U-tube of some sort having the two legs filled with mercury, through the ends of which platinum wires are sealed, the whole being exhausted as far as possible.

From the published results of the work of Arons and the fact that the arc gives out such a brilliant light, one would infer that the radiant efficiency, or the ratio of the luminous radiation to the total radiation, must be large. The paper then proceeds to describe the results of an attempt to measure the efficiency of that part of the radiation of the mercury arc which was transmitted through the glass tube within which it was formed. Any radiation from the glass itself was carefully corrected for and left out of account in the calculations.

The separate determinations varied considerably even at the same current. This variation may be due to several causes. In the first place the arc was extremely unsteady, the cathode being in constant motion. Arons states that the arc is a discontinuous one, basing his conclusion on the sound that is given by a telephone receiver when properly connected. Prof. Geer observed that when one places his ear close to the lamp an unsteady sound of low pitch can be distinctly heard. This unsteadiness is undoubtedly one of the causes for the variation in the efficiency determinations. Then, again, the mercury which distilled from the terminals condensed upon the cooler sides of the tube, forming an irregular layer, which absorbed considerable energy. Furthermore, the temperature of the tube at the time when the throw of the galvanometer was read varied a good deal with the different determinations, even in spite of great care. Since the total electrical energy used has been found to change with the temperature of the tube, it is quite probable that the efficiency may be influenced by this cause. Also the temperature of the tube would influence the rate of cooling and as a consequence it would be possible that the extrapolated values of the hot glass deflections may be in error in some cases. These errors could not be corrected with the apparatus at hand. The mean of a large number of determinations is doubtless quite near to the true efficiency.

Plotting efficiencies and currents as a curve, it would appear that, in general, the radiant efficiency of the mercury arc increases with the current. In other words, the intensity of the visible part of the spectrum increases more rapidly than that of the invisible part. This does not accord with the work of Ångström on the intensity of the radiation from vacuum tubes. To be sure, the case of the Arons lamp is not exactly similar to a vacuum tube. The condition here is that of a saturated vapor in contact with its liquid base, so that with the changing temperature the pressure in the tube changes as well. As the current is increased the temperature of the electrodes should increase and consequently the pressure in the tube should rise. According to the authority quoted the efficiency falls with an increase of the pressure. If the present measurements are correct the efficiency rises slightly under these conditions. In any event there is a field here which merits further and more thorough investigation.

The following are a few of the more common light sources and their comparative radiant efficiencies, which were measured by the general method described in the paper:

Source.	Comparative efficiency.
Illuminating gas, argand burner	1.61
Incandescent electric lamp	6.00
Arc light	10.04
Acetylene	10.50
Geissler tubes	32.00
Mercury arc	40.90 to 47.90

From these figures and the full data determined, it is seen that the mercury arc is quite remarkable. It has the highest known radiant efficiency. It is to be remembered, however, that these results indicate the efficiency only of that part of the radiation from the mercury arc which was transmitted through the glass tube within which the arc was formed.

When one recalls that the spectrum of mercury is a line spectrum it is to be inferred from the efficiency values that some well-defined lines or bands are to be found in the region of the infra-red. Indeed the high efficiency here recorded may in part be due to the presence of energy of such large wave length that the glass walls of the tube absorbed the waves, and, therefore, they were not taken account of in this method of determining the efficiency. The high heating of the walls of the tube may, at least to a slight extent, be ascribed to this cause. Several lines were predicted by Kayser and Runge, but they have not been found as yet, and, so far as could be found, nothing has been written which includes a systematic study of this portion of the mercury spectrum. In the near future it is purposed to publish the results of an investigation in this field.

Production of Zinc by Electricity.

United States Consul Bergh sends from Gothenburg the following translation of an article recently published by a local newspaper, in which he states that experts in metallurgy have for some time discussed the report that Dr. De Laval, after extensive experiments, has been able to produce zinc ore by electricity at the factory Önan, belonging to Trollhättans Elektriska Aktiebolag, Trollhättan. It is reported that the manufacture of carbide at Önan has been discontinued and the production of zinc by Dr. De Laval's method adopted. An expert states: "Dr. De Laval has for several years worked on the problem of producing zinc by electricity from lead-sulphur-zinc ores. He was probably led to this by his experiments in trying to separate iron from ores by electricity. An examining board has reported favorably on the method, and the result has been the organization of a company to exploit the invention and the ore deposits at Saxberget, near Ludvika. The minimum capital—$26,800—has already been paid, and the company will start operations as soon as circumstances will allow."

Analysis of the Seventh Annual Report of the Public Lighting Commission, Detroit, Mich.

THE annual report of the Detroit Public Lighting Commission is again at hand. In the ELECTRICAL WORLD AND ENGINEER, of February 15, 1902, we reviewed the Sixth Annual Report and it is with keen interest that we compare this report with the one that preceded it. The president's report states the cost of an arc lamp for the year ending June 30, 1902, to have been $63.82, a decrease under the preceding year of $3.49.

The items which make up the cost of an arc lamp are given as follows:

*Depreciation on the entire investment of $802,438.93, at an average of 3%, June 30th, 1902	$24,073.17
Interest on the net investment, July 1st, 1901, $721,861.56, for one year at 4%	28,874.46
Lost taxes (the amount the city would get as taxes were the plant owned by a private corporation) are figured by charging to the operation of the plant at the regular rate of taxation for the city, county and state. The probable assessed value based upon a comparison with the assessed values of other plants of like character, similarly located in the city, is placed at $389,183.00. This amount at $21.23 per $1,000 is	8,262.35
Cash cost of operation is	99,087.16
Making a total cost of	$160,297.14

Total cost proportioned between arc and incandescent plants according to output of each is as follows:

Arc plant	$136,140.73
Incandescent plant	24,156.41
Total	$160,297.14

Cost of operation per arc light (cost of operation divided by average number of lights, 2,133)	$63.82

Cost per arc light subdivided—		
Operating disbursements	$39.45	
Interest at 4% on investment	11.49	
Depreciation at 3% on investment	9.59	
Lost taxes on investment	3.29	
Total		$63.82

There are in this product $63.82, a number of factors; the variation of any of which would affect the total. We will examine these one at a time. The first is the divisor, 2,133, stated to be the average number of arc lamps operated during the fiscal year.

THE NUMBER OF LAMPS.

Regarding the number of lamps we quote the following from the ELECTRICAL WORLD AND ENGINEER of February 15, 1902:

> "The reckoning of 2,035 lamps includes some 55 lamps operated in the beautiful Belle Isle Park. It is proper that lights on the paths and avenues of this island should be considered as a part of the street lighting system, but inasmuch as they are only operated until midnight, that is to say, half the time of the regular street lighting, it is improper that they should be reckoned at their full value in estimating this number. Half of them—say 27 out of 55—should be cut off from the figure 2,035 used as a divisor of the annual operating expense per one lamp operated. It appears also from an examination of the statement of arc lamps on page 31, that 26 lamps in buildings and not on the streets, are included in the calculation. This includes evidently seven lamps in the Public Lighting Commission's own building and yard, which cannot be considered as forming any part of the street lighting. The Public Lighting Commission in all its reports has included as a part of its output the current used in lighting its own stations and offices. This is clearly wrong. The lighting of these buildings is an operating expense. To include it as a part of the output in estimates of average cost per arc lamp is just as absurd as if a contractor should bill to a city the arc lamps he used in his own power house. A further deduction of seven, bringing the average number of arc lamps down to 2,001, is, therefore, necessary. The same item of lighting in buildings includes apparently about a dozen of 16 alternating arc lamps supplied from the incandescent system. These are used in lighting the Ferry Dock and other places at Belle Isle. They burn until 11:30 or midnight. If these lamps are to be counted as street lights, they should only be considered as half-time lights. But we are informed that the current of these lights is included in the incandescent lighting output of the plant, and the commission deducts from its total expense before figuring the cost per street light, an amount proportionate to the incandescent light output. If we are rightly informed about this, there should be a deduction of these 12 lamps also from the divisor of 2,033. This double credit to the plant is doubtless a mistake and will be corrected in future reports; but the assumption of credit for the lighting of the public lighting buildings is not accidental, and the reduction necessary on account of half time lights on Belle Isle is indisputable."

These conditions still exist. The Belle Isle lights burn only until midnight and during the winter months fully half of them are switched off. The arc lamps in the public buildings other than the lighting station are alternating arcs, whose current is measured at the switchboard as incandescent lighting output. The lighting of the plant and the commission's offices is reckoned as output

On page 29 of the report we have the following tabulation:

Lamps on Belle Isle	58
Lamps in buildings	22

Assuming the Belle Isle lamps to equal 29 lamps that burned full time, we have:

Lamps on Belle Isle	29
Lamps in buildings	22
Total	51

Deducting this number from the given average of 2,133 gives a true average of 2,082, which should be used as the divisor, and would make the cost of an arc lamp $65.32 per year. So far we do not question the figure for total cost, but merely the divisor used.

DEPRECIATION.

The next factor requiring examination is the Depreciation Charge. This is figured as it was last year and as it has been for several years at an average rate on the entire plant of 3 per cent. A note, however, is added this year which represents this 3 per cent. as "being the average on the different items of property as shown by the actual depreciation of different types, varying from 7 per cent. on incandescent plant, arcs and switches, 5 per cent. on steam plant, etc., to nothing on land." Depreciation accounts have always been the subject of much controversy, but there is hardly anyone who will deny that the Public Lighting Commission's treatment of the subject is inadequate. The history of the Public Lighting Commission may be summarized as follows: Work was started in 1894 by installing practically the earliest 100-light arc machines. Extensive experiments made to determine the feasibility of changing the open arc lamps to enclosed lamps, 1898-1899. Discarding direct-current arc apparatus for enclosed alternating arcs, 1901-1903.

It would be a very rash man who asserted that the present alternating enclosed arc lamp will never be excelled for street lighting. A much more rash man would hesitate to predict that we are near the limit in the economical production and utilization of steam. The student of these reports of the Detroit Municipal Plant is irresistibly forced to the conclusion that not only the bond issue, but a respectable proportion of what now ought to be running expense must be taken care of in the future.

It is to be noted here that the bond issue made on account of the plant is $650,000. A sinking fund to provide for the retirement of these bonds is maintained by the City of Detroit, but properly does not enter in any way into the accounts of the Public Lighting Commission. The cost of the plant in excess of $650,000 has been provided for by direct taxation; concerning which some remarks will be made later.

Each year ELECTRICAL WORLD AND ENGINEER has questioned the propriety of the average 3 per cent. allowance for depreciation made by the Public Lighting Commission. This year, notwithstanding the explanation in a foot note, the inadequacy of the allowance is even more apparent than it has ever been before. At this moment the commission is discarding its equipment of direct-current arc dynamos and lamps which has been used an average of 6 years. This apparatus will barely sell for its junk value. At the 3 per cent. depreciation rate there has been charged off from its cost 18 per cent. If we accept the 7 per cent. foot note rate, still only 42 per cent. has been charged off. Those familiar with the market for second-hand apparatus will agree that even a 12 per cent. depreciation would have been too little.

Again; during the year covered by the report the commission sold three 50-kw alternators for $2,670. These machines cost $7,500. The loss is $4,330. At 3 per cent. for their 5 years' service $1,125 has been charged off; or at 7 per cent., $2,625; leaving the difference to be accounted for in some unknown way. In the same year some of the pole lines have been almost entirely rebuilt. The poles were of Norway pine and only lasted 6 years. The depreciation on the best pole lines is at least 8 per cent. The foot note shows that the commission is beginning to learn that depreciation is a condition and not a theory; but even the revised 5 per cent. allowance on the steam plant is absurdly low.

Let us assume 7 per cent. as being a reasonable average rate and on that basis recalculate the cost of an arc lamp per annum. We use in this calculation the commission's figures for interest, lost taxes, and cash cost of operation.

Depreciation on $802,438.93 at 7%	$56,170.72
Interest at 4% on $721,861.56	28,874.46
Lost taxes	8,262.35
Cash cost of operation	99,087.16
Total cost	$192,394.69
Proportion charged to arc	163,343.09
Proportion charged to incandescent	29,051.60
Total cost	$192,394.69

Dividing the amount charged against arc lighting by the average number of lamps given in the report, namely, 2,133, gives $76.58 as the cost of an arc lamp. Dividing by the number 2,082, which is the true average number of lamps, gives $78.45 as the cost of an arc lamp for a year.

ANOTHER LOOK AT DEPRECIATION.

There is another way in which the commission's estimate of depreciation affects the accuracy of their report. They have been adding depreciation to their operating costs at the rate of 3 per cent. since they began to publish reports. On page 25 of the present report we find the following tabulation:

DEPRECIATION ACCOUNTS.

Debits.

To investment prior to June 30, 1897	$729,222.73
To investment during year to June 30, 1898	60,923.00
To investment during year to June 30, 1899	23,657.74
To investment during year to June 30, 1900	14,284.53
To investment during year to June 30, 1901	23,566.83
To investment during year to June 30, 1902	80,577.37
Total amount charged to investment	$932,232.20

Contra.

By amount added to cost of lights for depreciation prior to June 30, 1897	$40,145.73
By amount added to cost of lights for depreciation year ending June 30, 1898	22,500.00
By amount added to cost of lights for depreciation year ending June 30, 1899	22,534.71
By amount added to cost of lights for depreciation year ending June 30, 1900	22,287.22
By amount added to cost of lights for depreciation year ending June 30, 1901	22,325.61
By amount added to cost of lights for depreciation year ending June 30, 1902	24,073.17
Total amount added to cost of lights for depreciation	$153,866.44
Balance present investment June 30, 1902	$778,365.76

Let us figure depreciation at 6 per cent. instead of the ridiculous figure of 3 per cent. We then have:

Contra.

By amount added to cost of lights prior to June 30, 1897	$43,753.36
Year ending June 30, 1898	44,783.00
Year ending June 30, 1899	43,515.99
Year ending June 30, 1900	41,762.10
Year ending June 30, 1901	40,670.03
Year ending June 30, 1902	43,064.83
Total	$257,549.31
Balance present investment	$674,683.20

The use of 6 per cent. instead of 7 per cent. as a depreciation rate in our calculation is intentional. We think 7 per cent. is a reasonable figure, but to use that figure would reduce the present value of the investment below the face of the bond issue. Our illustration as it stands shows that the money which has been raised for the plant by direct taxation has probably only made good the impairment of the bonded capital instead of having, as the commission claims, added to the net value of the plant.

ADDITIONAL PROOF OF DEPRECIATION INADEQUACY.

The fourth annual report is the first one in which the amount of the annual appropriation asked for by the Public Lighting Commission and the amount actually allowed by the Board of Estimates is given. The amount allowed for the year ending June 30th, 1900 (see fourth annual report, pages 53-54 and 55) to be expended in "Extensions and Betterments" was $41,945. Part of the money was to be used in the purchase of generators of a combined capacity (apparently) of 500 kw. For the year ending June 30th, 1901 (see fifth annual report, pages 67-68) no money was allowed for extensions. For the year ending June 30th, 1902, the amount appropriated for "Extensions and Betterments" was $55,328 (see sixth annual report, pages 67-68). From the seventh annual report we learn that with part of this money two generators of a combined capacity of 775 kw were purchased.

On pages 11 and 12 of the fourth annual report the total capacity of the electrical machinery of the plant is shown to be 1,337.5 kw. We have seen above that appropriations had been made in two succeeding years for about 1,275 kw capacity in generators. Naturally we would expect to find in the power house of the Public Lighting Commission an electrical capacity of 2,612.5 kw. But the seventh annual report prints a list of generators, on pages 16 and 17, whose combined capacity is only 1,954.5 kw. If all the generators were bought for which money was appropriated, it is evident that there has been a great deal of "replacement" under the guise of "Extension and Betterment." If this money has not been expended for the purpose for which it was appropriated, it is in order to ask whether or not it has been used to pay the operating expenses of the plant.

Returning to the seventh annual report we find on pages 72 and 73 a statement of the amount of money allowed for the fiscal year ending June 30th, 1903. The amount appropriated for "Extensions and Improvements" is $82,200. Among the items are two generators of combined capacity of 800 kw. We understand that this machinery has already been contracted for. If this is the case the eighth annual report for the year ending June 30, 1903, should show a total capacity in generators of 2,754.5 kw.

To show what are considered as "Extensions and Improvements" by the Public Lighting Commission we give below an extract from the *Detroit Free Press* of February 3, 1903. These estimates are for the year ending June 30, 1904:

"The Public Lighting Commission last night passed the estimates for next year. The total amount to be asked for maintenance, operation and extensions is $231,829, or $45,654 more than was granted by the Board of Estimates for the present year. The chief increases are in these lines: Coal, from $22,000 to $40,000, and station wages, from $23,000 to $25,000. The estimates in detail are as follows:

OPERATING AND MAINTENANCE.

Buildings, track, dock, etc	$1,100.00
Steam plant	2,700.00
Electric plant	1,600.00
Miscellaneous tools and machinery	1,000.00
Conduits	450.00
Towers and lamp posts	2,000.00
Arc lamps	3,300.00
Lines and cables	6,000.00
Salary and bonds, secretary and city electrician	3,670.00
Printing and stationery	600.00
Storeroom	1,300.00
Office expense	1,700.00
Engineering and drafting	2,850.00
Oils	1,100.00
Waste	350.00
Coal	40,000.00
Miscellaneous station expense	1,000.00
Station wages	25,500.00
Trimming and patroling	16,500.00
Carbons	9,000.00
Incandescent lamp renewals	2,600.00
Incandescent lighting expense	800.00
Globes and nets	1,800.00
Bags, belts, etc.	100.00
Belle Isle plant	1,300.00
Shop supplies	150.00
Surgeon and hospital	450.00
Relief for operating department	1,900.00
Total	$130,820.00
Increase of pay of 19 trimmers from $2 to $2.25 per day	1,733.75
Increase of pay of three dynamo tenders from $1.60 to $1.75 per day	164.25
Increase to three patrolmen from $3.25 to $3.75 a day	547.00
Increase of pay to one steam fitter from $2.75 to $3.25 per day for 304 days	152.00
Grand total for operating if increases are allowed	$133,417.00

EXTENSIONS AND IMPROVEMENTS.

500 lamps, new locations	$12,500.00
Work of installing a 100 lamps underground circuit	27,492.00
Work of installing 400 lamps on overhead lines	26,000.00
Increasing Washington Avenue conduit capacity	1,275.00
Removing four towers and placing in outlying wards	800.00
Operating 250 lamps 9 months	7,707.50
Operating 250 lamps 6 months	5,137.50
Connecting service to three schools	2,000.00
Removing wires from police poles	500.00
For purchase of two lots on southwest corner Randolph and Atwater Streets	10,000.00
For 200 series inclosed arc lamps to replace Brush lamps now in use	5,000.00
Total for extensions and improvements	98,402.00
Grand total for all purposes	$231,829.00

INTEREST ACCOUNT.

As previously stated, $650,000 of the amount expended in building this plant was raised by the issue of 4 per cent. bonds, maturing in 30 years. These bonds are taken care of by the general sinking fund, and not directly by the Lighting Commission, but the effect on the taxpayer's pocketbook is exactly the same. Seeing that the lighting Commission does not claim the sinking fund as an asset, there is no occasion to discuss that feature of its finances.

The remainder of the investment has been taken from the tax levy each year, being practically an assessment on the stockholders of the plant, i. e., the taxpayers. But the average taxpayer expects his money to bring in rather more than 4 per cent. per year. Therefore, the cost of an arc lamp would be somewhat more than the amount given above, depending on each taxpayer's estimate of the earning capacity of his money. The citizens of Detroit, if our memory serves us right, were always willing to invest their money in the electric lighting business; but we never heard that they were disposed to invest it in that or any other manufacturing business on the inducement of a 4 per cent. profit.

LOST TAXES.

This is the third line in the commission's calculations of the annual cost of an arc lamp. Once before we called attention to the manner in which this amount is arrived at. The commission speaks of the probable assessed value. Surely the commission can obtain as a matter of courtesy from the tax assessors of Detroit an assessment of the Lighting Plant. There are other lighting plants in the country which would be pleased to settle for taxes on the basis of "probable assessed value" if they themselves were allowed to estimate the probability.

APPORTIONMENT OF CASH COST OF OPERATION.

Thus far in our review of this report we have followed the commission's plan of apportioning the total expenses between the arc and incandescent departments according to the output in each department. In the average plant this is approximately fair, but in this case the arc output is so large in relation to the incandescent output that an error is introduced.

An analysis of operating costs on pages 58 and 59, dividing the costs of generating current, etc., between the departments in proportion to the output, but charging trimming, lamp renewals and other expenses which belong solely to one department, direct to their respective departments, gives the following:

Arc operating expense	$86,490.01
Incandescent operating expense	12,597.15
Total	$99,087.16

$86,490.01 divided by 2,082, the true average number of lamps in use, gives $41.06 as the cash cost of operating an arc lamp for a year instead of the commission's figure of $39.45.

OPERATING COSTS.

We come now to an examination of the reported cash costs. This is made in terms of average number of arc lamps operated one year of about 3,744 hours. We find it necessary to refer again to our analysis of the Sixth Annual Report and to quote therefrom as follows:

> "So far all our statements of expense have been on the basis of the commission's report, which is in terms of 2,000-cp arc lights operated for one year. It is now in order to inquire what the commission supplies to the City of Detroit as a 2,000-cp arc light. Such a light is generally understood to be one absorbing at the lamp terminals about 450 watts and utilizing about 435 watts in the arc. The commission's report, page nine, states that the total output of the plant for the year for arc lighting is 3,475,389 kw-hours. On the same page the average number of 2,000-cp arc lights is stated to have been 2,035. On page 24 the annual hours of burning are set forth as 3,720 hours 30 minutes. Multiplying the two latter, the figures give a result of 7,580,532 arc lamp hours. Using this as a divisor of the output for arc lighting, we find that the average power at the switchboard for each lamp is 458 watts.
>
> "This will not do. The transmisson from the swtchboard to the lamps requires considerable power. The system being a series system throughout, it is possible to estimate the power required from the mileage of wire in use. A careful estimate shows that this power lost in transmission is about 9 per cent. of the total. This reduces the 458 watts at the switchboard to 417 watts at each lamp.
>
> "Four hundred and seventeen watts per arc means inferior lighting. The lighting of Detroit several years ago in the early days of the plant was notably good, the current and the carbons being both what they should be. Observations on two occasions during the year just passed lead to the conclusion that either the current or the carbons, or both, are now inferior. The consumption of carbon in a night's run is less than it should be. The arcs in different lamps differ materially from one another, and, as a rule, are less brilliant than they should be, and we are satisfied that the power does not exceed the calculated 417 watts. If so, it would obviously be unfair to compare light for light, the street lighting of Detroit to-day with the street lighting of cities where contractors are compelled under watchful scrutiny, to give full measure of service."

This statement (with the exception of minor changes) holds true for the year covered by the seventh annual report. The watts per lamp at the switchboard and at the lamp were almost exactly the same in the year under examination as in the previous year. The service continued to be bad—so bad that had it been service by contract the commission could not have approved it. In this connection the following quotation is of interest:

Pages 32 and 34, Annual Report:

	1901	1902	Increase
Lamp hours out	4,092.21	6,825.15	66%

This is the greatest number of lamp hours out in any year in the history of the commission, with the exception of 1898, when the trimmers' strike was in progress. The enormous increase in "lights out" is promptly explained by a look at the tables on page 41. The cost of maintenance for 1901 was $7.80 per lamp; for the year just passed, $5.73. The apparently frantic effort to keep down expenses has led to the neglect of the property of the Lighting Commission with a consequent lowering of the service.

EMPLOYEES.

We quote again from Electrical World and Engineer of February 15, 1902:

> "It is an old failing of municipal boards to charge to construction account, when such an account is open, expenses that belong in maintenance. An examination of the list of employees in the maintenance department (page 36) leads to the conclusion that it is not excessively long, particularly when it is noted that the working day is only eight hours. The annual compensation of these 26 employees foots up $15,732.50; but the total expenditure for the year charged to maintenance account is but $11,288.67. Doubtless the men do not make full time. On the other hand, there must be rush repairs which make overtime. Allowing for these uncertainties, there remains a difference of $3,500 or thereabouts, to be explained. Men who ought to know say the difference covers time of these employees charged to construction, the excuse being that they were actually employed more or less on construction work. This excuse should not stand. If the plant were debarred from making any extensions these employees would necessarily remain on the pay roll and their pay would be charged to operating expense. Such a charge would add about $1.75 per lamp to the maintenance account of the plant."

Referring to page 40 of the Seventh Annual Report we find that the total maintenance and repair wages for 1901-1902 figured for 300 days are as follows:

1	Blacksmith	at $2.75	$825.00
1	Blacksmith Helper	at 1.00	330.00
1	Carpenter	at 2.40	720.00
1	Painter	at 2.25	675.00
1	Lathe man	at 2.75	825.00
1	Steam fitter	at 2.75	825.00
1	Foreman lamp and cable dept.	at 2.75	825.00
3	Helpers in lamp room	at 2.00	1,800.00
1	Helper in lamp room	at 1.60	480.00
1	Helper in lamp room	at 1.75	525.00
1	Apprentice in lamp room	at 1.10	330.00
1	Apprentice in lamp room	at .66⅔	200.00
1	Conduit man	at 2.75	825.00
1	Conduit helper	at 1.60	480.00
1	Line foreman	at 3.00	900.00
5	Linemen	at 2.50	3,750.00
1	Line helper	at 2.00	600.00
1	Ground man	at 1.75	525.00
	Total		$15,440.00

But the total wages charged to maintenance and repairs in the report is only $9,715.48. There is a difference of $5,634.52, which we fear must have been charged to construction. We arrived at a similar conclusion last year and nothing to the contrary has been set forth. If our present conclusion is correct there should thus be added to the operating expense something like $2.25 per lamp.

It appears that even the stated cash cost of the Detroit street lighting cannot pass without challenge. The lighting is not such as would be accepted by the City of Detroit from a contractor as satisfying a standard specification for street lighting, so that the cost per lamp does not represent an equivalent to the cost per lamp of contract lighting. Further, it appears that part of the time of employees necessary for the maintenance and repair of the plant is charged to construction account under circumstances which may be amenable to explanation, but with the result that the apparent operating cost is reduced.

MISLEADING STATEMENTS.

There are several less important statements in this report which may be classed as misleading because they only half state or else incorrectly state the facts. For instance: On page ten the president asserts that the city is saved $1,200 each year by work performed by the City Electrician and his assistant, which formerly had to be paid for. Before the organization of the Lighting Commission the Chief Electrician of the Fire Department acted as City Electrician. In transferring part of his duties to the electrician of Lighting Commission the city has not gained financially.

On page eleven is found this statement: "Our arc lighting has been increased over 12 per cent. and the incandescent lighting by the unprecedented amount of 71 per cent."

This statement is misleading as the following tables show:

	1901	1902	Increase in Lighting
Arc lamps, average number operated as stated in annual reports	2035	2133	98 or 4.8%
Incandescent lamps connected	6948	11780	71%

Current used for incandescent lighting in 1901	497,961 kw-hours
Current used for incandescent lighting in 1902	651,594 kw-hours
Increase in lighting	153,633 kw-hours or 30%

Another misleading statement is at the foot of page 24, where it is set forth that the investment cost to the City of Detroit of a 2,000-cp arc lamp is $263.35. We reprint the two tables which appear on page 24 as follows:

COST OF THE CITY LIGHTING PLANT.

The city's investment proportioned between the incandescent and the arc lighting on the basis of the electrical output, is as follows:

	Arc.	Incandescent.	Total.
*Conduits	$80,832.04	$14,342.59	$95,174.63
Cables	47,344.23	8,400.62	55,744.85
Real estate	53,612.21	9,512.79	63,125.00
Buildings and wharf	93,597.33	16,607.63	110,204.96
Lines and poles	147,638.66	26,196.57	173,835.23
Towers and lamp posts	97,981.00	....	97,981.00
Electric plant, arc	71,164.23	....	71,164.23
Electric plant, incandescent	....	24,835.24	24,835.24
Steam plant	109,997.68	19,517.66	129,515.34
Railway tracks and scales	9,327.30	1,655.01	10,982.31
Machine shop	6,806.45	1,207.71	8,014.16
Arc lamp and switches	65,243.06	....	65,243.06
Totals	$783,544.19	$122,275.82	$905,820,01
Belle Isle, lines, cables, lamps, etc.			26,412.19
Grand total			$932,232.20

* About one-quarter of these are occupied.

COST REDUCED TO A LAMP BASIS.

Reducing the above investment, exclusive of the Belle Isle, to the amount per lamp on the electrical capacity of the plant, viz.: 2,745 arc of 2,000 candle power, and 7,500 incandescent of 16 candle power, and we have the following:

	Arc.	Incandescent.
Conduits occupied	$7.36	$.48
Cables	17.25	1.12
Real estate	19.53	1.27
Buildings and wharf	34.10	2.21
Lines and poles	53.78	3.49
Towers and lamp posts	35.69	...
Arc plant	25.92	...
Incandescent plant	....	3.31
Steam plant	40.07	2.60
Railway track and scales	3.40	.22
Machine shop	2.48	.16
Arc lamps and switches	23.77	...
Totals	$263.35	$14.86

It will be noticed that the first table divides the investment on the basis of electrical output, while the second table gives the investment per lamp on the basis of the total capacity of apparatus in the possession of the commission.

The ordinary reader will assume that this $263.35 covers the investment necessary to maintain an arc lamp in the street. We expect, indeed, to see this tabulation made the basis of construction estimates by other municipalities. But the figure does not mean anything of the kind. Indeed, it does not mean any useful figure. It results from dividing the total investment by the total capacity of all kinds of machinery, old and new, good, bad and indifferent, in the possession of the commission. If the commission had on hand a few more idle arc lighting dynamos and lamps, having only a junk value, the figure would have been lower than it is. The maximum number of arc lights operated by the commission at any time during the year is reported as 2,302; not by any means 2,745. The commission is even now hastening additions to its arc lighting equipment, which it says it needs as a reserve.

Let us figure the investment per effective arc lamp from the first table as follows: The amount of investment in arc plant is $783,544.19. Dividing this amount by the *maximum* number of arc lamps operated at any time during the year, namely 2,302 gives $340.37 as the investment per lamp.

A DISCREPANCY.

There are some discrepancies in the report among which the following deserves notice: On page ten the president rejoices in the collection from rentals of $6,775.61. On page 66 the commission's secretary, and on page 70 the city accountant, show the collections as $2,786.53. This may be the difference between earnings and actual collections for the fiscal year, but in the estimate for the succeeding year published on page 72 the commission states that it expects to get only $3,525.

COMMERCIAL LIGHTING.

We find this year a positive recommendation by the president of the commission that the public lighting plant of the City of Detroit should engage in general commercial lighting. The president says that statistics show that he could place an 8-cp light in the humblest home at a cost of about ¼ of 1 cent per hour. Or if he were allowed to do commercial lighting and charge the going price per kw (we suppose he means kw-hour), he could light the city for nothing and have a handsome balance in the treasury at the end of each year. This statement would have greater weight did the report of the commission show that it was doing comparatively well in the work that it now does. Our analysis shows that a street light costs the City of Detroit not $63.82, as is reported, but not less than $80—probably more. Let us see what similar service by private companies costs in Detroit and vicinity.

COST OF SERVICE FROM PRIVATE CORPORATIONS.

The Edison Company, of Detroit, sells current for 16 cents per kw-hour for the first hour's use per day, and for 5 cents per kw-hour for all current used after that hour. The company at these rates furnishes and trims the arc lamps. Discounts on bills are from 10 per cent to 20 per cent. The commission's report shows that the city's street lights burned 3,744 hours last year. We will figure the cost of a 450-watt lamp burning this length of time at the Edison Company's regular rates.

365 hours x 450 watts = 164.3 kw hours at 16c	$26.28
3379 hours x 450 watts = 1520 kw-hours at 5c	76.00
	$102.28
Less 20 per cent	20.45
	$81.83

This cost is figured on the rates that would be given any customer who consumed enough current to make his bill $100 or more per month. The customer has the right to order out the service at the end of any year. It is fair to presume that with a long contract a much lower rate would be made to secure this desirable business. The city has virtually a perpetual contract with its public lighting plant.

The village of Highland Park, just north of Detroit, owns its own lines and lamp fixtures, but buys its current from a private company in Detroit. This company furnishes dynamo capacity, arc lamps and current; trims and cares for the lamps and maintains fixtures and lines for $70 per lamp per year. A proper interest and depreciation charge on lines and fixtures owned by the village would bring this cost up to about $76 per year.

It appears by these figures that the Public Lighting Commission instead of being in a position to undersell the private companies, does not at present succeed in meeting their rates for arc lighting.

Let us see what the commission will have to do to meet the current rates for residence lighting. The following figures represent fairly the rates for residence lighting in Detroit:

Mr ——— Residence No. —— Jefferson Ave.
November 27th, 1901, to November 28th, 1902.

Kw hours	Amount paid	Rate per unit	Per 16 c. p. lamp hour	Per 8 c. p. lamp hour
1866.4	$139.23	$.0745	$.003725	$.002135

Mr ——— Residence No. — Adelaide St.
December 24th, 1901, to December 20th, 1902.

Kw hours	Amount paid	Rate per unit	Per 16 c. p. lamp hour	Per 8 c. p. lamp hour
644.6	$70.17	$.108669	$.00543	$.00326

In the foregoing figures we have assumed that a 16-cp lamp required 50 watts and that the 8-cp lamp which is to be placed in the humblest home requires 30 watts. The Public Lighting Commission is now doing some incandescent lighting.

COST OF INCANDESCENT LIGHTING OF PUBLIC BUILDINGS.

We have not discussed this department of the commission's work because the interest in it is comparatively little. The commission's figures, however, should serve to show what could be done if its system of incandescent lighting were extended to those humble homes. The published figures prove unfortunately to be as deceptive as those on street lighting. To begin with, and as already noted, the incandescent lighting of the station and of the commission's offices is reckoned as incandescent output, and it thereby serves to reduce the average cost per kw-hour. Such lighting is an unquestionable operating expense. If we cut this out of the incandescent lighting alone, we would have to readjust the distribution of expense between arc lighting and incandescent lighting. Next we have to consider the duplications in output records already noted. It results that we must figure on the entire output of the plant as stated in kw-hours.

The total kw-hour output is given in the report as 4,323,849. The arc total is arrived at by volt and ampere readings on the arc board, from which a constant is derived, and this constant is multiplied by the number of lamps in use.

The alternating total is obtained from wattmeter readings on the alternating switchboard. As nearly as may be estimated, at least 5 per cent. must be deducted from these figures for current used in operating the plant which should not be considered as output; or doubly reckoned as output, as we have already seen in reckoning the true number of arc lamps. Therefore, the true number of kw-hours is 4,117,556.

But this output is measured at the switchboard. In order to find the cost of supply at the place of use the intervening losses of energy must be deducted. It is safe to say that in this combined arc and alternating plant with long transmission lines and step-up and step-down transformers, these losses are at least 30 per cent. of the output. Therefore, the supply available for sale would be 2,882,359 kw-hours. We have seen that the total output costs $192,394.69. Therefore, the cost per available kw-hour is 6.7 cents.

We have assumed that the 8-cp lamp at ¼ cent per hour requires 30 watts. This equals a rate per kw-hour of 8⅓ cents, or 1.63 cent per kw-hour above the cost of producing the current. While it is true that the above cost contains the items that pertain exclusively to the street arc lamps, yet a plant engaged in commercial work must not only furnish and trim commercial arc lamps, but must have an increased force of office men, meter men and trouble men, over that employed in the Detroit Municipal Plant. Moreover, five-sixths of the current furnished by the Detroit plant now is used in arc lamps burning 3,744 hours per year. This is in direct contrast to the average commercial plant, which has to keep machinery in readiness for a demand that extends over less than 2,000 hours per year. It is clear to us that should the Public Lighting Commission engage in commercial work with proper provision made for a sinking fund and a depreciation account, not only would the 6.7 cent, but in addition the 1.63 cent, would be required to meet the cost of each kw-hour produced.

THERE IS NO VALUED INVENTORY.

We have discussed thus far the statements contained in the Seventh Annual Report of the Public Lighting Commission of Detroit and have endeavored to draw conclusions warranted by the experience of those who have learned the street lighting business most thoroughly. But the fact remains that the one thing which would make our investigation complete, namely, an inventory, is missing from the pages of this report.

No valued inventory of this property has ever been taken. The commission states that the plant has cost, in round numbers, $930,000; that $153,000 has been charged off as depreciation; and that the difference, or approximately $775,000, is the present value. We learn that they are now discarding $100,000 worth of machinery and lamps; and that one costly pole line has been practically abandoned, the aerial wires being replaced by underground cables. We know that, apparently, operating expense has been charged to construction. What we do not know and cannot find out by the report is the real value to-day of the property of the Public Lighting Commission.

The only way in which the commission can prove that the cost of an arc lamp per year is $63.82 is by having an unbiased expert make an inventory of their plant. If this expert will show in his report that the present value of the lighting commission's property is equal to the estimated value in the Seventh Annual Report, then the commission's conclusions are correct and the proper amount has been charged to depreciation each previous year; on the other hand, should the inventory show a less value than that given in the report, then ELECTRICAL WORLD AND ENGINEER'S conclusions are correct that only a part of the operating expense has been accounted for each year, and that the remainder of these expenses must be met by the taxpayer at some future day, and we fear in a manner that must come as a very disagreeable surprise.

New York Central's Hotel.

The New York Central Railway Company plans to put up a big hotel at the Grand Central Depot, New York. The building is to comprise a large hotel containing more rooms than the Waldorf-Astoria, a department store, with a greater floor space than Wanamaker's, offices, besides all of the railroad facilities for its through and suburban trains, and with underground connections with the subway. These plans of the Central, and as to power, have been made public by Mayor Low at a meeting of the special committee of the Board of Estimate and Apportionment, which has had charge of the Park Avenue improvement. The committee report approves the plans outlined and several others. The New York Central agrees to begin work on the changes within 30 days after the proper legislation has has been secured, and agrees to substitute electricity or some other non-combustible agency for steam as a motive power below the Harlem. Relative to the change of motive power the report states: "Steam is forbidden on the whole of Park Avenue south of the Harlem River. The bill, as drawn, permits the use of steam in case of a breakdown of the new motive power, for a period not exceeding three days; and, for a violation of this provision, imposes upon the railroad a penalty of $500 a day after three days, unless meanwhile the railroad has obtained the certificate of the Mayor that the use of steam is further justified by the emergency. In view of the difficulty experienced this winter by the Manhattan Railroad Co. with its primary installation of electric power; and in view of the still more recent accident to the power house at Niagara Falls, your committee believes that such a provision for emergency is in the public interest. The clause in the bill relating to the emergency is so carefully drawn as to make abuse of it very unlikely."

Niagara Power in Ontario.

It is stated, so our Canadian correspondent informs us, that all the important municipalities within a radius of 100 miles of Toronto will co-operate in an effort to secure a Niagara Falls power concession at the approaching session of the Ontario Legislature. It is proposed to run trunk cables from Niagara Falls east as far as Toronto and west as far as London, Ont., and supply power to the different places along the routes. It is claimed that power can thus be obtained at a cost at least 50 per cent. lower than that of the present steam-produced electrical power in Toronto, which is $40 to $60 per horse-power-year.

The Construction of Aerial Telephone Lines--V.

By Arthur V. Abbott, C. E.

In last issue three tables were given, each presenting data for estimating the various items of cost in pole line construction. In Table 4, herewith, some examples of complete cost of pole lines are given—Tables 4, 5 and 6 being identical with Figs. 4, 5 and 6.

In this table two kinds of poles are shown—chestnut, pine—and two sets of curves are given, one for iron wire and one for copper. For both sets the height of poles is found on the lower horizontal scale reading from left to right for the iron wire line and from right to left for the copper wire lines. The total cost per mile is found upon the left-hand side of the sheet for iron wire lines, and on the right-hand side for the copper lines. The basis of estimating the total cost allows three standard ten-pin arms to a 25-ft. line, four to a 30-ft., five to a 35-ft., seven to a 40-ft., nine to a 50-ft. line, twelve arms each to a 55-ft., a 60-ft. and a 65-ft. line. Each arm is supposed to be fully equipped with a wire on each pin, but no knobbing is included. For iron wire lines No. 9 iron wire is assumed, and chestnut poles. For the copper wire lines three sets of two curves each are shown, one for .080 B. & S. copper, one for .104 B. & S. and one for .165 B. W. S. For each size of wire a curve for pine and a curve for chestnut poles is shown.

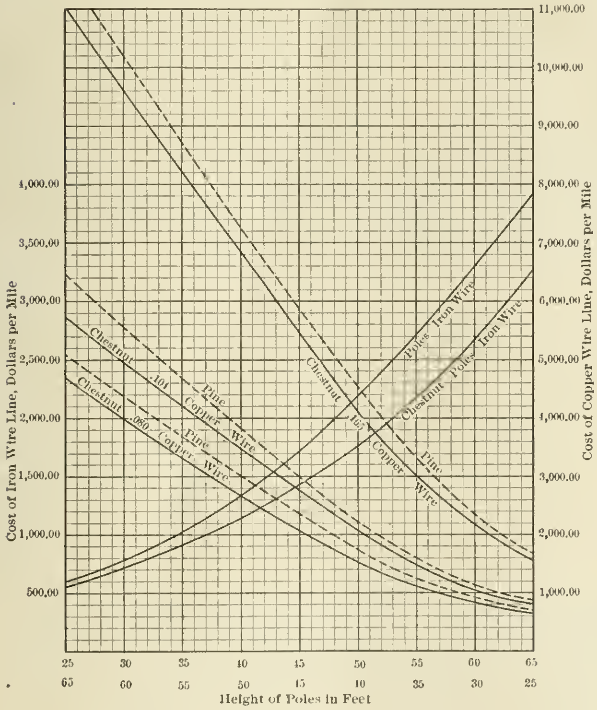


FIG. 4.—COMPLETE COST OF POLE LINES.

In Table 5 a comparison between the cost of aerial and underground lines is made. Holding the sheet with *B* in the lower right-hand corner the lower scale is height of poles in feet and the right-hand scale is the cost per mile of entire line using pine or cedar pole. There are two curves—*C* for .104 copper and *D* for .080 copper. Holding the table so that *A* is in the lower right-hand corner, there are on the bottom of the sheet two horizontal scales, one devoted to the height of poles in feet, reading from left to right, while the other is the cost of conduits per duct foot from 15 cents to 55 cents, reading from right to left. The cost per mile of completed line of either kind, is found on the right-hand scale. Ten comparative curves are shown upon this sheet. No. 1, headed "Open Wire Only," gives the total cost per mile for lines carrying only open wire and no cable. No. 2 includes one 25-pair aerial cable, No. 3 one 25-pair cable and one 50-pair, No. 4 one 25-pair cable, one 50-pair and one 100-pair, and No. 5 adds a second 100-pair cable. Curves Nos. 6, 7, 8, 9 and 10 give the cost per mile of cable installed in conduit of various prices as per the lower scale. Thus a mile of 100-pair cable in conduit at 20 cents per duct foot will cost $3,900—$39 per circuit mile. The cheapest open wire line to carry 100 circuits would be a 30-ft. line with three cables and three cross arms, and would cost $8,000, or $80 per circuit mile. On the other hand, a 25-pair cable in 35-cent conduit will cost $3,940 per mile, or $157.50 per circuit mile, while a 45′ open wire line will only cost $2,600—$105 per circuit mile. It is, therefore, obvious that when many circuits are needed, underground lines are by far the cheapest in original construction, to say nothing about decreased cost of labor, but when there are few circuits the open wire of aerial cable is the cheapest to install.

In discussing underground wire plant it was shown that it was impossible for many reasons to realize the full efficiency of all wire installed. Similarly with an aerial route there will be more or less of the pole and cross arm capacity that cannot be usefully employed. Insulators and wire can be more closely controlled than is possible with any form of cable, for only as many insulators and as much wire need be erected as can actually be put in service. Thus the working efficiency of the pole line is somewhat greater and the conduit or aerial cable, and in large exchanges carefully planned, 85 per cent. efficiency has been achieved. Taking probable inefficiency into consideration, Table 6 gives a comparison between underground wire plant, aerial cable and open wire on the circuit mile basis. On the bottom of the sheet there are two scales, one reading from left to right, showing the number of pairs per cable, applicable to both aerial and underground cable; the other from right to left for open wire. The left-hand scale shows the cost per available pair mile for all kinds of wire plant. There are three sets of curves. The full lines show the cost of underground wire in cables from 20 to 200 pairs. There are four curves, one for conduit of 4 ducts, one for 8 ducts, one for 12 ducts and one for 16 ducts; the cost of these various sizes of conduit being the same as shown in the article on "Conduit Construction." The dotted curves on the left hand of the sheet give the cost of aerial cable on 30-ft., 40-ft., 50-ft. and 60-ft. pole lines; the cable cost being that shown in the paragraphs on the "Cost of Aerial Cable." On the right hand of the sheet there are five "dot dash" curves, giving the cost of open wire on 25-ft., 30-ft., 40-ft., 50-ft. and 60-ft. pole lines, calculated by the data of this section.

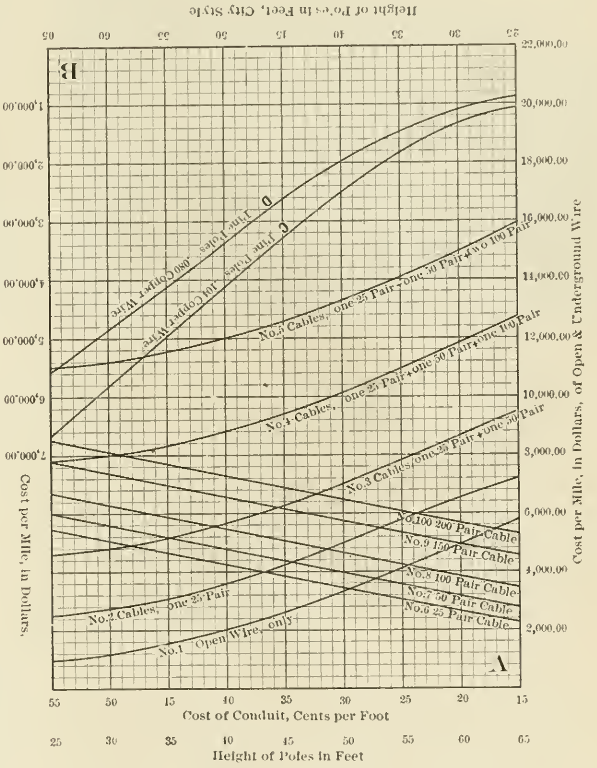


FIG. 5.—COMPARATIVE COST OF AERIAL AND UNDERGROUND LINES.

These curves show very conclusively that when from 25 to 100 circuits are needed the aerial cable is the cheapest form of wire plant so far as original cost only is concerned. For less than 25 circuits the open wire line is cheaper, while when there are more than a hundred circuits underground conduit is cheaper. But this comparison applies only to original cost.

In succeeding paragraphs it will be shown that the annual cost of maintenance and depreciation is for all forms of aerial line at least twice as great as for underground, to say nothing of the more reliable service rendered by the latter. Suppose now that a telephone company builds its plant from the proceeds of a bond issue, bearing say 6 per cent. interest. To cover depreciation and maintenance on underground plant, 7 per cent. per annum must be allowed, while on an aerial plant 10 per cent. is necessary for the same items. The total annual charges will then be 13 per cent. for the underground plant and 25 per cent. for the aerial, and hence about $200 can be invested in underground plant to every $100 in an aerial one, and make annual expense exactly the same. In any such calculation it is impossible to valuate the additional advantages to accrue from the better service that the underground system offers in securing an immunity of interruptions to subscribers, to which the aerial line is always liable. Subscribers are better satisfied; there is no lost income from telephones out of service, etc., none of which can be estimated in dollars and cents. For such reasons, therefore, it is safe to assume that whenever during the lifetime of the plant more than a hundred circuits may be expected the underground plant is the cheapest and best in the long run.

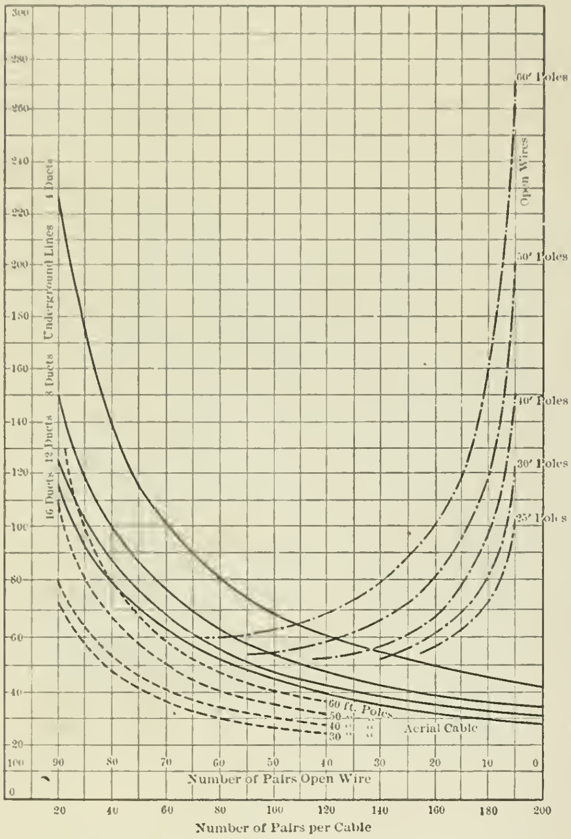


FIG. 6.—COMPARISON BETWEEN UNDERGROUND WIRE PLANT, AERIAL CABLE AND OPEN WIRE PLANT.

ANNUAL EXPENSE.

The annual expense of open wire lines is more variable and higher than on any other item in the telephone plant, for the pole line is subjected to a greater number of destructive forces, and those of greater intensity than any part of the plant.

Depreciation.—The causes producing depreciation are four: 1st. The gradual rotting of all the woodwork. 2nd. The growth of the territory served, so that sooner or later the pole line capacity is exhausted beyond the possibility of increase. 3rd. The constantly increasing demands of city authorities to substitute underground conduit for open wire. 4th. The sleet storm.

1st. *Decay*—Experience has shown that the rotting of poles takes place close to the ground level, within about a foot above and below it, where the pole is most exposed to air and moisture. Few forms of preservative treatment, except creosoting, seem to have any sensible retarding effect on the rot, and on the average poles must be replaced in about 8 years. Cross arms and pins last longer, though the point of attachment of the arm to the pole is a weak spot and soon rots. The base of the pole is also constantly exposed to all sorts of extraneous attacks; the impact of wheels, the nibbling of horses, the mischievous ingenuity of the street urchin; all conspire to shorten the life of the pole.

2nd. *Growth of Territory.*—Increase in the number of subscribers has a marked effect on the depreciation of pole lines. A certain number of subscribers is estimated for a given territory, but within a few years this number has possibly quadrupled. By no possible means can the original line be made to carry so great an increase; either a new line must be built on the old route or the new plant must go underground; in either case the old line must bear entire depreciation.

3rd. *Change in City Requirements.*—The regulations of all cities are each year growing more and more hostile to the employment of open wire, and almost universally the telephone companies are being urged to go underground, or to enlarge the territory of the underground plant they already have. This becomes a very potent cause of depreciation. Fifteen years ago there was little wire underground; now few cities will tolerate aerial lines except in the outskirts, and even the smaller towns are pushing toward the underground goal.

4th. *Sleet Storms.*—But of all the forces that prey on the open wire line the sleet storm is the most destructive, and most to be dreaded. No winter passes that does not wreck many miles of telephone and telegraph wires; few in which the havoc is not widespread; and the telephonic isolation of some of even the larger cities is more than occasional. Witness the "big storms" of 1888 and 1890 in New York and New England, and those of 1895, 1896 and 1900 in Chicago and St. Louis. A few specific instances may be of value. In the sleet storm of February last one telephone company operating along the Atlantic coast lost not less than $250,000, while five companies in Pennsylvania and New Jersey suffered more than $300,000, and about the same time so far south as Lexington, Ky., half of the poles in the country went down. Mr. Ellicott, city electrician of Chicago, reports a storm last March that required seventy-five miles of new wire; and the author has a very vivid recollection of a couple of sleet storms that cost a telephone company in the aggregate at least $60,000.

When all these items are carefully considered, in the light of experience over a considerable period of time, it is found that an allowance of 12.5 per cent. on first cost is the least that can be considered fair for open wire lines. It is probable, nay certain, that as large a percentage is not needed every year, but unless unexpended balances are carried to "Deferred Depreciation" the time comes when a very few hours' work of the wind will not only wreck the pole line, but wreck the treasury in the absence of such a safeguard.

MAINTENANCE.

The annual maintenance of aerial lines is equally onerous. Cross arms rot, insulators pull off, or boys break them with a rifle ball. A falling tree branch may tear open half a dozen lines. An extra frosty night will pull a lot of lines out of the McIntires, or even rupture the wire itself. A fire alone may be the knell of many circuits, for firemen are ruthless when a pole opposes the hose. Even a wastepaper basket fire will spoil all the aerial cable in a pole line, for the lead melts like butter under the least blaze. The ordinances of many towns contain provisions requiring the removal of lines to permit of house moving, for which the owner does not always pay. While even copper wire from its inoxydizable qualities is seemingly immune from maintenance, it yet falls sometimes a prey to those in whom enterprise is greater than their respect for the commandments, for there are instances recorded where many miles of working circuits have been stolen. For these and divers other reasons the maintenance of aerial lines will average at least 6 per cent. on original cost.

A Unique Electric Light Plant.

By L. B. Cherry.

An electric plant operated by hot water is the latest development in the Far West, and forms the subject of this article. Thermopolis, Wyoming, is the scene of this novel achievement, and it may be of interest to give a brief history of the town and the Big Horn Basin Hot Springs, which are so potent in healing and at the same time are the source of power for an electric lighting plant.

In 1897 the Government purchased a tract of land 10 miles square from the Indians, and donated one mile square and the hot springs to the State, the remainder of the tract being thrown open to settlement. Just across the Big Horn River from the springs the town of Thermopolis was laid out, and soon contained a number of fine cut-stone business houses and hotels. The State has built a $10,000 steel bridge across the river, and laid out a park ½ mile square, which will be set with trees and shrubbery next summer. The State has also built a free bath house of cut sandstone, and this, with a plunge bath house and sanitarium makes Thermopolis a health resort second to none in the Far West.

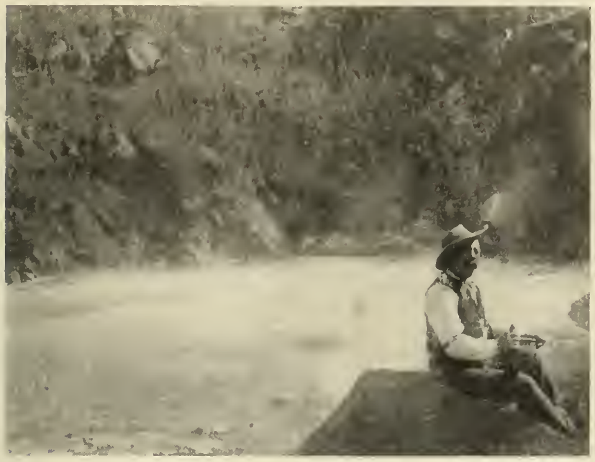


FIG. 1.—VIEW OF SPRING.

There are several large hot springs along the river, and from the river bed hot springs bubble to an extent that for miles the river never freezes over, thus making it an ideal stream for water power. The waste water from the largest of these springs is used by the Thermopolis Electric Light & Power Company for power. Fig. 1 shows the spring, which is a hot, seething pool 20 ft. in diameter and so deep that it has never been fathomed. Sulphurous gas and steam are released at the surface, the effect of which gases is to impart a bluish tinge to the water. The temperature of the water is 138° F. The volume of water is 750 cu. ft. per minute, with a head of 48 ft. available for power. Fig. 2 shows part of the water as it falls over a beautiful snow-white formation into the river 48 ft. below.

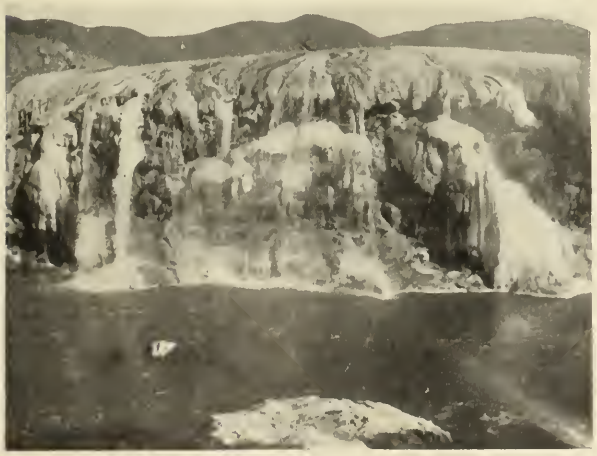


FIG. 2.—VIEW OF PORTION OF FALLS.

In the construction of the power house, a room 16 ft. by 24 ft. was excavated from the solid rock formation next to the river just to the left of the view represented in Fig. 2, and to gain access to it, one must go down a stairway to the river and land on a natural porch overhung with stalactytes tinged with many colors.

Fig. 3 gives an idea of the exterior of the plant. The equipment at present consists of a 30-kw., 1,100-volt Westinghouse alternator, belted to a 13-inch "American" turbine of the horizontal type. Owing to the steam and gas which the hot water gives off when being agitated, the turbine had to be placed as near tail-water as possible to get the full value of the power, as otherwise the steam and gas would have partly filled the draft tube.

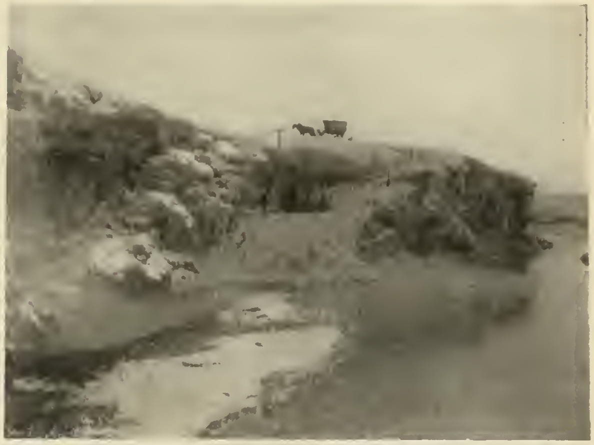


FIG. 3.—VIEW OF EXTERIOR OF PLANT.

A small street car line will be put in next summer to carry passengers to the springs, which are one mile from town. When the present plant becomes too small, a power will be developed in the river, where 1,000 hp can easily be obtained. The company will then have power to sell for irrigation, and for the operation of coal mines which are only a few miles out of town.

Gold and nickel were recently discovered while boring a well, and should these metals prove to exist in paying quantities electric power for the mines will probably be furnished.

Revenues of Wireless Telegraphy.

In regard to the expenses and revenues of wireless telegraph work, Mr. Marconi is quoted in a recent interview by a representative of Dow, Jones & Co., the financial news agency, as follows:

"I am informed that the cost of installing a transatlantic cable approximates $4,000,000, and that the cost of maintenance and operation approximates 10 per cent., or $400,000 per annum. The cost of installing wireless stations, capable of doing an equal amount of business, is $200,000. On account of this much lower initial outlay, the relative cost of maintenance and operation is proportionately greater. I estimate it at 25 per cent., or $50,000 per annum."

"What do you estimate the earning capacity of such a station to be?"

"The maximum speed attainable with the present apparatus is 30 words a minute. We consider 18 words a good average at present, but with the perfection of the instruments we shall be able to maintain a higher average than even 30 words a minute. Estimating the present average is but 10 words per minute and the average price of transmission but 7 cents per word, the revenue would be $42 per hour, or $1,008 per day, or over $365,000 per year for each station. Our contract with the Canadian government binds us to a maximum charge of 10 cents per word for ordinary commercial service and 5 cents for government and press service."

"Can you give an estimate of the probable earnings from marine communication between ships and from ship to shore?"

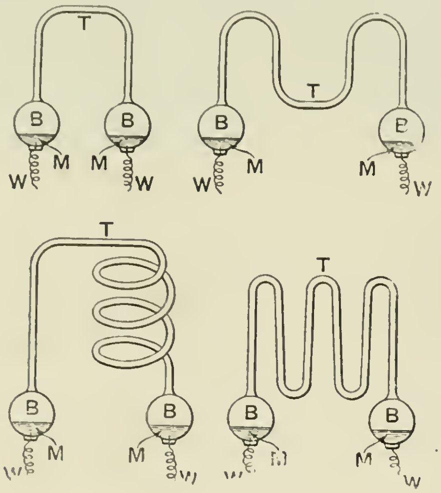
"The best answer to that is that the English Marconi Company has one contract which produces a revenue sufficient to pay 6 per cent. interest on the entire capitalization of the company."

The Mercury Vapor Lamp.

Mr H. J Dowsing, in a letter dated February 4, to the London *Electrician*, calls attention to a patent on a mercury vapor lamp (No 4,261) issued to him in 1896. The firms engaged in the lamp industry at that date seemed, he says, to be very busy, and quite satisfied with carbon "Now, however, that the mercury lamp has been shown to be practicable by the Americans, it might be possible to get such a patent taken up even by an English firm. I have learned, like many others, that the most likely source from which assistance could be obtained, or an invention even inquired into, is an American one

"I may mention that after spending a considerable amount of time and money in making this mercury lamp, and not succeeding in getting it taken up, I became somewhat tired of paying the annual patent fees, and, having stopped same, the patent has now lapsed. Mercury lamps, therefore, can be made free of royalty by British firms, who will probably think they have gained something by not being too rash in taking up a new invention.

"Previous to my experiments which led to the making of this lamp, I had not heard or read of a mercury vapor lamp having been made. I was led to take up the matter by noticing the particularly brilliant spark obtained from the vapor of mercury when using a mercury brake. I usually employed a small transformer to take the current from the city circuit at 100 volts, increasing the pressure to about 2,000. Of course, the lamp only wanted starting, after which the pressure might be considerably reduced."



VARIOUS DESIGNS OF MERCURY VAPOR LAMPS.

In the succeeding issue of the same journal the specifications of the Dowsing patent are reprinted, from which we reproduce the accompanying cuts. A glass tube is employed of very small bore, such as is used for thermometers, into the ends of which are sealed leading-in wires to terminals within the tube. The tube is exhausted so as to produce a partial vacuum, and through it is passed an electric current, preferably alternating. In order to obtain a considerable area of luminosity, the tube may be bent into a coil or like form, the convolutions of which being near together present, when illuminated, a considerable area of light. It is found of advantage to put in the bulbs into which the terminals are sealed a quantity of mercury or of an amalgam of mercury with other metal. The accompanying illustrations represent various forms of lamps. In each case two bulbs, *B*, are connected by a small bore tube, *T*, which may be sent and shaped in various ways. Each bulb, *B*, contains mercury, *M*, lying on the end of a leading-in wire, *W*, which is sealed through the glass. When currents of high tension are supplied, the interior of the glass tube becomes highly illuminated. It is of advantage sometimes to warm the lamp before starting, so as to render the rarefied atmosphere within it more conductive by the presence of a little mercury vapor. The patent claim is as follows:

An electric lamp consisting of a glass tube of very small bore connecting two bulbs containing mercury which are connected by leading-in wires sealed through the glass to a source of high-tension electricity, the atmosphere within the tubes and bulbs being rarefied.

Telephone Cables and a Suggestion as to Unreasonable Specifications.

By Frederick J Hall.

In an article on "Wire and Cable Specifications," published in the Electrical World and Engineer, December 13, 1902, the writer endeavored to show the impossibility of conforming to some of the rules of the National Board of Fire Underwriters for insulation resistance and pressure tests.

Impossible requirements, however, are not confined to these rules, nor to tests for determining the dielectric qualities of rubber compounds. The tensile and torsion tests required for hard-drawn copper by telephone companies is another example in point. A recent specification for 16 B. W. G. hard-drawn single-pair telephone cable, requires each wire to have a tensile strength of not less than 225 lbs. and to stand 45 twists in 6 inches.

Everyone at all familiar with copper wire, knows that to increase the tensile test is to lessen the torsion test. You cannot get the maximum of both tests from the same wire. These impossible requirements have come about by the assumption that if a short piece of wire can be made to stand certain tests, the same tests can be applied to the wire in commercial quantities. A wire is like a chain, only so strong as its weakest point. This is equally true when applied to tension, torsion, insulation resistance or pressure tests. In 1,000 ft. of chain perhaps a dozen links might be found that would show strength far beyond the average, yet no one would demand that all chains of that size and weight should show the same strength as those dozen links or be rejected as bad. If a 100-ft. length of 16 B. W. G. hard-drawn copper wire was cut into 5-ft. lengths, it is a safe gamble that no two pieces would give the same tensile or torsion tests.

Attention should also be called to the fact that telephone companies often issue specifications where the outside diameter is strictly limited and a certain insulation resistance is strictly required, without any regard whatever to the relaton one bears to the other. Under such conditions it is merely a question as to which requirement will be modified.

Nature endows her creations with definite properties. These properties man's ingenuity can modify to a certain extent; but his ability in this direction is strictly limited. When he attempts to go beyond this limitation he is—to use a slang expression—"up against it."

The troubles arising from manufacturers attempting to meet impossible requirements is largely their own fault. The remedy lies in their hands. If they had more confidence in each other, which would mean a freer interchange of ideas, these troubles would soon end. The condition for a long time has been simply this: Specifications imposing impossible conditions are given to a manufacturer. His protest is met by a statement that So-and-So has conformed to them or is able to. Instead of verifying this statement, the manufacturer courts failure by attempting the impossible. If, on the other hand, the relations between manufacturers were such that they would have no hesitation in conferring with one another on the subject, the result would be the elimination of impossible conditions.

Manufacturers are fully alive to the tough problems users of electric wires and cables are called upon to solve, and appreciate their anxiety to get the very best goods possible. They are always ready to go to the limit of their capacity in order to meet specifications, even when the requirements are far in excess of what would seem necessary to meet the conditions of service. But when a manufacturer attempts the impossible he is laying up trouble for himself and his customer.

Wireless Telegraphy Over the Pacific.

A telegram from San Francisco says wireless messages to Hawaii are to be sent soon from the Pacific coast, according to A. L. New, manager of the Pacific Wireless Telephone and Telegraph Company. "We have the machinery under way," he declared. "It now only remains to be decided whether Seattle or San Francisco shall be the terminus on this coast. We have constructed powerful dynamos, which will be adequate to send messages 3,000 miles. An intercontinental system is no more difficult of construction than two shore stations, and the last of our outfit is already built. We have sent messages a distance of 1,150 miles with the apparatus which we own and control."

A Discussion of Electric Automobiles.

At the meeting of the English Institution of Civil Engineers on January 13 Mr. J. C. Hawkshaw, president, in the chair, the paper read was "Electric Automobiles," by H. F. Joel, Assoc. M. Inst. C. E., who stated that, in London alone, there were over 16,000 licensed horse carriages, apart from private vehicles, tradesmen's vans, etc. It was estimated that over 200,000 horses were stabled each night in London, necessitating the daily removal of more than 5,000 tons of manure and refuse, in addition to what was distributed over the roads, and found its way into the residences of the people. The growth of London and other large cities made the problem of substituting motor cars for horse traction one of the first importance, and the object of the paper was to describe one form, possibly the most practical, and certainly the most interesting of all forms of motor car, the electric automobile. These had now become thoroughly practical vehicles, journeys of over 100 miles on one charge, and tours of over 1,000 miles (from London to Glasgow and back) having been satisfactorily accomplished.

The earlier experiences with various types of cars, etc., were first described, the information being tabulated as far as possible and the historical side of the subject being briefly dealt upon. It was only since the passing of the Locomotives on Highways Act, in 1896 that the problem of motor cars has been seriously attacked in England. In Germany, France, Austria, America, Italy, Spain, Belgium and many other countries earnest attention was being given to the manufacture and the perfection of electric vehicles, and in most of these countries inventors and designers were assisted by their governments directly by subsidies, by official trials as in Berlin, or otherwise. In England it had been left entirely to the enterprise of the private individual to compete with the foreigner for a share at least in this new and important industry, which even now gave employment to some 10,000 men in England. Tabulated examples of recent long-distance runs of carriages propelled by one charge were given, and these records were analyzed for comparison, elevations and plans of the carriages being shown to scale, and the disposition of the batteries indicated. As these were all special designs and not merely adaptations of carriages, they were instructive as examples.

Some very careful tests to determine the durability of storage batteries had been made by the Automobile Club of France in 1889, extending over 6 months, the results of which were given in the paper. The tests had been made under conditions analogous to those that would occur in the carriages in practical use. The sets of batteries had been equally charged with 24 amp at 2.5 volts per cell, but had been discharged at rates varying from 20 to 100 amp, with intermediate periods of rest, and whilst being discharged they had been subjected to artificial vibrations, to give the effect of road vibrations, and this treatment had been continued until the cells had shown signs of failure.

The ratio of weight of vehicle to weight of storage battery was next considered. Generally speaking, as the ratio of the battery to the vehicle increased, so the distance the vehicle could be run on one charge was increased. But of greater importance, from a practical point of view, was the load-carrying capacity, and ratio of the weight of useful load to the weight of the battery and vehicle. A battery of accumulators weighing 6 cwt would give 10 hp-hours, or 67.2 lbs of battery for 1 hp-hour, taking the efficiency of the motor and gear at 75 per cent. Assuming an output of 15 watt-hours for 1 lb of complete battery, such a battery would convey itself against a tractive resistance of 50 lbs per ton (or 1/45), at the rate of 12 miles per hour, for a total distance of 250 miles. If the vehicle to convey this battery weighed 6 cwt, the distance that could be run with vehicle and battery would be 125 miles; and with a load of 3 cwt (driver and passenger) the distance would, under the same conditions, be reduced to 100 miles, equal to 75 ton-miles. With twice the load, or 6 cwt, the distance of the run would be reduced 83.8 miles, but the ton-mileage would be the same; and with three times the load, namely, 9 cwt, the distance would be still further reduced to 71.4, also equal to 75 ton-miles. The cost of carrying the useful load would be, for the 3 cwt load, at the rate of 1.8 penny (3.6 cents) per ton-mile; for the 6 cwt load, 1.1 penny per ton-mile; and for the 9 cwt load, 0.9 penny per ton-mile. The conclusion would be that, as the load was increased, the cost of conveying the useful load per ton-mile was reduced; this was so, but the limit was soon reached when the vehicle must be made stronger and heavier to carry the increased load, and the running cost of the whole would be increased, as well as the first cost and the consequent allowance for depreciation and interest.

In America batteries were made which gave a very great output with a comparatively shortened life of the positive plates, and as these batteries were of comparatively small cost they could be entirely renewed, say, each year, and this had been stated to result in economy. The author considered that potentialities of electric propulsion of carriages on common roads were very great.

Laying of a Submarine Cable.

At the meeting of the New York Electrical Society on February 18, Dr. A. E. Kennelly, of Harvard University, and an honorary member of the society, lectured on "The Laying of the Mexican Government Gulf Cables." This is the first cable of American manufacture laid for a foreign government. Dr. Kennelly said that if all the cables now lying at the bottom of the sea were joined end to end they would measure 200,000 miles, or nearly as far as from the earth to the moon. The life history of the cable was shown by a series of lantern slides, from a view of the spool machines in the factory of the Safety Insulated Wire and Cable Company at Bayonne, N. J., to the final joining aboard ship in the Gulf of Mexico. The cable was 500 miles long, one inch thick, excepting near the shore, where it was twice that size, and weighed 1,300 tons. It was carried in four deep tanks in a Norwegian cable ship of 1,400 tons burden to Vera Cruz, and a partition cable house, which had been brought from the United States, was put togefher, and a two-mile length of the cable was towed ashore and dragged up to the house. The end at sea was joined to the cable on the ship, which then plied to Frontera, where another house was erected and the operation was repeated.

At Campeche serious difficulties were met. The water was very shallow for seven miles out to sea, and although the town had 19,000 inhabitants, it did not possess a steam launch or even a barge. A one-masted vessel was procured by the cable people, the mast was removed, and the coil of seven miles was stowed away in the boat. A schooner, with two masts, served as a tug. When this tug went too fast the sails were taken in and when it was becalmed there was nothing to do but wait. Eventually the end of the first long American cable was made fast at the cable house, which stands almost on the spot where the Spaniards first landed in Mexico 400 years ago.

In spite of the inclemency of the weather, there was a large audience, among which were many ladies. Representatives of all the prominent cable firms in the city were present and the splendid collection of cables recently presented to the society by the family of the late Cyrus W. Field was inspected with much interest.

Science Abstracts.

Our valuable contemporary, *Science Abstracts,* will in future be published in two sections, *Section A,* Physics, embracing light, including photography; heat, sound, electricity and magnetism, chemical physics and electrochemistry, general physics, meteorology and terrestrial physics, physical astronomy. *Section B,* embracing steam plant, gas and oil engines, automobiles, oil engine driven ships and launches, balloons and airships, general electrical engineering, including industrial electrochemistry; electric generators, motors and transformers, electrical distribution, traction and lighting, telegraphy and telephony. The subscription prices will be eighteen shillings or four and a half dollars for each section separately, including index; or for the two sections, thirty shillings, or seven and a half dollars. The American Physical Society is now joined with the Institution of Electrical Engineers and the Physical Society of London in the direction of the publication and has elected Prof. E. H. Hall, of Harvard University, as its representative on the publishing committee. In consequence of this arrangement, Section A will in future be received by all members of the American Physical Society. The American Institute of Electrical Engineers is also co-operating with the committee and taking special means to bring the publication to the notice of all their members, who will in future be able to obtain it at a reduced subscription rate through the secretary of the American Institute.

New Telephone Patents.

For some months past there have appeared at frequent intervals patents for various "receiver holders." These are all designed to supplement the everyday hook switch, forming a support for the receiver during conversation. In the patent issue of February 17 the latest device of this type is described in a patent granted to Arthur J. Briggs. This device, while embodying a few improvements over its predecessors, retains their inherent defect, which is of so grave a nature that it is probably fatal to the adoption of any such device by telephone engineers. This lies in the fact that such devices encourage the subscriber to leave the telephone off the hook, a practice which is even now, when every endeavor is made to make the hook the most convenient place for the receiver, a source of the greatest annoyance to telephone exchange managers.

This week a new type of antiseptic mouthpiece attachment appears. It consists of a wafer or disc of flexible elastic material, which is treated with an adhesive gum having antiseptic qualities. In using the wafer, which is of somewhat greater diameter than the mouthpiece, it is slightly warmed, then centered upon the mouthpiece, when the projecting edge of the wafer is turned back over the edge of the mouthpiece, in which position it adheres. Mr. Charles W. Clough is the inventor of this device.

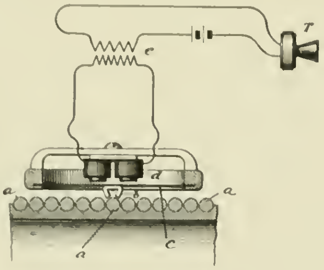


FIG. 1.—ROSENBAUM TELEGRAPHONE.

Under the title, "Apparatus for Electromagnetically Recording Speech," William A. Rosenbaum has patented an improvement in the apparatus known as the "Telegraphone." This apparatus is the invention of one Poulsen and affords means of recording for future reproduction any signals which are transmitted and received as electrical waves or impulses. In the Poulsen apparatus a steel wire or band is moved rapidly across the poles of an electromagnet somewhat similar to a receiver magnet, and connected in the receiving circuit. The arriving electrical waves, therefore, produce variations in the magnetization of this electromagnet exactly corresponding to themselves in characteristics, and these magnetic variations are recorded upon the moving steel strip. Reproduction of the signals may be made at any time by passing the steel strip over the poles of the recording or a similar electromagnet, having a telephone receiver connected to its windings.

With such an apparatus the volume of sound obtained in the reproduction has heretofore been rather minute, especially if the recorded waves have traveled a considerable distance. This is of course due to the almost infinitesimal energy available in the telephone receiver circuit. The present invention seeks to overcome this difficulty. Fig. 1 shows the method employed to do this. Herein *d*, the recording magnet, does not record directly, but serves to vibrate the diaphragm, *c*, which carries the recording magnet, the degree of magnetization recorded upon the steel at any instant being a function of the distance of the poles of the recording magnet from the steel strip. By this means, if the recording magnet is sufficiently powerful it is evident that a very diminutive wave received at *d* may record a very considerable magnetic counterpart upon the moving steel band. This invention appears a valuable addition to the telegraphone.

Pole changers for telephone ringing purposes have for many years received considerable attention as a ready source of ringing power for small central offices. One of their disadvantages has been the powerful primary battery necessary for their satisfactory operation. In a patent of the issue under consideration, granted to J C. F. Malthaner, there is described what may be called a magnifying pole changer.

From a pivot near the yoke of a permanent magnet there is suspended an iron core surrounded by two windings, one of relatively few turns, of low resistance and terminating upon springs projecting at the free end of swinging core, and the other of many turns and terminating at the fixed end of the core where wires are led off from it to the ringing keys. The relative lengths of the permanent magnet and the iron core are such that the free end of the latter will swing between the poles of the former. Near the poles of the magnet are also arranged two sets of springs which are engaged by the terminals of the primary winding of the swinging core to form a reversing switch. A low-voltage battery being connected to the reversing springs and properly poled, the core will swing from side to side, producing an alternating current in the secondary winding, under the combined influence of the reversed primary current and the permanent magnet.

Both of the remaining telephone patents of the issue of February 17 are assigned by their inventors to the Kellogg Switchboard & Supply Company. Of these patents, one covers a "Self-indicating Operator's Key," which has been invented by G. L. Burlingame. In this, a ringing key, the cam lever is so arranged that a portion only of its normal motion is effective in operating the keys, this working portion of the stroke only being unstable. In other words, there is a lost motion between the two key operating positions of the cam, which will cause the handle to have an inclination toward the key last operated by it. This inclination of the handle serves as an indication to the operator of what signal was last sent out by any set of keys, of great service in case it becomes necessary from any cause to duplicate it.

The second of the patents above referred to provides an improvement in the Kellogg two-wire system, which is the work of Francis W. Dunbar. Fig. 2 shows the rudimentary circuits of the improved system, the details of the supervisory circuits being exactly as in the earlier system described in these columns a few months since. The present change in the system lies in winding the controlling relay differentially, the middle point being connected to a third conductor or ground as shown. By this means this relay is under better control during the operation of ringing, for the live side of the battery may be permanently connected to one of the windings of the relay irrespective of the ringing key, while any alternating current leaking across the relay has no effect upon it on account of the differential relation of the windings. This differential relation has no effect upon the operation of the relay by the battery when the ringing key is normal, as one of the windings is connected between two grounds and therefore carries no current. At first sight it would appear that the differential winding would cause a considerable shunting of the talking current by the relay. Mr. Dunbar states, however, that this may be and is overcome placing the windings upon opposite ends of the core and not superimposing them.

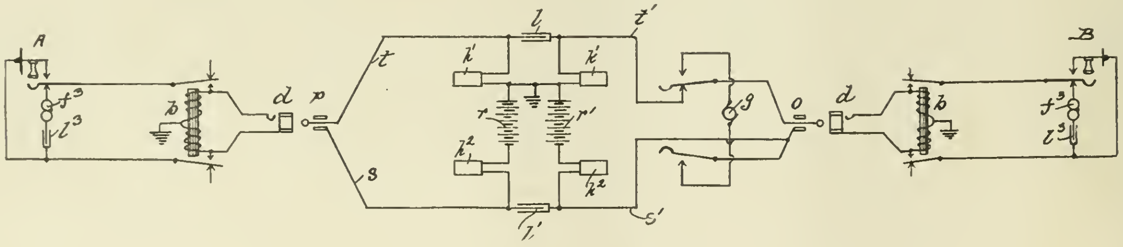


Fig. 2.—Dunbar Telephone System.

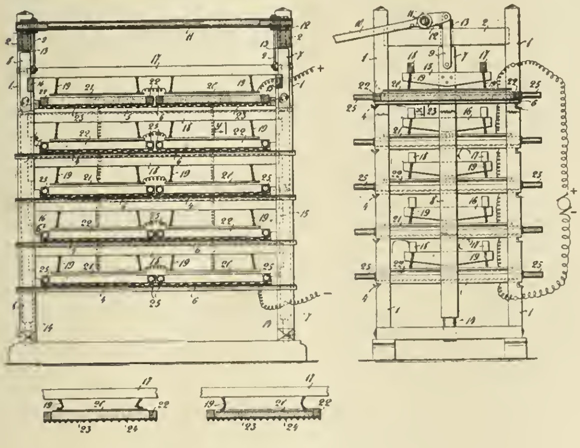
Extraction of Moisture by Electricity.

By Clinton Paul Townsend.

A patent recently granted to Dr. Botho Schwerin, of Berlin, covers an apparatus for carrying into effect his methods, heretofore described in these columns (Vol. XXXVIII, page 942), for drying peat and extracting moisture from various other substances by "electro-osmose." The method depends upon the well-known fact that liquids, and particularly liquids of low electrical conductivity, are transported from the anode toward the cathode under the influence of a strong electric current; if the liquid in question is in the form of moisture saturating a non-conductor, the latter may be interposed as a diaphragm between the electrodes, and the effect of the current will then be exerted in forcing the moisture from it, the cathode being preferably perforated to provide for its free discharge.

The latest construction is shown herewith in side and end elevation, the uppermost trays or cells appearing in section. Wooden side frames, 1, 2, with appropriate cross frames, support a superposed series of shallow trays, 6, the bottoms of which are of corrugated sheet metal. Within these trays rest the cathode boxes, 22, for receiving the peat or other material from which the moisture is to be expelled, the bottoms of these boxes being permeable, and illustrated as formed of copper or iron wire net, 23, supported by heavier net, 24.

As shown, two of these cathode boxes are supported side by side in each tray and connected electrically in parallel through the corrugated bottom of the tray. Above each cathode box an anode plate, 20, 21, of iron is suspended by chains, 19, from transverse beams, 17, 18. These beams are supported upon short cross bars, 15, 16, secured to vertical side bars, 7, 8, which in turn are hung by links, 9, from a cross bar, 11, and are free to move vertically in upper and lower guides, 13, 14. By means of a lever, 10, the beams, 17, 18, together with the several anode plates, 20, 21, suspended therefrom, may be moved upward into the position shown in the figures to permit the cathode boxes to be moved into place. The anode plates are then lowered into operative position in contact with the material in the trays, the chains, 19, being slack in order that the plates may follow the decreasing bulk of the material as the moisture is expressed.



APPARATUS FOR EXTRACTING MOISTURE BY "ELECTRO-OSMOSE."

The electrical connections will be clearly understood from the sketch: the anodes in each horizontal series are connected electrically in parallel, whereas the several superposed cells are series connected. Handles, 25, are provided for convenience in moving the cathode boxes and troughs, 4, for carrying away the expressed moisture.

A confusion of terms in the patent specification renders the data as to power required somewhat blind; it would appear, however, that the fall of potential through each cell is about 15 volts, and that about three hours' operation suffice for the removal of 40 to 50 per cent. of the contained moisture from peat. The current density is stated as 4 amp (per am^2?) at the beginning, falling to 2½ amp as the operation proceeds.

The Chicago Electrical Association Meetings.

A somewhat different plan of meetings from the usual will be followed by the Chicago Electrical Association in its spring programme. Every other meeting will take the form of an entirely informal dinner at the Albion Café, Pullman Building. After each dinner a paper or short address will be given. The dinner feature will give a chance for social intercourse between members and friends not offered by the regular meetings.

The following programme has been announced: March 6 at the Albion Café (Pullman Building), dinner at 6, followed at 8 by an address on "Middle West Engineering: an Optimist's View," S. G. McMeen, engineering department, Western Electric Company. March 20, at 1736 Monadnock Building, "Telephone Service," S. J. Larned, general superintendent, Chicago Telephone Company. April 3, at the Albion Café (Pullman Building), table d'hote dinner at 6, followed at 8 by a paper on "Effects Produced by Grounding the Neutral on an Alternating-Current System," G. M. Eastman, in charge of testing laboratory, Chicago Edison Company.

CURRENT NEWS AND NOTES.

MARCONI'S ITALIAN CONTRACT.—According to a dispatch from Rome, the contract between the Italian Government and Mr. Marconi for the establishment of wireless telegraphic communication with the Argentine Republic was signed on February 16.

RAILWAY TELEGRAPH SUPERINTENDENTS.—The twenty-second annual meeting of the Association of Railway Telegraph Superintendents will be held at the St. Charles Hotel, New Orleans, La., May 13, 14 and 15. A large and enthusiastic gathering is expected.

TELEPHONE IN GERMANY.—It is stated that the telephone can no longer be legally used by German physicians in dictating prescriptions to druggists, because of the chances of fatal misunderstandings. Only in urgent cases, to save life, is its use in this manner allowed.

NIAGARA POWER IN TORONTO.—An offer has been made by the Hamilton & Lake Erie Power Company to the mayor of Toronto to deliver 30,000 hp of electrical energy in Toronto at $20 per horse-power-year. The company offers to provide energy at Jordan, Ont., at $10. It is stated that the company intends to obtain the power by connecting the Chippewa River and the Jordan.

EARTHQUAKE WARNINGS.—A method by which warning of earthquakes may be signaled by the combined use of the seismograph and the telegraph was explained by Prof. Lippmann at the recent meeting of the Academy of Sciences in Paris. The elasticity of the earth's surface is such that the slightest seismic shock may be transmitted to the furthest end of the world. Prof. Lippmann would take advantage of this to unite all the observatories having seismological instruments by telegraph wires so disposed that when the first seismic impression should be received, as usual after an earthquake, all the other apparatus connected would signal the earthquake's approach, for the electric current moves more quickly than seismic waves.

WILKINSBURG ELECTRIC CLUB.—The spring programme of the Electric Club of Wilkinsburg, Pa., illustrates the excellent work which this organization is promoting aside from its social function. During the spring there will be general or technical lectures each Monday and Thursday evenings. On Tuesday evenings there will be classes in direct-current apparatus, C. H. Darrell, chairman; elementary electricity, R. D. De Wolf, chairman; switchboards, B. Hour, chairman; railway work, L. Watts, chairman. Wednesday evenings, lectures on drawing; alternating-current work, D. F. Rogers and A. F. Jones, chairmen; transformers, W. H. Thompson, chairman; testing, E. M. Olin, chairman. Friday evenings, elementary electricity, W. D. Cassin, chairman; transformers, W. P. Woodward, chairman; detail apparatus, T. S. Perkins, chairman; road engineering, F. P. Woodbury, chairman. On the third Saturday of each month there will be a visit to places of technical interest under the guidance of F. P. Newbury, chairman.

WIRELESS NEWSPAPERS.—Copies have been received in this city of the first Marconi "Wireless" newspapers printed on board the Cunarder *Etruria*. Several leading items of the news of the day are given in brief, intelligible form, well condensed, and there seems no good reason why such bulletins should not constitute a regular part of an ocean voyage.

INSTITUTE NOMINATIONS.—We are requested by Mr. W. Stanley to say that having learned that he has been put in nomination by many friends for the presidency of the Institute, he begs that the nomination be withdrawn. While appreciating deeply this honor, he feels that he could not at this juncture give to the office the time and attention it would require, should it be his good fortune to be elected.

REGULATION OF STEAM-DRIVEN DYNAMOS.—A patent issued February 17 to C. E. L. Brown, of Baden, Switzerland, describes a device for regulating dynamos driven by steam engines or turbines. The piston rod of a regulating cylinder fed with steam through a pipe from a point in the engine where the pressure varies as to load, is geared with a toothed quadrant on the arm of a rheostat, the resistance of which is in circuit with the field of the dynamo driven by the engine.

PARIS UNDERGROUND PROSPEROUS.—On the first section open of the Paris Metropolitan Railways the number of passengers carried in 1902 was 62,122,728, and the receipts 10,761,677 francs, an increase of 13,644,612 in the number, and of 2,413,392 francs in the earnings. Yet the construction of metropolitan railways was delayed for twenty years from apprehensions that Parisians would never consent to travel underground in the dark. Electric lighting has offset that objection, as the carriages and stations are brilliantly lighted. The traffic is already congested during certain hours of the day.

CARNEGIE INSTITUTION GRANTS.—The Carnegie Institution, through President Gilman, formerly president of Johns Hopkins University, has made five grants of money to Johns Hopkins men to assist original researches. Two of these were announced by President Remsen lately as follows: To Dr. Harmon N. Morse, professor of Analytical Chemistry, $1,500 for an assistant in his researches upon the new method he has evolved for measurement of osmotic pressures. Dr. J. B. Whitehead, in the physical department, has received a liberal grant to carry forward a research in the theory of the magnetic field developed by Maxwell, the English scientist.

TRANSIT PROJECTS FOR NEW YORK.—Further plans for improving transportation conditions on Manhattan Island and in Greater New York generally have been prepared by Mr. W. Barclay Parsons, chief engineer of the Rapid Transit Commission. It is proposed to spend $50,000,000, half of which would be expended by the city. The plans include a new subway down Broadway from Forty-second Street to the Battery southward, and another on the east side from Park Avenue and Fortieth Street up to the Harlem River at Mott Haven; both connecting into the earlier subways now partly finished. Third tracks and double-decking part of the elevated system are also proposed at needed points, and one important item is the running of through New York Central trains to the Battery. Mr. August Belmont, representing the interests in control of the Manhattan Elevated and Subway systems, is in agreement with these new plans.

ELECTROLYTIC DIAPHRAGM.—A patent issued February 17 to Hugh Rodman describes a porous electrolytic diaphragm for use in any electrolytic work requiring an inert highly porous durable diaphragm. An inert gum, such as rubber, gutta percha, etc., or a gummy mixture, such as crude rubber and sulphur, is mixed with a soluble substance, such as an alkali sulphate. This material is fashioned as desired, then vulcanized and the process finished by soaking the hardened jar or diaphragm for four or five days in running water, which will take out all traces of the sulphate. Potassium sulphate is recommended for the process. It is stated that the material so made is strong, light and has the appearance and smooth surface of ordinary hard non-porous rubber. It offers, however, very little resistance to electrolytic action through its pores, while at the same time it practically stops any diffusion other than that due to electrolysis.

MUNICIPALISM IN MASSACHUSETTS has been given a setback by the recent opinions of the Supreme Court of that State adverse to municipal trading. These opinions were in response to legislative inquiry whether a city or town might, within its constitutional powers, buy and sell wood and coal for the benefit of its citizens. To the several forms in which this question was presented the answer was entirely adverse. The court was divided on the question whether in a time of great emergency a municipality might be justified in buying fuel at wholesale and selling it at retail, even though such trading might be outside of its constitutional rights. One judge, however, was not content to leave the matter thus open, and filed his opinion that no emergency can make constitutional an unconstitutional act. The general ground was that the constitution did not contemplate empowering municipalities to raise money by taxation for commercial purposes.

STANLEY WATTMETER.—Three patents were issued February 17 to William Stanley on a wattmeter for direct and alternating currents, in which the shunt coil is mounted to swing on pivots, and a time-beater employed to pass current intermittently through an integrating magnet and a coil which actuates mechanism for the release of a detent short-circuiting the shunt coil at the end of stated periods. The principal elements of the apparatus consist of, first, a time-beater or a device for accurately producing a given value of motion or given rotation of a wheel in a given time; second, an electrodynamometer or device for accurately expressing by its torque the value of energy transmitted through it from instant to instant; third, an integrating system or arrangement for accurately recording the sum of the torque values developed by the dynamometer in terms of time. Thus, for example, the torque developed during a given period may have a value expressed by the length of a spring required to balance it and may, therefore, be expressed in inches. The number of such inches per hour would, therefore, represent the value of the energy transmitted per hour, and the term "inch-hours" would be equivalent to "watt-hours" multiplied by a constant.

LETTERS TO THE EDITORS.

Mr. Hewitt and the Mercury Arc.

To the Editors of Electrical World and Engineer:

SIRS: I wish to thank you for your courtesy in calling attention to my work on the vapor lamp in your recent editorial under the head of "The Mercury Arc."

Prior to Mr. Westinghouse becoming interested in my work on vapor lamps, I had negotiations with officials of the General Electric Company with a view to their becoming interested in the inventions. These negotiations extended from 1898 well on into 1899, when they terminated, as no agreement was reached. My work was shown them and their experts in my laboratory, Mr. Steinmetz being present as one of their experts at their request. If I remember correctly, Mr. Steinmetz then said that the lamp was efficient and I am glad to note in reading his article that upon further investigation he has found no reason to change his view. At the time of these negotiations, no patents had been issued to me.

A public exhibition to illustrate the principles involved in my lamps was made by me on April 12, 1901, at the Conversazione of the American Institute of Electrical Engineers, at Columbia University, at which the fundamental relations of current to the vapor column were demonstrated by experiments.

NEW YORK CITY. PETER COOPER HEWITT.

Arrangement of Power Stations for Operating Steam Railways Electrically.

To the Editors of Electrical World and Engineer:

SIRS: Referring to article on power stations for operating steam railways electrically, presented in your issue of February 14, I assumed the central station method of distribution a paying investment for street railways from the fact that it is so generally used, and confined my attention to showing that the advantages gained would not apply to steam railroads. As for the load factor, the storage batteries are intended for equalizing the load on the generating machinery, and I took particular care to make the point plain that, with the proper use of storage batteries, the load factor on one station supplying part of the load can be made equal to the load factor on a central station. I proposed a battery plant between generating stations for the reason that storage batteries may be economically installed in smaller units than the generating machinery.

Regarding the collection of large currents, I did not mention this subject for the reason that I did not consider it at all difficult. The collecting shoe in its present crude form cannot be expected to perform heavy service. No more difficulty should be experienced in collecting a heavy current by means of a contact shoe than in collecting a heavy current by means of a dynamo brush from the dynamo commutator. It can only be a few months before someone will make a shoe with carbon contacts and expend the same amount of ingenuity and workmanship on this as on other parts of the railway equipment.

C. J. Spencer.

New York, N. Y.

[Our correspondent does not seem in the least to realize the very great difficulties of collecting large currents from a third rail. The shoe question has kept our best engineers guessing for the last five years, and is no nearer a practical solution than at the beginning. The best shoes work pretty well most of the time, and that is about the most that can be said of them. For moderately heavy work, when the third rail can be kept well insulated and free from obstructions of every kind, the system works well, but even now its limitations are being seriously felt. In our opinion the only hope of heavy long-distance electric traction lies in a large increase of the voltage at the working conductors.—Eds.]

Recuperating Exhausted Dry Batteries.

To the Editors of Electrical World and Engineer:

Sirs: It might interest some of your readers to learn that ordinary dry batteries, after being "spent" and abandoned, can practically and with little or no trouble or expense, be repeatedly recuperated as good as new. Some two years ago I discarded several dozen fluid cells of various makes and substituted dry batteries, on account of their superiority with respect to cleanliness, small size and other advantages. After several had become exhausted I adopted the following method for their recuperation:

One cell was connected in series with a single 16-cp, 110-volt lamp, using the latter for illuminating, as its brilliancy was not perceptibly decreased by the slight voltage drop. After about one hour the cell was disconnected, and on being tested proved to be as strong as when new. At another time groups of cells joined in multiple were connected in series with a ventilating motor, and still another lot were coupled all in series in connection with an electrolytic bath; every cell was recuperated and seemed in every respect as good as new, life and efficiency included. In the two years' time most of these cells have in this manner been recharged several times, and only three abandoned, the latter from want of attention.

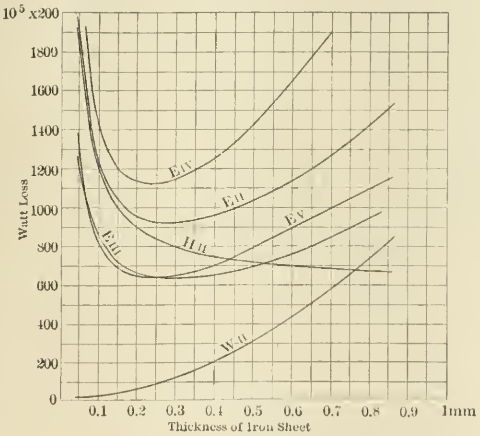
W. A. Sherlock.

San Francisco, Cal.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Thickness of Transformer Sheet Iron.—Kamps.—An article on the most favorable thickness of sheet iron for transformer cores. The total loss in a transformer core is the sum of the hysteresis and the eddy current losses. The eddy current loss is proportional to the square of the thickness of the sheet iron and becomes smaller, the thinner the sheets. At the same time, if the thickness of the sheets would be continually decreased, the volume required for insulations would also decrease, and, in the same total space, less space is now available for the iron, i. e., the useful cross-section filled by iron is smaller, so that, in order to have the same flux of lines of force, it is necessary to increase the induction. Hence, while the thickness of the iron sheets is diminished, the eddy current loss decreases and the hysteresis loss increases; for a certain thickness of the iron sheets the total loss becomes a minimum. Whether this thickness should be chosen for practical transformer design, is a question to be decided in each case by economical considerations; but it would surely be a mistake to use in practice thinner sheets of iron than indicated by his formula. His formula states that the most favorable thickness in millimetres is 79 times the third root of a quotient, the numerator being the product of the coefficient of hysteresis and the thickness of insulation, and the denominator being the product of the frequency and the 0.4 the power of the induction which would exist in the case of an entirely solid iron core.



VARIATION OF LOSSES IN SHEET IRON.

The thickness of insulation between sheets is assumed at 0.05 mm; he then determines the best (i. e., minimum) thickness for various frequencies; it is 0.34 mm for a frequency of 25 and an induction of 10,000; it is 0.30 mm for a frequency of 50 and an induction of 5,000; it is 0.24 mm for a frequency of 140 and induction of 2,000. The adjoining diagram shows the variation of the watt loss for varying thickness of the sheet iron; the four curves, *E*, refer to the total loss, *I I* to a frequency 50, induction, 6,000; *I I I*, frequency 50, induction 5,000; *I V*, frequency 100, induction 4,000; *V*, frequency 100, induction 3,000. The total loss in the case *I I* is separated into its two parts, the hysteresis loss being represented by curve *H* and the eddy current loss by curve *W*. From further discussion he concludes that a thickness of 0.3 mm might in general be considered as normal for transformer sheet iron; a greater thickness would be justified only, either by exceptionally high values of the coefficient of hysteresis and of thickness of insulation, or by exceptionally low values of frequency and inductions.—*Elek. Zeit.*, February 5.

Reference.

Heyland Machines.—Heyland.—The conclusion of his very long illustrated article, the first parts of which were abstracted recently in the Digest. He describes a three-phase winding, mainly used for compound machines, each phase consisting of four parts in parallel, which are connected to two stars and to two triangles. He then summarizes the various windings used for compound machines; all arrangements are illustrated by diagrams; their description cannot be given briefly. He then gives some details of the design of machines built by various firms, the general method of construction being quite uniform. He finally makes some remarks on large low-speed machines.—*Elek. Zeit.*, February 5.

Lights and Lighting.

REFERENCE.

Ship Lighting.—Broadbent.—The first part of an article in which he discusses the best system of ship lighting, the arrangement of the plant and the wiring. In the present part he discusses the best place of the generating plant, the choice of governors, steam and exhaust service, and the construction of dynamos, switchboards and fuseboards.—Lond. *Elec. Rev.*, February 6.

Power.

REFERENCE.

Gas Engines.—Graham.—A long abstract of a paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. and of the discussion which followed, on the design of gas engines for special use in electric lighting stations.—Lond. *Elec. Rev.*, February 6.

Traction.

Electric Road from Fayet to Chamounix.—A description of this line, which is 10 km in length, with a maximum grade of 9 per cent., and is owned by the Paris-Lyons-Mediterranean Railroad. The track is laid with 35 kg rails; the center rail is for emergency braking purposes. The so-called "third rail" is placed outside of the track and is supported by paraffined wooden insulators mounted on the ties. There are two generating stations each using water power; the equipment of these stations, which is thoroughly described, includes 200-kw direct-current generators, which have a series field winding and are also separately excited so that the voltage remains constant, independent of the speed of the generators. In one station an additional automatic short-circuiting device for the generators has been installed. The shafts of the motors are parallel with the rails and are connected to the axles by means of double gearing. There is an elastic coupling between the shafts of each motor and the axle which it drives. Trains are run by means of the multiple unit system in which the controllers are operated by pneumatic power.—*St. R'y Jour.*, February 7.

Ohio.—An article on Southern Ohio interurban improvements. Several electric lines in Southern Ohio have been absorbed in the Southern Ohio Traction Company and a traffic arrangement has been made with other lines entering this territory. During the last few months extensive improvements have been made including extensions of the lines, new equipment and additional power plant facilities. The company now has a direct connection between Cincinnati and Dayton, the principal point on the road being Hamilton. There are also several branches from the main line. The company has developed a very considerable freight business, and has also a well-organized express department. The company operates an electric freight locomotive and also uses single freight cars and combination express and passenger cars.—*St. R'y Jour.*, January 31.

Relation of Interurban Electric Railways to Steam Roads.—Wyly.—An article in which the rapid development of the interurban electric railway and the improved facilities which it offers are considered as well as the influence which its development has had in increasing the public travel. It is contended that the electric interurban extensions have materially benefited the steam railways in spite of the fact that much of the suburban traffic of the old lines has been taken by the new electric system. It is pointed out that this is not an unmixed evil as the steam trains are ill adapted to this class of service. This is now recognized by many steam railway managers who are encouraging the development of the electric lines as feeders to the steam trunk lines, and in some instances have substituted electricity as a motive power for suburban and branch roads.—*St. R'y Jour.*, January 31.

REFERENCES.

A Suspended Electric Car.—An illustrated description of a novel type of bridge which is being built across the Mersey River, in England. The span is about 1,000 ft. The car itself is about 55 ft. long by 24 ft. wide and is propelled by four electric motors.—*St. R'y Jour.*, January 24.

Shop Practice on the Grand Rapids, Holland & Lake Michigan Railway.—The method is first described of clamping babbitt in armature bearings while it is being machined in a lathe, so that it is not dragged out of place by the tool. A description is then given of a clamp for tightening commutators; this consists of an annulus or ring made of different parts which dovetail into each other. The ring is slipped over the commutator and then compressed by screws which bear on each segment of the ring, forcing the commutator to take a true cylindrical shape.—*St. R'y Jour.*, February 7.

Automobiles.—The first part of an article on the automobile exhibition at the Crystal Palace in London. Although the electrical exhibits are comparatively few, yet they are more numerous and important than at any previous exhibition in England. A list is given of the 40 exhibits of electrical automobiles or of electrical apparatus for automobiles.—Lond. *Elec. Rev.*, February 6.

Installations, Systems and Appliances.

Polyphase Work in 1903.—Eborall.—An article in which he discusses the lines along which polyphase work will probably develop. The single-phase system has not found such an application as its advocates had hoped for; on the contrary many single-phase systems have been converted to direct current distribution with polyphase transmission. The conversion of high frequency single phase to standard frequency two phase, which involves no scrapping of existing feeding and distributing systems, is a logical development. He thinks, however, that the two-phase system should be limited to converted systems, because the old concentric cables can be used with it; for new schemes it presents no advantage over the three-phase system, while in certain respects, such as in the copper economy, the latter system is superior. He thinks the general system of the future for new work outside the sphere of pure direct-current working, will be three-phase transmission and distribution for lighting and power at a standard frequency of 50 cycles, with converting sub-stations for the street railways. Regarding frequency, he recommends using either 25 cycles for pure railway and tramway work in which synchronous converters are used in sub-stations, or 50 cycles for general lighting and power work. He regrets that for one of the largest schemes now in course of construction, namely the Yerkes underground railways, a new frequency has been introduced, namely 33⅓ cycles. It is still undecided whether the compromise of 40 cycles, to be used both for general work and for the operation of synchronous converters, is thoroughly satisfactory; on the one hand it is the lowest frequency which can be used with success for general lighting and motor work, being inferior to 50 cycles in these respects; on the other hand, it is yet to be proved that synchronous converters can be operated from a 40-cycles circuit in a manner which will fulfill the stringent requirements of the present day. The author prefers 50 cycles and the use of synchronous motor generator tramway sub-stations. There is at present little prospect of three-phase street traction. A standard uniform system should be used for street railways, i. e., the present 500-volt, direct-current system should be used in extensions. However, for light railways and for long, high-speed lines, the three-phase equipment, even as it stands to-day, will fulfill the requirements in a perfectly satisfactory manner and will come to the front in the near future. In both cases the continual starting and stopping is not required, and the question of acceleration is of minor importance; in both cases the provision of sub-stations containing running machinery for feeding the overhead conductors, would also be altogether too costly. The article is to be concluded.—Lond. *Elec. Rev.*, February 6.

Charging for Electricity.—Bastian.—An article in which he discusses the different methods of charging for electricity. The two-rate system, whereby a high rate is charged during the period of maximum load on the generating plant, and a lower rate at all other times, possesses the advantage that the cost of production can be taken into account by fixing the high rate at a figure that will cover the standing charges in the plant installed; in addition the system can easily be explained to the layman. In the latter respect it is superior to the maximum demand system, while the Hopkinson method of charging appears inadmissible for the sound commercial reason that it tends to restrict the number of electric lamps installed. The best possible tariff cannot be regarded as in any way a permanent solution of the charging problem, as all of them must be based on existing conditions. For comparison he refers to the fact that the peak of the load curve of some provincial gas companies is attained between 12 noon and 1 P. M., owing to the cooking stoves in use and the introduction of electric light; but nobody could have foreseen this ten years ago. The conditions of electricity supply will also undoubtedly vary. He thinks it to be inevitable that the ultimate system of charging must be the simple "flat rate," with a discount on a sliding scale according to the number of units consumed; therefore, the policy of the electrical engineer must be to endeavor to reduce the cost of production and increase the efficiency of the lamps. A special charge for street railway lighting could be arranged, but this should be the only exception to the strict "flat rate."—Lond. *Elec. Rev.*, February 6.

REFERENCE.

Electrical Industry in Spain.—A statistical note stating that at the end of 1901 there were in Spain 859 electric plants, 648 of which were for public and 211 for private purposes. The oldest plant, in Santa Catalina, was opened in 1878; but nearly all plants which are now in operation were built during the last six years. In all cities of Spain which have electric light, there are used for public lighting 87,112 incandescent lamps and 1,470 arc lamps, and for private lighting 1,237,836 incandescent lamps and 2,819 arc lamps.—*Elek. Zeit.*, February 5.

Electro-Physics and Magnetism.

Spontaneous Ionization in Air.—Patterson.—An account of experiments in which he endeavored to determine the cause of the so-called spontaneous ionization in air. To measure the spontaneous ionization at different temperatures, the air was contained in an insulated iron cylinder containing about 13 litres, and the rate of leak was measured between the walls of the vessel and an insulated electrode. This electrode was connected to one pair of quadrants of a very delicate electrometer and the rate of leak observed. The experiments showd that from the temperature of the room (20° C.) to about 500° C., the current through the gas was constant, the air in the cylinder being at atmospheric pressure throughout the investigation. To measure the ionization at different pressures the same cylinder and electrode were used. The joints were made air-tight with sealing wax and the air filtered through glass wool. The results showed that down to a pressure of about one-third atmosphere the current through the gas was independent of the pressure and that for pressures below 90 mm of mercury the ionization was proportional to the pressure. The results of the experiments indicate that the spontaneous ionization is really due to easily absorbed radiation from the walls of the vessel.—*Proc. Cambridge Phil. Soc.*, Vol. XII, No. 1; abstracted in Lond. *Elec.*, February 6.

Light and Cathode Rays.—Zehnder.—A description of some new effects of cathode rays and light rays. Many salts are known to be colored under the influence of cathode rays, and to lose their color subsequently when exposed to light. The author has found that if an object is traced on a dry plate by means of cathode rays and the plate is subsequently exposed to light, it may happen that after development the portion illuminated by the cathode rays appear brighter than the rest, thus recalling the effects of solarization. "Celloidine" paper, once exposed to cathode rays, becomes less sensitive to the effects of light. If the paper is then exposed to diffuse white light, that portion becomes darker which was not previously exposed to the cathode rays. It is thus possible to obtain a negative of a positive image produced by cathode rays. Solio and other papers show similar effects. A circular patch exposed first to cathode rays and then to light, first becomes paler at the margin, where the cathode rays were presumably less active, and gradually the brightening extends to the center. A fixing bath bleaches the cathode-exposed portions much quicker than the light-exposed ones. Magnetically-deflected cathode rays have the same effect as ordinary ones.—*Ber. Deutsch. Phys. Ges.*, No. 1, 1903; abstracted in Lond. *Elec.*, February 1.

Magnetic and Electric Deflection of Cathode Rays.—Starke.—An account of an investigation of the reasons of the change of cathode rays due to reflection and transmission. It was formerly supposed that cathode rays suffer no change by reflection and transmission except in direction; but Gehrke and Leithaeuser have shown that a reflected or transmitted cathode beam is heterogeneous, and will be drawn out into a sheaf by an electric or magnetic field, although the same field is quite powerless to split the beam before reflection or transmission. On the electron theory, it might be supposed that it is either the ratio of charge to apparent mass of the cathode rays that is altered, or their velocity. The present author has made some experiments to test which of these alternatives is true; and finds that the latter is correct, as the ratio of charge to mass is unaltered, while both reflections and transmissions have the effect of considerably reducing the velocity of some of the cathode rays.—*Ber. Deutsch. Phys. Ges.*, No. 1, 1903; abstracted in Lond. *Elec.*, February 6.

Magnetic Friction in Gases.—Pellat.—An account of experiments in which a strong magnetic field was brought to bear upon a vacuum discharge and more especially upon the positive column; as the latter is squeezed together into a thin pencil, the phenomenon is called "magneto-friction." He used a tube 1 meter long and 1.7 cm wide. As the magnetic field increases, the anode light contracts until it becomes a thin pencil. This halo gradually increases until it obscures the central pencil, and finally the magneto-friction disappears, leaving the gas as if no field existed. The point is reached much sooner in hydrogen than in oxygen. With a field of 7,000 units, the diffusion is complete in hydrogen under a pressure of 1.3 mm. Oxygen still presents a sharp pencil, but this may be made to diffuse by reducing the pressure to 0.13 mm. Mixtures of gases have intermediate properties.—*Comptes Rendus*, December 29; abstracted in Lond. *Elec.*, February 6.

REFERENCE.

Potassium Amalgam Cathodes.—Lyman.—An account of an investigation of the action of sodium or potassium amalgums as cathodes in an exhausted discharge tube.—*Proc. Cambridge Phil. Soc.*, Vol. XII, No. 1, 1902; abstracted in Lond. *Elec.*, February 6.

Electro-Chemistry and Batteries.

Alloying of Metals as a Factor in Electroplating.—Kahlenberg.—An article pointing out that when one metal is deposited electrolytically upon another, the process of alloying always goes on to a greater or less extent, which is determined primarily by the nature of the metals, and secondarily by the conditions of the experiment. Among the latter are of special importance the original condition of the surface of the cathode, the nature and concentration of the electrolyte, temperature, potential and current density. The alloying power of the electrolytic deposit with the coated metal underneath is a factor determining not only the strength with which the deposit adheres, but also the length of time the plated article will wear and resist corrosion. The alloying power of two metals is a tendency to dissolve in each other; it is a force no doube chemical in nature. The stronger the affinity of the metals for each other is, the better the deposit is apt to adhere. On the other hand, the plating is also more apt to be absorbed by the base metal underneath, the greater the tendency of the metals to alloy. This is illustrated by various examples from practice. The electroplater must study the subject carefully so as to plate those metals or alloys upon each other that possess sufficient affinity to coalesce well, and yet will, at the temperatures at which the plated objects are to be kept, diffuse but very slowly into each other; he will also choose the color of the metals or alloys so that the final alloy formed may have the same, or nearly the same, shade as the electrolytic deposit and will itself be corroded less readily than the base metal alone.—*Electrochem. Ind.*, February.

Accumulator Plates of Slabs.—Leimer.—An article on the manufacture of such plates; they are claimed to have the advantage over the Planté and the Faure type of a very high capacity per volume and a relatively low weight, and that they are strong and light enough to be used for traction purposes. They require very careful treatment during their manufacture; he found phenole in aqueous solution to be suitable for a binder; it forms a basis phenylate with lead oxides; in alcoholic solutions it does not answer. The plastic mass must be handled with due rapidity and the plates should be perforated at once; they are left to dry at least 12 hours, after which they are put into an oven. They are then placed into the acid bath, where they remain only for a certain time. Great precautions seem to be necessary in all stages of the process. The article is to be concluded.—*Centralbl. f. Accum.*, January 1.

Electrometallurgy of Iron and Steel.—Ruthenburg.—An illustrated article in which he first gives figures for the power used in various electric iron processes: for one ton of metallic iron Stassano requires 3,000 hp-hours, De Laval 3,500 hp-hours, and Rossi 4,800 hp-hours. He remarks that for such measurements a recording wattmeter should always be used. He also thinks that the cost of power in a large steam plant with 1,000-kw or 5,000-kw units, and a fair quality of coal and with the facilities of a large plant, puts the prices now asked by prominent water powers very much in the shade. In his own iron process he needs only 500 kw-hours to produce a ton of products. As to the economy of the blast furnace he says that of the ton of coke which even good practice requires to make a ton of pig iron, but a little over 300 pounds are required for the chemistry of the furnace, i. e., reducing the iron, the balance is required to melt not only the reduced iron, but to form the cinder; an important portion is also consumed in the production of waste combustible gas, some of the value of which is recoverable under boilers and in the stoves for producing the blast. The 500 kw hours in the Ruthenburg process require the combustion of 1,000 pounds of soft coal, not coke. The reduction of the ore requires 300 pounds of carbon. To explain the great saving of power in his process compared with the other processes, he points out that he does something different from the others. The others melt the ore and maintain it molten, the molten mass being a path of low resistance for the passage of the current in which reduction takes place by the hot carbon of the electrodes and the gases of carbon given off; to maintain this mass molten requires a large expenditure of energy. Instead of this he holds the ore, in only small portions at any one time, by a powerful magnet, only the portion held by the magnet is melted, the ore supply from above resting upon the magnetic bridge and being thereby restrained from slipping through. The poles of the magnetic circuit are also the poles of the melting circuit. There are no electrodes, the resistance being the ore itself, which as fast as fused is carried out of the zone of fusion and dropped, its place being taken by ore from above. Preparatory to the electric furnace, the ore should be cleaned up to the highest possible point, so as to avoid the treatment of useless earthy and cinder-forming matters. Magnetic ores may be quite lean and yet pay to crush and to clean; in some cases the crushing must be quite fine to produce economic results. This iron dust cannot be used in a blast furnace, but is just what the electric furnace wants. The ore is mixed to produce the desired chemical analysis of the finished material and the required reducing material is incorporated. At the high temperature of the electric furnace the charge is fused into a homogeneous mass, less a large part of its oxygen, and is discharged from the furnace very hot and kept hot so that the cementation may finish the elimination of the contained oxygen. The material is then ready for melting in an open hearth furnace and is steel.—*Electrochem. Ind.*, February.

Molecular Induction.—Gross.—A description of some curious phenomena of electrolysis. In a concentrated solution of copper sulphate two copper wires are placed and are connected to a high-resistance galvanometer; when a plate of zinc is placed between them and closer to one of the wires, copper is deposited upon the zinc and a current goes from the zinc to the more distant electrode. He claims that the action is neither thermal nor due to concentration or local currents. A high e.m.f. may be obtained by immersing three zinc plates insulated on one side into the trough and connecting the two outside ones with the galvanometer. He explains it as due to a force not connected with chemical affinity, and, indeed, often opposed to it; he calls it molecular induction. He presupposes some effect of molecular vibrations.—*Ber. d. Deutsch. Phys. Ges.*, No. 1, 1903; abstracted in Lond. *Elec.*, February 6.

Units, Measurements and Instruments.

Radiation Scale of Temperature.—Lummer and Pringsheim.—A paper in which the authors discuss the three different methods now available for determining the temperature of a hot body by means of the radiant heat emitted by it; these three methods are expressed in the form of three different formulas, one being due to Stefan and Boltzmann, the other two to Wien. The authors point out that these laws are not merely empirical rules, but laws of Nature whose validity is as well established as the thermodynamic equations upon which thermometry is based. They prove by measurements with a hollow carbon cylinder heated to 2,300° absolute temperature, that all three methods give identical results, and that the region of accurate measurement of temperature is now extended into regions hitherto reached only by extrapolation of formulas governing thermo-electric forces.—*Ber. d. Deutsch. Phys. Ges.*, 1903, No. 1; abstracted in Lond. *Elec.*, February 6.

The same subject is discussed in an editorial note. The absolute and exact measurement of high temperatures has hitherto not gone beyond 1,150° C., that being the temperature at which the gas thermometer fails, owing to a softening or deformation of the containing vessel, whether porcelain or platinum. This recent progress is due to the work of various investigators who have raised the theory of the radiation of the "absolutely black body" into "a stately edifice of physical fact and mathematical reduction." Stefan's experimental radiation formula, which was later deduced by Boltzmann from the second law of thermodynamics, states that the total radiation from an absolutely black body—i. e., a body which absorbs all rays, whatever their wave-length—is proportional to the fourth power of the absolute temperature. To measure, therefore, any temperature, however high, it is only necessary to expose a bolometer or other radiation instrument to the black body having that temperature and measure the flux of radiant energy proceeding from it. A furnace closed on all sides, with a hole in one wall through which the radiation proceeds, behaves like an absolutely black body.—Lond. *Elec.*, February 6.

Constancy of Manganin Resistances.—Lindeck.—An account of some measurements made at the German Reichsanstalt with manganin resistances after they had been in commercial use for several years. Out of 31 resistances, consisting of sheet manganin, 15 showed variations amounting to less than 0.01 per cent. Six showed 0.02 per cent. of a secular alteration, five 0.05 per cent., three 0.1 per cent., and two more than 0.1 per cent. This shows that 26 out of the 31 resistances supplied to electrical works remained constant within the indications of the best direct-reading instruments. Among the 10 resistances showing alterations exceeding 0.02 per cent., seven were large resistances which had been used with strong currents. The two resistances whose variation exceeded the limit of accuracy marked on them (0.1 per cent.) had been used almost daily, for four years and 2½ years respectively. The former showed a decrease of 0.12 per cent., and the latter an increase of 0.23 per cent. The latter was covered with a brown mud, produced by a chemical attack of the petroleum used on the manganin. The other instrument had only turned slightly brown. The results show on the whole the admirable fitness of these resistances for industrial use.—*Zeit. f. Instrum.-Kunde*, January; abstracted in Lond. *Elec.*, February 6.

Braun Cathode Ray Tube.—Wehnelt.—A description of a Braun tube for electrostatic deflection. While the Braun tube is largely used to advantage for studying current curves by means of the electromagnetic deflection of a cathode beam, its use is very limited when it is the investigation of potential curves that is desired. He describes a Braun tube for electrostatic deflection, using internal electrodes and obtaining a permanent electrostatic deflection. His tube closely resembles the ordinary Braun tube in appearance. The curve of potential for an alternating arc shows a slight elevation at the beginning of the discharge which disappears when the discharge proceeds.—*Ber. d. Deutsch. Phys. Ges.*, No. 1, 1903; abstracted in Lond. *Elec.*, February 6.

Photometry at the British National Physical Laboratory.—Glazebrook.—A communication stating that the photometric room of the (Brit.) National Physical Laboratory is now practically ready, and that this laboratory will assume the position and responsibility of a standard photometric authority, so far as this can be done without legislation.—Lond. *Elec.*, February 6.

Miscellaneous.

REFERENCE.

British Westinghouse Works.—A long and fully illustrated description of these new works near Manchester.—Lond. *Elec.*, February 6.

New Books.

The Art of Illumination. By Louis Bell, Ph. D. New York: McGraw Publishing Company. 339 pages, 127 illustrations. Price, $2.50.

To the scientific reader Dr. Bell needs no introduction, and is no stranger, as there are few of even the most modest libraries upon whose shelves the "Electric Railway," "Electric Power Transmission" and "Power Distribution for Electric Railways," do not occupy a conspicuous position. So when one opens the covers of "Art of Illumination," it is with a hazy notion of a treatise on photometry, bristling with the law of inverse squares and redolent with symbols. But it is nothing of the kind. The mathematician will turn its leaves in vain, for in its three hundred odd pages there are not a half a dozen formulæ, and *x's* and *y's* are conspicuous by their absence. Here and there a table appears, but is so successfully interwoven with the text that the reader absorbs it unconsciously. Ruskin says that "art is nature viewed through temperament," and this is the case with "Art of Illumination," for the subject is largely viewed from the art side and not from the mathematic. It is illuminated as it appeals to the senses, and not the abstract laws of light that are discussed. Furthermore, it teaches how to make illumination attractive, comfortable and seductive, rather than an exhibition of the why-thereof. But the science of illumination is by no means neglected, for in all the methods advocated Dr. Bell clearly shows a scientific basis for the principles elucidated.

At the outset, in Chapter I, the author discusses the relation of light to the sensation of vision, showing why, under some circumstances, there is a gratifying comfort in working or reading, and in others an acute discomfort. In Chapters II and III the principles of color and reflection and diffusion are taken up, and some curious facts illustrated as to the proper methods to be adopted in using colored light. The effect of reflection and diffusion in modifying the color of illumination, is strongly presented. The next four chapters deal with the materials of illumination, and are descriptive of the illumination now available in common practice. Candles and kerosene are given but little more than a brief mention, probably because the author appears to feel that the "Art of Illumination" deserves better materials. To the various uses of gas, particularly the incandescent mantel, forms of re-generative burner, and the employment of acetylene, much space and particular attention is given. The next chapter deals with the incandescent electric lamp, particularly with the newer types of the Nernst variety. In the last few pages of this chapter there are some valuable observations as to the direction of probable improvement, and an interesting analysis of fire-fly light.

Chapter VII is occupied with the electric arc in its various forms of open and enclosed, direct and alternating current; instructive comparisons being drawn as to the usefulness of the various types. Chapter VIII, upon shades and reflectors, is really a continuation of the preceding chapters, dealing with the electric lamp under the modified conditions that are imposed by the various form of shades and reflectors that art and science have contrived

But upon Chapters IX, X and XI, treating of domestic illumination, the lighting of large interiors and street and exterior illumination, the attention of the reader is most sharply focused, for these chapters contain the real gist of the book. There is literature galore upon the arc and incandescent, but one may search through many libraries without finding a hint as to how to use lights in a manner to produce pleasing and satisfactory results, and withal with the greatest economy. In these three chapters Dr. Bell reads many an architect a most useful lesson, and one which it is hoped will be received with the attention it deserves.

Chapter XII deals with decorative and scenic illumination, probably from a sense of desirable completeness, for while all will admit the magnificence of the illumination of the Pan-American few would even view that spectacle with the same interest as would be excited by the comfort of an after-dinner easy chair and the evening paper, in a tastefully and artistically-illuminated interior.

In Chapter XIII the author indulges in some prophecies as to the illumination of the future, and tersely sums up the matter by stating: "Illumination is not a science with well-defined canons, which might be termed illuminating engineering, but an *art* wherein an indefinable and uncommunicable skill pertains, almost as it does in the magic of the painter." In this sentence Dr. Bell strikes the keynote of the work, and proceeds to show that improvement is far more likely to develop from the exercise of such skill than from the possible utilization of fire-fly light or new form of vacuum tube, although either of these is entirely within the range of conceivability. In the last chapter a résumé of standards of light and photometry is given.

In scientific literature the "Art of Illumination" is a distinct departure from the typical treatise with its numbers and its formulæ It is art and not science, and in it art is no less displayed in the style of the author, which so charms the reader, as to cause him to forget the treatise in the interest which it excites.

THE HOW AND WHY OF ELECTRICITY. By Charles Tripler Child. A Book of Information for Non-Technical Readers. New York City: Electrical Review Publishing Company, 1902. Olive green Cloth, 6 in. x 7¾ in. (13.5 x 10.5 cms); 127 pages 40 illustrations. Price, $1.00.

This is a charmingly written and interesting little book, not merely to the uninformed, owing to its simplicity, but also to the informed, owing to the precision of its statements and the clearness of its style. A wide range of practical subjects is covered in twenty-three chapters. Elementary information in all these subjects is conveyed in such a manner that an untechnical reader can readily grasp the meaning and at the same time the story of each subject is so entertainingly told that the reader is brought to understand the most recent development in that subject without losing interest or wearying of the study.

The book will commend itself to elementary students of electrotechnics, and to the great mass of the intelligent public interested in the developments and applications of electricity.

ELECTRICITY AND ITS SIMILITUDES: The Analogy of Phenomena, Natural and Spiritual. By Charles H. Tyndall, Ph. D., S. T. D. London and Edinburgh: Fleming H. Revell Co., 215 pages. 10 plates. Red Cloth, 5 in. x 8 in. (13 x 20 cm). 1902. Price, $1.00.

This is a very interesting book psychologically. The author is clearly an educated man and a good writer of English. He appears to be an earnest and honest writer deeply imbued with religious spirit; but he has adopted a method of mixing religion and science in a manner that to many scientists brings religion into ridicule. The religious thoughts suggested by the book we do not in any way desire to criticise or find fault with. That subject is, of course, in itself a sacred topic; but to write a book in which Scripture verses alternate with scientific propositions is to sail dangerously close to the farcical. Moreover, the tendency is promoted to make loose and inaccurate scientific statement. There are numerous accurate scientific statements in the pages under consideration, but there are also many very loose, inaccurate statements.

Wonderful analogies are presented to our minds by this book. Thus the Branly coherer in its normal condition of electric resistance is likened to the condition of the wicked soul in its normal sinful resistance to truth. The phenomenon of electric coherence is thus paraphrased: "Invisible energy from Heaven's battery has come into contact with the soul; disorder has vanished; spiritual continuity with God is established, and resistance has given place to conductivity of the tenderest sort, and it is one which also persists."

The last statement seems to call for "God save the King" at the end, as a fitting peroration. But in a certain sense it is immoral to inculcate such doctrines in a book that pretends to be quasi-scientific. The analogies are necessarily quite inapplicable to the real phenomenon in nature thus paraphrased. The wrong idea is given to the student's mind and the result is false teaching, which is worse than none.

We recommend the book to those versed in electricity and possessed of a sense of humor.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky.

Kentucky Independent Telephone Association, Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Piehardt, Huntingburg, Ind.

High Power Horizontal Gas Engines.

The Westinghouse Machine Company has for some time been engaged in developing the double-acting gas engine, and is now prepared to build this type, for powers ranging as high as 3,000 hp. As this type of engine possesses features somewhat novel to those accustomed to the usual reciprocating engine design, a brief description may be of interest.

Fig. 1 shows a perspective view of a single-crank engine of the new type and Fig. 2 that of a double-crank engine. Fig. 3 shows the general design of a single-crank engine direct connected to an electrical generator.

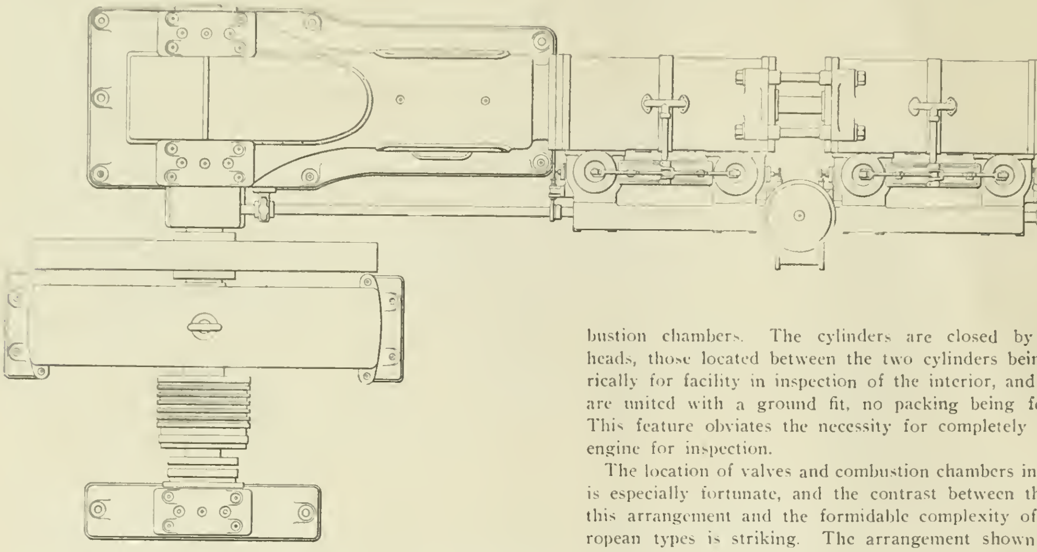


FIG. 1.—PLAN VIEW OF SINGLE CRANK GAS ENGINE.

It is quite apparent from the accompanying views that the general design of the engine resembles to a noticeable extent that of a modern high-speed tandem compound steam engine in the arrangement of cylinders, frames, bed plates, bearings, flywheel and generator. This resemblance is further carried out in the matter of crank effort. Each revolution is accompanied by two impulses, one occurring at each successive in-stroke and out-stroke. The engine operates, therefore, upon the four-stroke cycle, involving distinct periods of admission, compression, explosion, expansion and exhaust; this cycle yielding the highest practical as well as theoretical thermal efficiency and economy of fuel.

In direct distinction from the use of an explosive mixture varying in richness according to the load, the Westinghouse design employs a mixture of unvarying quality, which is initially proportioned according to the nature of gas used, but which remains constant under all conditions of load. As the load upon the engine increases or decreases, a corresponding greater or lesser quantity of mixture is admitted to the cylinders, thus utilizing at all times an explosive mixture of strength, resulting in higher thermal efficiency and economy of fuel. That this method is productive of the best results in engines of high power is apparent from the fact that reputable European builders such as the Deutz, Cockerill and Nurnberg companies, are abandoning the variable for the constant mixture method of governing.

The construction of the engine under description is in many respects unique, in that it departs materially from the accepted European design and embodies many established features of modern steam engine practice, which have been so instrumental in bringing about the success of the well-known Westinghouse vertical single-acting type. From crank to cylinders, the construction is that of a horizontal steam engine suitably strengthened in proportion to the increased maximum pressure resulting from the rapid combustion of the highly compressed gases. The design of cylinders, pistons and valves, of course, departs materially from steam engine practice. The cylinders are double-walled, with the outer walls split peripherally to permit independent expansion and contraction without placing the cylinder casting under stress. The two cylinders are united at the top by heavy tie rods, engaging peripheral bosses, and at the bottom by a stout cast-iron distance piece. The rear section of the bed plate which supports the two cylinders is cored hollow with a central dividing wall, and serves as a reservoir for incoming and outgoing circulating water. All connections are piped directly to these reservoirs, thus avoiding a large amount of piping about the engine. Through the bed plate extend the four vertical exhaust pipes, which connect immediately below with an exhaust main. The exhaust passages leading from the valve chambers are cast integral with the cylinders, upon their under sides, and are water cooled.

At the ends of each cylinder occur horizontal side ports, resembling straight steam ports, which communicate with removable combustion chambers. The cylinders are closed by water-jacketed heads, those located between the two cylinders being split diametrically for facility in inspection of the interior, and the two halves are united with a ground fit, no packing being found necessary. This feature obviates the necessity for completely dismantling the engine for inspection.

The location of valves and combustion chambers in the new design is especially fortunate, and the contrast between the simplicity of this arrangement and the formidable complexity of numerous European types is striking. The arrangement shown in the accompanying illustrations accomplishes the same purpose at far less cost and with less complexity. The combustion chambers are independent castings, with plain machined faces, circular valve-liner seats, and cored-out passages for circulating water. Both admission and exhaust valves, which are of the standard poppet type, operate vertically and with opposite throw. They open by cam movement and are held to their seats by spring pressure. The central space, closed by the admission valve above, and the exhaust valve below, communicates directly with the cylinder port before mentioned; the exhaust space with the exhaust passages on the under sides of the cylinders; the admission space with the supply pipe. This supply pipe is a rectangular cast-iron main extending along the entire front and provided with openings opposite each admission valve. It receives its supply from the governor chamber located midway between the two ends, this in turn communicating with a mixing chamber supplied on the one hand with gas and on the other with air through suitable valves.

These two valves are shown in Fig. 1, and are provided with graduated indices, so that the exact proportions of gas and air may at all times be visible, and under the control of the attendant. Another feature of the greatest importance is found in the provision for interchangeable parts. Each valve, together with its spindle and seating spring, is independently mounted, and by simply removing the bolts from the bonnet the entire valve, seat and liner may be drawn out for inspection or replacement by a spare. Similarly the igniters, which are of the "make-and-break" electrical contact type, employed in all Westinghouse engines, are mounted in a removable plug extending into the combustion chamber through the side walls.

The valve gear is of the standard cam and roller pattern, also employed in the Westinghouse vertical engines, and is driven by a helical gear, engaging a similar split gear bolted around the main shaft.

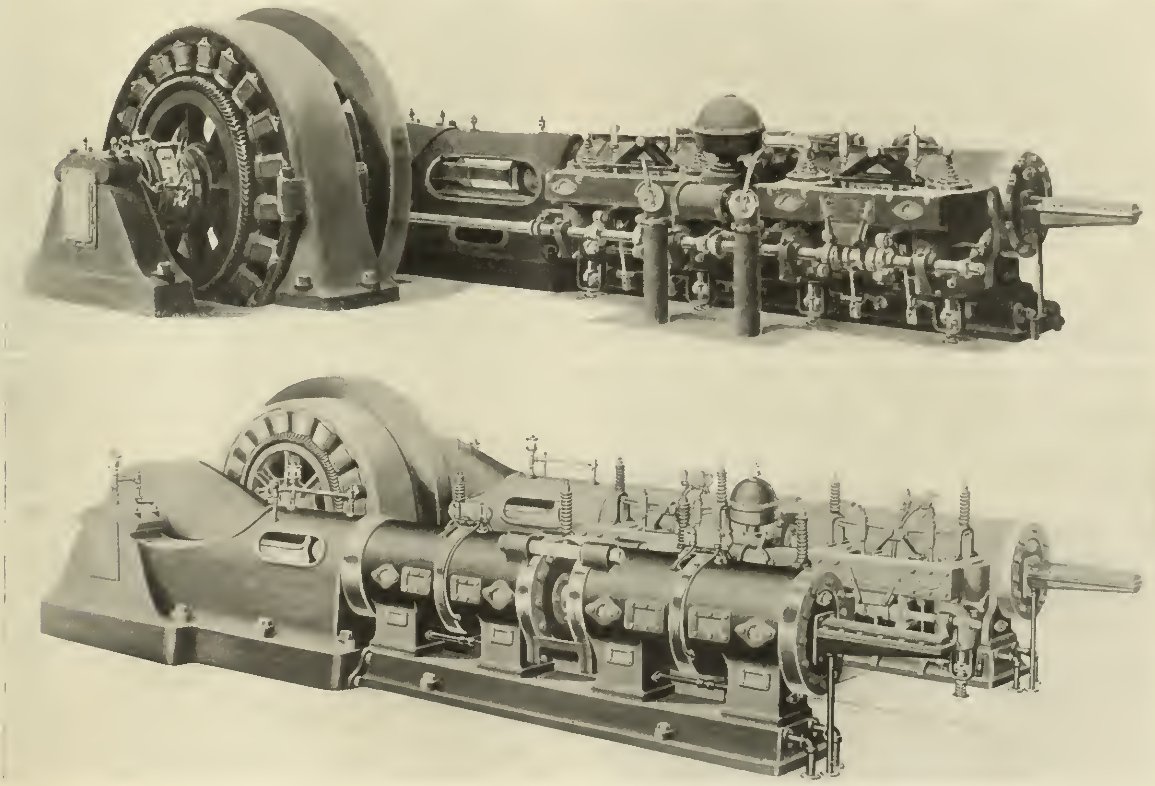
The method of circulating cooling water through the pistons is unique. This water enters a cavity on the cross-head by means of a flexible pipe connection provided with special swinging joints. It then flows through the hollow piston rod to the front and rear pistons, through which it circulates, finally emerging through a bronze tail rod extending through the rear head, there emptying into a cast-iron jacket communicating with the hot water return pipe. Similarly, cold water is conducted through suitable pipes to the cylinder jackets, thence to the jackets surrounding the exhaust valves and ports, and finally to the return pipe, emerging at a sufficiently high temperature for use in heating and drying coils, radiators, etc. By the above method the proper temperature relations between pistons and cylinders is at all times secured, thus allowing close piston fits to be employed without danger of excessive friction or rupture. This point may be more readily appreciated from the fact that a cold piston clearance of approximately 1/16 in. is necessary in moderate-sized engines not fitted with water-cooled pistons. The pistons are constructed in two parts, with packing rings and babbitted bearing surfaces. They are secured in position on the rods by internal nuts and present plain convex surfaces to the burning gases. Piston rods are of forged steel, with bored water ducts. The packing for both piston rod and tail rod is of metallic ring type.

The engine is started by compressed air pumped into a steel reservoir during a previous run before shutting down. For this purpose a special disengaging gear is provided which isolates the rear cylinder and on admitting the compressed air, allows this cylinder to operate as an air motor until the regular combustion cycle is taken up in the forward cylinder. The rear cylinder may then be thrown into normal action. Oiling is accomplished by steam engine appliances, such as sight feed cups, cylinder pumps and oil rings for crank pins.

The engine is governed by a sensitive flyball governor of the standard design, protected by a circular housing. It operates a vertical piston valve supplying a fuel mixture of constant quality, but in quantities proportionate to the load.

The single-crank engine is at present manufactured in sizes ranging from 250 to 750 hp. and the double-crank from 750 to 1,500 hp. In the latter cranks are placed at 90° angularity, giving four impulses per revolution, and a crank effort corresponding to that of a cross-compound, double-acting steam engine.

It is of interest to note that several installations of this type of engine are in progress. The first to be put into operation will be at the works of the Consolidated Industries Company, Batavia, N. Y., employing 250 hp, single-crank, double-acting engines, direct connected to Westinghouse alternating-current generators, operating in parallel upon a general light and power distribution system. A special coke and gas process known as the Lowe will be employed, yielding three products, metallurgical coke, coal and water gas, the former to be retailed and the latter used for power purposes.



Figs. 2 and 3.—Views of Single-Crank and Double-Crank Gas Engines.

A second installation at the works of the Atlantic Refining Company, Philadelphia, the engines are double-crank, double-acting, of 500 hp each, and are direct connected to Westinghouse 350-kw, three-phase generators, arranged for parallel operation. The engines will operate upon rich oil gas of approximately 1,400 B.t.u. per cubic foot, a by-product of the refining process.

A third interesting installation at Hillburn, N. Y., will supply the entire Ramapo Valley with light and power from a new station now building for the Rockland Electric Company. This plant will also operate upon producer gas, using the Loomis-Pettibone process. The producer plant is located in a separate building and supplies water gas to the Ramapo Iron Works and the Ramapo Foundry Company for heating and metallurgical purposes, as well as power gas to the generating station. The electrical distributing system will supply power to local industries, as well as lighting for the Ramapo Valley, some fourteen miles in extent. The equipment aggregates 1,200 hp, employing 350-hp single-crank engines of the double-acting type, and a small vertical single-acting engine for driving the exciter. Each main engine is direct connected to Westinghouse polyphase generators, arranged for parallel operation. This plant will be one of the first alternating current stations in the country to be operated from gas power.

A further and more recent instance of the confidence placed in the gas power apparatus is that of the Potosina Electric Company, of San Luis Potosina, Mexico, a town of 70,000 inhabitants, situated at an elevation of 6,000 ft. above sea level, about 275 miles northwest of Mexico City. The town was formerly supplied with electric light and power from a direct current steam driven plant, which passed into the control of the present company, and has been converted into a gas central station.

The plant has been laid out for five main units, an exciter unit and a compressor, aggregating 1,225 hp, and will employ the Loomis-Pettibone process for generating a power gas of approximately 120 B.T.U. per cubic foot, calorific value. At the present time but five engines will be installed, comprising three 160-hp, single crank, double-acting machines, direct connected to Westinghouse polyphase generators, operating in parallel upon the general 2,200 volt, three-phase distributing system; one 50 hp, two cylinder, vertical single acting, direct connected to an exciter, and one 15 hp, two cylinder vertical compressor engine. The remaining units, each of 340 hp, will be installed later, when required. The producers will be located in a separate gas house and the best grades of Virginia coals will be used for gasification purposes.

The four installations above noted are among the first applications of fuel gas to power purposes, and the advent of the modern high-power gas engine should serve to open up an entirely new field in gas engineering. A number of power gas processes are now available, including the Loomis-Pettibone, Taylor, Mond, Otto, Hoffman, Lowe, Dellwick, Fleischer and Dowson, and the results obtained from installations now in service give every reason to believe that the gas power will be shortly much in evidence.

A Perambulating Wireless Telegraph Plant.

One of the most ingenious and interesting innovations seen lately in the wireless telegraph field is the introduction of a perambulating plant by the American De Forest Wireless Telegraph Company, ostensibly for stock reporting purposes, though it serves equally well to advertise the company itself as an investment, to the enterprising financiers of the Wall Street district. On February 7 a decided sensation was made on the "curb" by the appearance of an electric automobile of special design bearing on one side the legend, American De Forest Wireless Telegraph Co. On another side was the statement, "Aerograms Received," and on still another side, "Approved and Adopted by the United States Government." The vehicle is surmounted by a glass showcase cupola about three feet square, and in front is a brass pole about twenty feet high, which serves in place of the usual antennæ wires. The operator sits inside the glass box, seen and seeing, so that all his operations can be watched by the "man in the street." Great interest was manifested in the novel machine, when it took up its position among the curb brokers and began to send the market reports into the offices of the *Wall Street Journal* and the nearby brokers.

WIRELESS TELEGRAPH PLANT.

In equipping this automobile outfit it was not possible to use the full De Forest system as that would require a motor generator, and high voltage transformer, which there was not sufficient space to accommodate; therefore, recourse was had to an induction coil giving a two inch spark actuated by the storage battery furnishing power for the propulsion of the auto. The De Forest Company states that De Forest responders were placed in offices up and down Broad Street and successful aerograms giving the latest market reports were furnished to all simultaneously. It is understood that the company have a number of similar machines in course of construction and will rent them for the reporting of athletic events, and for the use of any one who wishes to leave the city and still keep in touch with his house or business.

Electrical Gold Dredges in the Klondike.

The Western Engineering & Construction Company, of San Francisco, is about to instal, in the territory south of the Yukon district, a power transmission plant for the operation of a gold dredge which will be erected at Atlin, B. C., two miles distant from the power plant. This is a new development in the methods of mining in this region, which is a very important placer district, and much gold that would otherwise be lost will be saved by the use of electrically-operated dredges. The work to be done here is similar to that carried on at Oroville, Cal., although the gold is coarser in the Atlin District, being found in nuggets from the size of a pinhead to that of an ostrich egg.

The electrical equipment for this plant consists of the following apparatus, recently purchased from the Westinghouse Electric & Manufacturing Company: Two 180-kw belted alternators, which are to be driven by water wheels; two variable-speed induction motors with controllers; two standard induction motors for driving the pump, one of 20 hp and the other of 50 hp; and a 15-hp motor for operating screens.

It is expected that the machinery will be in operation in July of this year, and enough gold recovered during the season to pay the entire cost of the installation, which, including the hydraulic machinery, amounts to over $150,000. A gold dredge costs from $40,000 to $75,000, depending upon its capacity, and consists of the dredging machine proper and the pumping apparatus which supplies the necessary water for washing and sluicing. The dredge machinery comprises a chain of electrically-driven buckets which pick up the material, a steel hopper into which the material is emptied, a revolving screen designed to receive and wash the excavated material, an appliance for carrying off all the coarse tailings and stones that are rejected by the screens, a sluice box in which the water and fine material containing the gold are disposed of and in which the gold is saved. The stone chute is of a sufficient height and inclination to discharge the material clear of one side of the boat, so that no obstruction can take place on account of the accumulation of tailings. From the under side of the screen all the fine material,

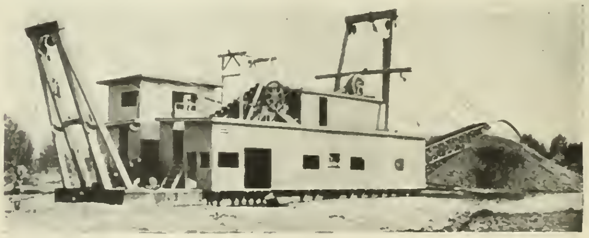


FIG. 1.—ELECTRIC GOLD DREDGE.

including the gold, is discharged with a considerable quantity of water—all of which is carried off and over the stem of the dredge through a sluice box containing a series of riffles in which the gold is caught, and of a length sufficient to carry the tailings clear of the dredge and to save all the gold. When the gold is of too fine a character to be efficiently collected in the ordinary sluice box, a finer screen and gold saving tables are employed.

Formerly the dredging apparatus and pumps were operated by steam engines, and this practice is still largely continued. Electric power, however, is preferable, since it admits of the operation of dredges where fuel is difficult to obtain, the lighting of the dredge by electricity and, if necessary, the carrying on of the work at night. An electrically-operated dredge is illustrated in Fig. 1, showing at the left groups of incandescent lamps mounted in reflectors. Fig. 2 is an interior view of a dredge, showing a variable-speed, Westinghouse induction motor driving a countershaft from which the main dredging buckets are operated.

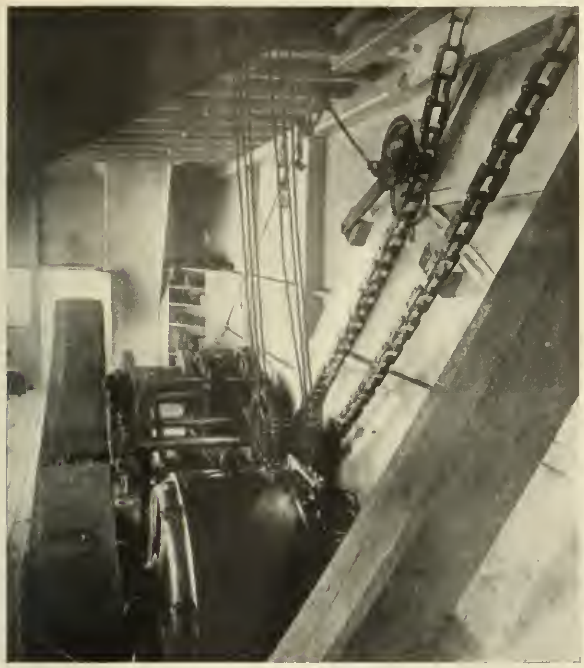


FIG. 2.—DETAILS OF DREDGE.

St. Louis Fair Boiler Plant.

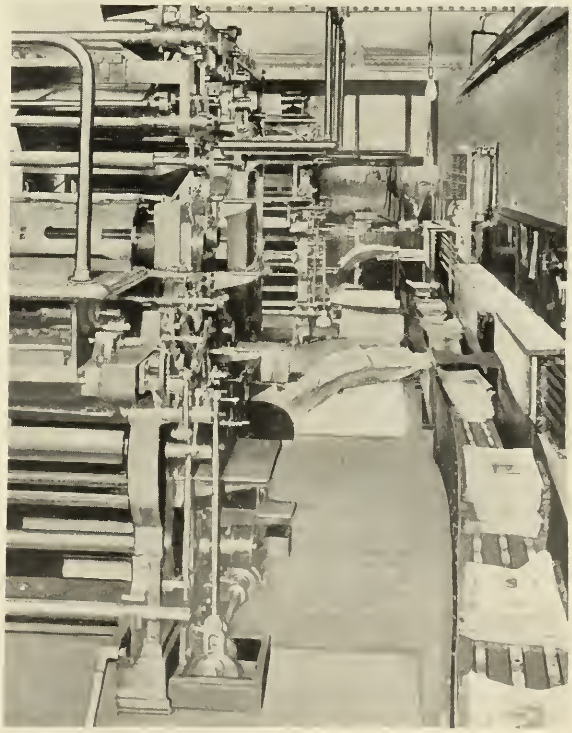
Williams & Wollender signed a contract on February 7 for the erection of a temporary boiler house on the site of the permanent boiler house just west of the Machinery Building, St. Louis Exposition. The temporary boiler house will be built of corrugated iron and wood, of such size that the permanent boiler house can be erected around it and so that it may be wrecked and removed after the permanent house is finished. Here will be installed boilers, engines and generators which will make the light for the dedication ceremonies, for the Saengerfest and for the International Press Congress following. The erection of the temporary house was made necessary by the impossibility of erecting in time for the dedication ceremonies the permanent boiler house and its operating appurtenances. It was found impossibile also to secure from the street railway companies sufficient current for lighting the grounds, and it was learned that the outside contractor, who will supply a part of the vast amount of current needed, would not be ready in time to furnish the light for the dedication. The temporary boiler house will cost considerably less than $2,000, but will house securely machinery capable of producing about a thousand horse-power. Its dimensions will be 66½ by 36 ft. It will contain the Duerr marine boiler recently received from Germany, and two boilers from the Clonbrook Boiler Company, of Brooklyn, N. Y., with ratings, respectively, of 350 and 300 hp. The engine room will contain one engine of 150 kw. capacity from the Skinner Engine Company, and another of the same capacity from the Buffalo Forge Company.

Handling Newspapers by Motor Driven Conveyor.

A recent installation in the office of the *Philadelphia Bulletin* is of novelty and interest. It is the application of the link-belt conveyor to handling newspapers in the press room.

In several features this carrier is unique. There are three parallel roller chains, of special design, running on edge. The conveyor trough is of sheet iron and of sufficient depth to carry piles of 200 papers safely. The action of the carrier is steady and practically noiseless. Its trough occupies scarcely 2 ft in width and it winds in a tortuous course around various obstructions in the most amazing fashion, always with the same easy movement of well-oiled regularity. Mr. Loveland, chief engineer of the *Evening Bulletin*, has supplied an auxiliary carrier from the fly box of each press to the side of the main carrier. It consists of two parallel Ewart chains which convey the papers from the fly box to a shelf alongside the trough of the conveyor. The fly boy is thus able to stand upright and to easily lift the papers, in counted bundles of 50, to the chains of the carrier. The movement of this auxiliary carrier is so timed that the ink dries sufficiently in transit to prevent smudging of the papers in handling.

There are seven large quadruple presses in the *Bulletin* press room, each rattling off finished 16-page papers at the rate of 24,000 per hour, or 8-page papers at the rate of 48,000 per hour. Before the introduction of the link-belt carrier 14 men with 14 trucks were kept busy carrying these papers from the fly boxes to the circulation department. The carrier does away with all these men, their confusion and wages, and does the work better, quicker and with unvarying efficiency. Mr. McLean states that if the carrier did not save a penny in wages, it would still be a good investment, because it dispenses with the maddening confusion of 14 healthy men rushing to and fro with their 14 trucks in the none too ample avenues between the rapidly-moving presses. The Link-Belt Engineering Company, Nicetown, Philadelphia, devised and installed this conveyor, which is driven by a 7½-hp Storey electric motor, connected to the drive shaft by Renold silent chain.



VIEW OF PRESS ROOM SHOWING NEWSPAPER CONVEYOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was in good demand and business of considerable size was transacted, closing at 5 per cent. for 60 to 90 days, 4½ per cent for 4, 5 and 6 months. The stock market was irregular and rather heavy, with trading in the hands of professionals. Various unfavorable rumors of rather indefinite character, aimed apparently at Metropolitan Street Railway, circulated throughout the week, but as such have been common of late the latest had little apparent effect upon the market. The approaching holiday also had an apathetic effect on trading. Amalgamated Copper was strong, but afterwards reacted. Metropolitan was vigorously attacked by bear operators and weakened the other transactions, but Friday's market showed a tendency to recover all around. Brooklyn Rapid Transit made a net gain of ¼ point, closing at 69½, after having touched 71⅛, the sales aggregating 76,745 shares. Metropolitan Street Railway reached 140½ and closed at 139¾, being a net gain of 1¾ point on sales of 63,730 shares. The electrics exhibited general weakness, all closing with losses as compared with the last previous quotations. After having mounted to 204 General Electric closed at 190⅝, which was ⅝ above the lowest quotation of the week. The net loss on the week's trading was 2¾ points. Westinghouse common suffered a decline of 7 points, closing at 211, the highest figure of the week being 217. Western Union receded fractionally, closing at 89⅝, which represents a net loss of ⅜ point. American Telegraph & Telephone was the exception, making a net gain of 5⅜ points, the closing quotation being 168½, only 200 shares having changed hands. American District Telegraph receded 1½ points, closing at 37. Commercial Cable kept steady at 161 throughout the week, this figure being 4 points lower than the last quotation. Following are the closing quotations of February 24:

NEW YORK.

	Feb. 17.	Feb. 24		Feb. 17.	Feb. 24
American Tel. & Cable	84	83¼	General Electric	200	198
American Tel. & Tel.	165	167	Hudson River Tel.	..	..
American Dist. Tel	37	37⅛	Metropolitan St. Ry.	139⅛	137¼
Brooklyn Rapid Transit	70¼	68⅞	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	20	20	N. Y. E. V. T. Co.	10	10
Electric Boat pfd	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	3	3	Western Union Tel.	90	89½
Electric Vehicle	6½	6	Westinghouse com.	217*	212
Electric Vehicle pfd.	11⅛	11	Westinghouse pfd	220*	210

BOSTON.

	Feb. 17.	Feb. 24		Feb. 17.	Feb. 2
American Tel. & Tel	165½	167½	Western Tel. & Tel. pfd.	..	99½
Cumberland Telephone	.	125	Mexican Telephone	2¼	2¼
Edison Elec. Illum	305	..	New England Telephone	.	137
General Electric	200¼	199	Westinghouse	104	105
Western Tel. & Tel	25¼	25	Westinghouse pfd.	105	105

PHILADELPHIA.

		Feb. 24			Feb. 24
American Railways	Election Day.	52	Phila. Traction	Election Day.	98¼
Elec. Storage Battery		..	Phila. Electric		7⅞
Elec. Storage Battery pfd.		..	Pa. Electric Vehicle		..
Elec. Co. of America		9⅛	Pa. Electric Vehicle pfd		3

CHICAGO.

	Feb. 17.	Feb. 24		Feb. 17.	Feb. 24
Central Union Tel	..	..	National Carbon pfd.	98	98
Chicago Edison	162	..	Northwest Elev. com	..	..
Chicago City Ry	220	222	Union Traction	10	10
Chicago Tel. Co	157	158	Union Traction pfd.	45	44
National Carbon	25	25			

*Asked.

BOSTON EDISON EXTENSION.—The Edison Electric Illuminating Company, of Boston, has awarded a contract for the building of the first two units of its South Boston plant to Whidden & Co., of Boston. The two units will be of 10,000 kw capacity. The South Boston plant will contain five units eventually, and aside from the plant of the Edison Company in Chicago will be the largest in the world and capable of supplying light and power to all of the companies within a radius of 20 miles from Boston. The Edison Company acquired recently the Dedham, Blue Hill, Milton, Natick and Framingham Electric Light Companies, and aside from this a number of gentlemen, among whom is President Edgar, of the Edison Company, have bought the Somerville, Woburn and the Newton & Watertown. The latter companies were not bought directly for the Edison Company, but merely as an investment, and for the present at least will be operated independently of the parent company. It is probable, however, that within a short time practically all of the companies in and around the city of Boston, with the exception of the Cambridge Company, will be acquired by the Edison Company. A petition to the gas commissioners for authority to issue new stock to pay for the companies acquired will be presented shortly.

UNION SWITCH & SIGNAL.—The financial statement of the Union Switch & Signal Company for the year ending December 31, 1902, follows:

Earnings.	1902.	1901.		Changes.
Sales	$1,772,385	$1,604,009	Inc.	$168,376
Interest	1,620	1,639	Dec.	19
Total	$1,774,005	$1,605,648	Inc.	$168,357
Total disb., includ. int. on bonds	1,420,321	1,308,142	Inc.	112,179
Total	$353,684	$297,506	Inc.	$56,178

As already noted, Col. H. G. Prout has become associated with this concern, and has just been elected first vice president and general manager.

WESTERN ELECTRIC STOCK DIVIDEND.—The directors of the Western Electric Company have voted to issue a stock dividend of $2,000,000, or 20 per cent. This will increase outstanding stock to $12,000,000. The dividend is payable March 10 in certificates of $100 each, no fractional shares to be issued. All fractions are to be aggregated and sold by the company's officials at the best obtainable price, the proceeds to be divided among the persons entitled thereto pro rata. Stock certificates are to be issued and mailed on March 10 or as soon thereafter as possible. The stock of the Western Electric Company sells on the Chicago curb at around 280 to 300 and very little of the stock is understood to come out on the market, it being very strongly held.

NATIONAL CARBON REPORT.—The annual report of the National Carbon Company shows that the company's assets February 1, 1903, amounted to $10,324,028.88, of which $9,270,000 was in real estate, plants, machinery, etc.; $448,215.57 in merchandise, manufactured and unmanufactured and $364,601.51 in bills and accounts receivable. The liabilities include: Preferred stock, $4,500,000; common stock, $5,500,000; accounts payable, $89,278.01, and profit and loss, $156,000.87. The net earnings of the company for the fiscal year ended January 21 were $594,371.76.

LAKE SHORE ELECTRIC.—The stockholders of the Lake Shore Electric Railway, extending from Cleveland to Toledo, have ratified plans of the directors for issuing a total of $11,000,000 in bonds and $1,500,000 in new preferred stock. Only $5,000,000 of the bonds will be issued immediately, and the new preferred stock will be offered to the old stockholders at 60. The receiver will probably be relieved within 60 days. At least $500,000 will be devoted to betterments of the property.

EVERETT-MOORE SECURITIES COMPANY.—It is reported that Mr. Henry A. Everett, E. W. Moore and other associates contemplate the organization in Cleveland of a securities company with a capitalization of about $50,000,000 for the purpose of taking over, under a lease, the Detroit United Railway, the Toledo Railway & Light Company, the Cleveland, Painesville & Eastern, the Lake Shore Electric Railway and probably the Northern Ohio Traction Company.

NEW BONDS LISTED.—The New York Stock Exchange has listed the following securities: New York Gas & Electric Light, Heat & Power Company's $3,500,000 first mortgage, collateral trust, 5 per cent. bonds, making the total amount listed $15,000,000, and Western Union Telegraph Company's $1,000,000 4½ per cent. funding and real estate mortgage 50-year bonds, making the total amount listed $14,000,000.

AMERICAN RAILWAYS.—The management has under consideration the taking over of a new property which will involve the expenditure of about $100,000. The concern referred to, as a result of bad management, is to-day practically in the hands of its bondholders. If this deal goes through, $100,000 will have to be put practically all on the plant, which is in very bad condition.

MARCONI WIRELESS.—The Marconi Wireless Telegraph Company of America, it is stated, may issue new treasury stock in order to raise $250,000 to complete construction work now needed for regular commercial operation.

NEBRASKA TELEPHONE.—Dispatches from Omaha state that the Nebraska Telephone Company has increased its capital from $1,800,000 to $2,400,000, to pay for extensions and improvements.

GENERAL ELECTRIC STOCK.—Application has been made to the New York Stock Exchange to list General Electric Company $1,973,000 additional common capital stock.

TWIN CITY RAPID TRANSIT.—The annual report shows that Twin City earned 7.06 per cent. on its common stock in 1902, the gross being $3,612,211 and the net $1,982,042. The total of revenue passengers carried were 71,830,971, against 63,009,957 last year. There are 252.55 miles of track in the entire system and President Thomas Lowry says that the physical condition of the property is better than ever before. The company has sold $1,501,000 of its common stock to its stockholders at par. The proceeds of the sale were used partly for improvements during the past year and the remainder is held for the same purpose in the future. There was expended during the year the sum of $1,330,683 for power plants, cars and new construction. The first of last May the company cancelled $20,000 of the remaining $250,000 7 per cent. 1st mortgage bonds of the Minneapolis Street Railway Company, redeeming them in cash.

AMERICAN GRAPHOPHONE COMPANY.—The American Graphophone Company reports for the year ended September 30, 1902, total earnings of $276,778, from which was deducted for dividends, etc., $132,490, leaving a surplus of $144,287. Surplus October 1, 1901, was $186,528, thus making the total surplus October 1, 1902, $330,815. The general balance sheet as of September 30, 1902, follows: Assets—Patents, franchises, etc., $1,270,280; stock, not issued, $144; plants, $744,249; raw material, $78,153; goods in process of manufacture, $164,382; goods on hand, $138,447; accounts and bills receivable, $274,721; cash, $66,847; stock and bonds, $68,818; total, $3,216,652. Liabilities—Preferred stock, $800,000; common stock, $1,200,000; mortgage, $100,000; debenture 5s, due 1918, $451,500; accrued interest and taxes, $308,990; balance due Burt Company, $15,000; depreciation, etc., $10,347; surplus, $330,815; total, $3,216,652.

ST. JOSEPH TRACTION DEAL.—Redmond, Kerr & Co., of New York and Chicago, and Graham, Kerr & Co., of Philadelphia, are offering at 102½ and accrued interest St. Joseph Railway, Light, Heat and Power Company first mortgage 5 per cent. thirty-five year gold bonds. In a letter from the President of the company to the bankers, it is stated that the company has acquired the St. Joseph Traction & Lighting Company, People's Railway, Light & Power Company; Citizens' Railway Company, Union Railway Company, St. Joseph & Lake Railway Company, and Wyatt Park Railway Company, which form the entire street railways of St. Joseph, comprising about forty miles of trolley line and the entire commercial electric lighting and power business of the city.

CUMBERLAND TELEPHONE GROWTH.—The Cumberland Telephone and Telegraph Company now has 338 exchanges, 49 of which were built and opened during the year, showing a net gain of 15,893 subscribers, making the total December 31, 1902, of 92,425 subscribers. The Cumberland Telephone Company is regarded as one of the strongest of the American Bell Telephone Company's licenses. Its 5 per cent. bonds due in 1918 are selling at 110, while the 7 per cent. stock is at present quoted at 123, having sold as high as 140. The company operates in Kentucky, Tennessee, Mississippi and Louisiana.

THE INTERNATIONAL WIRELESS TELEGRAPH COMPANY, with a capital of $7,500,000 and $1,000 paid, has filed articles of incorporation at Camden, N. J. The objects of the corporation are to purchase or acquire the letters patent for the United States granted to any person or persons covering the discovery of wireless telegraphy and telephony, and the invention, improvement, manufacture and use of apparatus.

DIVIDEND.—The stockholders of the Binghamton Railway Company and the subsidiary companies have received notice that a dividend of 2 per cent. will be paid on their stock on the third day of March next. This is the third dividend of 2 per cent. that has been declared by this company.

Commercial Intelligence.

THE WEEK IN TRADE.—Despite drawbacks due to wintry weather, spring jobbing trade is far in advance of a year ago. For the same reason retail business has been noticeably affected and buying has been lessened temporarily. The favorable side of the weather situation is the heavy fall of snow which has covered the entire surplus-producing winter-wheat belt, putting that plant, temporarily at least, beyond danger from seasonal changes. Wholesale buyers are reported more numerous in all the leading markets and Chicago, St. Louis, New York, Kansas City and Boston and most northwestern cities report active inquiry and increased sales for Spring account with numerous re-orders already noted. Active preparations for a heavy building season are going forward. Jobbing trade is improving in the South, a tone of cheerfulness having been imparted by the advance in cotton. In iron and steel, consumption still leads production in the cruder forms. Finished materials are in active demand, but there is general complaint of delay in making deliveries. There is a special activity in plates, bars and structural material and pipe, the transportation problem, however, still affecting the entire trade. Business in copper was very quiet, brokers complaining of scarcity of orders. The closing quotations are 12.90 to 13c. for Lake and electrolytic, 12.60 a 12.80c. for casting stock, and 12.35c. for Standard. The business failures for the week ending February 19, according to *Bradstreet's* report, aggregated 188, against 217 the week previous and 228 the corresponding week last year.

EQUIPPING STEEL WORKS.—Chairman Bacon, of Tennessee Coal & Iron, says in his annual report that it has been decided to erect immediately a large furnace at Ensley, and later to replace four of the stacks now there with others of much greater capacity. Coke oven gas, which has heretofore been a waste product at nearly all of the ovens, is now used to make steam for hoisting and pumping, and will soon steam the boilers that are to run the electric power and light station, now being constructed to supply all of the furnaces, mills and shops at Ensley. In the same manner the Lackawanna Steel Company, at Buffalo, is to equip immense new works specially with electric power. Its dock and ore bank on Lake Erie, supplied with Buffalo electric power to carry iron ore from boats to the top of the stacks of the blast furnaces and empty them automatically, are all ready for operation. One stack is in blast and produced the first pig iron a few days ago. It has a capacity of 300 tons per day and there will be completed as fast as possible five other stacks, two of which will have the enormous capacity of 800 tons of iron daily. The steel plant, which was originally planned for 1,000,000 tons, will have its capacity increased. The electric power to run the works will be obtained from the Canadian side of the Niagara River, as the electric company will be closely identified with the Lackawanna Steel Company. The proposition is to furnish 30,000 hp at the start and to increase this to 100,000 hp.

SOME ALBERGER CONDENSER ORDERS.—The Alberger Condenser Company, White Building, Liberty Street, New York, has obtained a contract from the Westinghouse Electric & Manufacturing Company, Limited, for a high-vacuum surface condensing equipment for two 1,000-kw Westinghouse-Parsons turbines to be installed in the new extension to the Westinghouse works, East Pittsburg. The centrifugal circulating pump will be electrically driven while the vacuum pump will be operated by a Corliss engine. A contract has also been taken for a condensing equipment of the before-mentioned description for the purpose of taking care of two 500-kw Curtis turbines built by the General Electric Company for installation in the Dover (N. H.) plant of the United Gas & Electric Company.

TRAIN LIGHTING.—At a meeting of the directors of the Consolidated Railway Electric Lighting & Equipment Company, held February 11, 1903, Mr. Isaac L. Rice was re-elected president, and J. L. Watson secretary and treasurer. The duties heretofore performed by Mr. John N. Abbott, as vice-president and general manager were added to those of the president, and Mr. Abbott's connection with the company ceased. All communications to this company should be addressed to 100 Broadway, New York.

CONDENSERS FOR CHICAGO COMMONWEALTH PLANT.—The Commonwealth Electric Company, of South Chicago, has just placed a contract with the Alberger Condenser Company, New York, for two high-vacuum condensing equipments with circulating and vacuum pumps. The auxiliaries will be operated by Corliss engines. Each of these equipments will take care of 5,000 kw. This will make three equipments, for which the Alberger people have secured contracts from the Commonwealth Company.

LACHINE RAPIDS POWER COMPANY.—The annual report of the Lachine Rapids Hydraulic & Land Company, of Montreal, shows net earnings, over and above operating expenses, of over 12 per cent. on the paid-up capital. After providing for all fixed charges, bad debts and the usual dividends on a basis of 8 per cent., there was carried forward a surplus of $91,070.

ELECTRIC HOISTS FOR AUSTRALIA.—The Lidgerwood Manufacturing Company, of 95 Liberty Street, New York, has secured a contract from the New South Wales government for two 40-hp double-drum derrick hoists which are to be operated by motors built by the General Electric Company. The machinery is intended to be used on the Sydney docks.

ELECTRICITY FOR MELBOURNE SUBURBS.—Australian advices state that the Victorian Light, Heat & Power Company, Limited, has secured the consent from the local municipal authorities to supply Williamstown, Port Melbourne & Brighton—all suburbs of Melbourne—with electricity for both light and power purposes.

NEW ZEALAND LIGHTING PROJECT.—The New Zealand electrical engineering firm of Wilson & Company, of Wellington, has submitted a proposition to the municipal authorities of Eltham for the electric lighting of that place.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended February 7. Argentine Republic—5 pkgs. machinery, $2,700; 19 pkgs. material, $2,270. Athens—2 pkgs. material, $250. Antwerp—20 pkgs. material, $3,557. Amsterdam—1 pkg. material, $12. Brazil—108 pkgs. machinery, $33,074; 40 pkgs. material, $2,033. British Guiana—78 pkgs. material, $2,030. Berlin—1 pkg. machinery, $902; 3 pkgs. material, $184. British Australia—15 pkgs. machinery, $4,135; 19 pkgs. material, $905. British East Indies—10 pkgs. material, $500. British West Indies—17 pkgs. material, $281; 1 pkg. machinery, $50. British Possessions in Africa—33 pkgs. machinery, $1,100; 66 pkgs. machinery, $5,420. Cowes—25 pkgs. machinery, $1,631. Copenhagen—1 pkg. machinery, $210. Central America—6 pkgs. material, $188. Chili—2 pkgs. material, $172. Christiania—24 pkgs. material, $918. Colombia—23 pkgs. material, $761. Cuba—63 pkgs. material, $2,471. Dutch West Indies—34 pkgs. material, $215. Dutch Guiana—6 pkgs. machinery, $3,838. Egypt—1 pkg. material, $50. Gothenburg—2 pkgs. machinery, $288. Hayti—15 pkgs. material, $364. Havre—18 pkgs. machinery, $1,805; 11 pkgs. material, $268. Hamburg—6 pkgs. machinery, $373; 123 pkgs. material, $5,300. London—67 pkgs. machinery, $13,530; 343 pkgs. material, $8,263. Liverpool—338 pkgs. machinery, $52,740; 22 pkgs. material, $1,200. Lisbon—3 pkgs. material, $9. Mexico—454 pkgs. material $4,725. Manchester—72 pkgs. machinery, $8,113. Milan—1 pkg. material, $80. Middlesborough—1 pkg. machinery, $75. Newfoundland—8 pkgs. material, $260. Nova Scotia—5 pkgs. material, $85. Patras—1 pkg. material, $50. Preston—3 pkgs. material, $3,225. Portuguese Possessions in Africa—53 pkgs. machinery, $4,000. Peru—18 pkgs. machinery, $678. Riga—7 pkgs. material, $350. Southampton—208 pkgs. material, $1,070; 4 pkgs. machinery, $52. San Domingo—6 pkgs. material, $66. Vienna—1 pkg. material, $75.

TELEPHONE FREE DELIVERY.—Though Senator Fairbanks's proposal for an appropriation of $25,000 for an experimental "rural telephone free delivery" will find no place in this year's post office appropriation bill, says a Washington dispatch, it may foreshadow an interesting line of postal development. In many parts of the West almost every farmer has a telephone in his own home, and the service is extending rapidly. Now, Mr. Fairbanks proposes that a special stamp be issued which will denote to the postmaster at the receiving office that the envelope is to be torn open, and the contents telephoned to the person addressed. This would often save the greater part of the day in the rural delivery region, which will soon embrace all the settled parts of the country. Arrangements would be made with local telephone companies for this service. Mr. Lodge objected to the amendment, saying that while our rural free delivery service was still experimental we should not take on new enterprises. Mr. Proctor opposed it as "paternalism run mad," saying that it would be but the entering wedge for the government's delivering express packages or goods from the department stores. The amendment was lost on point of order, but it is likely to be heard from again. The telephone development in the Mississippi Valley has been so extraordinary that its promoters desire to make it contributory to the betterment of the postal service.

EXPORT TRADE.—The export figures furnished by the Treasury Bureau of Statistics continue to indicate that the foreign commerce of the United States is resuming its normal conditions. The January exports were larger than those of any preceding January in the history of our commerce except those of the year 1901, in which the January figures were about $2,000,000 above those of last month. The total value of exports in January, 1903, was $134,040,952, against $136,325,601 in January, 1901; $108,426,674 in January 1898, and $67,673,669 in January, 1893. Turning to the import side, last month's figures show also the largest January imports, being $85,109,891, against $79,138,192 in January of last year, and $75,168,267 in January, 1893. For the 12 months ending with January, 1903, the total imports approximate the billion-dollar line, being $975,283,637, against $742,068,925 for the 12 months ending with January, 1898. This increase in importations is chiefly due to the continuing demand of the manufacturing interests for raw material from abroad for use in their industries. Exports for the month were nearly $50,000,000 to the good.

GOULD STORAGE BATTERY CONTRACTS.—Among the recent contracts closed by the Gould Storage Battery Company are the following: Philadelphia & Lehigh Valley Traction Company; battery to be located near Quakertown, Pa.; 196 cells in glass jars and switchboard; discharge capacity, 200 amp. Warren Electric Street Railway Company, Warren, Pa.: 240 cells in glass jars, switchboard and Gould regulating booster; discharge capacity, 160 amp. Dayton & Muncie Traction Company, 4 plants, located at Winchester, Ind.; Selma, Ind.; Union City, Ohio; Greenville, Ohio; each battery consisting of 305 cells in lead-lined tanks; plate capacity, 320 amp; tank capacity, 400 amp; switchboard and 44-kw regulating Gould booster. Odell Illuminating Company; battery located at Odell, Ill., consisting of 124 cells in jars, capacity, 240 amp hours at 240 volts, for three-wire lighting system. Manhattan Heat, Light & Power Company; battery located at St. Paul, Minn., consisting of 56 cells in lead lined tanks; capacity, 2,080 amp-hours; switchboard and automatic Gould booster for block lighting and regulation.

THE LAWRENCEVILLE MANUFACTURING COMPANY, of Lawrenceville, Va., organized with a capital from $25,000 to $100,000, will build at once a furniture factory to make chamber suits and tables and power house to furnish power. An electric light plant will be installed to furnish Lawrenceville with light. General information, catalogues, etc., are asked from supply houses, machinery makers and electric construction companies. The secretary will furnish data on request. The officers are: Robert Turnbull, president; J. D. Barkley, vice-president; Hugh C. Rirdon, secretary and chairman; O. L. Bostick, treasurer; Charles Hooper, general manager.

A NEW SUPPLY HOUSE IN ST. LOUIS.—The Ewing-Merkle Electric Company has been incorporated in St. Louis to do a strictly jobbing business in electrical supplies and apparatus. The personnel of the company is made up of N. W. Ewing, formerly assistant treasurer; Milton Mill, formerly assistant manager; W. S. Merkle, formerly manager of the engineering department; W. G. Brown, formerly manager of the apparatus department, of the Western Electrical Supply Company. They have rented a six-story and basement building at 1100 Pine Street, and will make a specialty of the jobbing interest in the West and Southwest.

MORE MEXICAN WATER POWER PROJECTS.—Richard Honey, the Mexican mining and railroad capitalist, has acquired a concession granted in 1901 to Juan Fernandez for the purpose of utilizing the waters of the Santa Catarina River on the boundaries of the State of Puebla and Hidalgo at a point called La Cantera. To increase the power, Mr. Honey has applied to the Mexican authorities with a view to including in the concession the necessary rights to permit of employing 5,000 meters of the water from La Cantera up stream and a similar quantity down stream from that point.

LIGHTING AND TRACTION SYSTEM FOR BALLARAT, AUSTRALIA.—The Electric Supply Company, of Victoria, Limited, has been organized for the purpose of installing an up-to-date electric lighting and traction system in the mining town of Ballarat, Australia. Arrangements have been completed for taking over the existing horse tramways and converting them over to electric traction. The overhead trolley system will be employed. The lighting and traction project combined will represent an expenditure in the neighborhood of $600,000.

10,000-HP PLANT TO OPERATE MEXICAN MINES.—An extensive power plant is to be constructed for the purpose of furnishing energy to operate several of the principal mines located in the El Oro district, Mexico. Jose Luis Reguena, one of the prominent mine owners in that section, has secured the requisite concession. The plant, which will be capable of developing 10,000 hp, will be built on the Lerma River. The current will be conveyed for a distance of about 80 miles.

THE LLEWELLYN IRON WORKS, of Los Angeles, Cal., are to be equipped throughout for driving by electric motors. Induction motors will be direct-coupled or belted to lathes, planers and other machinery, and line shafting will be entirely done away with. The Pacific Light & Power Company has recently purchased from the Westinghouse Electric & Manufacturing Company for this plant 20 induction motors, ranging in size from 2 hp to 75 hp, which are now being installed.

ANOTHER MEXICAN WATER POWER PROJECT.—The Dos Estrellas Mining Company is after a concession from the Mexican authorities to permit of the utilization of 25,000 liters of water per second from the River La Cienega. It is proposed to operate the company's reduction works by water power and to furnish the mining town of Tlalpujahua, located in the State of Michoacan, with power for electric lighting use.

LIDGERWOOD ELECTRIC CABLEWAYS.—The Peachbottom Slate Manufacturing Company, of York, Pa., has placed a contract with the Lidgerwood Manufacturing Company for two horizontal cableways with stationary towers. The span will be 700 feet. Each of the cableways will be capable of handling a three-ton load. They will be operated by four 35-hp Westinghouse direct-current motors, series-parallel control.

DE LAVAL TURBINES FOR AUSTRALIA.—J. Bartram & Sons, Melbourne, have placed a contract for two De Laval steam turbine dynamos for installation in their new refrigerating and ice making plants in that Australian city.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, has, it is stated, secured the contract for the municipal plant at Nashville, Tenn.

General News.

THE TELEPHONE.

JACKSONVILLE, FLA.—A long distance line between Jacksonville and Miami will probably be built by the Southern Bell Company at an early date.

LA HOGUE, ILL.—A farmers' mutual telephone company is being organized at this place.

OTTAWA, ILL.—The Bureau County Mutual Telephone Company has just been organized at this place.

MANHATTAN, ILL.—The Manhattan Telephone Company has increased its capital stock of $2,400 to $5,000.

BARRY, ILL.—The Pike County Telephone Company intends to build a line from New Canton to Hannibal.

WINDSOR, ILL. The Windsor Mutual Telephone Company has increased its capital stock from $10,000 to $25,000.

ODELL, ILL.—The farmers north of here have formed a company to build a telephone line between Odell and Nevada.

MASCOUTAH, ILL.—The Mascoutah Electric Light Company proposes to erect and maintain a telephone and telegraph line.

MARTINTON, ILL.—The Local Telephone Company has been incorporated with a capital stock of $10,000 by Horace Barton, J. L. Shaw and E. C. Vanderpoorten.

LONG POINT, ILL.—Long Point Automatic Telephone Company has been organized with a capital stock of $2,500. The incorporators are H. H. Swift, C. E. Goldschmidt and C. W. Johnson.

EAST ST. LOUIS, ILL.—The St. Clair and Eastern Telephone Company, of East St. Louis, has been incorporated with a capital stock of $10,000 by E. M. Evans, C. E. Wise and C. A. Coombs.

BELLEVILLE, ILL.—The Marissa Telephone Company, with a capital of $2,500, has been incorporated by J. A. Hamilton, Henry Finger, R. S. Coulter, A. C. Elder, R. P. Jenson and A. J. Mathews.

ANDERSON, IND.—The Delaware-Madison Telephone Company is considering the question of building a farmers' line.

INDIANAPOLIS, IND.—The Blue River Telephone Company has incorporated to build an exchange in the Friends Church, Blue River, Shelby County. The company will do a local business.

FRANKFORT, IND.—Frank F., and Victor Smith, local capitalists, have become interested in the local telephone company and improvements will be made in the system calling for the expenditure of a large sum of money.

OAKLANDON, IND.—The Oaklandon Telephone Company, with a capital stock of $1,000, has been incorporated by John Moore, J. M. Emery, F. M. Kimberlin, Henry Alford, J. T. Newkirk, O. A. Klepper and T. A. Silvey, all of Oaklandon.

NICHOLS, IOWA.—The Nichols Mutual Telephone Company will establish a local exchange.

NEW HAMPTON, IOWA.—The Sumner Telephone Company has applied for a franchise in this place.

JORDAN, IOWA.—A company will soon be formed to start a new telephone line west and south of Jordan.

THORNTON, IOWA.—The Latimer Telephone Company has been granted a local franchise and will begin work soon.

AVOCA, IOWA.—The Harlan & Avoca Telephone Company is planning to extend its lines to Council Bluffs and South Omaha.

STORM LAKE, IOWA.—W. L. Geisinger, of this city, proposes to construct a telephone line from Storm Lake to Spencer and intermediate points.

WATERLOO, IOWA. The Commonwealth Telephone Company has been incorporated with a capital of $900,000 by R. C. Dawes, C. B. Geist, A. G. Wheeler, Jr., and others.

LIBERTYVILLE, IOWA.—The Libertyville Telephone Company has been incorporated with a capital of $7,000. Among those interested are Ed. Glotfelty, S. K. Davis, J. G. Hutton and Lew Fordyce.

SIOUX CITY, IOWA.—The Sioux City Telephone Company has asked the city council for a franchise to establish a system here. Among those interested are T. A. Thompson, Wm. Milchrist and E. W. Rice.

BOWLING GREEN, KY.—The Home Telephone Company recently organized here, has elected officers as follows: President, Nerge Clark; vice-president, E. H. Stout; secretary, W. B. Mayes; treasurer, J. W. Porter.

BOWLING GREEN, KY.—An independent telephone company headed by Nerge Clark, E. H. Stout and others is putting in a new telephone system at Bowling Green. The capital stock of the company is placed at $100,000.

BETHEL, ME.—The Androscoggin Lakes Telephone and Telegraph Company has been organized with a capital stock of $5,000. Mr. T. Peasle, of Upton, Me., is president.

BOSTON, MASS.—The Cape Cod Telephone Company, with a capital stock of $1,000, has been incorporated. Mr. F. P. Goss is president, and Arthur G. Guyer, treasurer.

ONONDAGA, MICH.—A new telephone company has been organized here with Frank Gukland as president.

FLINT, MICH.—The Bell Telephone Company is making preparations to place its wires underground in this city.

DETROIT, MICH.—The Michigan Telephone Company has just completed a two-wire long distance line between Bay City and Alpena.

GIBBON, MINN. The Gibbon Telephone Company has been incorporated with $10,000 capital stock.

CASTLE ROCK, MINN.—A telephone line is projected to Farmington. C. A. Thompson is interested.

HAMMOND, MINN. A movement is on foot to organize a new telephone line to cover the country trade.

NORWOOD, MINN.—The Norwood-Young America Telephone Company has been incorporated with a capital stock of $50,000 by Geo. J. Bradley, Geo. W. Ocobock, J. D. Kranse and others.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will make extensive improvements in the Northwest during the year. A number of toll lines will be built in Minnesota and between Minneapolis and Duluth.

ST. PAUL, MINN.—The Jasper Telephone Company, of Jasper, has incorporated with a capital stock of $1,500. The incorporators are W. W. Stearns, Alexander Mitchell, E. P. Le Seur, P. O. Olson, M. D. Martin, I. Turner, S. S. King, A. W. Jameson, Andrew Carlson, J. H. Berg, John Peterson, J. H. Taylor and Andrew Rae.

ARLINGTON, NEB.—The Arlington Telephone Company will erect an exchange building in this city.

PLATTSMOUTH, NEB.—The Local Independent Telephone Company is contemplating the erection of a new exchange building in this city, and one for Havelock.

OMAHA, NEB.—The Nebraska Telephone Company will increase its capital stock from $1,800,000 to $2,400,000 for the purpose of extensions and improvements in Nebraska and Iowa. The company will establish new exchanges in Omaha, Lincoln and Council Bluffs. The wires will be laid underground in the latter city.

CHARLOTTE, N. C. It is reported that the Southern Bell Telephone Company has bought a 21-mile independent line between Charlotte and Gastonia.

TRENTON, N. J. The Central New Jersey Telephone Company has been incorporated with a capital stock of $100,000.

NEW BRUNSWICK, N. J.—The People's Co-operative Telephone Company has been incorporated here with a capital stock of $100,000.

TRENTON, N. J.—The Central Illinois Telephone and Telegraph Company has been incorporated here, with a capital stock of $500,000, by L. B. Daily, K. K. McLaren and H. O. Coughlan.

BUFFALO, N. Y.—The Haines Telephone Company has increased its capital stock of $20,000 to $100,000.

BUFFALO, N. Y.—The Independent Union Telephone Company, of Buffalo, has increased its capital stock from $200,000 to $1,000,000.

WAYLAND, N. Y.—The Wayland Independent Telephone Company has been incorporated with a capital stock of $5,000. The directors are G. M. Peabody, G. E. Whiteman and Alexander Engel, of Wayland, N. Y.

SYRACUSE, N. Y.—The Syracuse Telephone Company will place its wires in conduits under the Erie Canal at Salina Street. There will be a manhole at either side of the waterway. The contract has been given to C. J. Sullivan for the construction of nine iron ducts.

WAPAKONETA, OHIO.—The St. Mary's Telephone Company will rebuild its entire system.

MARSHALLVILLE, OHIO.—The Marshallville Telephone Company has increased its capital stock from $1,000 to $10,000.

CINCINNATI, OHIO.—The Board of Fire Trustees contemplates making extensive improvements in the fire alarm service. It is proposed to secure an issue of $125,000 in bonds, part of which will be used in the installation of underground fire alarm telegraph cables and an improved switchboard. A new building will also be erected for the accommodation of the new telegraph system.

PHILADELPHIA, PA.—The annual meeting of the United Telephone & Telegraph Company, of Harrisburg, was held in this city. The following named officers were elected: R. G. Park, president; W. D. Barnard, vice-president; E. A. Scott, secretary, and S. R. Caldwell, treasurer.

GEORGES, S. C.—The Georges Telephone Exchange has been incorporated by R. L. Weeks, M. S. Conner and D. S. Dukes. The capital stock is $5,000.

MEMPHIS, TENN.—The Bald Knob Telephone Company, of Bald Knob, has been incorporated with a capital stock of $5,000. E. R. Wynn is president, George Dickey, vice-president, and L. G. Wynn, secretary and treasurer.

RICHMOND, VA.—The Richmond Telephone Company, recently absorbed by the Bell, has issued notice that it will discontinue business after Feb. 28.

FREDERICKSBURG, VA.—The directors of the Upper Rappahannock Telephone Company have decided to run the line across the Rappahannock river at Port Royal.

MONTEREY, VA.—At the annual meeting of the stockholders of the Monterey and Staunton Telephone Company officers were elected as follows: J. C. Matheny, president; F. Glen Mauzy, secretary and treasurer, and E. H. McClintic, general manager.

MARINETTE, WIS. The Superior Construction Company, of Superior, has petitioned for a telephone franchise in this place.

MILWAUKEE, WIS.—The Western Wisconsin Telephone Company, of Arcadia, has increased its capital stock of $35,000 to $40,000.

MILWAUKEE, WIS.—The Wind Lake Telephone Company, of Norway, Racine Co., has been incorporated with a capital stock of $3,000 by Charles Flett, J. E. Jacobson and Otto E. Schmidt.

WAUSAU, WIS.—The annual meeting of the stockholders of the Wausau Telephone Company was held here a few days ago. The present officers were re-elected. The annual report shows the company to be in a satisfactory financial condition. The company has 525 telephones in use.

ELECTRIC LIGHT AND POWER.

AUGUSTA, ARK.—P. H. Potter, of Clinton, Ky., has secured the contract for an electric light plant.

BLACK HAWK, COL.—The council has granted the Seaton Mountain Electric Light & Power Company an electric light franchise.

TRINIDAD, COL.—It is stated that the Las Animas Light, Power & Mfg. Company is to increase the capacity of its gas and electric plants and extend the system.

SOUTH NORWALK, CONN.—Bids will probably be received in March for an extension to the electric light plant here.

SEAFORD, DEL.—The Town Council will borrow $10,000 for an electric light plant.

ALBANY, GA.—Smith D. Pickett and Chas. F. Garner, of Jacksonville have purchased a water power near Albany for $6,000. A power plant may be erected.

ATLANTA, GA.—The S. Morgan Smith Company, of York, Pa., has secured right of way for transmitting power to Atlanta from the power plant on the Chattahoochie river.

ATLANTA, GA.—J. Frank Lester has made a proposition to the city to erect a lighting plant in connection with the city crematory where lights may be furnished for the city at $30 each, instead of at $82.50, the present price.

ALBANY, GA.—The Albany Power and Manufacturing Company, of Albany, has applied for a charter. Alex. W. Smith and others are the petitioners. The capital stock will be $200,000, with the privilege of increasing to $500,000.

EDWARDSVILLE, ILL.—The Edwardsville Electric Light Company has been granted a franchise.

VENICE, ILL.—The Venice and Granite City Electric Light and Power Company will erect a new power house.

QUINCY, ILL.—C. E. Mead, of Quincy, is general manager of a company being formed to construct an electric light plant, at a probable cost of $150,000.

MORRISON, ILL.—The Morrison Electric Light Company has been incorporated, with a capital of $40,000, by A. V. Viner, Luther R. Ramsey and Saml. L. McCalmount.

GREENCASTLE, IND.—Bids will soon be asked for the electric light plant of the Putnam Electric Company.

ALEXANDRIA, IND.—Suit has been brought to have a receiver appointed for the Alexandria Electric Light & Power Company.

JEFFERSONVILLE, IND.—It is stated that the United Gas & Electric Company will make extensive improvements to its plant.

DECATUR, IND.—The Warring Glove & Mitten factory will purchase a large installment of electric machinery for its plant here.

CAYUGA, IND.—Mr. Barford, of Washington, is reported to have secured the contract for an electric light plant and water works for Cayuga, for about $30,000.

BLUFFTON, IND.—The Olds Construction Company, of Ft. Wayne, Ind., has secured the contract for constructing the electric light plant in this city for $15,000.

SOUTH BEND, IND.—A. M. Barrow, of this city, is at the head of a syndicate which proposes to organize a public utility company for Indiana and consolidate electric light and water plants which have proved unprofitable to stockholders. The syndicate has already secured fifteen plants.

RICHMOND, IND.—The report of the municipal electric light commissioners for the month of January shows municipal ownership is making a failure to the tune of nearly $2,000 per month. The report shows that the plant cost the city during the month $1,277.56. At the beginning of the month the commissioners had a balance of $1,539 and the cash on hand Jan. 31 was $261. This brings the cost of the plant to the city of $1,779.91 over and above the receipts.

MUSCATINE, IA., is asking until March 10 for bids on street electric lighting for ten years with 100 arc lamps.

STRATFORD, IA.—It is stated that Allen Cox, of Linnsburg, will construct an electric light plant to furnish light to Stratford and Dayton.

ST. MARTINSVILLE, LA.—Bids will be received by H. C. Fournet, Chairman Executive Committee on Water and Light, until March 3, for all machinery, apparatus, material and supplies for a water and light plant.

SHREVEPORT, LA.—As a result of the strike among linemen in this city the mayor issued an order suspending the electric light and street railway service. This order was necessitated by the sympathizers of the strikers cutting the wires.

NEWBURYPORT, MASS.—It is stated that the Newburyport Gas & Electric Light Company will construct and equip a new electric light station. W. R. Johnson is president.

SPRINGFIELD, MASS.—Mr. Samuel Rockwell has applied for an act of incorporation for an electric power and light company. It is proposed to use the water of Crystal Lake and the power of the Foxville plant. From Crystal Lake to the foot of the Foxville fall, a 200 ft. fall is available.

BOSTON, MASS.—The Edison Electric Illuminating Company, of this city, has purchased the Natick Gas and Electric Company and the Framingham Electric Company. The Edison Company has already obtained control of the Somerville and Woburn companies and its purpose is said to be the control of all the suburban electric lighting business.

IRON MOUNTAIN, MICH.—It is stated that the Iron Mountain Electric Light & Power Company will expend about $20,000 in improvements.

ST. JOSEPH, MICH.—Congress has reported favorably on the bill permitting the construction of a dam across St. Joseph River in Berrien County, Mich.

LAKEPARK, MINN.—Bids are wanted March 2 for $11,000 electric light and water bonds. O. Larsen is Recorder.

DULUTH, MINN.—The Highland Canal & Power Company will develop the water power of St. Louis River for electrical purposes.

JACKSON, MISS.—Thos. McClelland, of Jackson, is at the head of a new company proposing to put in an independent lighting plant.

NATCHEZ, MISS.—The stockholders of the Natchez Gas Light Company are considering the matter of selling their electric light plant, which may be bought by the Natchez Electric Street Railway Company.

ST. LOUIS, MO.—The King Electric Light Company, of De Hodiamont, has been granted a franchise in St. Ferdinand and Central townships.

HIGH POINT, N. C.—The High Point Electric Company has been incorporated, with $50,000 capital, by W. S. Thompson, of Greensboro, and others. The plant is now owned by C. M. Richardson.

RALEIGH, N. C.—A movement is on foot here for the combination of the street railway system, the gas and electric lighting plant and the big power plant at Milburnie on the Neuse River.

HUDSON, N. H.—A bill has passed second-reading in the House to authorize the town to establish an electric light plant, and construct water works.

TRENTON, N. J.—The Bozeman Light & Traction Company has been incorporated at Jersey City with a capital stock of $500,000 for the purpose of operating gas plants, electric, heat and power plants, etc. The incorporators are Charles H. Hendrickson, Jr., John M. Quinn and Jay Noble Emley.

LIVERPOOL, N. Y.—Fred Wyker has been granted a franchise to light the village by electricity.

WATERTOWN, N. Y.—The People's Power & Light Company, of Watertown, has been incorporated, with a capital of $60,000, by J. M. Carpenter and G. H. Smith, of Watertown.

ALBION, N. Y.—It is reported that the Albion Power Company, which has purchased the plant of the Brockport Electric Light Company, will enlarge and improve the Waterport plant and improve the central station in Albion.

NEW YORK, N. Y.—The United States Light & Heating Company has elected officers as follows: R. H. Beach, president; W. J. Arkell, vice-president; Chas. S. Furst, of Jersey City, secretary and treasurer, and A. Sandford Adler, general manager.

MEDINA, OHIO.—The Medina Electric Illuminating Company has been incorporated with a capital stock of $25,000.

CLEVELAND, OHIO.—A resolution has been introduced in the Board of Control, calling for municipal street lighting.

WILMINGTON C. H., OHIO.—The United Water & Light Company is stated to have purchased the electric light plant of the city.

HARRISON, OHIO.—It is proposed to issue $25,000 in bonds for the purpose of purchasing the electric light plant and water works now in operation in this place.

OAK HARBOR, OHIO.—The plant of the Oak Harbor Electric Light Company has ceased operation, owing to the inability of the company and the town authorities to agree as to charges for arc lights. The present rate is $50 per light, but the company asks $65.

OTTAWA, ONT.—The Consumers Electric Company has increased its rates for current from 8 cents per kw-hour to 12 cents, allowing 40 per cent. discount on payments within fifteen days; thus making a net rate of 7⅕ cents per kw-hour.

PENDLETON, ORE.—It is reported that the Pendleton Electric Company will double the capacity of its plant at a cost of about $20,000.

FT. STEVENS, ORE.—Bids will be received by F. H. Hathaway, Vancouver Barracks, Wash., on March 6 for furnishing and delivering material for the construction of an electric light plant at this post.

UNION, S. C.—T. C. Duncan, of Union, is interested in a big scheme to utilize the water power of Broad River and bring electric power to Union for commercial purposes.

DOLAND, S. D.—Wm. Wells will receive bids about June 1 for the construction of an electric light plant.

WHITE LAKE, S. D.—If private parties cannot be induced to construct an electric light plant here the citizens will urge the town to establish a plant, to cost about $4,000.

KNOXVILLE, TENN.—The Knoxville Power Company, it is stated, has been authorized to dam the Little Tennessee River.

SPRINGVILLE, UTAH.—The citizens have voted to issue $20,000 bonds for the construction of an electric light plant.

ALEXANDRIA, VA.—An engineer will be employed to prepare plans for an electric light plant.

PETERSBURG, VA.—The council of Petersburg has invited bids from the Virginia Passenger and Power Company for lighting the city for a term of years. The company offers to furnish arc lights at $57 per year each, if a five-year contract is made.

BLUEFIELD, W. VA.—The Bluefield Railway, Light & Power Company has been incorporated, with a capital stock of $10,000, by S. R. Bullock, C. C. Brown, John W. Avery, A. C. Bagg, F. B. Daniels, New York City.

BRUCE, WIS.—It is reported that the Bruce Electric Light Company will construct a plant.

BELOIT, WIS.—The city is figuring on a complete electric light system, to consist of about 20 miles of wire, 250 arc lights and incandescents according to demand. Robert Caldwell is city engineer.

THE ELECTRIC RAILWAY.

OPELIKA, ALA.—An electric railway will be built at Opelika. The new company has purchased the plant of the local electric light company.

HARTFORD, CONN.—The West Side Street Railway Company, of Stonington, is seeking a charter.

HARTFORD, CONN.—The Middletown & Meriden Traction Company is seeking incorporation. It plans to build from Highland Station to Meriden.

HARTFORD, CONN.—The Willimantic & Southbridge Street Railway Company has applied to the Legislature for permission to increase its capital stock to $200,000. The plan of the company is to build an electric railway to connect Willimantic, Conn., and Southbridge, Mass.

WOODBURY, CONN.—The application of the Woodbury & Waterbury Street Railway Company for incorporation has been presented to the Legislature. The incorporators are Floyd F. Hitchcock, Levi A. Curtiss, of Woodbury; Christian Stroebel, of Waterbury, and Fred L. Averill, of Bradford. The capital stock is to be $200,000.

DELAWARE CITY, DEL.—It is proposed to build an electric railway between Milford and Delaware City. H. L. Evans, of the Wilmington and New Castle Railway Company, is said to be interested.

ATLANTA, GA.—The dispute between the Georgia Railway and Electric Company and the city of Atlanta over the company's taxes for 1902 has been settled by the company's paying to the city $23,695.

ATHENS, GA.—The J. Morgan Syndicate, builders of electric and steam railroads, Toledo, Ohio, have written to the mayor of Athens expressing a desire to work up a company to build an electric railway to Atlanta, Washington and other towns.

ATLANTA, GA.—The Chattahoochee Terminal Railway Company, capital $250,000 is being organized at Atlanta to build a line to Marietta, 20 miles distant. The petitioners for a charter are represented by Thos. A. Gramling, N. A. Morris and others. The company asks for the privilege of increasing its capital to $2,000,000.

BOISE, IDAHO.—Howard Sebree, of Caldwell, has applied for the right of way for the construction of an electric railway from Boise to Caldwell, a distance of 30 miles.

SYCAMORE, ILL.—The De Kalb-Sycamore Electric Railway Company plans to extend its lines to Belvidere.

CHICAGO, ILL.—The City Council has granted an ordinance to construct a mile of track on Western Avenue, to connect the cross-town lines of the Chicago City Railway and the Chicago Union Traction Company. The ordinance becomes effective only after these two companies make an operating agreement whereby transfers will be exchanged.

EAST ST. LOUIS, ILL.—The Interstate Transit Company will put in operation April 1, twenty-four improved electric automobiles, forming a passenger service scheduled to traverse the greater portion of the East St. Louis thoroughfares. Until a few weeks ago this company operated an automobile line over Eads bridge, which received a liberal patronage. For the purpose of charging the batteries the company will utilize a power plant which is now being established in East St. Louis.

RICHMOND, IND.—The Richmond Street & Interurban Railway Company will build an extension from Milton to Connersville.

MT. VERNON, IND.—The city council has granted a 50-year franchise to the Evansville, Mt. Vernon & Union Town Traction Company.

HUNTINGTON, IND.—The Ft. Wayne & Southwestern Traction Company is furnishing power for the grist and other mills in this city. The company promises to have such patrons all along the line.

LOGANSPORT, IND.—The Knox, Chicago & Northern Traction Company has been organized to build an electric railway 140 miles long. The company is to be capitalized at $150,000. J. C. Fletcher, of Knox, is president.

INDIANAPOLIS, IND.—The Indianapolis, Columbus and Southern Traction Company has filed a mortgage to secure its issue of bonds lately sold in the East. The mortgage is for $1,000,000, but at present only $300,000 of the bonds will be issued. The money is to provide for extensions and betterments.

GREENWOOD, IND.—The name of the Indianapolis, Greenwood & Franklin Railway Company has been changed to Indianapolis, Columbus & Southern Traction Company, and the capital increased from $150,000 to $285,000. A bond issue of $300,000 has been ratified by the directors. The headquarters of the company will be moved to Columbus.

SOUTH BEND, IND.—Employees of the Indiana Railway Company went on strike a few days ago and as a result the cities of South Bend, Mishawaka, Elkhart and Goshen were practically without car service. The strike was caused, it is said, through the discharge of ten men who were officers of the union. The union now demands that the company reinstate the discharged men, grant a nine-hour day schedule, adjust greivances by arbitration, recognize the union and pay 20 cents an hour on city runs, $2.25 a day on interurban runs and 25 cents an hour overtime. The company carries the mail between South Bend and Goshen and trouble will result if the mails are held up.

LOUISVILLE, KY.—The Louisville, Anchorage & Pewee Valley Electric Railway Company has increased its capital stock to $1,250,000. The charter has been changed to enable the company to build to Shelbyville, Frankfort, Eminence and Mt. Eaton.

AUGUSTA, ME.—A bill has been introduced in the Legislature to incorporate the Winterport, Frankfort & Prospect Electric Railway.

ELKTON, MD.—The City Council has granted a franchise to the Cecil & Kent Electric Company.

PITTSFORD, MICH.—Dr. Ducket, of Toledo, and C. B. Bettis, of Adrian, are projecting an electric railway from Adrian to Hillsdale to pass through this place.

GRAND LEDGE, MICH.—The organization of the Michigan Central Traction Company was perfected at a meeting held here a few days ago. The company is capitalized at $1,500,000. The officers are Samuel Burgert, of Cleveland, president; J. W. Ewing, of Grand Lodge, assistant treasurer; E. F. Pangborn and A. J. White, of Battle Creek; Warren Craig, R. Rosenstock, Samuel Burgert, of Cleveland, F. H. Goadby, of New York, J. S. Mudge, of Grand Ledge, directors.

GLASGOW, MO.—A charter has been granted to the Central Missouri Electric Railway with a capital stock of $4,000,000.

ST. LOUIS, MO.—The St. Louis Suburban Railway Company filed articles showing that it had made an increase in its capital stock from $3,000,000 to $7,500,000. The St. Louis & Meramec River Railway Company has increased its capital stock from $2,000,000 to $3,000,000.

DURHAM, N. C.—J. S. Manning, R. H. Wright and H. A. Fanshee are named as incorporators of the Chapel Hill Trolley Company, which proposes to build a line from Durham to Chapel Hill, a distance of 12 miles.

BUFFALO, N. Y.—The Buffalo & Depew Electric Railway has been granted a franchise to extend its line through Le Roy.

CANISTEO, N. Y.—The Canisteo, Jasper & Woodhull Railway Company has obtained authority from the State Railroad Commissioners to construct its proposed road.

TOLEDO, OHIO.—The Toledo & Western Railway Company has re-elected the present officers.

ASHTABULA, OHIO.—The Ashtabula & Lake Shore Railway Company has been formed by L. A. Robinson, W. S. McGheehan, Frank Hood and others.

WOOSTER, OHIO.—The Wooster & Mansfield Railway Company has elected these officers: W. A. Craig, president; J. B. Keys, vice-president; David Collier, secretary, and J. C. Chretown, treasurer, all of Shreve.

BUCYRUS, OHIO.—The Buckeye Traction Company has awarded a contract for the construction of the first section of its road between Norwalk and Plymouth. Later the road will be extended to Bucyrus.

CINCINNATI, OHIO.—The Cincinnati & Columbus Traction Company has decided to adopt the overhead trolley system instead of the third rail system as originally planned. Contracts will be closed in the very near future.

CLEVELAND, OHIO.—The Cleveland City Railway Company has issued $1,000,000 worth of new stock at par, which is 10 points below the present selling price. The capital stock is increased from $8,000,000 to $9,000,000.

XENIA, OHIO.—The Xenia & Wilmington Traction Company is planning to erect a large power station at Xenia to supply its own road as well as the Springfield & Xenia railway which has no power house of its own. Charles Orr, of Cleveland, is interested in both companies.

EAST LIVERPOOL, OHIO.—President Healey, of the East Liverpool Street Railway, announces that important improvements are to be made to the system. A number of new cars have been ordered and a 250-hp boiler is to be installed in the power station. A portion of the road will be double tracked and other portions of the road will be relaid.

COLUMBUS, OHIO.—Colonel Albert A. E. Boone, of Zanesville, has incorporated two companies for the purpose of encircling Cleveland and Columbus with belt lines. The Cleveland line is incorporated as the Cleveland Manufacturers' Belt Line & Terminal Railway Company, while the Columbus company is known as the Columbus Belt Line & Terminal Railway Company. Both have temporary capital stock of $10,000.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has awarded contracts to the Bullock Electric Company, Cincinnati, for two 1000-kw alternating current generators, five 400-kw rotary converters, fifteen 150-kw and six 370-kw transformers. Contract for the high tension line has been placed with the Pittsburg Reduction Company. The power house will be at Reese's Station and plans have been prepared by W. E. Baker, New York.

CLEVELAND, OHIO.—Extensive improvements will be made to the Cleveland street railway system during the coming season and it is stated that the Cleveland City Railway Company and the Cleveland Electric Railway Company will expend $1,500,000 in betterments. The Cleveland City Railway Company will extend its Clifton boulevard line to Rocky River and will also extend its West Madison Avenue line. It will also extend its Collinwood line to connect with those of the other company. The Cleveland Electric Railway Company is installing a new storage battery station at the Wildermere barns and another will be built at Newburg. Its line from East Cleveland to Euclid will be double tracked.

CARLISLE, PA.—The York and Gettysburg Street Railway has been incorporated by C. C. Baschore, E. J. Wilkes, C. M. Ligget, E. M. Biddle, Jr.; J. L. Zug and J. S. Shapley.

SPRING CITY, PA.—The Montgomery & Chester Electric Railway Company and the Schuylkill Valley Illuminating Company have authorized the expenditure of $120,000 in improvements.

PITTSBURG, PA.—The main office of the Pittsburg, McKeesport & Connellsville Railway Company and all the affiliated light companies have moved to and are now located in the Title & Trust Building, Connellsville, Pa. The million dollar power plant of the railway company will be put in operation within thirty days and power wil be delivered from this plant to all points of the system just as soon is the high tension lines are completed. The main links in the system are being rapidly closed up and the final bridges are being erected so that the entire road will be in operation in the near future, with the exception of the extensions which are to be built this summer. The company has recently completed a very nice layout of new shops at Connellsville, and is in the market for the equipment for these shops. Mr. Thos. Elliott is general manager.

HARRISBURG, PA.—The following named street railway companies have been incorporated: Elizabethtown & Middletown Street Railway Company, capital stock, $54,000, President, Edward Bailey, Harrisburg. Directors: H. K. Alwine, A. L. Etter, Middletown; H. H. Nissley, E. E. Coble, H. C.

Lewis, H. K. Blough, Elizabethtown; John E. Fox, Harrisburg; Isaac R. Herr, Lancaster. Meadville, Conneautville & Albion Traction Company, capital stock, $100,000, President, J. J. De Kinder, Philadelphia, Directors: J. J. De Kinder, J. H. McNeal, R. M. Anderson, L. M. A. Stifel, A. C. Wood, Philadelphia. Lake Erie & Albion Traction Company, capital stock $72,000, President, J. J. De Kinder, Philadelphia. Directors. J. J. De Kinder, J. H. McNeal, R. M. Anderson, L. M. A. Stiefel, A. C. Wood. Philadelphia Girard & Conneaut Traction Company, capital stock $36,000, President, Robert L. Forrest, Philadelphia. Directors Robert L. Forrest, M. M. Freeman, John H. Cromie, Jr., J. H. McNeal, Philadelphia; Walter H. Wood, Holmesburg. Monaca Heights Street Railway Company. Capital stock, $7,500. President, James H. Welch, Monaca. Directors: John T. Taylor, Frederick Bechtel, Edward Kaye, Walter G. Moffat, Monaca. Sewickley & Leetsdale Electric Street Railway Company, capital stock $18,000, President, J. H. Park, Beaver. Directors. W. A. Park, J. D. White, Rochester; John Warren, Beaver Falls; J. M. Beal, Beaver. Hall Park Street Railway Company, capital stock $18,000, President, T. N. Barnsdall, Pittsburg. Directors: Robert C. Hall, C. V. Reid, William M. Robinson, Pittsburg. Chester Glass, Spokane, Wash.

COLUMBIA, S. C.—The Columbia Electric Street Railway Company has bought out the local gas company and the two companies consolidated.

WARE SHOALS, S. C.—The Ware Shoals Manufacturing Company contemplates building a 5-mile road, to be operated probably by electricity. W. B. Smith Whaley, of Columbia, S. C., is interested.

LEXINGTON, S. C.—Col. G. T. Graham has bought Ranch Shoals on Saluda river near Lexington and a large power house will be erected. It is presumed that the purchase was made for the proposed Lexington Columbia electric railway.

MINERAL CITY, WASH.—Fred E. Sander is interested in a plan to build an electric railway to connect Index and Mineral City, 14 miles distant.

BLOOMINGTON, WIS.—Local interests propose incorporating a company to build an electric railway from Bloomington to Dubuque.

NEW INDUSTRIAL COMPANIES.

PORTER & BERG have incorporated, in Chicago, with a capital stock of $30,000, to manufacture electrical apparatus. Messrs. J. W. Porter, M. I. Berg and L. C. Howard are interested.

THE UNION ELECTRIC LAMP AND GLASS COMPANY, of Kentucky, has been incorporated in Delaware, with a capital stock of $300,000, by Albert H. Kreitler and George F. Haynes, of Owensboro, Ky.

THE METROPOLITAN BUREAU ELECTRICAL AND MECHANICAL MAINTENANCE COMPANY, St. Louis, Mo., with a capital stock of $50,000, has been incorporated by Samuel Barnes, B. C. Seaton and W. F. Seaton.

THE CRYSTAL PALACE POWER COMPANY, of Arizona, has been incorporated under the laws of that territory with a capital stock of $2,000,000, of which $50,000 is to be employed in Missouri. The company will maintain an office in St. Louis.

THE GIBBS ENGINEERING AND MANUFACTURING COMPANY, of Corning, N. Y., has been incorporated with a capital of $1,000,000 to manufacture motors. The directors are Samuel Riker, Jr., Percy I. Fuller and Charles M. Kirby, New York.

THE IGNITO COMPANY OF NEW ENGLAND has been organized at Portland, Me., to deal in lighting and heating apparatus. The capital stock is $150,000. Mr. Frank M. Copeland, of Newton, Mass., is president and J. L. Jellerson, also of Newton, is treasurer.

OBITUARY.

MR. WALTER A. HUSTON, for fifteen years superintendent of the People's Light and Power Company's plant, died last week, at Orange, N. J. He was fifty years of age, and was born in Pennsylvania. He leaves a widow and three daughters.

LEGAL.

NEW YORK SUBWAY CONDUITS.—The Appellate Division of the Supreme Court of the State of New York has unanimously reversed an order of the Supreme Court denying Subway Contractor John B. McDonald's application for a mandamus to compel Controller Grout to issue a warrant for the payment of $400,000 for certain extra work brought about in a change in the plans for the construction of the underground road. The question before the court was whether this extra work was part of the road's construction or part of its equipment—if the latter, Mr. McDonald was to bear the expense, if the former, the city. When the contract between Mr. McDonald and the city was first entered into the question of motive power was to be subsequently determined. It was however contemplated at the time that if electricity was chosen the wires, etc., were to be strung in the tunnel itself. After Mr. McDonald had proceeded for some time with the construction of the road, it was decided that the wires should be placed in conduits in the sidewalls of the subway. This made necessary a greater excavation to one side and the construction of brick conduits. The court holds that the brick conduits are an integral, inseparable part of the wall. "Being such," said Justice Hatch, for the court, "the city has the absolute title to the whole structure, and it seems to me absurd to say that the contractor can share any ownership therein or the city any lien thereon."

PERSONAL.

MR. THOMAS I. FAY is no longer associated with the Storey Motor & Electric Company, of Harrison, N. J.

PROF. R. H. THURSTON, of Cornell University, is to lecture before the New York Electrical Society next month on steam turbines, a subject of great interest to all classes of electrical men.

MR. W. D. RAY has become connected with the Westinghouse Traction Brake Company to represent its air brakes and magnetic brakes in the Central States, with headquarters at the Union Trust Building, Detroit, Mich.

MR. F. A. L. TURNER has resigned his position as general manager of the Standard Telephone Company, of Atlanta, Ga., and accepted the general managership of the Federal Telephone Company, of Cleveland, Ohio.

PROF. JOHN M. BARR, of the Department of Mechanical Designing of Cornell University, has been engaged as general manager of the Smith Premier Typewriter Company, of Syracuse, N. Y., and will assume the duties at once.

MR. CHARLES C. GALBRAITH has resigned as general manager of Armour & Co., and has become one of the vice presidents of the De Forest Wireless Telegraph Company, and treasurer of the American De Forest Wireless Telegraph Company.

MR. W. J. HAMMER made an interesting exhibit before the New York Academy of Medicine last week, of the sample of radium given him by Mr. Curie, and already brought by him to the attention of the American Institute of Electrical Engineers.

MR. BEVERLY R. VALUE, third division engineer of the Rapid Transit Commission, of New York City, has resigned to accept a position with the Toronto Light and Power Co. He had charge of the underground work north of One Hundred and Fourth Street, on the Manhattan-Bronx subway. At the last meeting of the commission C. V. R. Powers, now chief assistant to Mr. Value, was chosen as the latter's successor.

MR. C. T. YERKES.—Speaking at the Mayor of Kensington's dinner, in London, last week, on schemes for the improvement of London transportation, Mr. C. T. Yerkes said that so far as he was concerned, it was not a matter of making money with him. He could make more money by remaining in America, but he had got to the point now where he did not care so much for that. What he wanted to do was to accomplish something for the British metropolis.

MR. FRANK B. RAE, consulting electrical engineer, New York City, has arrived at Parral, Mexico, and is looking over the ground at the mines of the Terrenates Consolidated Mining Company preparatory to the installation of a complete electrical equipment. The plant will consist of two 300-hp De Laval turbine dynamos of 200-kw each, two 50-hp electrical hoists and two 350-gal. pumps. Power will be transmitted on aluminum conductors 1¼ miles to the distributing center. These are the first De Laval turbines to be installed in a Mexican mine—probably the first in Mexico—and it is believed that the plant will be one of the most economical in the district.

MR. ANDREW CARNEGIE.—Announcement was made last week of an additional gift of $125,000 by Andrew Carnegie to the endowment fund of the Carnegie Engineering Laboratory of Stevens Institute. The gift was in railroad bonds, and was sent to Alexander C. Humphreys, the new president of the institute. This gift makes the third to the institute by Mr. Carnegie, all of them applied to the Laboratory of Engineering, at the dedication of which on Feb. 6 of 1902 he chose his own epitaph: "Here lies a man who knew how to get around him men who were cleverer than he." The original gift for the laboratory was $50,000, made on May 20, 1899, for the erection of the building. The second was $100,000 as a laboratory endowment fund.

MR. W. D. SARGENT, the amiable and popular vice-president of the New York & New Jersey Telephone Company, was married last week at Somerset, Pa., to Miss Mary Kooser, daughter of Judge Kooser. The party from Brooklyn had a lively time getting there, owing to the heavy snow storm. Their train over the Pennsylvania Railroad was four hours late and it missed connections with the morning train over the Baltimore and Ohio. The afternoon train would not arrive at Somerset until two hours after the time set for the wedding. The couple had also arranged to start on the afternoon train for their bridal trip. No engine was available except a yard shifter. It was speedily attached to the car in which the party was travelling and rattled off the forty miles of snow-drifted roadbed in an hour, bringing in the bridegroom and his party to Somerset a short time before the hour set for the wedding. Then everything went well and the happy pair are now in Florida on their honeymoon.

THE ORTHWEINS, of St. Louis, Mo., are at the head of a new competitive telegraph enterprise. The family fortunes there were started by Charles W. Orthwein and his brother William D. Orthwein, who went to St. Louis from Germany many years ago, and established themselves in the grain commission business. The firm gradually built up a big export trade, in which in the last quarter of a century a fortune estimated at from $2,000,000 to $3,000,000 was made. Charles W. Orthwein died several years ago, leaving three sons, Max, Ralph and Armin. Max and Ralph are interested in the grain commission business with their uncle. William D. Ralph is largely interested also in the Sempire Clock Company, the American Association Baseball Club and minor enterprises, taking but little active interest in the grain business. Max is also financially interested in the baseball club, but devotes most of his time to the grain business. William D. Orthwein has one son, William D., Jr., who has been abroad for two years.

EDUCATIONAL.

Y. M. C. A.—A course in electricity is now being given by Mr. Edward Montchyk in the West Side Young Men's Christian Association, 318 West Fifty-seventh Street, New York City. The course aims at elementary but very practical instruction.

UNIVERSITY OF MICHIGAN.—The new engineeing building which is now being erected at the University of Michigan at a cost of $140,000 consists of a main part and three large wings. The main part, which is in the extreme southeast corner of the campus is 57x66 feet on the ground and four stories high. It spans the diagonal walk which passes beneath the building as an arcade fourteen feet wide. A wing 60x174 feet in size extends west from the main portion, and another 60x213 feet extends to the north. At the end of this latter wing there is an extension 22x100 feet. Another wing 60x60 feet projects in the direction of the tall power house chimney.

STEVENS INSTITUTE OF TECHNOLOGY.—The Alumni of this excellent college are largely represented in the engineering and other scientific societies of the United States. A recent compilation showed that the American Society of Mechanical Engineers has in its membership list about 178 Stevens alumni, the American Institute of Electrical Engineers 63, the American Gas Light Association 30, the American Society of Naval Architects 9. The American Institute of Mining Engineers, American Institute of Heating and Ventilating Engineers, the American Association for the Advancement of Science and the several local engineering societies throughout the country all contain many Stevens graduates among their membership.

Trade Notes.

THE BURT MFG. CO., Akron, Ohio, has just made a shipment of 11 exhaust heads to a concern in Philadelphia.

THE NEW YORK AND OHIO COMPANY, Warren, Ohio, is putting on the market a high class of insulating cloths and varnishes. This is a new departure for the well-known concern named.

THE EASTERN CARBON WORKS, Jersey City, N. J., are sending out some handsome blotters about their carbons, batteries, brushes and other specialties, which are well spoken of wherever used.

REMOVAL.—The Columbia Electric & Mfg. Co., Newark, N. J., will, about March 1, move to its new factory at the corner of High Street and Boyden Place. Its business has increased to such an extent that it has been compelled to move into more commodious quarters. All interested in electric lamps are invited to call and see the Columbia arc lamp.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., gives much attention to the manufacture of lead pencils for special uses. As a result there are a great many different kinds of pencils, each with its special name. The latest addition to the list is the "Car Inspector" pencil. It has a strong, smooth lead, which will be found very suitable for general desk work.

THE BENJAMIN ELECTRIC MFG. CO., of Chicago, is opening offices at 27 Thames St., New York. The company manufactures the well-known Benjamin wireless clusters, in addition to which are some other specialties; and it is comtemplated that a full stock will be kept on hand. Mr. R. B. Benjamin, manager of the company, was a visitor to New York last week.

THE NATIONAL ELECTRICAL SUPPLY COMPANY, 1417 New York Avenue, Washington, D. C., has issued a series of 7 bulletins, devoted respectively to the Sumter "Bull's-Eye" express switchboard; "Sumterphones;" intercommunicating telephones; telephone accessories; construction tools, and line material. All of these devices and apparatus are illustrated and briefly described.

WESTINGHOUSE ELECTRO-PNEUMATIC CONTROL SYSTEM.—The Westingnouse Air Brake Company, Pittsburg, Pa., has brought out an artistically designed pamphlet describing and illustrating its electro-pneumatic system for controlling railway and other motors. This system as used on the Brooklyn Elevated Railways was described and illustrated in ELECTRICAL WORLD AND ENGINEER, Jan. 10.

THE MECHANICAL BOILER CLEANER COMPANY has received a letter from Mr. John I. Beggs, president of the Milwaukee Electric Railway & Light Company, in which he states that he now has fifteen of the Garrigus cleaners in operation, is equipping eight more and is gradually putting them on all his boilers. He writes that his experience has been such that he "unreservedly commends the cleaner," and that its use has enabled him to more than double the time between cleanings.

MESSRS EUGENE MUNSELL & CO., 218 Water St., New York, who have long been engaged in mining and importing mica, have recently added to their business the manufacture of mica specialties, such as lamp chimneys, canopies, candle shade protectors, etc. In their 1903 catalogue and price list, just issued, is a line of reflectors for incandescent electric lamps, which is absolutely new. Being made of the best clear mica, they cast absolutely no shadow, and it is claimed that they intensify the light four fold. Some of the forms are made to produce a flower-like effect, and when used with colored lamps for decorative purposes, the results are marvelous. Application has been made for a patent on these reflectors, and all of Messrs. Munsell & Co.'s mica specialties will be distinguished by the copyrighted word "Micanite." The catalogue and price list can be obtained on application.

PRINTERS' INK, which has rightfully earned the sobriquet, "The Little Schoolmaster of Advertising," has issued a book entitled "Leading Newspapers." This publication is not only devoted to dailies, but takes up class journals in addition. In commenting on the science of electricity mention is made of the fact that eighteen periodicals are published in this line, and a list is given of three weekly publications which are known to have a circulation of five thousand copies or over per issue. Of these three papers one is ELECTRICAL WORLD AND ENGINEER, and the other two are admittedly not electrical, except by association. Under the heading of "Engineering" a statement is made that 31 publications appear under this classification, and then follows a list of papers having admittedly a circulation of six thousand copies per issue or more. Under the heading of "Engineering" appear publications devoted to different branches, and the only electrical paper which is mentioned at all is ELECTRICAL WORLD AND ENGINEER. The testimony of the leading authority on newspaper advertising is convincing. The book contains 204 pages and is bound in cloth, with gold edges.

THE ALLIS-CHALMERS COMPANY will, on May 1, remove its general offices from the present location in the Home Insurance Building to the New York Life Building, corner of Monroe and La Salle Streets, Chicago. This move is only another indication of the progressive spirit which prevails in the management of this strong industrial. The Allis-Chalmers Company has for the past two years been expending enormous sums of money in betterments at its various plants at Milwaukee, Chicago and Scranton, so as to give its customers the best possible service in point of economy and quick deliveries. The new offices of the Allis-Chalmers Company will provide ample space for the various sales departments and general business offices which will be inducive of the best possible service to its trade. To give a fair idea of the scope of the business enjoyed by the Allis-Chalmers Company, it may be mentioned that during the past two months orders for either engines, mining machinery, rock crushing machinery, saw mill machinery and flour mill machinery were booked from every state in the Union, besides the following named foreign countries: England, South Africa, Mexico, Canada, Chile, Central America, Brazil, West Australia, Turkey, Finland, Yukon Territory, Belgium, British Columbia, Bolivia, Peru, China and Alaska, also the Hawaiian and Philippine Islands.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 17, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

720,550. ELECTRIC CIRCUIT AND POLARITY INDICATOR; V. G. Apple, Dayton, Ohio. App. filed June 17, 1901. A push button containing a small vessel of liquid which changes color when the current passes through it, to show that the circuit is operative when the button is pushed.

720,563. STORAGE BATTERY SYSTEM; R. N. Chamberlain, Depew, N. Y. App. filed Oct. 17, 1901. A polarization cell having a counter electromotive force equal to that of the end cell sections is included between the successive positions of a switch.

720,568. SPACE TELEGRAPHY; L. De Forest, Chicago, Ill. App. filed March 6, 1901. Provides means for the selective selection of waves, receivers being placed at nodal points of the circuit.

720,577. ELECTRIC BATTERY; E. R. Gill, New York, N. Y. App. filed June 26, 1900. A block containing cavities for dry cells, each of which has a spring contact which is engaged by terminals in a plate resting over the block.

720,592. ELECTRIC BATTERY; M. M. Kohn, Chicago, Ill. App. filed July 31, 1895. Details of a sealing and venting plug.

720,595. RINGING-GENERATOR; J. C. F. Malthaner, Minneapolis, Minn. App. filed September 13, 1902. (See page 364.)

720,596. ELECTROMAGNETIC RECIPROCATING TOOL; C. Marshall, Lafayette, Ind. App. filed June 8, 1901. A commutating switch adapted to alternately energize the solenoids and to momentarily short circuit each solenoid at the instant its circuit is broken, to discharge the self-induced current.

720,599. X-RAY TRACER; F. Moritz, Munich, Germany. App. filed Oct. 13, 1900. An adjustable frame embodying a drawing surface by means of which the exact shape, size and location of an object disclosed by the X-rays can be traced.

720,604. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Jan. 24, 1901. This invention and those which follow, by the same patentee, consists of various devices for automatically controlling the generation, storage and distribution of current in train lighting systems wherein the dynamo is driven from the axle of a car.

720,605. ELECTRIC TRAIN LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Sept. 9, 1901. See 720,604.

720,606. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Sept. 14, 1901. See 720,604.

720,607. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Oct. 26, 1901. See 720,604.

720,608. ELECTRIC TRAIN LIGHTING; J. F. McElroy, Albany, N. Y. App. filed Jan. 13, 1902. See 720,604.

720,609. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Jan. 16, 1902. See 720,604.

720,610. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Feb. 19, 1902. See 720,604.

720,612. TROLLEY WHEEL; T. McWilliams, Kings Park, N. Y. App. filed April 12, 1902. A knock-down wheel in which the tread portion can be easily renewed.

720,621. APPARATUS FOR ELECTROMAGNETICALLY RECORDING SPEECH; W. A. Rosenbaum, New Rochelle, N. Y. App. filed June 22, 1901. (See page 364.)

720,633. TROLLEY; J. Spena, Lilly, Pa. App. filed Aug. 4, 1902. A device adapted to hold the wheel on the wire until the cord is pulled to release it.

720,636. AUTOMATIC HAMMER; E. H. Swift, Hartford, Conn. App. filed April 28, 1902. An electric hammer for gold beating, provided with automatic devices for regulating the stroke.

720,650. ELECTRIC ARC LAMP; A. Witte, New York, N. Y. App. filed

Feb. 16, 1902. An improvement in the gas check and an arrangement of two passages through one of which air can be forced to blow out the carbon dust in the globe, through the other.

720,651. ELECTRIC BATTERY; V. G. Apple, Dayton, Ohio. App. filed June 3, 1901. The conducting portion of one set of plates is cast integrally with the containing vessel.

720,661. REGULATING DEVICE FOR ELECTRICAL MACHINES DRIVEN BY STEAM MOTORS; Charles Eugen Lancelot Brown, Baden, Switzerland. App. filed Aug. 30, 1902. (See Current News and Notes.)

720,668. PRINTING TELEGRAPH; L. Cerebotani, Munich, Germany. App. filed July 3, 1899. Details.

720,674. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Feb. 12, 1902. A small regulating motor whose direction of rotation and consequent insertion or withdrawal of resistance in the field circuit of the dynamo is dependent upon the output of the dynamo, the latter being driven from the axle of a car.

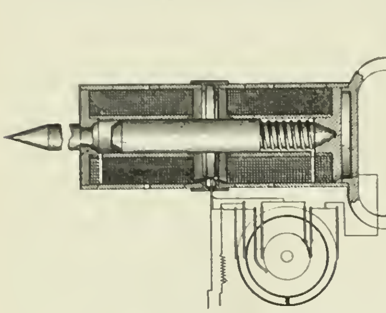
720,675. SYSTEM OF DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Feb. 12, 1902. Means for maintaining the voltage of a variable speed generator constant, and for regulating the lamp circuit in accordance with the rise in voltage while the load is being raised from zero to its maximum.

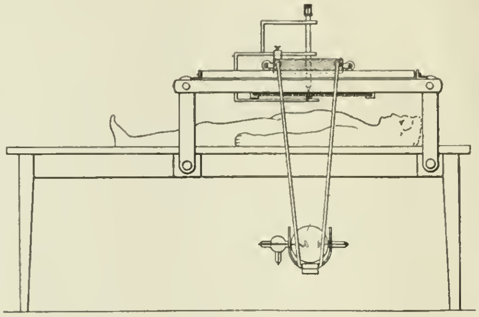
720,683. ENGINE STOP; W. H. Dunn, Wallingford, Conn. App. filed Feb. 3, 1902. The object is to maintain an alarm circuit so that a signal may be sent in from any point of the system to the attendant in charge of the mechanism to which the stop device is applied.

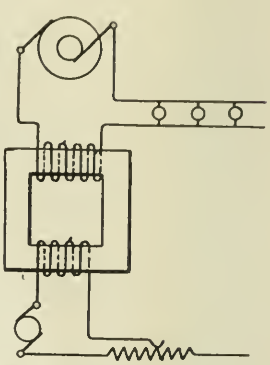
720,684. ELECTRIC RAILWAY; G. L. Fowler, New York, N. Y. App. filed July 18, 1900. A third rail having two contact faces, one on each side and protected by a sheet metal shield.

720,711. ELECTRICAL INFLUENCE MACHINE; S. Lemstrom, Helsingfors, Russia. App. filed Oct. 6, 1902. The drums are supported upon a pair of separate spindles which extend only to the ends of the drum and are thus as far apart as possible.

720,729. ELECTRICAL INTERRUPTER; G. P. McDonnell, St. Louis, Mo. App. filed March 17, 1902. A rotary disk having contacts on its face and a brush movable with respect thereto for interrupting the circuit to vary the strength without the aid of resistance.


720,506.—Electromagnetic Reciprocating Tool.


720,599.—X-Ray Tracer.


720,884.—Regulation of Electric Circuits

720,741. ELECTROLYTIC DIAPHRAGM AND PROCESS OF MAKING SAME; Hugh Rodman, Philadelphia, Pa. App. filed March 18, 1902. (See Current News and Notes.)

720,772. ELECTRIC ARC LAMP; H. Baggett, London, England. App. filed Dec. 15, 1902. Details.

720,783. ANTISEPTIC ATTACHMENT FOR TELEPHONE-MOUTHPIECES; C. W. Clough, Watsonville, Cal. App. filed April 17, 1902. (See page 364.)

720,793. APPARATUS FOR REINFORCING AND STANDARDIZING FILAMENTS OF GLOW LAMPS; F. Fanta, London, England. App. filed July 11, 1901. Means for simultaneously treating the filament with hydrocarbon gas and taking photometric tests to determine when the filament has been sufficiently built up.

720,808. INCANDESCENT LAMP SOCKET; H. Hubbell, Bridgeport, Conn. App. filed May 26, 1902. Details.

720,858. SNAP SWITCH; W. C. Tregoning, Bridgeport, Conn. App. filed July 5, 1902. Details of a single button push switch.

720,875. TELEGRAPH SYSTEM; W. E. Athern, Brooklyn, N. Y. App. filed March 19, 1902. Apparatus whereby separate signals can be sent respectively by direct and alternating currents.

720,879. OVERHEAD TROLLEY; J. J. Bouchard, Bradford, Pa. App. filed Nov. 15, 1902. The wheel is mounted upon a kind of universal joint affording it freedom to alter its position when traversing curves.

720,880. TELEPHONE-RECEIVER HOLDER; A. J. Briggs, Allegheny, Pa. App. filed December 10, 1901. (See page 364.)

720,884. REGULATION OF ELECTRIC CIRCUITS; C. F. Burgess and B. Frankenfield, Madison, Wis. App. filed June 12, 1901. The circuit includes a coil of wire wound upon a core of magnetic material and constituting an inductive resistance for regulating the current and potential on a line.

720,885. SELF-INDICATING OPERATOR'S KEY; G. L. Burlingame, Chicago, Ill. App. filed April 3, 1902. (See page 364.)

720,888. X-RAY APPARATUS; E. W. Caldwell, New York, N. Y. App. filed Nov. 10, 1902. Details of the circuit interrupting apparatus.

720,898. MEANS FOR DISSIPATING ELECTRICITY IN SHEETS OF PAPER; Thomas C. Dexter, Pearl River, N. Y., and Thomas F. Brown, Colwyn, Pa. App. filed March 17, 1902. A heated blast is directed against the sheets of paper in feeding. The blast consists of heated air or the heated products of combustion of a mixture of air and gas.

720,901. TELEGRAPHIC SYSTEM; J. Doyle, Norwood, N. J. App. filed June 19, 1902. No circuit closers are employed on the keys, the normal position of the key being such as to keep the line closed.

720,91[illegible]. ELECTRIC BRAKE; J. C. Henry, Denver, Colo. App. filed April 1, 1901. A reversing switch having contacts to connect the motor with the power circuit to drive it in either direction and also having contacts to connect the motor in a local circuit with a braking magnet.

720,951. ELECTRIC BRAKE; F. C. Newell, Wilkinsburg, Pa. App. filed April 18, 1901. The invention consists in means whereby the same contact points on the controller may be used for braking as for running, while at the same time the controller handle is adapted to be moved in opposite directions from its "off" or neutral position for regulating the current in the running and braking circuits, respectively.

720,953. ELECTRIC LAMP SOCKET; M. Norden, New York, N. Y. App. filed May 12, 1902. Details of a lamp receptacle.

720,962. INCANDESCENT ELECTRIC LAMP; C. Panthonier, Paris, France. App. filed July 7, 1900. An arrangement by which lamps can be connected in groups on high potential circuits as well as on the ordinary commercial circuits and afford increased illuminating power and reduce the consumption of current.

720,978. ELECTRIC VEHICLE BRAKE; C. J. Specht and C. R. Krueger, New York, N. Y. App. filed June 7, 1902. A hollow brake shoe containing electro-magnets for transforming the shoe into a magnet.

720,979. METER; William Stanley, Great Barrington, Mass. App. filed April 5, 1902. (See Current News and Notes.)

720,980. METER; William Stanley, Great Barrington, Mass. App. filed June 25, 1902. (See Current News and Notes.)

720,981. APPARATUS FOR MEASURING THE ENERGY OF ELECTRIC CURRENTS; W. Stanley, Great Barrington, Mass. App. filed July 16, 1902. (See Current News and Notes.)

721,000. STREET RAILWAY SWITCH; W. J. Bell, Los Angeles, Cal. App. filed July 25, 1902. The switch tongue and switch throwing rail are normally coupled together to move in unison, the uncoupling being effected by electrical means controlled from the car, when the latter is to be switched from the main track.

721,025. DYNAMO DRIVING MECHANISM; J. L. Creveling, New York, N. Y. App. filed Nov. 29, 1902. Clutch mechanism and co-operating pulleys supported independent of and on opposite sides of the armature and adapted to communicate motion in one direction only to the armature irrespective of the reversals of the direction of movement of the source of power.

721,032. ELECTROMEDICAL BELT; F. Farmer, Richmond, Ind. App. filed Nov. 29, 1902. Details.

721,042. SOCKET EXTENSION TAP; H. F. Holland, Boston, Mass. App. filed Feb. 11, 1901. Taps located in the side of a lamp socket from which a branch circuit may lead.

721,068. APPARATUS FOR DECOMPOSING WATER BY ELECTROLYSIS; William F. Mason McCarty, Rockyridge, Md. App. filed April 22, 1902. Two upright tanks are connected about midway of their height by a horizontal conduit and have outlets at the upper ends. Each tank has an electrode having its upper end located between the upper and lower edge of the conduit. A water jacket surrounds the tank.

721,084. AUDIBLE ELECTRICAL TELEGRAPHY; R. Oxlade, Redfern, Sidney, New South Wales, Australia. App. filed April 9, 1902. The signals utilized are those produced by the break of the current in the primary of an induction coil and are responded to by telephone receivers.

721,124. CENTRAL-ENERGY TELEPHONE SYSTEM; F. W. Dunbar, Chicago, Ill. App. filed March 22, 1901. (See page 364.)

721,128. MULTIPLE SERIES SYSTEM OF ELECTRICAL DISTRIBUTION; F. H. Loveridge, Coldwater, Mich. App. filed Nov. 9, 1896. Means for automatically balancing a multiple series system of distribution.

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ELECTRICAL WORLD AND ENGINEER.

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CONTENTS.

Editorial ... 385
Tesla Split-Phase Patent Invalidated ... 388
Union College Electrical Course ... 388
An Interurban Road with Hooded Third Rail ... 389
A Hydro-Electric Power Plant in Newfoundland. By Earl E. Boardway ... 391
Tuned Wireless Telegraph Circuits ... 393
Elster and Geitel's Improved form of Exner's Electroscope. By A. Frederick Collins ... 394
A Simple Current Interrupter. By C. Francis Jenkins ... 395
The Use of High Tension Underground Conductors. By Henry Floy ... 396
Alternating Currents in Coal Mining ... 397
Electrical Exhibits at St. Louis, 1904 ... 398
Electric Ore Smelting ... 399
The Construction of Aerial Telephone Lines—VI. By Arthur V. Abbott, C. E. ... 400
Municipal Ownership Convention in New York ... 401
New Brooklyn Rapid Transit Power Station ... 404
Axle Train Lighting ... 405
Current News and Notes ... 408
LETTER TO THE EDITORS:
  Power Required to Drive Machine Tools. By Chas. P. Sands ... 410
Digest of Current Electrical Literature ... 410
New Books ... 413
British Westinghouse Works ... 414
Hydro-Electric Development in Italy ... 416
Italian Recording Wattmeters ... 417
The Henry Train Lighting System on the Chicago & Alton R. R. ... 419
Western Electric Fans ... 419
Central Station use of "Hylo" Lamps ... 421
Alkaline Storage Battery ... 421
Keeping Labor Costs in Factories ... 421
A New Type of "Button" Telephone Transmitter ... 421
New Revolving Desk Fan ... 422
Lineman's Climbers ... 422
News of the Week ... 423

INTERNATIONAL PATENT PROTECTION.

It is interesting and encouraging to note that amidst all the blockading and filibustering in Washington over necessary legislation, the Senate has passed the House bill to render effective the provisions of the additional act of the International Convention for the Protection of Industrial Property. It amends the application of the patent laws so as to make the practice in the United States conform to that of the international convention. This is a decided step forward in creating uniformity of patent law and the extension of international patent protection; and we have no doubt that President Roosevelt will find the measure worthy of his signature. The ultimate aim of such work must be, however, to effect something similar to international postage. It will be remembered that not long since we quoted in these pages the admirable argument of Mr. John S. Seymour, United States Commissioner of Patents under President Cleveland, in favor of a universal patent examination system, which should practically validate a good patent everywhere throughout the civilized world and economize in the cost of securing and maintaining the rights of worthy inventors. Mr. Seymour may seem to some people a little in advance of his time, but civilization means nothing if it does not mean the execution of such ideas as his.

THE ST. LOUIS EXPOSITION.

Elsewhere we print an article which gives a gratifying account of progress on the St. Louis Exposition. From this it appears that the Electricity Building—which promises to be the architectural *chef d'œuvre* of the Exposition—is almost completed in its main structure, and that applications for space thus far made indicate that instead of there being any surplus at the time when the procrastinator usually wakes up, a problem will be encountered in supplying the demands of the early-comers. An admirable feature of the plans for the show proper is that which provides for working exhibits which will not only be of the highest interest to the technical visitor, but will also appeal to the layman. In this respect the Exposition promises to set a precedent which will give a new impetus to the international exposition idea which, owing to the sameness of such shows in recent years, was beginning to lose its erstwhile potency. The electrical arrangements decided upon show throughout a grasp of the situation highly creditable to Prof. Goldsborough and the authorities who are upholding his hands.

THE BRUSH STORAGE BATTERY PATENT.

It is now almost twenty-two years since Sir William Thomson sensationally introduced the storage battery to the world by remarking dramatically at a scientific gathering that a small box he held in his hand contained one million foot-pounds of stored energy. The statement caught the fancy of the newspapers of the world, and for a long period the storage battery monopolized attention to the exclusion of other current electrical developments. Highly capitalized companies were everywhere formed to exploit the new marvel, inventors the world over turned attention to its improvement, and patent offices were overwhelmed with applications based upon their work. Four years later the electrical public was startled by the issue of a patent to Charles F. Brush, which not only covered the whole previous art, excluding Planté cells, but also any improvements to the composite plate that might be made during its life of seventeen years—which only ended last week. Though the very principle of the storage battery as developed from the beginning of last century involved a metallic structure, the Brush patent of March 3, 1886, covered absolutely the use of a metallic support in connection with any improvement offered, which claim practically closed the art to all except the owners of the patent, and rendered subsidiary to it the many hundreds of patents which irrepressible inventors nevertheless insisted upon taking out during its life. It is true that in suits which immediately followed the issue of the patent, it was established that Brush had anticipated Faure in the conception of the composite plate, but the intrinsic merit of the specific invention which the patent covered seems to fall very far short of having justified for a period of seventeen years the complete monopolization of an art well developed before its issue. The expiration of the Brush patent appears to remove the last obstacle to the general manufacture of storage batteries. Whether this means much or little commercially cannot be safely predicted; for in the past, in some cases the lapsing of fundamental patents has been followed by important developments, as has been witnessed in the telephone art, while in other cases not much headway has been made in free competition with the interest which during the life of its patents had taken advantage of the opportunity afforded to place itself in a position to meet such competition. Without doubt, however, a careful investigation of the many hundreds of storage battery patents issued since 1881 and dormant since 1886 would reveal improvements of merit, and particularly in details that could be applied to present types.

AXLE-CAR LIGHTING.

The three papers read last week before the American Institute of Electrical Engineers, on the subject of railroad car electric lighting by axle-driven generators, are of interest in pointing out the divergence in methods employed, notwithstanding the fact that electric car-lighting was one of the earliest applications of the incandescent lamp. It is to be regretted, however, that the budget of papers did not include one or more on the system of train lighting now most largely in use—that employing an engine generating set taking steam from the locomotive. The problem involved in train lighting is very easily enunciated. A railroad car is propelled by a steam-engine, with the occasional aid of gravitation. The rotation of the car-axles furnishes the motive power for a dynamo. The dynamo supplies the lamps on the car, and also charges a storage battery for service during halts and stoppages. On paper, nothing could be simpler.

When, however, the actual problem in steel and copper is confronted, it proves to be most tantalizing and harrassing. The axle of a railroad car is sacred to a railroad man and "taboo." Its integrity must not be interfered with by the lighting engineer who wants to harness to it his dynamo. The dynamo must be supported from the car truck, and the distance between the dynamo shaft and the driving car-axle is, therefore, subject to variation, and often to oscillatory variation. The dynamo and its connection with the car axle is hidden under the truck, where no man wants to look at it, and where no man does look at it unless he is obliged to, and then in a cramped, crouching attitude of defiance; so that self-reliance and self-lubrication are qualities that are of the highest importance to the dynamo and gearing—qualities that have to be imparted thereto at birth, as they cannot be satisfactorily added afterwards.

The dynamo is driven at continually varying speeds. The speed at which it must take up its load and march means some 18 miles-per-hour of the car-wheel tread. Yet if the cars runs at five times this speed, the dynamo must not only work safely, but the lamps must not suspect that there is anything unusual happening. There must be hand switches to turn on the lamps in the car. There must be automatic switches to cut in the storage battery when the dynamo throws down its task at slow speed, and also to cut in the dynamo when the latter comes up to the speed at which it again lays its shoulder to the wheel. If anything goes wrong with these switches, it may be at a place where no man within a hundred miles knows how to rectify their behavior. The man actually in charge of the plant on the car may be fatally charged with the mission of smashing and mishandling whatever mechanism comes to his hand. So this mechanism must be fool-proof, water proof, snow-proof, dust proof and yet do faithful service withal. The man who can design a reasonably good axle-driven train lighting system is a good engineer; but the man who can stand by and bring it to perfection and satisfactory service is either in league with the powers of darkness, or else deserves an aureola. One of the systems described before the Institute uses 32-volt lamps. Another uses 64-volt lamps. In some systems 100-volt lamps are employed. Again, one system uses a dynamo, a motor and a "bucker," with four armature windings and commutators, divided among the three. Another system employs a motor-driven shunt-rheostat controller, and the third system, as described in its paper, is almost absolute perfection—only we are not told what it is.

HIGH TENSION CABLES.

Mr. Floy's paper in the present issue is a comforting, if brief account of high voltage underground work. By many engineers the transmission of energy at high voltage underground is considered a *dernier resort,* never to be undertaken save under stress of absolute necessity, and then for the smallest possible distance and with some trepidation. Not that it is impossible to get good cables even for 25,000 volts or more, and so to install them that they will be fairly enduring; but it is held that this underground work is enormously expensive if well done, and that generally it is not necessary. Going underground from choice or unless forced there by the stern hand of the law is pretty nearly unthinkable to the average American engineer, who is not so much deterred by the cost nor the short life of the cables, as by the eternal uncertainty as to the risks. For, he reasons, you cannot tell when a cable is likely to go, nor at what spot it is in danger. It may test out excellently well month after month, and then go up without warning some day and leave the plan paralyzed, unless duplicate cables are already in place, for many hours or even days; and interruption of service is a calamity not easily to be over-estimated in its material and moral effect.

Even assuming this standpoint, in some cases local conditions make underground cables, even for high voltage, a necessity, and to the credit of our cable manufacturers be it said that they have turned out, as Mr. Floy clearly shows, some exceedingly good material. In fact, the high voltage cables are as a rule given a factor of safety rather more considerable than in the ordinary distribution cables for moderate voltage, and they do, therefore, better than one would naturally expect. The exact nature of the insulating material is in this instance less important than the thoroughness with which it is protected from moisture and mechanical injury. It is not an excessively difficult matter to find insulation that when firm and dry will stand the highest voltages yet in commercial use, but it must be confessed that to preserve its integrity is quite another matter. However insulated, high voltage cables should be installed in the dryest of conduits and with the minimum possible number of joints. Joints are always danger spots in any cable, and if conditions permit it is wise to arrange the conduits so that rather long runs can be made, and to plan for extraordinary drainage facilities. As to the particular nature of the insulation, every system has its earnest advocates, and every system has its failings. Rubber has been the canonical insulation for a long time, but some highly successful cables have been made without it, and in the present scarcity of rubber there is a strong incentive to try something else. Rubber is a magnificent insulator when of first-rate quality, but it is chemically somewhat unstable, and it is a good sign to see other materials coming into use, particularly when of lower specific inductive capacity.

In spite of the relatively small trouble that seems so far to have arisen from resonance and the particular case of it known as surging, it still is a menace of a very serious character, and is a commoner cause of trouble than is generally supposed. Even on overhead lines it often breaks loose with very sensational results, and we have known of instances where cables have given continual trouble from this cause until proper remedies were applied. Static capacity is a thing to be dreaded from this point of view, and even on overhead lines it steadily tends to unpleasantly large values. But danger comes generally not from the normal relations between capacity and inductance but from the abnormal ones. The inductance of a system is not a constant quantity and one may easily get into danger without suspecting it. Hence, when underground cables are included in the system they need watching with the possibilities of resonance in mind. As to the lack of danger from lightning to which Mr. Floy refers, we recall the fact that in 1898 three submarine mines near Hampton Roads were exploded during a single thunderstorm by, if we remember aright, the same flash of lightning. Of course, the conditions are not quite parallel, but while underground lines surely are safer from certain kinds of lightning effects than overhead lines, it is not safe to assume that there is complete security. Extended experience alone can decide as to the strength of the position of those who hold that while a well-planned underground line is less liable to minor accidents than an ordinary overhead one it runs greater risk of serious and protracted interruptions of service. For assurance, in putting down an underground high-tension line, not only should the very best materials be employed, but for greatest security the line should be in duplicate and so separated that even in the man-holes the failure and destruction of a cable cannot involve its neighbors. An entirely separate conduit from the low-tension lines should be used in large installations whenever feasible, so as still further to remove the likelihood of complete disability.

THE PROPOSED NEW YORK STATE ELECTRICAL LABORATORY.

The report of the Commission, consisting of Messrs. Bond, Steinmetz and Buck, appointed to investigate the necessity of establishing a State Laboratory, has been issued in pamphlet form. The report commences by stating that according to the best available information, the capital invested in New York State in electric railroads, light and power stations, telegraph and telephone systems, amounts to nearly one and one-half billions of dollars; while the capital invested in the manufacture of electrical apparatus is, moreover, about one-seventh of the above, or over two hundred millions of dollars. Fourteen reasons are then assigned for the utility which a state laboratory may possess. The plant recommended in the report consists of a 500-hp power-house, a storage building with an elevator, an electro-chemical building, a machinery building, and an administration building with a lecture hall. The estimate for these buildings is about $80,000, which seems very low. The estimate for equipment is about $180,000, or about 2¼ times the building allowance. Ten thousand dollars more for superintendence and etc., brings the total estimate to $275,000. The report concludes by recommending that this sum be appropriated, that the selection of a site and nomination of a director be confided to the Commission, as well as the preparation of a plan of control. A circular letter is appended which was issued to a number of persons and corporations in and out of New York State. About fifty replies to this circular are printed. The consensus of opinion thus elicited appears to be in favor of a state electrical laboratory properly conducted, though a number criticize one or more features of the proposed plan and scope. As the adverse action of the American Institute of Electrical Engineers had not been taken when the report was rendered, naturally no mention of it appears.

It seems that if the laboratory is conducted in co-operation with the National Bureau of Standards at Washington, some useful results might be secured therefrom. Any attempt, however, to set up a laboratory in a State usurping the functions of the National Bureau of Standards would be a deplorable catastrophe to the progress of electrical science in the country at large. It is open to doubt whether there will be a real necessity for the New York State laboratory as soon as the National Bureau at Washington is completed and also in view of commercial testing establishments already existing. Moreover, it has been announced that the former proposes to foster the establishment of calibration bureaus in the electrical engineering departments of our universities to cater to local needs. Indeed, the report is far from convincing on this point. A section entitled "Misconceptions Corrected" is devoted to a reply to the criticism which has been freely directed against the establishment of the proposed laboratory, and in this it is stated that all the Commission proposes is the establishment of the laboratory for (1) the calibration of all forms of electrical meters and other electrical apparatus and appliances. (2) Experimental tests which may be called for by the courts, by municipalities or by individuals, for impartial evidence on disputed questions of fact. (3) Continual investigation and experiment with a view to the development of electrical science and to further application of electrical power to useful ends. It would appear that (1) and (3) would in part involve conflict with the functions of the National Standardization Bureau; that (3) in part would cover ground that the Carnegie Institute, with its annual fund of a quarter of a million for the purposes of investigation, has preempted; and that (1) would in part place the State in competition with existing commercial testing bureaus.

But to our mind, the greatest objection to the project is the precedent it would set. In some states the electrical hanger-on with a political pull would most surely be inspired to become perniciously active in working for the establishment of a similar institution in his state, to the directorship of which he would naturally aspire; with state laboratories generally established, each with its own methods of work, there could scarcely fail to be cases in which apparatus pronounced entirely satisfactory in one state would be found wanting in another, thus involving trouble and annoyance to manufacturers; and in states where the municipal ownership feeling is strong, the control of the state laboratory would inevitably become a political question, as witness the strenuous efforts made for the control for ulterior purposes of the State Railroad Commissions where such exist. If, however, the project is viewed with favor at Albany and meets with realization, there is every assurance that the laboratory, so long as its work is supervised by gentlemen of the standing and ability of those who constitute the present commission, will make a return for the money expended; for the more work that is done in experimental science, the more rapid should be the advance of engineering, and of national wealth consequent upon engineering. The agricultural experiment stations, more than fifty in number, which are scattered over the States are operated in conjunction with a central bureau in Washington, and it is to this co-operation that at least part of the excellent results of the system are attributable. It is equally important that a state laboratory issuing physical standards should be co-operated with the central and National Bureau of Standard at Washington, otherwise we may find that a multiplication of laboratories introduces confusion and a multiplication of different standards The report assures that such co-operation is part of the present plan —but who will answer for the future proper conduct of the institution?

Tesla Split-Phase Patent Invalidated.

The United States Circuit Court of Appeals, sitting in New York, handed down a decision last week, invalidating two Tesla split-phase patents issued December 26, 1893. These are the same patents which were involved in the Ohio fan motor suit, in which case they were sustained (April, 1902) on appeal, against the defence that the patents were anticipated by an earlier patent granted to the same inventor. In June, 1901, Judge Lacombe in the present case sustained the patents, and is thus reversed on appeal. The defence in the lower court was no infringement, the grounds being taken that the patents merely covered motors and did not apply to meters; and that the meter in suit did not involve the use of a rotary field. The suit was instituted against the Catskill Illuminating & Power Company, but was directed at the Scheefer meter, manufactured by the Diamond Meter Company, of Perior, Ill.

The ground upon which the patents have been invalidated is that the principle which they covered was disclosed in a report of a lecture delivered by Prof. Galileo Ferraris, in Turin, March 16, 1888, and printed in the Italian journal, *L'Electricitta,* April 22, 1888. The applications for the Tesla patent were filed Dec. 8, 1888, and the court held that the complainant failed to establish that Tesla had conceived the invention prior to the Ferraris publication. The opinion was written by Judge Townsend, Judges Coxe and Wallace concurring.

The opinion, after setting forth the facts of the Ferraris disclosure, is occupied principally with a discussion of the value of the testimony offered by two witnesses for the complainant, which supported the contention that the conception of Tesla antedated this disclosure. The court held that one witness, owing to the length of time that had elapsed, must have confused dates, and that it was in 1888 and not 1887 when Tesla explained to him the principles of the split-phase motor. As evidence of this it is adduced that in 1888 Tesla spent nearly two weeks at the factory of the Mather Electric Company explaining his new alternating-current motor inventions with a view to interesting that company in their development and manufacture; that one of the objections made to their operation was the fact that they required a special generator and extra wires, but that Tesla did not then claim he had made any invention whereby two currents of different phase could be derived from a single source. Moreover, the second witness above referred to, who was Tesla's patent attorney, has testified that up to a few days after April 8, 1888, Tesla had never intimated that his invention of the rotary field motor could be practiced by any means which did not involve the use of two independent circuits from the generator to the motor.

After discussing further testimony of this latter witness, the court concluded that it relates to events which occurred twelve years ago concerning which he had no means for refreshing his recollection except a diary which was not produced, having been lost several years ago. The opinion in concluding states that in view of the character of the testimony of this witness it was incumbent upon the complainant to furnish additional evidence in order to remove its uncertainties, or to account for its failure so to do. This was not done, nor was Tesla summoned to testify in the matter. The Court therefore felt constrained to hold that invention by Tesla prior to April 22, 1888, has not been proved. The decree was reversed with costs, with instructions to the court below to dismiss the bill with costs.

Union College Electrical Course.

The current issue of *Concordiensis,* of Union College, contains an article by Mr. C. P. Steinmetz on the new electrical course of that institution, of which he is director. Mr. Steinmetz states that the reasons which led him to undertake the organization and direction of the electrical engineering course of Union College were that the conditions at Schenectady are unusually favorable for an electrical engineering school superior to any, due to the old and well-established reputation of the college in engineering education and the proximity and favorable disposition of the largest electrical manufacturing company, which affords the students chances to see and familiarize themselves with apparatus and receive information which no other electrical engineering school could offer.

While the electrical laboratory, after being refitted, will not be as large as the laboratories of some other colleges, after all a large and well fitted laboratory, however desirable and useful, is usually vastly overrated in its importance. It is not the laboratory which makes the success of an engineering school but the teaching force, directly by their work and indirectly by the educational policy of the institution inspired by their co-operation. After all, in the General Electric Company's works, which are open to the students, Union College has an electrical laboratory vastly greater than the electrical laboratories of all the colleges of the world combined.

Regarding the educational policy of an engineering school, the opinions are divided between those who desire to make the college a training school for specialists and those who endeavor to give a general all-around education leading up to specialization in the art chosen by the students. Theoretically the former is correct and four years by no means too long a time to be devoted to engineering studies. However, the first condition which the college should fulfill is to turn out educated men and not mere trained artisans. To devote the total college course to engineering studies, therefore, pre-supposes that the general culture studies required for any educated man are completed when entering the college. But neither graduation from the modern high school nor the entrance conditions of the college comprise a sufficiency of general culture studies, and therefore a part of the college year must be devoted to them, if graduation from the college should be a qualification of educated men. This broad educational policy has always been a feature of Union College and will remain so, and it is hoped that with the complete establishment of the new course it will be feasible to increase the amount of general culture studies and at the same time increase the special engineering studies while still decreasing the work which is required from the students, by the increased efficiency resulting from the increased teaching force.

The first two years of the courses are essentially devoted to general culture studies, as languages, literature, logic and composition, history of man and natural history, biology, etc. Only such general engineering studies as mathematics and mechanics, which must be familiar before engineering work can be undertaken, are included in the first two years.

The last two years are devoted essentially to special engineering studies. The foundation of electrical engineering is mechanical engineering, and while a young electrical engineer cannot be expected to be fully familiar with all branches of electrical engineering, he must be familiar with the fundamental principles of mechanical engineering. Hence the junior year will be largely devoted to mechanical engineering, as experimental and theoretical mechanics, hydraulics and hydraulic machinery, as turbines and their design, steam machinery, as steam engines and their design, locomotives, gas engines and thermodynamics, etc.

The senior year and a part of the junior year will be devoted to electrical engineering. The complete course will be published shortly in the university catalogue, so it may be sufficient now to say that it will give a thorough grounding in the fundamental principles and their application to all branches of electrical engineering, such as will enable the graduate rapidly to acquire the practical experience necessary to electrical engineering success.

A post-graduate course in electrical engineering has been established, which when completely organized will give advanced instructions, comprising many subjects which, while of fundamental importance in the modern development of electrical engineering, are not taught by any college, hardly not even published yet. It is such knowledge which establishes engineering reputations. It is not sufficient for an electrical engineer who desires to reach high positions to be able to solve ninety-nine out of one hundred problems which he meets in practice, but it is the solution of the one hundredth problem, where everybody else fails, which establishes the reputation of the engineer and raises him to positions where he can leave the solution of the other ninety-nine problems to his subordinates.

Secretary Root and the Metric System.

Secretary of War Root in a letter acknowledging receipt of resolutions adopted by the Paris Chamber of Commerce, favoring a metric system, said that he considers the universal adoption of the system as inevitable within a short time, and added that it would have been adopted before but for the habit attached to the old system.

An Interurban Road With Hooded Third Rail.

A STRIKING advance in third-rail methods of operation has been made by the Wilkesbarre & Hazleton Railroad, an interurban electric system occupying a territory in Pennsylvania all to itself, and flanked by the steam lines of the Pennsylvania and the Lehigh Valley systems. The map shown herewith indicates clearly the region and the respective routes. The intercourse between Hazleton and Wilkesbarre, even under the old conditions, is large. The distance between the railway terminals in the two cities by the railways named is, respectively, 50.4 and 49.6 miles. The Pennsylvania runs four trains a day in each direction, while the Lehigh Valley provides six trains in one direction and five in the other. The new electric line is 26.2 miles long between points of junction with the local electric railways in Wilkesbarre and Hazleton. By the existing steam roads, two hours are required to make the trip between the two cities. At the same average speed, the Wilkesbarre & Hazleton Railway would carry passengers in about seventy minutes, but this running time can be materially cut down, and it is proposed to operate regular express trains between the terminal points named in one hour. The speed ordinances governing the movement of cars on the streets of the respective cities leave only forty minutes of the sixty to cover the distance over a private right of way between the two city limits. Owing to the character of country traversed and the difference of 1,200 feet in the altitude of the terminal points, it became a serious problem to select a route and establish a line entirely free of heavy grades and sharp curves. A private right of way, 60 ft. wide and fenced in on both sides, was acquired, and throughout the entire line there is not a grade exceeding 3 per cent., and only one curve of 18°. The grade thus established necessitated some bold engineering, heavy fills, deep rock cuts, and driving a tunnel 2,600 ft. long through Penobscot Mountain, about 600 ft. below the summit and through solid rock. The eliminations of grade crossings of all kinds was also determined upon, in order that high speed operation might be adopted with safety. This involved the construction of thirty-three highway crossing bridges, and railroad bridges over streams of various sizes, all of these structures being of concrete. The roadbed also includes two large bridges of granite masonry, one of the stone arch type and the other of girder form supported by high masonry piers. The roadbed construction throughout this system has received very close attention, and in some respects marks a distinctive advance among interurban electric properties. The track rail is a Boston & Albany section, 95 pounds to the yard, laid on 8-ft. ties, spaced to 24-in. centers. Nine-ft. ties are used for every fifth tie, where insulators support the contact rail. At present the ties are laid on a bed of cinders, and this will be continued for a year or more, and then a top dressing of broken stone 10½ in. high will be added, the cinders forming a cushion between.

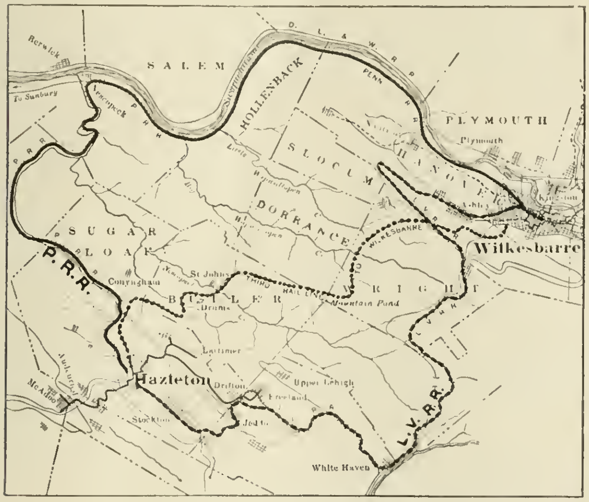


FIG. 1.—MAP OF ROUTE OF THIRD-RAIL ROAD.

The contact rail is a notable departure from common practice up to the present time, as it is protected from sleet and snow by a 2-in. x 6-in. pine plank held directly over the rail. Already this protection has demonstrated its usefulness, for during the severe sleet and snow storms of December, the cars operated with perfect ease. The added element of personal safety is also a very great factor. This guard plank is supported by oak posts spaced every 8 ft. and both guard and rail are carried by unglazed vitrified clay insulators, furnished by the Ohio Brass Company and spaced every 10 ft. To prevent creeping the fish plates are left moderately loose and an anchoring insulator is placed in each rail midway between joints. The contact rails are 66 ft. long and weigh 80 pounds to the yard. They are of special composition embodying high conductivity. Both contact rails and track rails are bonded with Chase-Shawmut soldered bonds. The bonds have been applied for over six months and the great shock due to heavy steam locomotives and freight cars passing over the line during the entire construction period has not produced thus far the least indication of breaking away.

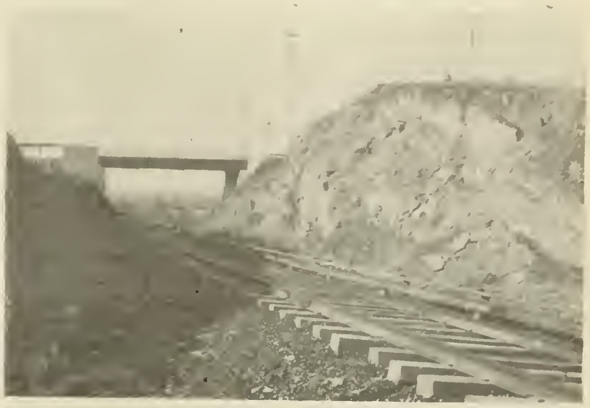


FIG. 2.—VIEW OF PROTECTED THIRD RAIL.

The application of the soldered bond necessarily involved a departure from the usual method employed in laying track where protected bonds are used. The bond is under the foot of the rail, and to facilitate the work it became necessary to turn the rail bottom side up. As the track men had only spiked the rails center and joints this was easily done by drawing the inside spikes for a length of about 20 rails, depending on the local degree of curvature in the track. The joints were then surfaced, bond applied and eight men with a few short bars could return the rail to its normal position. The spikers in this work followed the bonders rather than the railmen, thus avoiding delay and keeping the spikers busy.

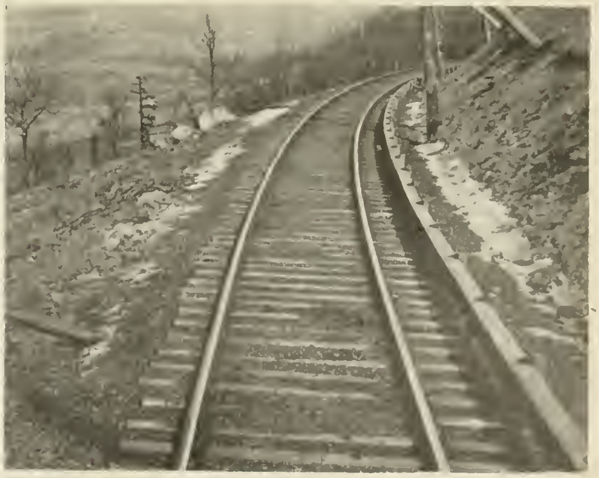


FIG. 3.—A GRADE ON THE MOUNTAIN SIDE.

The train schedule to be inaugurated consists of an hourly express service and a local every hour and a half. Six Brill combined coaches have been provided to perform this work, and each consists of a passenger and baggage compartment, the former seating 38 passengers. The baggage compartment is also provided with seats for smokers. The seats fold up when not in use. The car is 51 ft. in length over all and 9 ft 6 in in width. Loading steps are provided at only one side of each platform. The opposite side is used for a motorman's cab The equipment of the car consists of a General Electric motor attached to each of the four axles These motors are practically the same as those used on the Manhattan Elevated road in New York, and are governed by the Sprague multiple-unit automatic control as embodied in the contactor system. The management expects that the traffic will soon warrant the operation of trains of several cars, and for this reason introduced this system of control. Westinghouse automatic air brakes are used, and the customary hand brake is attached in the usual manner. An additional independent foundation hand brake equipment has been applied from the brake shoe up, which is designed to permit of the ready application of the Newell electric brake. The cars are furnished with an air signal system whereby the conductor at any part of a long train may signal the operator at the head, as is now done in steam passenger service.

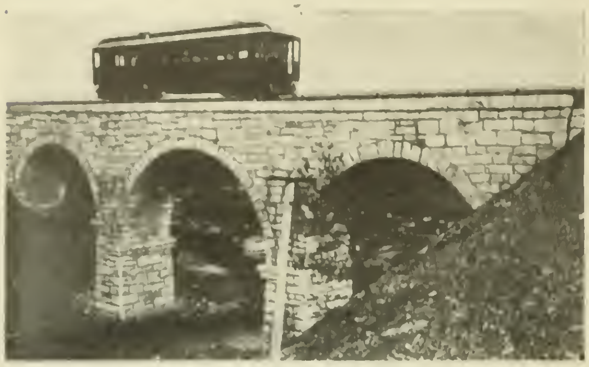


FIG. 4.—STONE BRIDGE.

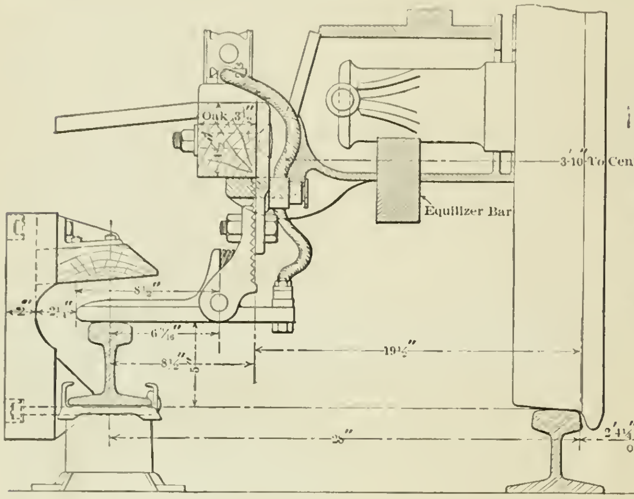


FIG. 5.—DETAILS OF THIRD RAIL, SHOE, ETC.

Another new feature is the contact shoes of special design for use with the protected third rail, the details of which are also shown herewith. Trolley poles are also provided on these cars for use on the city traction systems over which they operate, and the switch governing the connections to trolley and shoe is designed to permit the change being made on a grade without losing contact.

The design of the contact shoes has been worked out by Mr. W. B. Potter, of the General Electric Company, and the method of protecting the third rail is, in a general way, similar to that recently erected on the experimental track of the General Electric Company at Schenectady.

A telephone system is installed which includes a special portable outfit in each car, and plug-in boxes are placed every quarter of a mile along the line. The telephone line is No. 10 hard-drawn copper wire run on wooden brackets and placed 3 ft. below the cross arm carrying the high-tension line, transposed to meet requirements. Heavy gongs are placed at each siding in order that cars passing over the line can be reached by signal from the office. The entire telephone equipment was furnished by the Wilhelm Manufacturing Company.

The power house and sub-station electrical equipment is of standard Westinghouse make throughout, with three-phase generators and Harrisburg and Brown-Fitchburg engines. One of the most interesting features of the plant is the portable sub-station, which consists of an equipment similar to that in the permanent sub-station and is installed in a car especially designed for this purpose, so that it may be shifted to any part of the system where the demands are unusually heavy, as, for instance, in the neighborhood of Triangular Lake during the excursion and picnic season. The length of car over sheathing is 36 ft., and the width over posts is 9 ft. 6 in. The roof can be removed in one piece, like that of a box car, to permit the placing of large and heavy machinery that can best be handled by cranes. Eight large eye-bolts, set in blocks secured to the rafters and top plate of the monitor deck, facilitate the hoisting process. Every alternate rafter is re inforced with angle iron and all parts of the roof are made extra strong to withstand the stress of moving. Brill trucks are employed. The rotary converter on board is placed directly over the forward trucks, and the three transformers at the other end of the car over the rear trucks, with the switchboard between. The total weight of the equipment is about 51,000 pounds. The car is not equipped with motors, as it can readily be attached as a trailer to a regular passenger car and hauled to any part of the line when it is needed. As already mentioned, the apparatus is similar to the equipment in the sub-station. A slight variation exists in the connection of the high-tension side of the transformers to the line from those found in the power house and sub-station. In the latter the individual leads from a transformer are connected by means of bayonet switches so that a single transformer may be taken out of service by pulling two switches. In this sub-station car sufficient room did not exist to put on the bayonet switches and the three transformers are supplied with solid connections. The transformer cases are made very high to prevent oil running out on the floor of the car. Long poles are provided to hook connection on to the transmission line at any point alongside of the track. Bayonet switches complete the connection to the car and an oil-break switch furnishes a means of opening or closing the connection between the transformers and the high-tension line.

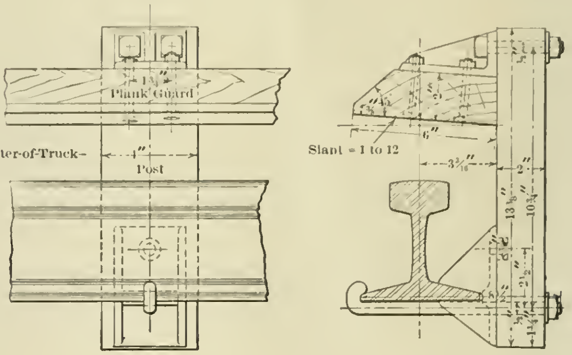


FIG. 6.—PLAN AND CROSS SECTION OF THIRD-RAIL HOOD.

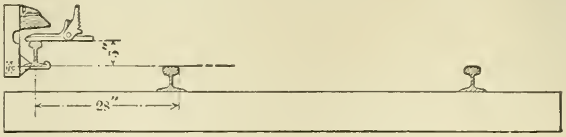


FIG. 7.—RELATIVE POSITIONS OF THIRD RAIL AND ROAD BED.

A great deal of credit is due to the enterprise of President A. Markle, of the Wilkesbarre & Hazleton Railway Company, who developed the project, and has given the closest personal attention to the building and equipment of the road. Mr. L. B. Stillwell, who is consulting engineer for the company, designed the entire plant and the road was built under his direction. He was represented during the construction period by J. E. Wallace, the construction engineer. C. A. B. Houck, chief electrician for the traction company, was associated with Mr. Wallace in the work. A great deal of interest and importance attaches to Mr. Stillwell's use of the hooded third rail and its application in other work may follow its satisfactory test this winter.

A Hydro-Electric Power Plant in Newfoundland.

By Earl E. Boardway.

On the bleak east coast of Newfoundland nestling in one of the numerous fiords that make the coast line of this island so ragged, wild and picturesque, is the little fishing village of Petty Harbor, eight miles south of St. John's. From some small lakes back in the mountains comes tumbling down over the rocks a small stream to empty into this arm of the sea. To R. G. Reid, of Montreal, who owns and operates the entire railroad system of 638 miles on the island, besides a fleet of eight coastwise steamers, it appeared that this little stream could be turned to useful account if its power could be harnessed and carried to the capital and metropolis of the island, St. John's, to run the street cars and supply light to the city, besides furnishing power to operate other industries. Accordingly, in 1898, after making the surveys, Mr. G. H. Massey, the chief engineer of the Reid interests, began the construction of a wooden dam and flume about a mile back in the hills, while A. C. Rice, consulting engineer, of Worcester, Mass., was making the plans for the power station.

The power house was located at the mouth of the stream, with its tailrace about down to tide water, as the wooden flume is carried along the steep hillside to a point opposite the power house, where a steel penstock, six and one-half feet in diameter, drops over the cliff, at an angle of 45°, to the power house 185 ft. below. The flume is built of 12 x 12 timbers and lined with three-inch plank, the inside dimensions being 13½ ft. wide and 13 ft. deep. At its upper end a wooden crib dam 15 ft. high thrown across the stream backs up the water and diverts it to one side through the racks and gate house into the flume.

The flume then starts upon its tortuous path, winding in and out along the steep, rocky hillside for a mile, but as it approaches the power house the rocks become so precipitous, projecting out to form a ridge, that it was necessary to tunnel through this ridge for 250 ft. At the lower end of the flume it widens out into a small forebay with water racks and head gates to form a suitable entrance to the steel penstock leading to the power house below. The gate house envelopes the forebay entirely and the flume is covered on top, its entire length, with planking.

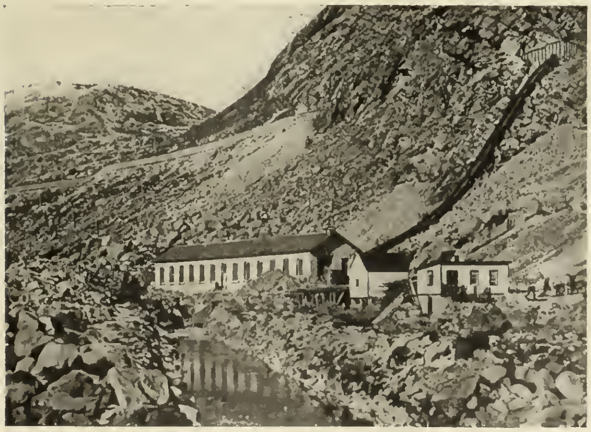


Fig. 1.—Power House, Flume and Pipe Line.

The penstock leaves the wooden flume by a tapering piece and continues to the power house of uniform diameter—6½ ft.—where it branches into two pipes 4 ft. in diameter leading to the wheels. At the upper end the penstock is ¼ in. thick, which is increased to ½ in. at the lower end and it is about 360 ft. long.

The power house is a stone building 130 ft. long by 24 ft. wide on the inside, with the roof trusses 16 ft. clear of the floor. One end of the power house is set off for 30 ft. as the transformer room by a glass partition separating it from the generator room. At the time the power house was built, in 1899, but one wheel setting was installed, with a generator coupled to each end of the wheel shaft. This wheel, especially designed for this high head, was an inward discharge or Francis reaction turbine, rated at 1860 hp, at 327 r.p.m. The generators are Westinghouse, 600-kw, 500-volt, 60-cycle alternators, with 22 poles. The exciter set is entirely separate and consists of a 21-in high-head turbine with a small generator direct connected to the wheel shaft, both standing upon the same cast iron bed. The exciter wheel is of 45 hp, with a speed of 600 r.p.m., and is fed by a 9-in. pipe from the large penstock. A gate valve controls the admission of water to the wheel.

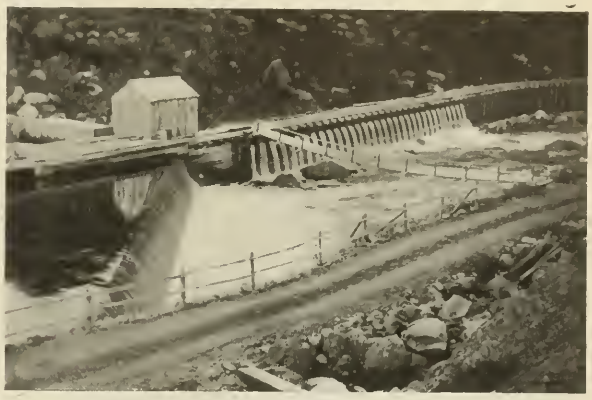


Fig. 2.—Dam and Intake End of Flume.

The transformer room contains 6 step-up oil transformers with cast-iron top and wooden cover. They are 500 kw, raising the 500 volts of the generators to 15,000 volts to transmit the current to St. John's, nine miles distant. The transmission line is a double-pole, and goes up over the hills back of the power house.

Early in 1902 the Reids decided to install the second wheel setting, as they had come into possession of the dry dock and large machine shops in St. John's, for which they would need extra power. Accordingly, Mr. Rice, their consulting engineer in this work, began the designs of a new wheel of the same capacity as the first one installed, but of a somewhat different pattern. Wheel No. 1, as mentioned above, was a Francis reaction turbine, and according to the general practice of turbine building, the discharge end of the buckets was somewhat throttled in order to obtain the full benefit of the reaction; good wheels of this type, being found to give 80 per cent. efficiency. But after a year or two of continuous running, pitting of the backs of the buckets takes place, until it is eaten clear through to the face.

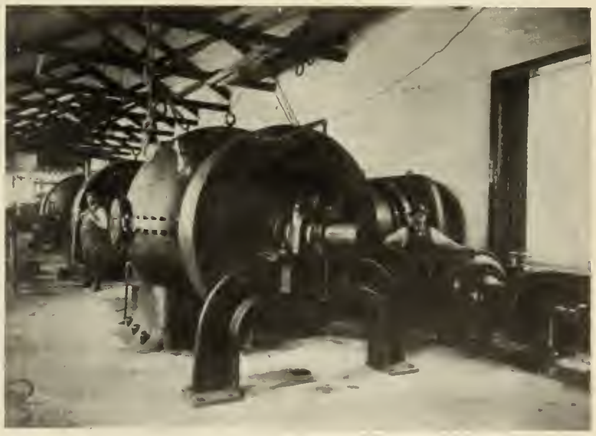


Fig. 3.—View of Interior of Power House, Petty Harbor.

At a recent meeting of the Pacific Coast Electrical Transmission

Association this subject was brought forward and it was shown that in addition to turbine buckets, the nozzles used with impulse wheels were often deeply pitted, while the backs of centrifugal pump runners and often propeller blades, are eaten through to the front and the tips bitten off, causing much trouble to engineers. Electrolysis has been advanced as a cause, but careful tests showed that no electric current whatever passed through the parts. It is evident, however, that this pitting is due in some cases, probably to the sudden throttling of water under high velocity and the consequent scouring action of the eddies that are set up. Hence in the design of wheel No. 2 this fact was taken advantage of and a turbine having a Girard type of bucket, but inward flow, was used. This form has a very free course and discharge for the water, giving a still better efficiency, and is expected to do away entirely with the pitting action.

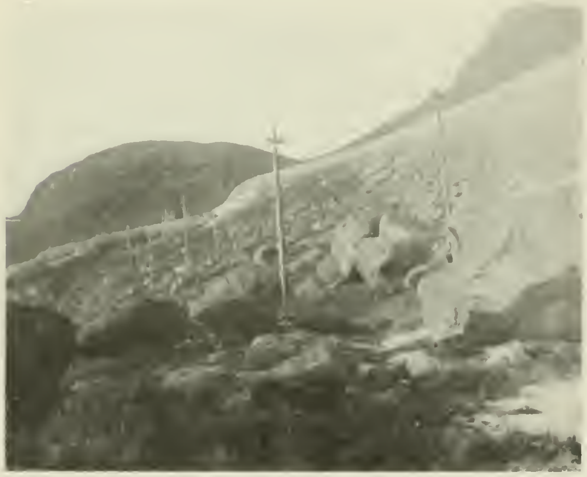


FIG. 4.—POLE LINE AND FLUME.

In the controlling of this wheel for electrical purposes, Mr. Rice has introduced an entirely new feature, which should render this little plant of much interest to many engineers, from the fact that it was first tried and found successful in the remote and undeveloped Island of Newfoundland. The controlling gate of this wheel, to regulate its speed, is nothing else than a large hydraulic gate valve located between the penstock and wheel case, there being no inside gate of any kind near the guides as is usually the case. But the idea was to use the hydraulic cylinder, the piston of which actuates the gate, as the relay of a speed governor.

FIG. 5.—VIEW OF PETTY HARBOR, N. F.

Accordingly, the speed governor of a Lombard water wheel governor was mounted on the hydraulic cylinder, the gate valve lying horizontally, the hydraulic cylinder of the gate corresponding to the large pressure cylinder on the standard Lombard governor, and the piston rod of the gate corresponding to the piston rod with the rack that operates the gate shaft on the standard Lombard governor.

This arrangement gives perfect regulation, and works on the principle that the gate causes a reduction in pressure on the wheel side, corresponding to a reduced head, yet permitting the turbine buckets to receive the full application of water at all stages of the load. It also does away with all the inside wearing parts, such as the ordinary speed gates require. Both No. 1 and No. 2 wheels are equipped with momentum wheels 7 ft. in diameter, weighing 15,500 pounds, and running with a peripheral speed of 7,200 ft. per minute. All the wheel work was built and erected by the Stilwell Bierce and Smith Vaile Companies, while the electrical equipment, as already noted, was furnished by the Westinghouse Electric & Manufacturing Company.

American Street Railway Association Affairs.

In accordance with preliminary steps taken at the Detroit annual convention last October, the master mechanics, superintendents of motive power and electrical engineers of various street railways met at Cleveland on February 12 and organized the American Railway Mechanical & Electrical Association. Membership will rest in companies, and each member will be entitled to one vote by delegates presenting proper credentials. There will also be non voting associate and junior membership. The meetings will be held at the same time and place as those of the National Street Railway Association. Dues are $20 for full membership, $5 for associate and $3 for junior. The association will restrict its work to the questions and topics that belong to the mechanical and electrical operating end of the business. The following officers were elected: President, Thomas Farmer, superintendent of motive power, Detroit United Railway Company, Detroit, Mich.; first vice-president, E. W. Olds, superintendent rolling stock, the Milwaukee Electric Railway & Light Company, Milwaukee; second vice-president, Alfred Green, master mechanic Rochester Railway Company, Rochester, N. Y.; third vice-president, C. F. Baker, superintendent motive power and machinery, Boston Elevated Railway Company, Boston, Mass. Executive Committee—W. O. Mundy, master mechanic, St. Louis Transit Company, St. Louis, Mo.; T. J. Mullen, master mechanic, Scranton Railway Company, Scranton, Pa.; H. H. Adams, master mechanic, United Railways & Electric Company, Baltimore, Md.; D. F. Carver, chief engineer, Cleveland Electric Railway Company, Cleveland, Ohio; secretary and treasurer, Walter Mower, Detroit United Railway Company, Detroit, Mich.

At a meeting of the Executive Committee of the American Street Railway Association, at Saratoga, on February 23, it was decided to hold the next annual convention there during September 2, 3 and 4, with headquarters at the Grand Union Hotel, which can accommodate 1,700 guests. The court of the hotel makes an admirable place for the display of exhibits.

Philadelphia Chapter of A. I. E. E.

A Philadelphia branch of the American Institute of Electrical Engineers is to be formed, and will hold its first meeting on Monday evening, March 9, at 8 o'clock, in the rooms of the Engineers' Club of Philadelphia, 1122 Girard Street (near 12th and Chestnut). This will be an organization meeting for the election of local officers and the adoption of a few by-laws concerning the time and place of meeting, etc. After organizing, the three papers on car lighting, which were presented at the New York meeting of Feb. 27, will be read in abstract, possibly by the authors themselves, and will be open for discussion.

President Scott, Vice-President Sheldon, Chairman Rice, of the committee on local organization, and Secretary Pope may be present. A temporary committee has arranged for this meeting and will suggest a list of officers and a few by-laws. The temporary officers are Carl Hering, chairman, and H. F. Sanville, secretary.

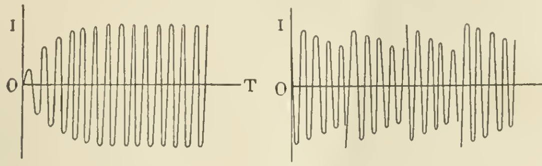
Government Wireless Telegraph Plant.

It is announced that the Government will erect the greatest wireless telegraph station in the world at Cape Henry. The Marconi system will not be used, but Commander Clinton Custis, of the Norfolk Navy Yard, says messages will be sent across the ocean. The principal use of the station will be to communicate with war vessels at sea, Tampa, Key West and Dry Tortugas and northern navy yards. The poles will be 200 ft. high.

Tuned Wireless Telegraph Circuits.

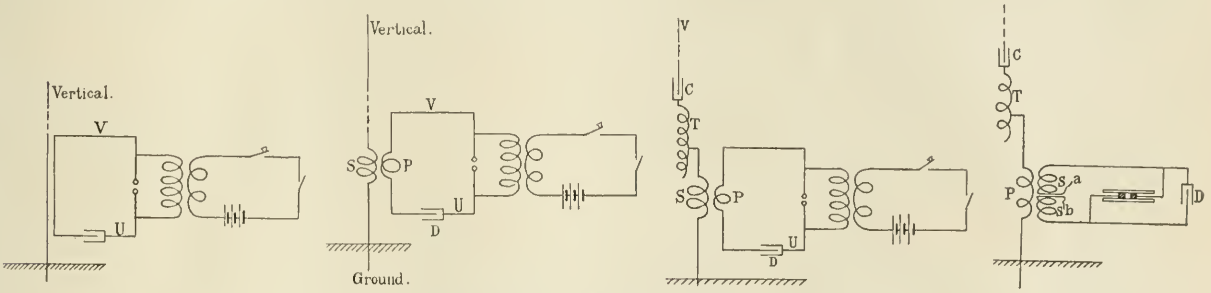
In a paper in the December issue of the United States *Monthly Weather Review*, Mr. A. V. Thiessen describes in simple terms the principles of wireless telegraphy, and we abstract below the portion dealing with tuned circuits.

The simple wireless telegraph system may be called a "rapidly damped system"; that is to say, their oscillations die out very quickly. The mechanical analogue is a bell with a finger placed on its lip; when hit with a clapper the bell gives a large initial vibration, but the subsequent ones are feeble. It may be compared to a pendulum swung in a liquid. With this kind of a system it is not necessary to have accurate tuning, for by tuning is meant that the natural oscillations of the sending wire are the same as those of the receiving wire, so that the oscillations of the latter may be strengthened, before they die out, by rapidly succeeding impulses sent out by the former. By a tuned sending and receiving system is also meant a system the receiver of which will not respond to waves of some other frequency, and the sender of which will not cause a receiver of different tune to respond.



Figs. 1 and 2.—Oscillations.

To have accurate tuning one must employ a sending system which is a persistent oscillator, and also a very rapid break and make device, so that the trains of waves succeed each other very rapidly. The receiving system must also be a persistent oscillator, so that before the oscillations set up in it by a preceding train of waves die out, they may be increased by the succeeding trains of waves. The conditions of oscillations to be satisfied in a tuned system are shown graphically in Figs. 1 and 2.



Figs. 3, 4, 5 and 6.—Tuned Wireless Telegraph Circuits.

Fig. 1 represents the vibrations in the transmitting system and the waves sent out will have, of course, the same character. It is seen that before the oscillations completely die out another impulse is given, and that the several trains of waves succeed each other rapidly. Fig. 2 represents the vibrations induced in the receiving system; it shows the additive effect of all the separate waves which build up the oscillations in the receiving system until they finally break down the resistance in the coherer and a signal is heard.

If near the rectangle, *V U*, Fig. 3, a vertical wire be placed, as shown, the oscillations of that system would be induced in the vertical wire and then the desirable features of both methods would be combined. To further improve this a coil may be used having the terminals of its secondary, *S*, connected to the vertical and to ground, and inserting its primary, *P*, in the closed condenser circuit, as shown in Fig. 4. It is understood that the turns of *S* are wound around *P*, just as the secondary of an induction coil is wound around its primary, and that the coil described is a kind of transformer.

It is necessary to have the two circuits in tune; that is to say, the oscillations in the system vertical—*S*—ground must harmonize with oscillations in the closed condenser circuit, *P, D, U, V*. To tune these two systems a construction somewhat the same as that shown in Fig. 5 is used by Signor Marconi. To alter the tune of an electrical circuit either the capacity of self-induction or both must be changed. To this end a capacity *C* and a few turns of wire terminate the vertical wire. One terminal of the secondary of the Tesla coil may be moved up and down, cutting in or out as many turns as is necessary to sufficiently alter self-induction; the capacity *C* is also made variable. The tune of the closed circuit may be changed by altering the variable capacity, *D*, of its circuit.

In Fig. 6 the connections for the receiving apparatus are shown. The vertical, *V*, is terminated with a few turns of wire, so that its induction may be changed. It is connected to one terminal of a transformer, *T*, the other terminal of the primary, *P*, being grounded. The terminals of the secondary, *S S*, are connected to terminals of the coherer, which has a variable capacity, *D*, which is connected in parallel to the coherer. Any induction or capacity may be added to the terminals, *a* and *b*, of the secondary coil. It is seen that a receiving system similar in construction to the sending system in Fig. 4 is given. It is a good absorber, a persistent oscillator, and capable of having its tune altered at will.

A duplex system may be arranged with the system just described by connecting differently tuned transmitters to verticals through different inductances at the sending station; and by connecting a suitably tuned receiver the same way to the receiving vertical. The connections for the transmiter are shown in Fig. 7.

In general we may speak of two kinds of telegraphic systems, namely, tuned and untuned. It is evident that with a perfectly tuned system of transmiters and receivers the number of stations may be multiplied and placed at will, connecting points far and near.

A system that is not arranged for tuning is called an open system, and with such an open system the selection of stations cannot be done arbitrarily. To illustrate: Suppose we wish to connect two points, *A* and *B*, Fig. 8. Set up instruments of the open system at each point; assume that the waves sent out having traveled a distance, *A B* are just strong enough to work the receiving instruments. Now circumscribe both stations with circles having a radius equal to the distance *A B*. It may be seen that no other two independent stations can be worked within these two circles without confusion unless they have receivers which cannot be affected by the feeble waves from *A* and *B*. For example, two independent stations may be erected at *C* and *D*, with less sensitive receivers and weaker transmitters than those at *A* and *B*. The waves sent out by the transmitters at *A* and *B* cannot affect the less sensitive receiver at *C* and *D*, and the waves sent out by less powerful trans-

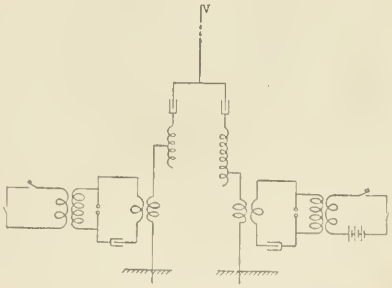


Fig. 7.—Connections for Transmitter.

mitters at C and D will affect receivers at these points, but on arrival at A and B they will be so weak that the receivers at these points will not be affected. Thus, stations properly placed, with

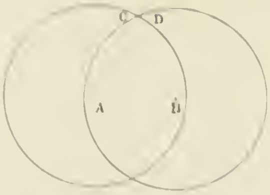


FIG. 8—OPEN SYSTEM

instruments properly selected as to power and sensitiveness may be worked "open" simultaneously and without confusion.

◆

Elster and Geitel's Improved Form of Exner's Electroscope.

By A. Frederick Collins.

The apparatus shown in the accompanying diagrams was designed by the eminent physicists, Messrs. J. Elster and H. Geitel, whose work is well known in connection with radioactivity measurements and deductions.

Exner's electroscope, in view of its various advantages, among which may be cited its small capacity, convenient and handy form and ease of conveyance, especially in relation to atmospheric electricity, has maintained its superiority. By means of an improvement in the construction by Elster and Geitel, namely, through the transferring of the insulated fastenings of the plate carrier in the interior of the electroscopic casing, the can be as nearly perfected as it is possible to make it with the normal self-ionization of the air.

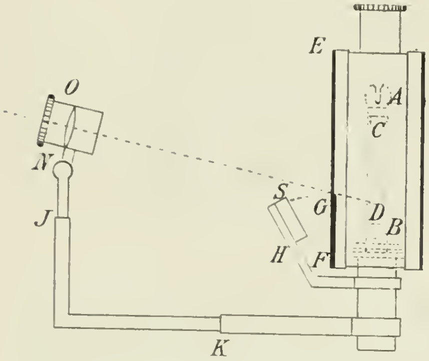
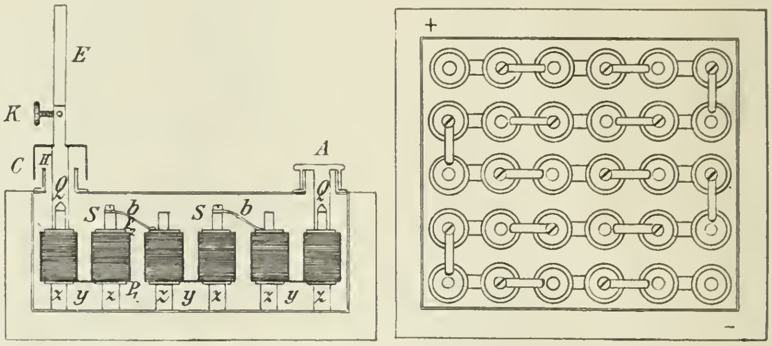


FIG. 1.—SIDE VIEW OF ELECTROSCOPE.



FIGS. 2 AND 3.—PORTABLE APPARATUS FOR DETERMINING RADIO-ACTIVITY OF AIR.

Heretofore the reading of Exner's electroscope has not only been difficult but even defective for the reason that the scale was pasted on the front glass wall of the casing; in this case the scale lies nearer the eye than the plates and the greater the difference in the distance the more pronounced will be the parallax between the plates and the scale. Again observers with eyes of different focal lengths will bring the instrument in various positions relative to the eye—either closer or farther distant, and thus effecting important variations of the reading.

To overcome these errors Elster and Geitel have devised a simple contrivance which disposes entirely of this difficulty and moreover renders it possible, by means of a magnifying glass, to more accurately make the readings. The principle involved is to remove the scale from the glass wall of the casing entirely and instead, project its picture by reflection on the plates or discs themselves.

In the accompanying diagram shown in Fig. 1, the electroscope presents a side view. *A B* is the carrier of the two aluminum discs, the one, *C D*, which is projected on this carrier, being presented to view. The front glass wall of the casing is silvered on the interior surface at the lower part to *G*—the sharp upper border of the silvered surface at *G* running in a horizontal line.

The upper border of the scale, *S*, which is fastened to the holder, *H*, is the same distance in front of the silvered surface, whilst the front edge of the electroscopic plates or discs is oppositely disposed in the rear. This enables the eye at *O* to perceive the picture or reflection of the upper border of the scale on the same level as the edges of the disc facing the eye.

A parallatic shifting of the plates or discs against the reflection of the scale by a change of the position of the eye is therefore not possible. In fact, it is possible with the assistance of a magnifying glass fastened at *O*, through which the divergence of the discs is enlarged in the same manner as the picture on the scale and assists in the accuracy of the reading. At *J* and *K* the magnifying glass may be placed horizontally and vertically and at *N* it may be adjusted on a level with the drawing. The magnifying glass is in the correct position when, to the observing eye, the upper edge of the reflection of the scale merges with that of the silvered surface; the rear wall of the casing is formed by a semi-opaque glass prism, and by means of a micrometer screws at the base of the instrument a symmetrical adjustment of the plates may be obtained.

The position of the front edges of the plates is always read off or reproduced on the scale; this standardizing permits of symmetrical or equal results on both sides. A slight deviation of uniformity in the position of the plates is on the whole unimportant, as the one having a surplus of the required amount and the other an insufficient amount when the results of both sides may be deducted and added accordingly.

A portable apparatus for determining the radio-activity of air is shown in the following diagrams. In this case it is necessary that the body to be tested be placed for a few hours on a negative potential of several thousand volts. In all cases in which a static electric machine or an induction coil is made difficult or excluded entirely, Elster and Geitel have, with excellent results, made use of a high-tension dry pile or column consisting of 6,000 pairs of elements (platten-paaren) of the usual type made of gold and silver foil; this battery is divided into thirty separate columns, each of which have a potential of approximately 75 volts, the piles being arranged on an ebonite rod and placed in insulated metal casings. When the column is not in use the self-discharge may be greatly decreased by disconnecting the parts. An external covering of the column preserves the elements and the ebonite insulators from dust, moisture and light.

Fig. 2 presents a vertical view; the supports of ebonite merge into sustaining rods of the same material on which are arranged the single, centrally-perforated elements. The number of these elements is so chosen that they are firmly held in place by the pressure of the metal plates, P^1 and P^2. The continual insertion of the separate parts is instituted by the elastic metal strips attached to *S*, so that the column when ready for use and viewed from the top assumes the dimensional form portrayed in Fig. 3.

Through the metal cover of the casings enclosing the columns, which are made almost air-tight by means of soft rubber bands, are inserted short metal extensions or projections, *H*, which are arranged at suitable intervals through which, after the removal of the cover, metal tubes may be attached and passed through to the interior of the casing at *E*; these tubes slide over the projections, *Q*. At *K* they carry a set-screw for fastening the leading-in wires. The tightly adjusted metal cylinder, *C*, should exclude as much as possible the penetration of moist air. At one of these tubes, *A*, the insulating handle is eliminated; the pole of the column will thus be connected with the metal casing, and this extended to the ground; in Fig. 1 the pole at the right of the column is thus manipulated.

While operating the column it is necessary to control the tension with a high-tension electroscope. For this purpose Elster and Geitel chose the form invented by Dr. Braun, the well-known savant of Strassburg, who designed the Braun-Siemens & Halske system of wireless telegraphy. Braun's electroscope is shown in Fig. 4, a slight modification being made, however, by the introduction of Bernstein's insulator and an arrangement, *N*, for drying the interior of the electroscope with natrium. The metal column, *M*, carrying the index or indicator, *Z*, is put into a Bernstein holder at the bottom of the metal casing. The metal pin, *S*, furnished with a set-screw and isolated handle, *E*, and is fitted into a conical groove through the medium of a sliding connection. Should the electroscope after being separated from the column not work properly, the metal pin, *S*, is to be removed, the metal cover, *D*, closed and the handle, *H*, turned to 90°; the stirrup, *B*, presses the upper part of the index, *Z*, against the column, *M*, very lightly. The instrument is then to be taken from its supports and enclosed in the casing. A current cannot be taken from the column, but its purpose is—and on this point particular stress is laid—to keep the conductor at a constant potential of 2,000 volts.

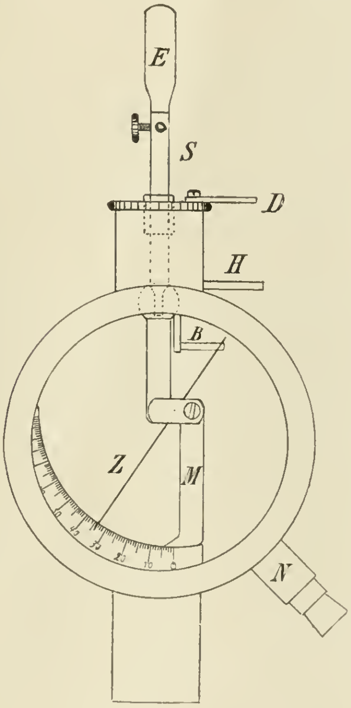


FIG. 4.—BRAUN'S ELECTROSCOPE.

Notwithstanding all precautions, it is possible that the column, in consequence of the difficulty experienced in absolute insulation of the exposed conductor, or owing to penetration of moisture to the interior of the casing will deteriorate and constantly decrease in tension. Should this occur the cover is to be opened and to be placed in the warmth of a stove for several hours, when the cover is again closed, thus giving the column an opportunity to become thoroughly heated. Should the instrument not be used for a long time, the connections between the columns after being securely protected are to be kept in a warm dry place. During transportation silk cushions are employed to fill the space between the column and cover; this precludes all danger from breakage.

According to Elster and Geitel, these battery columns will remain in excellent condition for several years. When the elements are exhausted—which of course cannot be avoided—they may be replaced with ease.

These columns and electroscopes have maintained their superiority for years in virtue of their adaptation to open air researches, in the moist air of cellars and wells, and on expeditions, as, for example, when experiments was made relating to the radio-activity in caves and at the shore of the North Sea.

A Simple Current Interrupter.

By C. Francis Jenkins.

The use of the Ruhmkorff or induction coil is rapidly coming into use for a variety of purposes, not only in the laboratory but in commercial work as well. It is also a fact that no entirely satisfactory interrupter has yet been brought out. When the coil is used on the main wiring circuit of the building, as is almost always conveniently available, lamps or some other suitable unvarying resistance must be put in circuit with the primary. Even when this is done the platinum contacts on the coil get hot and burn if heavy sparks are required. To overcome these defects various devices have been employed, the Wehnelt interrupter being one of the simplest of them. In the Wehnelt interrupter, however, trouble is experienced with the mercury-filled glass tube and its platinum point. This gets hot and the glass tube frequently cracks, destroying its usefulness.

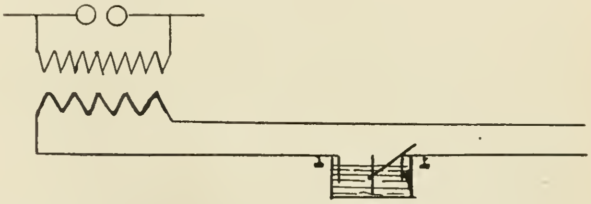


FIG. 1.—DIAGRAM OF CIRCUITS, CURRENT INTERRUPTER.

The function of the platinum point seems to be to focus the current upon the solution to form bubbles of steam (or gas) which interrupt the current, momentarily re-establishing it again when the bubble rises and the solution again completes the circuit. If the function of the platinum point is thus to focus the current in the solution, any other method which would do this would answer, doubtless. The device herewith illustrated depends upon this theory and has proved satisfactory. It consists of a glass cell (or any other cell of suitable insulating material) with a partition dividing it into two compartments, the partition having a small aperture therein fitted with a pointed glass rod. Circuit terminals are inserted in each compartment. Into the cell is then poured an acidulated solution of a strength depending upon the potential of the line in which the interrupter is used. The cell is then put directly in series with the primary of the coil, and the vibrator (if the coil has one) is screwed up until it is constantly in contact. When the main circuit is closed a violent ebullition takes place and a veritable torrent of flame surrounds the aperture in the partition, accompanied by a strident noise and a rapid interruption of the current. The greatest amount of current flows when the aperture is wide open. The interruptions increase in frequency and the current diminishes as the point of the rod is further and further advanced into the aperture. The device is therefore not only an interrupter but a variable resistance as well.

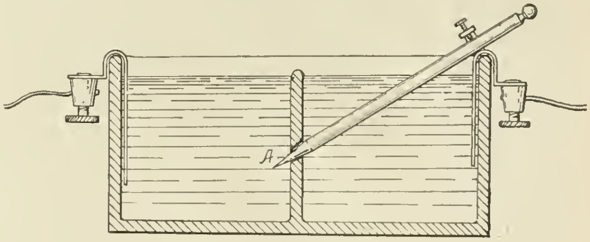


FIG. 2.—CURRENT INTERRUPTER.

This cell has many advantages. It is inexpensive, reliable, contains nothing to get out of order, can be put directly in the circuit in series with the primary of the coil, and is adjustable to give a different flow of current and a wide range of interruption. Possibly the method might be of use in experiments requiring the boiling of water in a vessel insulated from the heat of the atmosphere, etc.

The Use of High Tension Underground Conductors.

By Henry Floy

BASING the conclusion on figures recently secured direct from various manufacturers the writer estimates that there was expended in the United States during the year 1902 at least $14,000,000 for the purchase of insulated conductors designed for the transmission of electrical energy other than that used in telegraph and telephone service. Of this considerable outlay a comparatively small part, probably not over one per cent., was invested in what may fairly be termed high tension insulated conductors; that is, conductors which are used for transmitting energy at a pressure of at least 10,000 volts.

It is a remarkable fact that while the engineering profession has made rapid strides in the utilization of higher and higher voltages for electrical transmission until at present 40,000 volts is not considered extraordinary, and 60,000 volts is employed in at least one installation, all of this advance work is being done with the use of aerial circuits, and very little has been accomplished through the use of an insulated conductor in the form of a cable. It is almost possible to count on the fingers of one hand all the installations in the world which are transmitting energy at 10,000 volts or above by means of underground cables. This is the more surprising when it is considered that several comparatively high-tension underground systems have been in operation a number of years, that they have given almost perfect satisfaction and that not one of them has proven a failure.

For several years, as is well known, Ferranti has been operating successfully a single-phase, high-tension underground transmission in London. During the past six years, the Twin City Rapid Transit Company, of Minneapolis, has had in constant operation two 11,000-volt, three-conductor cables respectively ten and ten and three-quarter miles in length. Two and one half years ago the St. Croix Power Company installed in St. Paul two three-conductor cables, each a little over three miles in length, which have ever since been in satisfactory operation at about 25,000 volts.

Buffalo is distributing thousands of kilowatts of power from Niagara Falls through 10,000-volt cables. The Montreal Light, Heat & Power Company last autumn put into successful operation a considerable length of 22,000-volt, and a few hundred feet of 30,000-volt cable. In New York City the Manhattan Elevated has laid about twelve miles of "unusually high" 11,000-volt cable, part of which has been in satisfactory operation for over a year. The Rapid Transit Underground Railway has installed thus far some 20 miles of 3-0 tri-phase, 11,000-volt cable, and it is even whispered that the city is to see a 44,000-volt underground transmission in the not distant future.

It will be argued by some engineers that one reason for the slow introduction and small use of high-tension cable is due to the relatively small saving in copper and greater cost in insulation resulting from increasing the pressure. It seems to the writer, however, that this conclusion is not warranted, judging from the figures he has available as to the relative cost of the cables suited for different potentials up to 25,000 volts. Furthermore, such conclusion entirely neglects a consideration of the money that may necessarily be invested for transformers, real estate, etc., as for example in the Niagara Falls-Buffalo transmission, where, although 20,000 volts is being used on the overhead line, step-down transformers are interposed to reduce the voltage from 20,000 to 10,000 volts before the energy is distributed underground.

While it may be necessary to confess that we have not yet found the ideal insulator, which must be water and heat-proof, flexible, a perfect dielectric with low capacity, and withal inexpensive, nevertheless with the insulation now available we are prepared to make much further advance and widespread use of underground conductors than has heretofore been done. Perhaps the present and increasing price of Para rubber does not encourage the partisan of rubber insulation to the belief in the growing use of high-tension insulated conductors, but resin, oil and paper cost considerably less and conductors insulated with the latter materials have fully demonstrated their trustworthiness and long life in actual service.

The insulation of a cable should satisfy, it seems to me, the following conditions given in the order of their importance: First, strength against rupture; second, durability, and third, minimum leakage.

Tests of small areas of insulating material prove but little. Ignorance of the properties of insulating material may lead one to seek a very high test in megohms as the qualification necessary for a high tension cable. Megohms may be serviceable in "facilitating fault finding," but as a measure of volt resistance they are of little value. Don't pay for megohms per mile when what you want is disruptive strength.

Strength against rupture depends upon the character of the material and the skill exercised in applying it to the conductor, and while a material used may show comparatively small insulation resistance, it may at the same time show very high rupture strength; on the other hand, a small quantity of insulation may be good and a larger quantity but very little better.

It is becoming pretty generally realized that high insulation depends not so much upon the material used as upon treatment of that material. The processes of manufacture are very much more important in high-tension insulation than designation of material or specification of thickness. In fact, the conditions surrounding the process of manufacture are so important that a representative of one prominent manufacturing concern stated to me that he considered it probable that with the same material and workmanship we could produce in this country cables better adapted to high tension work than could be manufactured in England, for example, owing to our better climatic conditions.

To properly test the insulation of a cable involves applying the tests to considerable lengths of the completed cable. It is questionable whether after a cable is laid, it is advisable to test it very much above the working pressure, as such a test may permanently injure the insulation. It has been suggested that it is better to measure the insulation against rupture over a sample of the total cable requiring a considerably larger factor of safety than customary, and if the sample passes this test assume that the cable as a whole will do so.

High-tension cables are not such "breeders" of harmonics, resonance oscillations and such phenomena as may commonly be supposed. Possibly the elaborate theoretical calculations of certain writers on "Oscillations" may unnecessarily have prejudiced those not experienced with high-tension transmissions, and deterred the use of cables in connection with such installations. As a matter of experience it may be interesting to note the fact that the St. Croix cables, although of considerable capacity and on one end of a 25-mile overhead transmission, have never failed from "oscillations" even though the switches have been opened under short circuits. Mr. Fred. R. Cutcheon, the electrician of this company, writing me recently as to his experience along these particular lines, said:

"We usually notice a discharge on the arresters, especially at the generating end, when switching cables in and out of parallel. We find less disturbance when we cut in and out cables at the distributing end first and then at the generating end. The rise in voltage, however, is only about 5 per cent. There have been three occasions to my knowledge when the high-tension switches have been used to open the circuit under short circuit. On two of these occasions the current jumped across insulators on the switches, but I am not certain whether this was caused by the switching or was due to a previous breakdown at another point. On the third occasion I opened the switches when we had a short circuit on the low-tension side of the step-down transformers and no bad effect was noticed. On the whole, I am inclined to believe that switching does cause serious rise in voltage, for a sudden change of load seems to produce a strong surging discharge on the arresters when the generators remain in circuit with a portion of the previous load, although this may simply be due to the oscillating character of our water-wheel governors."

The high static capacity of cables as compared with aerial lines is looked upon by some engineers as an objection. Certainly not as an advantage, but may it not be a gain to have added to the system an element which will result in increasing its power factor, thereby reducing the size of the generating and distributing apparatus required for a given output. The question of the increased capacity affecting the line regulation is unimportant, for the old plan of holding the voltage constant at the generating plant is being abandoned for that of constant pressure at the point of distribution. Possibly those who prefer rubber to paper insulation, appreciating the value of the gain in capacity, might be willing to pay the additional cost for rubber in their cables, as a rubber cable will have about double the capacity of a cable designed for the same conditions as to voltage and conductivity.

The question has been raised whether there are variations in the capacity of a cable with variation in voltage, but published tests made by Felton & Guillaume on a lead-covered cable indicate that the capacity of a cable shows no change whatever with potentials ranging between 1,000 and 10,000 volts.

Some early measurements made by the writer on the St. Croix cables seemed to show evidence of undue and unexplainable drop in voltage throughout their lengths. In a later attempt to make exact tests to definitely settle this matter, some of the apparatus was burned out, and the writer coming in contact with a 25,000-volt circuit, he left open a question which he has no further opportunity to investigate.

The St. Croix Power Company has never had any trouble with its cables that was directly traceable to lightning, although the cables are connected direct to the end of a 25-mile aerial line I am inclined to the opinion that lightning will seldom injure cables, as they act as a condenser, on somewhat the same plan conceived by Mr. Thomas, of the Westinghouse Company, in connection with his system of lightning protection. In this conclusion, Mr. O. Schaffer, manager of the Duisburg Cable Works, agrees with me that there is practically no danger to cables from lightning when forming part of an overhead transmission circuit, although no arresters whatever be installed at the point of connection.

Because of the many advantages in the way of durability of construction, freedom from wind, weather and lightning, avoidance of malicious interference, elimination of danger of crosses and grounds from other circuits, non-interference with fire departments, and the strong prejudice to poles and overhead transmission lines anywhere except in open country, does it not seem that the more extended use of high-tension underground cables is delayed not by the cost or inability to manufacture successful insulated cables, nor by the opportunity for the use of such cables, but largely by an overconservatism in this particular direction?

Alternating Currents in Coal Mining.

In a paper recently read before the American Institute of Mining Engineers by Mr. W. B. Clarke, reference is made to the extensive electric coal mine haulage plant at the mines of the Berwind-White Coal Mining Company in the Allegheny Mountains, near Altoona, Pa. The plant has a capacity of 2,900 kw generated in 8 power houses, and supplies 44 mine locomotives having an aggregate horsepower of 4,400, the number of miles of underground trolley being 75. The paper describes in detail the mine haulage plant installed at Ehrenfeld, Pa., by the Webster Coal & Coke Company, which is the first to embody the advantages of underground transmission with alternating currents at a high voltage. The haulage at this mine was accomplished by the rope system and mules until the main heading attained a length of nearly two miles, when the necessity of substituting a more efficient and flexible system became very apparent. Since the main heading will eventually extend five miles underground, there was practically no alternative, and an electric haulage system was adopted which embodies the generation of three-phase, 25-cycle, 5,600-volt alternating currents near the pit mouth. This is transmitted to a sub-station in the mine near the center of actual operations, and 9,000 ft. from the power house, where, by means of transformers and a 250-kw converter, a direct current at 275 volts is delivered to the haulage circuits.

The power house contains two 150-kw General Electric, belt-driven, double-current generators, separately excited and delivering direct current at 275 volts from one side, and from the other three-phase alternating currents at 165 volts. The direct current at 275 volts is fed into the outer end of the haulage circuit in the usual manner, one terminal of the generator being connected to the trolley circuit and the other to the rail return. The potential of the alternating currents is raised from 165 to 5,600 volts by "step-up" transformers. The transmission line consists of a three-conductor, No. 6 B. & S. rubber-insulated, lead-covered cable, laid in the return air-way, which parallels the main heading.

The step-up transformers in the power-house and the step-down transformers in the sub-station are oil-cooled and are duplicates. Taps are brought out from the primary windings in order to compensate for the line-loss and consequently the direct-current voltages of the rotary converter and the generators at the power house are the same. The transformers are connected in "delta," so that the temporary disconnection of one of them cannot affect the system, beyond overloading the remaining two.

The double-current generators in the power house are simply rotary converters, being duplicates of the converter in the sub-station, with their shafts extended to receive the driving pulleys. It is proposed, as the occasion requires, to remove these two generators from the power house and establish additional rotary converter sub-stations in the mine beyond the present sub-station. A 300-kw engine-driven, revolving-field alternator has recently been installed in the power house, and delivers 5,600-volt, three-phase currents direct to the transmission line without the interposition of step-up transformers. A duplicate unit will be added at a later date, and direct current for the outer end of the haulage circuit will probably be supplied by a rotary converter, located in the transformer room of the power house, although it may prove advisable to retain one of the double-current generators permanently for this purpose. By using the double-current generators a very considerable saving in the original investment was effected. These machines have operated in the most satisfactory manner, and their regulation with rapidly varying alternating and direct-current loads has been surprisingly good.

In many mines the conditions are such that double-current generators would constitute an ideal permanent installation. The alternating-current induction motor, with its "squirrel-cage" armature, is pre-eminently suitable for use in coal mines, on account of the absence of the commutator and of armature insulation. The Davis Coal & Coke Company, for instance, with extensive operations in West Virginia, use direct current for mine haulage only. For all other purposes, alternating-current induction motors are employed, and generators of both types are installed in each of the power houses. By means of the double-current generator, both classes of service may be operated from one machine, while at the same time the advantages of high-voltage transmission may be secured by the use of step-up transformers. The author predicts an extensive field for the double-current generator in mining work.

In the installation described above, a cable containing three No. 6 B. & S. wires transmits 350 hp with a line loss of barely 5 per cent., and delivers direct current to the trolley circuit at 275 volts. On the other hand, if the direct-current system were used with a voltage as high as 300 at the power house and 250 at the center of distribution, i. e., 16.6 per cent. line loss, the transmission line would consist of eighteen No. 0000 feeders on one side of the circuit and six No. 0000 feeders in addition to the bonded double track on the other side. With the alternating-current system the copper for 5 per cent. loss weighs 2,200 lbs., while with direct-current system the copper for 16.6 per cent. loss would weigh 138,500 lbs., and for 5 per cent. loss approximately 560,000 lbs.

The system of power distribution outlined above is especially suitable for the operation of several neighboring coal mines from one central power plant. The United States Coal & Coke Company are at present installing an interesting plant of this nature in the Tug River field, near Welch, W. Va. The initial installation consists of 400-kw, 6,600-volt, 25-cycle, three-phase alternators, operating three 150-kw, 275-volt rotary converters, together with induction motors for driving coal crushers and conveyors At first three mines will be operated from this central power plant, but other openings will be added from time to time.

Train Signalling in France.

A dispatch from Paris says: "The Basantias system of electric intercommunication between moving railway trains was successfully demonstrated and explained on the Chemin de Fer de l'Etat line this afternoon on sections of the track between the Chateau du Loire and the Chateau de la Vallière. Two sections of the train traveled a considerable distance apart and were then brought into the same block. There was a telephone and alarm bell in a car of each section, so that when the two sections—which in actual use means two separate trains—were found in the same block both alarm bells rang and signalled the danger. A shoe at the side of the car slides on a wire string alongside one of the rails, and signalling on the alarm bell occurs the moment both trains are in the same block and therefore in dangerous proximity. Constant communication was also maintained yesterday between passengers of the two sections of the train by means of the telephone. A speed of eight to ten kilometers per hour is required to give to the dynamo attached to the axle the speed necessary to produce a sufficient current for this purpose."

Electrical Exhibits at St. Louis, 1904.

ONE of the most important departments of the World's Fair that will be held in St. Louis during 1904, and a department that will attract much attention, is that of electricity. The building in which the electrical exhibits will be seen, the Electricity Building, is, according to the latest statement of the Director of Works, 95 per cent completed. It is beautiful and imposing and is already attracting the attention of the thousands of visitors who flock to the grounds on Sundays. The very liberal use of Greek honeysuckle ornamentation is noticeable, especially around the interior court, where hundreds of these graceful designs, following the roof lines of the building, can be seen silhouetted against the sky.

The building is in direct contrast to the Education Building, just across the Grand Basin, for, although the two are identical in size and ground plan, yet the latter is severe and dignified, its imposing rows of Corinthian columns and unbroken sky line being directly opposed to the general contour of the Electricity Building, with its massive corner towers and step like roof construction, the lines of which are well defined in the scheme of ornamentation. While the interior court of the Electricity Building is not so large as that of the Educational Building, still the colonnade and elevated promenade are more pleasing to the eye, and with the completion of the decorative scheme involving statuary, palms, flowers and perhaps electro-aquatic features, it will be one of the most attractive spots on the grounds.

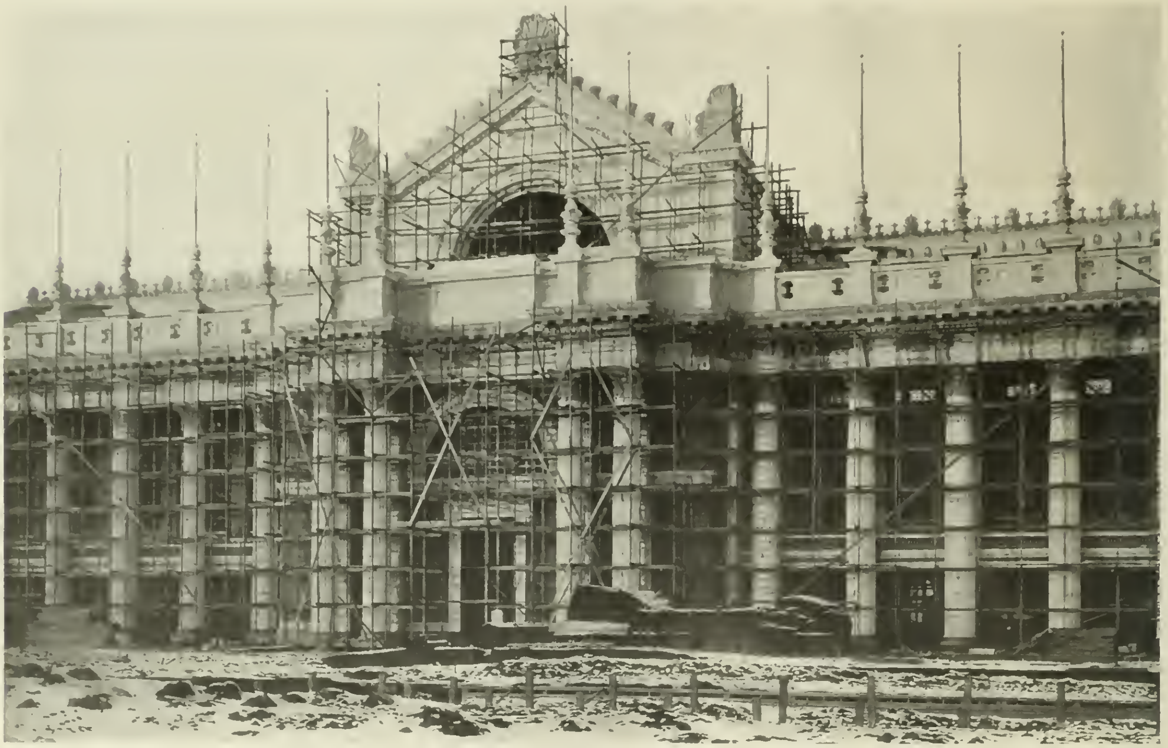


Fig. 1.—South Entrance Electricity Building, St. Louis Exposition.

The lighting of the interior of the Electricity Building has received especial attention, and the general arrangement of the main aisles, as shown in the accompanying ground plan, is one in the development of which the interests of the exhibitors were carefully considered.

The exact location of the various classes of exhibits has not yet been definitely determined, but it is probable that the foreign exhibits will occupy the north and east corridors of the building, while the entire western portion will be devoted to the display of the heavier classes of electrical apparatus.

Attention has been called more than once to the fact that Chief Goldsborough has, in all his departmental circulars, especially emphasized the value of working exhibits, and that this idea has met with the favor of manufacturers throughout the country is evidenced by the fact that the greater number of applications now on file specify a working exhibit will be made; many of these are on a much larger scale than anything that has heretofore been attempted in exposition work.

Perhaps the most spectacular of the working exhibits will be made by the companies now actively engaged in the commercial application of wireless telegraphy. The most important of these are arranging to install exhibits on a large and comprehensive scale, which will probably be in touch with stations erected in Chicago, Minneapolis and other Western cities.

The opportunities for a demonstration of selective signalling through space thus afforded are good and the ability of any system to send and receive messages simultaneously with the working of other sending and receiving wireless telegraph stations will form a conclusive proof of the commercial value of this late and most interesting development in the electrical field. The various methods of duplex and multiplex telegraphy, as well as wireless telephony, will also be shown, and it is the desire of Chief Goldsborough to bring together working examples of every system for the electrical transmission of intelligence.

Several applications are now on file involving most elaborate and lucid expositions of the principles involved in the various methods, and in addition to providing an object of curiosity to the millions of laymen, the exhibitor will be afforded ample opportunity to lay before the electrical fraternity and those interested in the technical and commercial development, the possibilities of the apparatus.

Another important branch will be that devoted to the electrochemical interests, and various electrochemical processes will be shown in operation. The Department of Mines and Metallurgy is co-operating in the arrangement for these displays.

The many electrochemical industries that have sprung up in Buffalo, Sault Ste. Marie and various other points in this country, as well as in Europe, are taking a lively interest in the possibilities for the exploitation of their products, and the reduction of ores, the manufacture of calcium carbide, various alkalies, and even of carborundum, it is hoped, will be carried on.

Storage battery makers will show the process of construction and demonstrate the advantages of their product, and, in all probability, very extensive tests will be made to determine the performance of the many accumulators now on the market. Several of the largest storage battery manufacturers in the United States have already filed applications for space, and it is understood that several of the leading German manufacturers will exhibit accumulators on an extensive scale.

Of live interest to all will be the exhibit of light-emitting devices. The developments of the past few months indicate that, by the time the Exposition is opened, several new types of lamps will be manufactured on a commercial scale. The exhibit of electric lamps will include, in addition to these, historic displays illustrative of the development of this important phase of electrical progress.

The advantages to be derived from a comprehensive display of electrotherapeutics and electrosurgical apparatus have appealed to the profession at large, as well as to the manufacturers of this apparatus, and the action recently taken by the American Electro-Therapeutic Association is indicative of the universal desire by its members that the profession be adequately represented.

The opportunity to exhibit in the Electricity Building is being rapidly taken advantage of, and it is learned on good authority that over 80 per cent. of the space appropriated to American exhibits has been applied for.

The organizing committee for the World's Fair Congress of Science and Arts adjourned on February 24, after a session of two days in New York, attended by Dr. N. M. Butler, of Columbia University, and World's Fair Director John Schroers, of St. Louis. Prof. Simon Newcomb, of Washington City, was designated as President of the Congress, with Hugo Muensterberg, of Harvard, and Albion W. Small, of Chicago University, as Vice-Presidents.

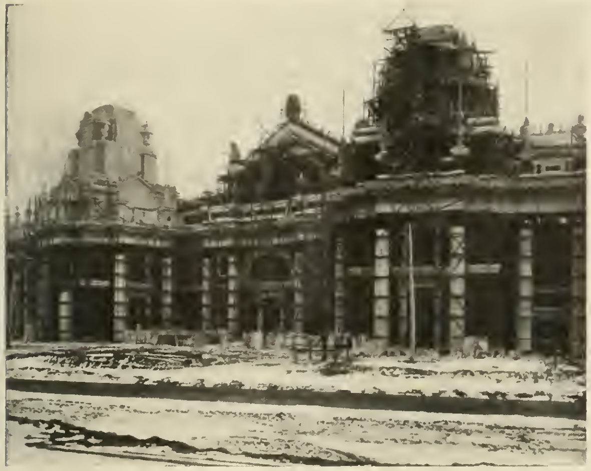


FIG. 2.—NORTH ENTRANCE.

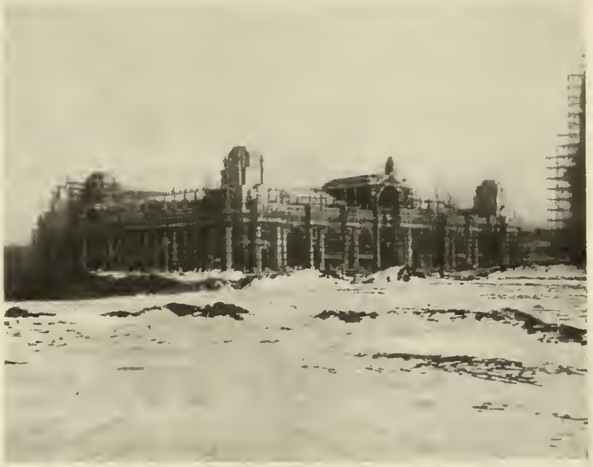


FIG. 4.—NORTH AND WEST SIDES.

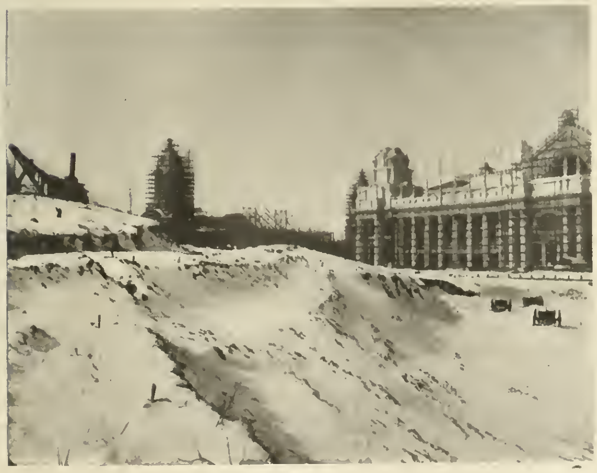


FIG. 3.—ANOTHER VIEW OF ELECTRICITY BUILDING.

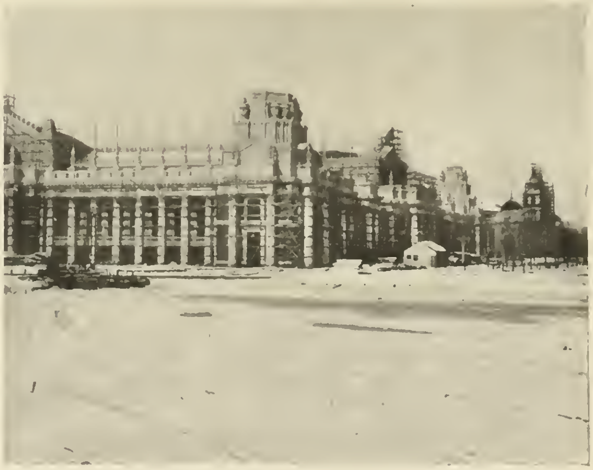


FIG. 5.—ELECTRICITY BUILDING FROM GRAND BASIN.

VIEWS OF ELECTRICITY BUILDING, ST. LOUIS EXPOSITION.

Electric Ore Smelting.

An experimental plant has been established at Lockport, N. Y., to apply the Ruthenburg system of ore smelting by electricity. From an electrical standpoint the interesting features consists in the holding of the magnetic ore (during the melting) as a bridge between opposing rolls, which are water-cooled and do not get hot. Though the rolls are faced with carbon, the carbon is not for the purpose of acting as a hot electrode, but in order that should the furnace flash it will not weld the metal to the rolls.

Dry, cold magnetite is a non-conductor. Formerly a furnace was started by wetting the magnetic bridge with salt water. When hot the bridge is a fairly good conductor. More lately this trouble has been overcome by mixing a small proportion of fine cast iron borings or shotted pig iron with the ore. This reduces the voltage required to force 1,500 amp through a bridge 1¼ in. x 1¼ in. x 10 in., from 150 volts to 70 volts.

It is claimed that the finest and dustiest magnetic concentrates which cannot be used in a blast furnace make an ideal charge for this electric smelting. Besides, the more finely the ore is ground the more thoroughly it may be freed from silica and phosphorus. An example of this is Port Henry magnetite, crushed to roughly an eight mesh carrying .6 per cent. of phosphorus. This is crushed to 60-mesh and the concentrates carry but .135 per cent. phosphorus. The power consumption is stated to be 450 kw-hours per ton of product, or the continuous expenditure of 19 kw will produce a ton in 24 hours. Fifteen per cent. of carbonaceous dust is mixed with the ore charge and the product of the rolls has 10 per cent. less oxygen than the raw ore. Dropping into soaking pits removes the most of the remaining oxide. This product may be melted in the open hearth for making steel or in a common cupola for making a superior, strong, soft cast iron.

The Construction of Aerial Telephone Lines--VI.

By Arthur V. Abbott, C. E.

POLES.

THE rapid extension of telephone and telegraph plants and the demands upon the timber resources of the country by wood-absorbing industries, raises so serious a probability of the early exhaustion of the supply of poles, that line constructors are anxiously casting about for both new supplies of timber, and for methods to increase the life of those which shall in the future be erected. Year by year the price of poles rises, and so rapidly that this factor in the cost of open wire lines is now becoming a most serious problem in telephonic installations. Of available woods it is usually considered that northern cedar or pine yields poles which are the most durable and the strongest. But on the Atlantic coast the supply of such timber is nearly exhausted and cedar and northern pine poles can rarely be obtained except by importation from the forests of the Northwest. In lieu of pine and cedar a great deal of chestnut is being used in New England and the central middle states. On the whole chestnut is a fairly good wood for poles, but it lacks the strength and solidity of pine and cedar. The chestnut as a tree is much slimmer than the pine or cedar and consequently the butt of the pole has considerably less resistance than with the other woods. As chestnut can be obtained in fair quantities at reasonable prices throughout Massachusetts, Connecticut, New York, Pennsylvania, Delaware and Maryland, a very large proportion of lines recently constructed, particularly those of moderate height, say 35 to 40 ft., are built of this material. The Southern States should apparently afford an inexhaustible supply of pole line material in yellow pine timber. But experience has shown that notwithstanding the pitchy quality of that wood, yellow pine rots with most alarming rapidity when cut and set in the ground. It is commonly believed that yellow pine poles unprotected will not last more than four or five years. From the District of Columbia southward to and including all of the Gulf States, southern cedar, so called, usually really juniper or cypress, is chiefly employed for pole lines. In the Middle West, Norway pine cut in the forests of the Northwest, or on the edges of Canada, is common, and makes excellent timber for open wire lines, but is now rapidly rising in cost.

The question of treating wood in some manner, to withstand the ravages of decay, has occupied attention for years, and many methods have been proposed. Of all the processes, creosoting is the only one which has made extensive headway, and from which the results appear, on the whole, to be worthy of attention. Under the paragraphs treating of conduits a description and specification for creosoting lumber, to prepare it for use as duct material, is given in detail, and the treatment for poles differs in nowise from that there described, excepting that it is possibly unnecessary to inject quite so large a quantity of oil per cubic foot of timber, as is desirable in underground work. The chief objection to be urged against the creosoted pole is its expense. In a general way the cost of creosoting may be estimated at about $20 per 1,000 ft. board measure, or in other words, this process very nearly doubles the cost of the pole. There are plenty of reliable records showing that creosoted poles and cross arms, if properly treated, will have a life of from 18 to 30 years, while untreated wood, in similar locations, cannot be depended upon for more than 10 or 12 years. A conservative estimate assumes that creosoting will certainly double, and probably triple the life of the pole line. But decay is not the only destructive force which operates against the pole. The impact of passing wheels may damage a creosoted pole as much as an untreated one. The sleet storm is no more a respector of a preserved pole than one unpreserved, nor does creosoting materially strengthen the pole except in so far as it may prevent a decay which weakens; and in city lines the progress of urban development may render the substitution of underground lines for aerial ones imperative long before even an untreated pole will fail through natural causes. In 'cross-country lines the normal increase of business may demand so many additional circuits as to necessitate rebuilding the line from the standpoint of required increased capacity before its lifetime is over. Thus in considering the relative advantages of treated and untreated line material, it is necessary to remember that rotting pure and simple is by no means the only reason that compels a reconstruction of the wire plant, but a pole line built of creosoted timber, wisely designed in a location where it is likely to remain undisturbed for a considerable period of sufficient strength to resist the elements and with capacity to meet all probable demands is a sagacious investment, and where it is possible to realize such conditions, the treated pole is by far the best material to select. As decay takes place most rapidly close to the ground level, about one foot above or below this point, it would seem superfluous to treat the whole of a large pole in the endeavor to save such a small portion from rotting. Many attempts have been made to invent a local treatment which would be satisfactory, but so far none of these efforts have succeeded in accomplishing their object, for all forms of local treatment which have been sufficiently efficacious to prevent decay at the ground surface have been attended by so much greater expense as to nullify the attempted saving. As yellow pine poles can be obtained at a considerably less price per pole than northern timber, the expense of creosoting is not so burdensome, when yellow pine is used as in the case of the other woods. So, for all these reasons the process of cresoting is steadily making headway, and within the last few months more than one telephone company has installed its own plant for the treatment of pole line material and report favorable results.

One or two suggestions for local treatment, which involve very little expense, are worthy of some consideration. Poles, which are carefully shaved, then thoroughly charred over a hot fire, and while hot soaked in tar, last perceptibly longer than those which are set without such precautions. A plan has just been suggested that involves setting the pole in a kind of socket, slightly larger than its diameter, which may be made of either a piece of iron or vitrified pipe or a cylinder of concrete, and filling the space between the socket and the pole with an asphalt concrete. By allowing the socket to extend a few inches above the ground it is hoped that the surface decay will be prevented. This idea looks hopeful, but there is as yet no experience therewith.

Owing to the greater scarcity of timber in Europe than in America, much more attention is there given to methods of preservation and to the construction of metal poles than in this country. Other processes for timber preservation, such as kyanizing and similar methods, based upon the injection into the timber of salts expected to coagulate the vegetable albumen, and thus preserve the wood from decay, have attained much greater currency and meet with much more favor abroad than in America. The use of structural iron poles, built either of wrought iron pipe or of a combination of angles and channels, is widely in vogue. The majority of European cities insist upon pole structures which are architecturally far superior to anything we here possess, and of a much more durable character. America, however, has developed the conduit system to a very much greater extent than has been adopted in European practice, and it is probably for this reason that the structural iron pole has not here received the attention it deserves. In street railway work iron poles, where trolley lines are permitted in business districts, are almost universal, and there seems to be no good reason why the telephone and telegraph companies should not follow a similar example in their most important lines. An ingenious inventor has suggested a plan for repairing pole lines, which decay has already rendered insecure. He proposes to saw off the pole square, as close to the ground as possible. Then to extract the rotten stub and to replace it with an artificial butt of concrete, to which the pole is subsequently bolted, by means of 4 or 6 iron straps. Certainly this is a novel expedient, and where lines are not subjected to great bending moments, may have some value, but it has been shown that the greatest stress on the pole occurs at the ground surface, hence the impossibility of designing any kind of splice at this point which will confer any sensible amount of strength.

But omitting from consideration all preservative processes, the telephone company should exert strenuous endeavors to secure the best possible timber for poles. There is no better method than to have the standing trees examined by an inspector, somewhat skilled in forestry, and withal a good line man, with a knowledge of the kind of poles necessary for the particular job under consideration. The accepted pole should be marked, and only felled during the three winter months when the wood carries the least sap, for poles cut in spring and summer decay much more quickly. As soon as on the ground the poles should be trimmed, cut to the required length, peeled and roofed. They should then be stacked up on skids, away from the earth and allowed to season at least for a year, prior to setting. Unfortunately, only the largest telephone companies can afford to carry a sufficient stock to justify so careful a selection, and the majority must content themselves with poles purchased from a dealer, who probably does not endeavor to do anything beyond supplying poles, which approximately correspond to the specifications for length and top and butt circumference, and cases are on record where standing poles have, within a week, been doing duty in a working line. Consequently, a lot of very poor material is creeping into pole lines.

Municipal Ownership Convention in New York.

A convention described as "National" was held last week at the Reform Club, New York City, to consider municipal ownership and public franchise questions. While some of the papers and discussions were important and valuable, the public interest was at no time striking, and the attendance never appeared to reach more than forty or fifty, of which number, if applause is any indication, several were "cranks" in favor of undiluted socialism. In fact, the more extreme the statements or arguments against individual enterprise or private ownership of anything, the louder and heartier was the applause elicited.

The first paper was read by Prof. Joseph F. Johnson on "Recent History of Municipal Ownership in the United States," prepared under the direction of the late Charles Waldo Haskins, Dean of the New York University School of Commerce. It called attention to the backwardness of this country in municipal ownership, and in the matter of gas lighting said that Philadelphia was the only large city which owned its gas plant. Of street railways, the paper said that out of 928 companies reported in this country only one, in Grand Junction, Colo., was owned by the municipality.

The necessity of some relief from the charges of private corporations was urged, with the Consolidated Gas Company, of New York, as an example. The paper stated that in 1902 this company, after paying all fixed charges and 8 per cent. on its stock, put aside a surplus of $2,100,000.

"The demand for municipal ownership is finding an outlet in the growing agitation for franchise taxation. Dr. Whallen, the Sociology Librarian of New York, in a published discussion of this subject, states there are but two bases of taxation—net income and actual value. Two noticeable efforts to increase the taxes of corporations are the Illinois Supreme Court decision of October 24, 1901, authorizing the Board of Equalization to assess gas, traction and other corporations at fair cash value, thus increasing the returns demanded by the Chicago Teachers' Association; and the work of Tom Johnson's new board, which raised the assessment of railway, gas and electric companies $17,000,000, resulting in a reduction of the tax rate from 3 per cent. to 2.6 per cent."

Mr. C. R. Bellamy, general manager of the municipal street railways of Liverpool, read a paper in person on the subject. Facts, as shown in Liverpool, said Mr. Bellamy, proved more than any amount of speculative opinion. In 1897 a company rented the city's tramway lines, which belonged to the municipality. The service was inadequate. The city bought the concern's rights for $2,723,400. Electric traction was adopted throughout the system, and other improvements were made. The carrying capacity was doubled. This table was quoted to show the results:

	1897.	1902.	Percentage Increase.
Passengers	58,409,084	100,335,585	184.66
Mileage	6,013,180	11,790,815	96.08
Receipts	$1,395,552	$2,431,320	74.25

"The city had developed its system so that many times more passengers were transported annually than under the company's management. The city had grown until it had a population of 700,000. A unit fare of 1 cent had been established, carrying a passenger an average distance of two and a half miles, and a large percentage of passengers were obliged to pay only this small fare, the double fare for long rides not affecting many travelers. In the last year of the company's old horse traction the fatalities had numbered 8 out of 6,000,000 passengers; under city regulation the number had come to be 8 out of 13,000,000."

Mr. Bellamy continued: "Reviewing the position as between company and municipal control, in the case of Liverpool, which may be taken as typical of the large British towns, it may be pointed out, first, that no one is suffering by the change, the share and stockholders, directors and officials having been bought out, or compensated on ample terms. The competition with the local railway service has been helpful to the citizens, and will lead the railway companies to a better organization. The gain to the traveling public during last year amounted to £320,000 (or $1,536,000) as a result of lower fares. The employees gained £40,000 (or $192,000), with free uniform clothing. Notwithstanding these important concessions, the gross profits amounted to 9½ per cent., after maintaining the rolling stock, permanent way and machinery in the highest state of efficiency. Six per cent. of this amount has gone to interest and sinking fund, 2½ to a general reserve, or depreciation fund, and the remainder, amounting to £25,000 (or $120,000), transferred to the relief of the local taxes. The capital expenditure of the complete undertaking has been shown to be $8,756,280. In addition to the building up of the sinking fund, which will extinguish the debt within twenty-five years, a renewal or depreciation fund of nearly $1,056,000 has been set aside, an amount equal to 12 per cent. of the capital, which will continue to grow."

Mr. Bellamy had to answer many questions. He said they did not have the crowded car trouble in Liverpool, as the cars were double-decked. Two-thirds of the year was warm enough to make outside riding comfortable. In winter the Traction Committee allowed nine passengers to stand up inside, but the tenth had to get outside. It was planned, however, to close the top decks for protection against the weather.

The Traction Committee of the city, he said, was composed of eighteen members, appointed by the council. He himself had sole power of all appointments in the service, and there were some examinations, always subject to his prerogative. The limit of speed fixed by law was ten miles.

Mr. C. T. Yerkes presented a paper against public ownership of street railways and said:

"There are several reasons, however, why I am sure that municipal control should rarely exist. First, all business ventures should be taken hold of intelligently and with due consideration for economy. How ridiculous to think that a municipality could run a railroad economically or wisely. The people who are connected with our railroads are with few exceptions men who have been brought up at the business, many of them having large interests in the companies. The little details are understood, and everything done to the ends that the roads may be profitable. Economics are practiced, extensions are well considered, improvements are carefully looked into and the business is carried on in a profitable and economical way. Can we for a moment imagine one of our railroads being managed by our city council or the state legislature?

"The results would be really amusing if they were not so serious. And I now ask the question, 'Who owns our railroads?' and I answer, 'The people.' I may safely say that millions of the population of our country have interests in our railroads throughout the land. They are, however, that class of people generally who have earned the right to that ownership. I fail to see any attempt at municipal ownership, in Europe particularly, but is a failure as considered with what it might be with private ownership. Take Glasgow, for instance, which is looked upon as being one of the best instances of municipal ownership in the world, and we find the expenses of construction and operation amounting to such a sum as would shame any private corporation. And the people who are in charge of the Glasgow works are most honorable gentlemen, and I believe did the best that their abilities permitted.

"We look through Europe and find railroad lines operated by the government, and where such is the case we can rest assured that the operation is not only most expensive but extremely poor. Who would have the hardihood to think that if we had had municipal control in this country for the last twenty years we would have had this great system of railroads that now exists? It is a fact that every state by its laws promotes the growth of railroads and encourages private ownership and makes our country teem with the rails and its accompaniments. That this private ownership can be abused there is no doubt, but what cannot be? No matter what the abuses have been as relates to this country, it is far ahead of anything like municipal control."

Mr. R. P. Porter presented an interesting paper on municipal versus private ownership. He said that he had been asked to discuss for the convention that boundless field of municipal activity which is prepared to make the British citizen the constant subject of municipal solicitude from the time when in his cradle he is fed on municipal milk to the day when his remains are reduced to ashes in a municipal crematorium. Besides the numerous industries at present being carried on by British municipalities, applications have been made to Parliament for powers for the manufacture of steam engines, dynamos, gas and electric fittings, paving materials, cold air storage, ice manufacture, milk supply, stores, saloons, hotels, bicycle tracks, etc. Street car factories had been established, municipal telephones were being undertaken, and a system of fire insurance is being discussed. Municipal banks, municipal pawnshops, municipal bakeries and even municipal collieries had been seriously proposed. To the common place duties connected with public health, streets, policing, protection from fire, etc., must be added all the more intricate businesses. These industries, he said, must be carried on at the risk of the ratepayers, by representatives not elected because of special experience, but because of party affiliation.

"The rush of English municipalities into speculative enterprises," Mr. Porter said, "has resulted in an enormous increase in local indebtedness. Last year sanction was given to loans amounting in the aggregate to no less than $144,677,465, and the average amount added in each of the last three years has been only just short of $125,000,000. Never before has there been any approach to these figures. In 1891 the sum was $37,021,495, while the average for some years previously had been about $25,000,000. In 1875 the English local debt was about $20 per head of the population. It is now over $50. While local indebtedness in the United Kingdom has risen from $464,100,500 in 1875, to $1,469,320,000 in 1900, and stands at $1,650,000,000 at the present time, per capita increase of from $20 to $50 per head of population, the aggregate per capita debt of the 137 largest cities in the United States has decreased from $56.62 in 1880 to $48.05 in 1902."

Omitting New York, where the per capita debt had remained about stationary while the assessed value of property had more than doubled, Mr. Porter said that in the thirty-five principal cities of the United States the net per capita debt had decreased in twenty-two and increased in thirteen, the increase in four out of the thirteen being only slight. In the same period the value of taxable property had more than doubled in many cities and had in some increased threefold. A similar comparison of a like number of the principal British cities showed an increased debt per head of population in nearly every case.

It seemed evident, he said, that the results of municipal trading in England had greatly increased debt, not only actually but relatively to the assessed ratable values and per head of population. "The excuse offered for the enormous increase of local debt in England," he said, "is that a considerable part of it has been contracted for productive industries. But the profits from many of these concerns, under municipal management, are very small indeed. The only reliable estimate on these profits may be found in a paper by the president of the Royal Statistical Society in which he showed that on a borrowed capital of $416,895,000, with an average annual income of $44,490,000, upon which only the sum of $405,835 had been set apart for depreciation, or about ⅛ per cent., there was an average net profit for the five years ended March, 1898, of $1,851,705.000, or about ½ per cent. on the outstanding debt, which the local government board then put at $359,415,000."

Mr. Porter went on to point out that public utilities in the United States were far ahead of those in England. In England, as elsewhere, the private companies set the pace in enterprise, he said, and even in reducing the price to the public. This was true of gas plants. Municipalities, he said, had not been known to lead in enterprise. The street railways of England, where about half are owned by municipalities, were not nearly comparable, he said, with those in the United States. Great Britain, he declared, would have had 4,000 or 5,000 miles of first-class electric railways by this time, but for the stifling effect of municipal trading. In conclusion, Mr. Porter said a municipality could work no cheaper than private enterprise, and a city council, constantly changing its membership, was not superior, as a board of management, to the directors of a successful company. With municipal ownership, he said, employees must always be retained at high wages.

"It would go ill at the next election with any one who suggested that they be discharged because they are useless, or that expenses should be cut down," Mr. Porter added. "The Birmingham City Corporation now employs over 7,000 men, and the street railways, if taken over by the city, would employ 1,500 more. The servants and officials of the Glasgow Corporation are put at about 15,000. Well organized, such groups must have great influence in municipal elections. Reflect for a moment what an organization like Tammany would become if, in addition to the present force of officials an army of industrial employees should be added. These are not imaginary but real dangers from the adoption of municipal ownership and operation. The establishment of enormous bureaucracies and the creation of a privileged class of employees would constitute a menace to the public weal."

Mr. Robert Donald, of London, on the subject of "Municipal Ownership of Tramways in British Towns," said in part: Almost all the large cities (Great Britain) not only own but operate their own tramways. The London County Council is operating 72½ miles and is building 100 miles. Glasgow owns and operates 103 miles, Liverpool 90. Edinburgh owns lines and a company operates them. Companies are confined to the smaller towns in England and Scotland. One of the elements which helped forward the municipalization movement was the bad management of companies which allowed their undertakings to become dilapidated towards the latter end of their leases. They paid their workmen so disgracefully that there were serious strikes. Cars were dirty, horses bad, service irregular. The advantages of municipal ownership are considerable. It regulates fares, provides for workingmen's cars, and fair treatment to employees; all this besides a yearly rental when the lines are leased. Local civic pride and jealousy, however, prevent co-operation between municipalities on a large scale. In Glasgow the aim of the municipality has not been to make a profit in relief or local taxation, but to carry the greatest possible number of persons the longest possible distance at the lowest possible fare. By the end of the present year most of the municipalities will have complete systems of electric traction and in almost all large centers of population municipal ownership of street railways is likely to be extended. The scope for private enterprises will be confined chiefly to linking towns together and opening up rural districts.

Mr. Donald gave the subjoined statistics as to municipal and private roads:

	Municipalities			Companies		
	No.	Capital Expended. £	Mileage.	No.	Capital Expended. £	Mileage.
1882-3	28	2,227,192	170½	113	7,523,635	501
1888-9	29	2,959,633	243¼	125	10,704,958	706¼
1892-3	35	3,105,636	274¼	118	10,998,516	686½
1896-7	42	4,459,488	367¾	117	10,405,622	663½
1897-8	47	6,116,687	450	116	10,376,282	614
1898-9	61	8,134,530	519½	108	10,468,692	602½
1899-1900	70	10,203,604	584¾	107	11,532,284	592¼
1900-1	99	14,057,664	689½	114	12,741,359	616

While public bodies, at the end of that year (March, 1901), operated only 27 per cent. of the total undertakings, they earned 43 per cent. of the aggregate net revenue and carried 46 per cent. of the total number of passengers conveyed. Since 1901 the greatest development in municipal tramways has taken place, while many of the companies figuring in the above returns have been expropriated.

On the subject of electric lighting, an elaborate paper was presented in manuscript by Mr. Victor Rosewater, of Omaha. Mr. Ellicott, city electrician of Chicago, also defended the work done there. Mr. J. B. Cahoon, past president and secretary of the National Electric Light Association, read a pithy analytical paper on the subject and said: Each community or municipality may do as it seems best in the matter of lighting its streets; may either enter upon the business itself or contract with a private corporation to furnish it with the necessary lights. The great majority of cities in this country still continue to let out the contracts for this work to private corporations and on the whole this has worked satisfactorily. The big plant in Chicago is only doing about 12 per cent. better than the average of the small plants throughout the State, when we might fairly look for 30 per cent. In other words, if by operating a big plant with approximately a capacity of 5,000 lamps, it cannot show a better economy than 12 per cent. over the average country plant in the same state, we may fairly assert that this plant has failed to effect any saving to the city by operating its own plant.

If we municipalize electric light plants we take away the incentive to progress towards a cheaper method of production and a cheapening of the price accordingly; for it is a well-known fact that where municipalities have started into any such enterprise so far as they were concerned progress ceased. Electricity is by no means fully developed, and the only way to make further improvements is by private companies forcing the manufacturers to improve apparatus.

To-day the old electric light companies are heavily capitalized, not from injecting water into their securities, but from the fact that they have paid the usual penalty for entering a new field. They paid high prices for the original apparatus. In a short time this had to be replaced by a better grade, and this in turn has had to be replaced by modern apparatus. What profits were made were promptly paid out in dividends, and nothing was set aside for the replacement of apparatus. Depreciation was never thought of; hence the burden on the electric light plant is much heavier than on any other form of manufacturing plant. We do not want to stop progress in the electrical fields and fall behind the world we are now leading.

I think the great trend of all arguments on the municipal ownership question in the past has been along the lines as to whether the municipal plant can be operated so as to furnish lights for a city at a less cost than the existing company can furnish them. I say frankly that the municipal plant cannot furnish light at as low a cost, all things considered, as the city can obtain from the local private company.

Mr. Rosewater's paper said: We are told that even if it were possible for the municipality to effect a large financial saving for its taxpayers and private consumers of electric light, and to secure for them the increment accruing from the steady growth of population and business which, for the private corporation, is absorbed in the franchise value, political exigencies would stand in the way. The bugaboo of politics is always handy for use upon timid people or those who merely seek for an excuse. Establish municipal ownership by the acquisition of an electric lighting plant, declare its opponents, and it is at once dragged into politics. That with proper civil service regulations the plant can be operated without undue political interference is certainly a possibility, and that the acquisition of such a plant would exert the strongest influence for protecting the public service from the bane of politics, is no more than reasonable to expect.

On the other hand, who will deny that the private electric lighting corporations are constantly in politics. The regularly recurring necessity of securing new franchise grants, of barring out competitors, or heading off hold-ups, of renewing contracts for street illumination, almost compel each privileged corporation to be active in politics in order to claim favors from the powers that be. In every city of any pretentions in this country the franchised corporations constitute the most pernicious factor in local politics. They have a community of political interest that draws them together, and they exert themselves as a rule in political contests on one side or the other with their consolidated strength.

The real question is whether it is better for the municipality to operate its own electric lighting plant or reserve to itself only the right to regulate, with compensation for the franchise either by fixed money payment or profit sharing arrangement. If financial considerations alone were to govern, the answer would depend upon the terms agreed to, although it is hard to see how, if the city may rightfully claim part of the profit on the percentage plan, it may not with equal propriety and justice, do the work itself and take it all.

The city owes it to its citizens who may be private consumers of electric light to protect them against exorbitant charges, and it can do this best when it is alone interested as owner and operator. Municipal ownership of electric lighting may have to wait its turn among the many demands urgently pressing upon the resources of American cities, yet no progressive programmes of contemporary municipal reform will, without it, meet the requirements of current popular thought.

Mr. Fred. F. Ingram, electric lighting commissioner of Detroit, made a statement very favorable to the municipal plant there, but quite refuted in every detail by the analysis given in these pages last week, so that to repeat them would require a reprint of that five-page criticism of the recent annual report of the commission.

Dr. Charlton T. Lewis made a vigorous argument against municipal business and in favor of private ownership and management. "Personal initiative, individual self-respect, the independent thought of the free man—these are all utterly inconsistent with paternalism in government." As to debauchery of the electorate, he said: "The merest glance at the body of voters in any of our great cities is conclusive. In New York, for example, the taxes are borne almost wholly by the owners of the soil. These are much less than one in twenty of the voters. The city government, by its taxing power, draws its supplies directly from less than 5 per cent. of the population. It disburses these vast revenues at the will of the entire body. Now it is not in the end the interest of any large body of citizens that extravagance and corruption should prevail in the government. The average family in the city suffers serious loss and injury from such conditions. But the number of voters who, in their immediate daily wages, in salaries, in favors obtained by political influence, in peculations and benefits, direct or indirect, profit by extravagance and corruption in the administration, is several times as great as the number of those who pay the taxes. In other words, for every business investment of enterprise which we put into the hands of a municipal government, we are increasing the power and the temptation of those who are not taxpayers to take unjustly from those who are. We are bribing voters against reform. We are creating a vast and permanent corruption fund to prevent our local elections from resulting in a pure and efficient administration. As long as this condition of affairs remains every such proposition is a blow aimed at the foundations of our institutions."

Mr. Thomas Fulton, secretary of the Citizens' Union, told of the investigations he had made of municipal affairs in this city, and of the great waste of public moneys they had revealed to him. "I find that a large proportion of the employees of this city work from thirty-five to forty hours a week, not deducting holidays or vacations. Thousands of our employees actually work about twenty-five hours a week the year round, deducting holidays and vacations, and they give very inferior service at that. The present government very rightly stands for the eight-hour day. Trade unions were responsible for it. It means eight hours of actual labor. I would respectfully point out to the present administration that eight hours does not mean seven or six or five hours, any more than it means nine or ten hours. The heads of the departments work hard and many hours, but too little of their time is spent in seeing that other people work. We are spending more money than ever, and with proper supervision the government ought to be run at 75 per cent. of the present outlay."

On the question of the public or private ownership of telephones a spirited controversy arose. The introductory address on this subject was made by Mr. U. N. Bethell, general manager of the New York Telephone Company, on the topic, "The Superiority of Corporation Ownership of Telephones." A number of statements made by Mr. Bethell in support of his position were controverted by Prof. Frank Parsons of the Boston Law School, who, going over the same ground that Mr. Bethell had traversed in his address, drew entirely different conclusions. There is a general impression in electrical circles that Mr. Bethell is an absolute master of his subject, as well as a model of fair and direct argument in his discussions of the subject.

Prof. Parsons favored municipal ownership. He submitted charts showing reductions in the cost to the public where independent concerns had entered a monopolized field, and said that greater reductions could be made by the municipalities. A paper, prepared by A. R. Bennett, on "European Experience of Public Ownership of Telephones," was read by the secretary. Mr. Bennett is engineer for Glasgow and other British municipal telephone systems. Several of these papers are of interest, as well as the discussions, but reports or copies are not at present available for publication.

Allan Ripley Foote, editor of *Public Policy*, spoke of the "Regulation and Taxation of Public Service Corporations." Among the other speakers were John R. Commons, secretary of the Taxation Committee of the National Civic Federation; Raymond V. Ingersoll, George H. Shibley and Eltwed Pomeroy, the subjects of the last two being direct government by the people through the initiative and referendum. After Mr. Ingersoll had defended labor unions and mentioned "scabs," Dr. William Henry Hale, a lawyer of Brooklyn, rose and said that he was surprised to hear a man like Mr. Ingersoll use the word "scabs." Not long ago, said Dr. Hale, he painted his own fence in Brooklyn. It took him one day, whereas a union painter employed by a neighbor occupied a whole week painting the same sort of fence in no better style. Then, he continued, as he worked late at his painting, a painter walked up to him and threatened to report him to the union for painting after union hours. "And it was my own fence!" said the speaker. "The tyranny of labor is worse than the tyranny of capital." The last sessions of the convention were given up chiefly to a discussion of franchise questions.

New Brooklyn Rapid Transit Power Station.

The Brooklyn Rapid Transit Company will soon add to its electrical generating system a new power house, now approaching completion. At present there are four main generating plants, aggregating about 23,000 kw. The capacity of the new station will be 32,000 hp, part of which will, however, be in substitution for that of obsolete generating apparatus in one of the older stations.

The new power house, known as the "Central Station," is located at Third Avenue and First Street. The accompanying illustrations show the building and the interior of the generating room in its present condition. The engine room will contain at first six 4,000-hp units, placed in rows of four each, leaving space for two more units, which at present is occupied by two direct current railway generators.

The boilers, which are of the water tube type, are arranged on two floors, there being thirty-two 650-hp boilers in all, with coal storage above. The condensers are furnished by the Worthington Company, as are also the air pumps and other auxiliary apparatus relating thereto. The engines were built by the Allis-Chalmers Company, and are of the vertical marine type of 4,000-hp rated capacity each, directly connected to Westinghouse 2,700-kw generators. Although the most economical cut off for the engines is at 4,000 hp, the guarantee calls for efficient working at 6,000 hp, and the generators are also guaranteed to operate successfully under 50 per cent. overload. Six of these generators are of the three-phase alternating-current, revolving field type, generating current at 6,000 volts and 25 cycles, and the other two are Westinghouse railway generators, delivering current at 575 volts. The steam pressure is to be 175 pounds. There is a 50-ton traveling crane with a 10-ton auxiliary hoist, which traverses the entire length of the engine room. Coal-conveying apparatus is to be installed in duplicate, and will have a capacity of moving 125 tons of coal per hour. This limit being made by the capacity of the coal tower on the receiving dock. Ashes will be handled by means of an electric locomotive and hopper cars.

This station will supply five sub-stations, of which four are now erected, namely, the Tompkins sub-station, located at Tompkins Avenue and Fulton Street, which serves the central portion of the system; the Halsey sub-station, which serves the eastern district; the Essex sub-station, which furnishes power to the East New York district, and the Coney Island sub-station, which takes care of the large summer excursion business in that direction. There will be a fifth sub-station in Flatbush, which has not yet been commenced. This station will be near the Brighton Beach line and will supply power to the district now supplied by the Thirty-ninth Street power station. The total proposed rotary capacity of the sub-stations is as follows: Essex sub-station, 2,000 kw; Tompkins sub-station, 3,500 kw; Halsey sub-station, 7,000 kw; Coney Island sub-station, 3,000 kw.

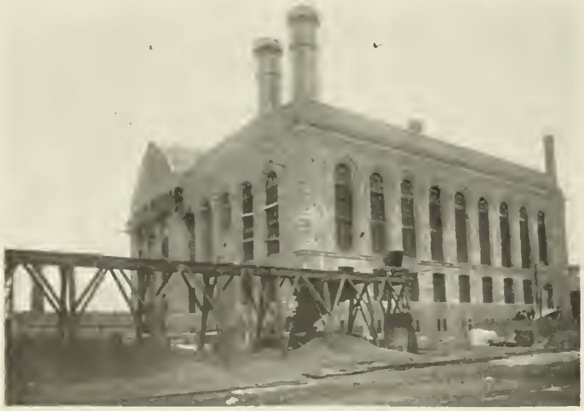


FIG. 1.—VIEW OF EXTERIOR OF NEW CENTRAL STATION.

All of the transformers and rotary converters in the sub-stations, as well as the switchboard apparatus, were furnished by the Westinghouse Company. The Halsey sub-station equipment consists of five 1,000-kw rotaries. This station also contains a booster made from two direct-current generators that were saved from a fire in one of the company's power stations a year or two ago, and which have been rewound for this service. In the view of the interior given in the illustration below this booster can be seen on the left, while on the right is shown the method of starting the rotaries by means of an induction motor. Throughout the entire system the rotaries are started in this manner. The Essex sub-station consists of a combined storage battery and rotary converter station. The storage battery rooms are behind the rotary room, the rear part of the building consisting of two stories, both being occupied by the batteries. The present capacity of the Essex battery is 2,000 amp-hours. There has been installed one rotary converter of 1,000 kw capacity, and there is accommodation for three other rotaries. The Tompkins sub-station contains two 1,000-kw rotaries and one 500-kw rotary. The Coney Island sub-station is already equipped with its full complement of 3,000 kw, containing one 1,000-kw rotary and four 500-kw rotaries. This station is a very important one, although it serves a territory upon which only the summer traffic is heavy. It has been the custom to help out this part of the road by means of a portable storage battery, contained on old elevated cars, which could be moved from one part of the system to another, being used at East New York during the winter and at Coney Island during the summer. These cells have now been permanently placed at the Essex sub-station, as the completion of the Coney Island rotary sub-station has given sufficient current supply to this section of the system. It is the intention of the company to move a part of these rotaries to other sub-stations during the winter months to take care of the car-heater load. This will keep the equipment in use throughout the year and relieve the road from paying fixed charges on idle machines.

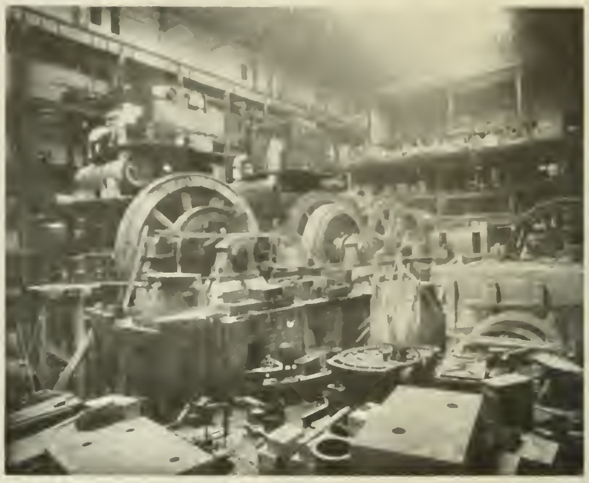


FIG. 2.—VIEW OF INTERIOR OF GENERATING ROOM.

There will also be erected a 6,000-kw sub-station near the Brooklyn terminal of the Brooklyn Bridge, and to be known as the Bridge sub-station. The conduits for the high-tension feeders leading to the station have already been laid, four 1,000-kw rotaries, the initial equipment, have been ordered, and the station is expected to be running before next winter.

A temporary sub-station has recently been constructed near the site of the permanent Bridge sub-station. It consists of a wooden building about 30 ft. x 50 ft. The walls are covered on the inside with asbestos board and the roof is of tin. This sub-station has been built during the last few weeks, and will receive high-tension current from the Edison Illuminating Company, which until recently was not available. The railway has been buying all the power it could get from the lighting company for many months, and this temporary sub-station will be used to handle any that may be set at liberty by the operation of the new power station, or such additional as can now be spared from the lighting circuits. The Manhattan and Brooklyn illuminating companies are connected by three-phase cables laid across the Brooklyn Bridge. One of these cables has been cut, and both ends are connected to the switchboard of the temporary sub-station. The controlling switches are so arranged that current can be obtained directly from Manhattan, directly from the Brooklyn power station, or the two ends can be joined, and the illuminating companies work without connection with the railway circuits. The present installation of the sub-station consists of one 1,000-kw Westinghouse rotary and three 400-kw transformers, but this is expected to be duplicated in the near future.

Axle Train Lighting.

The topic considered at the February meeting of the American Institute of Electrical Engineers was "Axle Train Lighting," on which subject three papers were presented describing the same number of commercial systems of train lighting. A communication by Prof. Geo. D. Shepardson treating the subject from the general engineering standpoint was also read, and will be reprinted in these columns in a following issue. In opening the session President Scott sketched the conditions applying to train electric lighting. The fundamental difficulty, he said, lies in the fact that the available methods of transforming energy and of storing electrical energy are so cumbersome and inadequate. The very difficulties are an appeal for new methods, for simple and efficient methods of transforming energy from its abundant and convenient sources into the desired form of electrical current. The motion energy of the train is almost infinite compared with the meagre amount of energy required for a few glow lamps, but apparatus for transforming, regulating and storing that energy is complicated and costly. The chemical energy contained in a few pounds of coal would be ample for the evening lighting of a whole train could it be efficiently transformed into electrical energy. An ice machine by which the heat in a pail of water could be abstracted in the form of electrical energy would illuminate a car during a long journey as a lump of ice was being frozen.

Mr. Elmer E. Sperry, in a paper entitled "Axle Lighting," announced a new system of axle lighting now in process of development. Few details were given, but the claim was made that taking the items of deterioration and up-keep, as developed by the plants which have been longest in operation and including interest and all essential factors, it can be stated that a candle-power-hour can be produced for about 68 per cent. of the cost of compressed gas, and that such gas, as now used, costs in the neighborhood of 46 per cent. more than an equal illumination in candle-power by the new system. Following is the disclosure of the system so far as given in the paper:

The sensitive moving parts may be statically balanced, freeing them entirely from any response to the vibrations, jerk and jar of the car, and rendering them entirely independent thereof. This device may be relied upon thoroughly to regulate not only the potential as deliverd to the lighting circuit under varying conditions of load and battery pressure, but also to handle the generator under all possible conditions of speed variation, reversal and change of load. Furthermore, it has been found that a number of valuable features, having an important bearing on this particular subject, and which have never before been introduced as factors, may be employed with perfect success with this system of control and regulation. Not the least of these is a constant-speed generator, the use of which cuts down the torque delivery from the axle, and thus the power absorbed from the axle, in exact accord with the demand for electricity at the time from the generator. When the battery is nearly charged, this current should be largely reduced, and its e.m.f. slightly and gradually increased. Any device which will take from a moving train only the power that is at that instant required to be developed and as the demand falls off will release all overplus of power to the train, is certainly desirable, if not positively necessary to the success of the coming train-lighting equipment. Especially is this true in view of the fact that by this device a large amount of power now wasted is not only saved but left available for traction purposes to the locomotive, which is already taxed to its utmost to meet the modern demand for high speeds of heavy equipment. Moreover, by this system the weight of battery and generators may be reduced, and the whole system rendered simple in the extreme.

Nothing is found necessary to the installation inside the car except the ordinary switch-panel for controlling the lamps of the car. In some instances, such as private and wild-cat cars, it might be advisable to install a voltmeter and ammeter or a combined single instrument which has been designed. Again, in this particular style of equipment, there has been included apparatus designed primarily to reinforce the battery when such a car is required to stand idle on a siding for a considerable length of time. This equipment allows the batteries to be charged from the ordinary 110-volt alternating current as well as direct-current service. Such service is to be had in almost any station whenever the necessity arises, thus furnishing an element of the system not met in equipment heretofore offered on the markt. In this instance the constant-speed machine does not require to take on its load at lower than its normal speed. Therefore, it is of minimum weight and size. The generator is suspended interior to the truck and no belts or other than toothed wheels are employed in driving. All parts are housed in dust-proof cases and automatically oiled, and designed to operate for long periods without attention. The generator itself is sealed and can work in snow, wet or dry with equal reliability. The heating factor is low and radiation ample to keep the temperature well within prescribed limits. The air-wash still further reduces the liability to overheat.

A paper by Arthur J. Farnsworth entitled "An Axle Light System of Train Lighting," described the system of the Consolidated Railway Electric Light & Equipment Company, of which company the author is chief engineer. The general principle of the system is the control of the output of the generator, which is kept constant by varying the resistance in the field circuit to correspond to the train speed. The regulating mechanism which accomplishes this is thrown into action by any variation of the generator current whenever the generator current varies from normal. It is designed, first, to maintain a constant output of the generator at all train speeds above the "critical speed," or the speed at which it becomes operative; and, secondly, to maintain a constant voltage at the lamps, whether they are being fed from the battery alone, or whether they are connected in multiple with both the generator and battery at speeds above the critical speed.

The generator in this system is installed upon the truck of the car, and driven from the axle by means of a belt; a regulator is installed in any convenient location in the interior of the car, and a storage battery hung in a suitable box from the car body. The generator is an iron-clad, bipolar, shunt-wound, laminated field motor. The armature shaft carries a worm operating gear and cam, which throws a switch when the direction of rotation of the armature is reversed. The polarity of the generator is thus maintained correct, independent of the direction in which the train is moving.

The regulator contains a solenoid with spring-balanced plunger to control its operation; the generator field rheostat; a small electric motor, connected by means of worm gear and ratchet mechanism to the rheostat to operate it; an automatic switch or cut-out, for automatically switching the generator in multiple with the lamps and battery at the critical speed, when the speed is rising, and for cutting it out at the same speed when the speed is falling; and a variable lamp resistance operated by the same mechanism that works the field rheostat. All the operations of the regulator are automatic.

The battery is usually proportioned to provide for about ten hours' continuous burning of all the lamps, although in the case of cars subject to long lay-overs, this capacity may be increased. Current for the lamps is thus insured under all ordinary circumstances arising in practice. Fig. 1 gives a diagram of circuits.

As the train accelerates and the generator voltage builds up, current flows through the fine wire windings of the cut-out coils and their cores become magnetized in proportion to the rise in voltage. When the voltage of the generator reaches the point where it about equals that of the battery, the magnetic pull of these coils overcomes their weight and that of the lever and resistance of an opposing spring, and the switch goes in and connects the generator in multiple with the battery and lamps. The main dynamo circuit is then complete from the generator, *G*, through a fuse, *F*, and through the solenoid, *S*, through the two coarse wire coils in multiple of a cut-out, *C*, cut-out switch, *N*, through the battery, and back to the negative terminal of the generator. If the lamp circuits are turned on, the current divides, part going to the battery and part through a lamp resistance, *E*, to the lamps, *L*. As the speed of the train increases above the critical speed, i. e., the speed where the cut-out goes in, the generator current increases in proportion until it reaches the point where the magnetic pull on the solenoid core balances the pull of its opposing spring.

Any further increase of train speed, tending to increase the current generated, will cause the solenoid spring to be overbalanced and throw into gear the ratchet mechanism, and move the generator field rheostat arm through one or more contacts until the current is cut down to the proper amount and the solenoid plunger is again in equilibrium. A still further increase in speed will act in the same manner. A decrease in speed will cause the mechanism to act in a similar manner to cut out resistance from the field circuit of the generator The generator current is thus maintained nearly constant at all speeds above the critical speed.

At high train speeds, when the battery is being charged, the potential difference between its terminals necessarily increases, and to maintain the voltage at the lamps constant it is necessary to insert in series with the lamp circuits a resistance proportional to the increase in voltage of the battery above its normal discharge voltage. By means of a reach rod engaging through a roller a circular cam upon a rheostat shaft, *A*, rtsistance begins to be thrown in the lamp circuits at the same time it is first thrown in the generator field.

The regulator is adjusted in each case for the average run of the car, so that it shall maintain the generator output sufficient to keep the battery charged without excessively overcharging it. As will be noticed on the wiring diagram, the series solenoid may be partially short-circuited, if desired, by means of the same switch that turns on the lamp circuits. In this manner, during the daylight run of the car, the generator output is maintained at a small amount, but, as soon as the lamps are lighted, the output instantly increases—each value of the output being maintained constant.

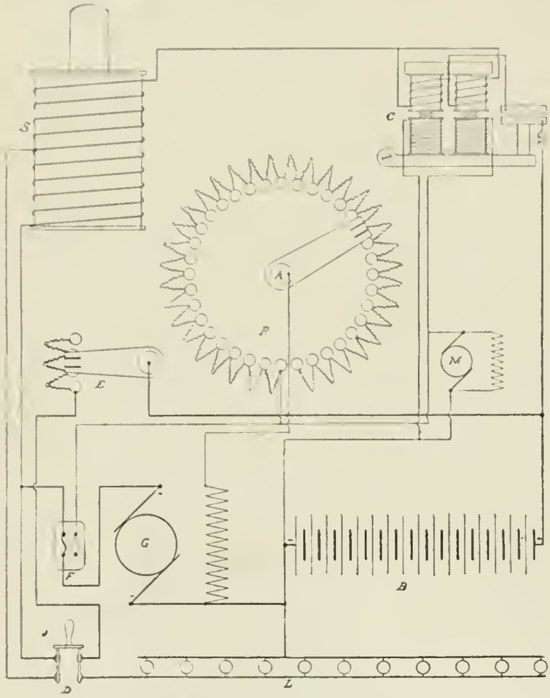


FIG. 1.—CONSOLIDATED CAR LIGHTING SYSTEM.

Except for those few moments when the lamp resistance is being inserted, the voltage variation at the lamps can easily be kept within 4 or 5 per cent.

The power required to operate this system varies with the equipment of the car, and the number of lamps it contains, and varies from one to two hp per car. It is, therefore, insignificant compared with the power developed by a moderfn passenger locomotive. There is no drag on the locomotive when starting, or until the critical speed has been reached, which, on through trains, is from twelve to fifteen miles per hour. Under this speed the armature is simply revolving with no other than frictional resistance.

The following table gives approximate data of the equipment:

Equipment.	Capacity.	Space Occupied.	Weight.
Generator	75 8 c.p. lamps.	33"x14"x13"	500 lbs.
Regulator	75 8 c.p. lamps.	17"x19"x9½"	75 lbs.
9 E Battery (Single) 24 lamps for 10 hours	160 amp. hours.	54"x20"x21"	865 lbs.
13 E Battery (Single) 36 lamps for 10 hours	240 amp. hours.	72"x20"x22"	1280 lbs.
9 E Battery (Double) 48 lamps for 10 hours	320 amp. hours.	85"x20"x27"	1730 lbs.
13 E Battery (Double) 72 lamps for 10 hours	480 amp. hours.	91"x20"x36"	2560 lbs.

The third paper, entitled "An Electric Car Lighting System," described the system of the Bliss Electric Car Lighting Company, the author being Mr. W. L. Bliss, president of that company. In this system the generator is located directly on the truck frame, and so arranged that its armature is caused to rotate by means of a mechanical connection with the axle. A storage battery carried on the car supplies the electrical energy necessary to operate the lamps whenever the armature of the generator revolves at a speed too low to render the same operative, or when the armature ceases to rotate, which condition is obviously attained when the car is at rest. Auxiliary automatic apparatus, acting in conjunction with the above, render the operation of the entire system automatic.

The motor is installed on the truck frame. Two brackets on the frame of the generator carry in roller bearings a hollow gear shaft, through which the car axle passes. Driving connection between the gear shaft and axle is obtained by means of a two-armed dog secured on the axle, and four driving springs attached thereto by means of ball-and-socket fastenings, and also to a similar dog on the gear shaft. This gives a flexible connection which allows for axial variations of the axle and hollow shaft.

The generator is of the iron-clad type, with four poles, the frame being so designed as to render the interior readily accessible with a minimum of trouble. The armature winding is of the two-circuit type requiring but two brushes. The brushes are mounted on a carrier which causes them to take up a diametrically opposite position when the motor of the car is reversed.

Fig. 2 gives a diagram of circuits. The generator switch shown is automatic in its action and completes the circuit between the generator and battery when the former is delivering its normal charging voltage, and breaks the circuit, and breaks it when the voltage drops below this point. It consists of a solenoid with two separate concentric coils. The inside, or lifting coil, is wound with fine wire, and is connected as a shunt across the terminals of the generator. The outside, or releasing coil, is wound with heavy wire and connected in series with the generator and storage battery. Within the central tube and free to work in a vertical direction, is a soft iron plunger, attached to and insulated from which is a laminated metal brush. When the generator develops its normal voltage, the fine wire coil will raise the plunger, causing the metal brush to make connection between two metallic contacts. The current then flows through the contacts, brush and series coil and through the battery, the series coil being wound in such a direction that this current aids the shunt coil in holding up the plunger and brush. When the voltage of the generator becomes less than that of the battery, current will flow from the battery in a reverse direction through the series coil and generator and oppose the action of the shunt coil. The weight of the plunger and brush is now sufficient to cause the opening of the switch by gravity.

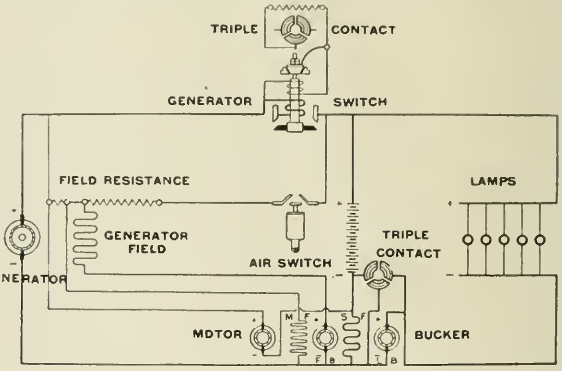


FIG. 2.—BLISS CAR LIGHTING SYSTEM.

Upon the top of the iron frame of the automatic generator switch is mounted a triple contact, consisting of a three-part segmental socket and a conical plug fitting the same. The plug is raised and lowered by means of a tail-rod attached to the plunger of the switch. When the plunger is down and the generator switch open, the plug connects the three segments together. When the plunger and plug are raised by the lifting coil, the triple contact is broken. The plug is insulated from the tail-rod and a flexible conductor permanently connects the plug with an insulated terminal, also mounted on the iron frame. One lead of a resistance coil, located in the upper part of the switch-box, is connected to this insulated terminal, and the other lead is connected to the front segment of the triple contact. The negative lead of the generator is also connected to this segment. The leads of the lifting coil are connected, respectively, to the positive of the generator and the terminal to which the flexible conductor is attached. Thus it will be seen that when the plug establishes the triple contact, it also short-circuits the resistance coil. When the plug is raised, it throws the resistance into series with the lifting coil.

The resistance is thrown into series with the lifting coil; first to reduce the current and consequent heating in the coil, which would otherwise change its resistance and alter the adjustment of the switch, and second to reduce the magnetizing effect of the coil, so that less discharge current will be required in the releasing coil to open the switch, as above explained.

The function of the triple contact is to short-circuit the lamp "bucker" and series field, to be described later, thus avoiding the drop that would otherwise take place in the lamp circuit when the battery was discharging, and to render the bucker inoperative at speeds below 20 m.p.h., when the generator switch is open.

There are 32 cells of battery, and the generator is so designed that when running at 20 miles per hour it generates 64 volts. At 60 miles per hour the voltage would be 192, but regulation limits the voltage delivered to 80 volts. The method of regulation consists in generating, by independent means, a counter e.m.f. in the field circuit of the generator, which increases in proportion to the speed and voltage, and hence reduces the field current. This is done by means of an arrangement called a "bucker," consisting of a revolving shaft carrying two armatures. One of these armatures with its commutator and field, constitutes a plain shunt motor, which takes its power from the generator mains and whose sole function is to rotate the shaft. It is obvious that this motor runs only when the generator is in operation. The other armature has two windings and two commutators, and revolves in a field excited by the current flowing through the battery. This double-wound armature, with its two commutators and field, constitutes the "bucker" proper. The motor simply drives it. The winding connected in the lamp circuit is called the "lamp bucker," and the winding connected in the field circuit of the generator the "field bucker." The field of the "bucker" is referred to as the series field, that of the motor as the motor field.

When no current flows through the battery none flows through the series field, and hence no e.m.f. is generated in the "bucker"; but when current flows through this series field e.m.fs are generated in almost exact proportion to the strength of the field. No current will flow through the series field under the following conditions:

1st. When the generator is inoperative, automatic generator switch open, and no lamps lighted, e. g., car standing still in day time. 2d. When the generator is operative, automatic generator switch closed, no lamps lighted and the generator voltage equal to the battery voltage, e. g., running 20 miles per hour in day time. 3d. When the generator is operative, automatic generator switch closed, no lamps lighted and batteries discharging, carrying all or a portion of the lamp load, e. g., running 20 to 25 miles per hour at night, lamps lighted. Current would, in this case, flow backward through the series field, as the battery is discharging, were it not prevented from so doing. 4th. When the generator is operative, automatic generator switch closed, lamps lighted, and generator just carrying the lamp load, batteries neither charging nor discharging, e. g., running 25 miles per hour at night, lamps lighted.

Under these conditions, no regulation of generator or lamps is necessary. Only one condition obtains when regulation is necessary, and that is: 5th. When the generator speed and voltage have risen and the battery is being charged, e. g., running above 25 miles per hour. Then the voltage at the lamps rises and must be kept constant, whether the lamps are lighted or not. The conditions are such that the e.m.f. of the "bucker" increases in proportion to the rise of e.m.f. at the battery terminals.

The other winding of the "bucker" is connected inversely in series with the field of the generator, and generates a counter e.m.f., which weakens the field of the latter to such a degree that the e.m.f. of the generator is just sufficient at the maximum train speed to force the maximum predetermined current through the battery and series field. The regulation tends to maintain constant current through the battery and series field at a given train speed. The lamp load is carried by the generator precisely as in the case of a constant potential machine and does not affect the charging current flowing through the battery. Since the "bucker" receives or absorbs energy from the lamp circuit and the field circuit of the generator, such energy is transformed into mechanical power and tends to revolve the shaft and thus relieve the motor of that work. In fact, when the apparatus is fully loaded, the motor becomes a generator and puts back into the system about 60 per cent. of the energy consumed by the "bucker" in effecting regulation.

In this system, the generator remains connected as a self-exciting machine, and eventually furnishes the strong current in its field required to produce 64 volts at the low speed of 20 miles per hour. Separate excitation for the field of the generator, and also for the field of the motor which drives the "bucker," thus enabling the motor to start readily, is supplied by means of current from the storage battery, which current is limited to a small value by the field resistance. The circuit from the storage battery through the field resistance is controlled by an automatic device called the air switch, which is connected with the air brake system. When the locomotive is coupled the air switch circuit is closed, and vice versa. When the automatic generator switch closes, it short-circuits the air-switch, in addition to its other functions.

The discussion which followed the reading of the papers was participated in by Messrs. Scott, Carhart, Arnold, Lyndon, Bliss, von Recklinghausen, Blodgett, Henry, Hogan, Farnsworth, Lockwood, Sloan, Stott, Sperry, W. N. Smith and McElroy. In reply to further information concerning the system described by Mr. Sperry, Mr. Lyndon said that the attorneys had forbidden disclosures further than given in the paper. Mr. Blodgett described a train-lighting plant experimented with about 14 years ago on the Boston & Albany Railroad, the storage batteries being charged at each end of the line. Mr. W. N. Smith regretted that the scope of the papers was not extended to include the system used on the New York Central, Lake Shore, Pennsylvania, Chicago & Northwestern, Milwaukee & St. Paul, Northern Pacific and possibly other roads, which consists of an engine generating set supplied with steam from the locomotive, in connection with a storage battery. Mr. Bliss criticised this system and Mr. Sperry corrected a statement that it was applied to all fast trains. The Twentieth Century Limited and other fast trains have axle equipments. Mr. McElroy condemned belt and similar drives, and announced a car-lighting system which he would possibly make the subject of an Institute paper.

Several references having been made to the adaptability to train lighting of the vapor lamp on account of the wide range of voltage through which it will give efficient service, Mr. von Recklinghausen said that he feared the same problem would be met that the Cooper Hewitt Company has encountered in trying to persuade the public, especially the ladies, to consider the mercury vapor lamp a nice light. As to the lamp being put to such use under the varying voltages which are met with in train lighting, that is a thing he could not say very much about, practically nothing, except that it is a very ticklish question and not at all as simple as it may seem to be from present indications.

Russian Fire Alarms.

"In St. Petersburg, the capital of Russia, the arrangement of fire alarms is rather peculiar and decidedly unique, and the fire alarm telegraph is an unknown thing. Instead a fireman is at all times in the tower of the City Hall, and he watches the surrounding city to catch the first glimpse of a fire. When a fire is discovered during the day he runs up black balls on the top of the tower as signals; at night red lanterns are used. The number of the balls or lanterns shows the district or ward in which the fire is located," says a writer on "Foreign Fire-fighters," in the January *Cosmopolitan.* "As soon as the signal is seen by the man on duty at an engine house he rings a bell outside, which calls together the members of the company, who may be scattered over a couple of blocks. This method is not conducive to quick time in reaching the scene; and from twenty minutes to half an hour is good work, unless the fire happens to be near an engine house."

Wireless Telegraph Congress.

It is alleged that the attitude of the German Government on the whole subject of wireless telegraphy will not be defined until the proposed meeting of the international congress on the subject is held. The date of this conference is still uncertain, as the British reply to the invitation has not been received.

CURRENT NEWS AND NOTES.

IOWA TELEPHONE ASSOCIATION. The seventh annual meeting of the Iowa Telephone Association will be held at the Savery House, Des Moines, Iowa, on March 10 and 11. Mr. Charles C. Deering, the secretary, is assured that there will be a good attendance from all over the state.

NEW GERMAN CABLE.—The German Cable Company has finished laying its second line to New York as far as the Azore Islands, 1,200 miles. The remainder will not be laid for several months, as the cable is still being manufactured. The British and German postal authorities are arranging to lay new North Sea cables, to facilitate communication between Berlin and London.

ANGLO-BELGIAN TELEPHONE CABLE.—The new Anglo-Belgian cable telephone line has just been opened at a charge of $1.92 for a three minute conversation. The cable connection is from St. Margarets Bay to Ostend, a distance of sixty miles. This is said to be the longest telephone-cable in the world. Paris telephone authorities say that London will be able to speak with Rome before the summer.

PALACE TROLLEY CARS.—Society women in New Orleans have begun a movement to have the street railway company put on palace cars for their convenience and comfort. They say they cannot ride in the present cars when they are in afternoon or evening dress, as the cars are dirty and there is no telling who their seatmate may be. They do not mind paying extra fares for the use of exclusive cars.

U. S. UNITS OF LENGTH AND MASS.—An amusing feature of the present controversy concerning the metric system, in which one party holds to the yard and pound as consecrated Anglo-Saxon standards, is that the United States fundamental legal standards of length and mass are the meter and the kilogram, respectively, and not the yard and pound. Owing to discrepancies found between the standard yard kept at Washington and that of the British Government, a meter made under the direction of an international committee was adopted by our government as the standard of length, and the yard is legally expressed as the 3600/3937 part of this standard. For similar reasons the kilogram was adopted as the fundamental unit of mass, and the pound is legally defunct in terms of this unit.

CHICAGO INSTITUTE MEETINGS.—The Chicago branch of the American Institute of Electrical Engineers will have a combined social and technical meeting at the rooms of the Western Society of Engineers in the Monadnock Block, Tuesday evening, March 10. A short time will be devoted to a discussion of train lighting and the remainder of the evening given over to a smoker, with light refreshments and a social time. The executive committee of the Chicago branch met February 28 and decided on the dates and subjects of meetings for the rest of the season. A number of features of especial local interest have been introduced into the programme which will be announced later. One of these will be a discussion of his report on the Chicago transportation problem by Bion J. Arnold, on March 24.

BRITISH TRAMWAYS.—An official report relating to tramway undertakings shows that in the United Kingdom, at the end of June last, there were 1,484 miles of tramway open to traffic, 885 miles being in the hands of local authorities. The capital expenditure on these lines was $125,782,680, of which $74,029,295 was spent by the local authorities. The total expenditure on capital account was $157,811,335. The number of horses employed was 24,120, of "locomotive engines" 388, and of cars 7,752. The passengers carried during the year totalled up to 1,394,452,983, and the gross receipts were $33,396,455. The net receipts were $9,307,090, the working expenses being $24,089,365. The net receipts in 1898, when there were 1,064 miles of lines open to traffic, were $5,161,155. Of 1,186 miles of lines in England and Wales, now open, 691 are worked by electricity. The rest will soon follow from present indications.

BRITISH STANDARDIZING.—A cable dispatch from London of March 2 says: The report of the Engineering Standardization Committee has been completed. Its recommendations in regard to the standardization of various iron and steel sections approximate very closely those adopted in the United States and Germany. It is estimated that the standardization will result in saving millions of pounds sterling annually to the British manufacturer and user. In structural steel alone the reduction of cost, it is said, will amount to $3,750,000 annually, and it is held that the standardization will enable the British manufacturer to deliver quicker, and to avoid the delay which has resulted in the United States securing so many locomotive and bridge contracts for South Africa and Egypt. The British Government has promised the co-operation of all the heads of departments, and is determined to enforce the use of standards, so that in an emergency it may be able to get its requirements from British firms.

ELECTROPLATING APPARATUS.—A tumbling drum for plater's use, patented to Joseph Walters, of Sumter, S. C., differs from prior devices of the kind in the minor details of construction and mounting. Its elements are the usual perforated wooden barrel mounted for rotation upon a stationary cathode shaft, the cathode conductors extending from the shaft into proximity to the periphery of the drum and into contact with the articles contained therein, and the charging door for the small articles which it is designed to treat. An unusual feature of the invention relates to use rather than structure, and consists in the portable character of the whole device, and its employment not only for the plating but for the preliminary cleaning and washing of the articles as well. The suggestion is that the drum containing the articles to be prepared for plating be first immersed and revolved in a suitable cleaning solution or in several such solutions in sequence, then rotated in water until the articles are thoroughly washed, and finally transferred bodily to the plating bath. The novelty of the conception lies therefore in the portability of the device and its use in such manner that all manipulation of the articles is avoided.

TOOL STEEL.—A report on the Taylor-White process of treating tool steel was recently submitted to the Franklin Institute by a sub-committee composed of Mr. Charles Day, chairman, and Messrs. James Christie, Coleman Sellers, Arthur Falkenau and Wilfred Lewis. The process consists of a particular method of treating steel of a particular composition, described as follows by Messrs. Taylor & White in their patent papers: "Our invention is based on our discovery that, while it is true tools made of air-hardening steels, that is to say, their cutting speeds, and also their uniformity red (though it must be understood, not all at the same temperature), it is also true that when air-hardening steels are made with certain constituents in ascertained proportions, this deterioration prevails only during a limited range of temperatures above the bright cherry-red; that is to say, from about 1,550 F. to about 1,700 F. (corresponding to a light-salmon color), and on our further discovery that above this range of temperature, which we will call the 'breaking-down point,' and from 1,725 F. up to a temperature at which the steel softens or crumbles when touched with a rod (approximately 1,900 or 2,000 F.), the efficiency of tools of such special steels, that is to say, their cutting speeds, and also their uniformity in efficiency, is greatly increased and largely so in proportion to the degree of heat to which they are raised." The report adds that to obtain a suitable steel for the process it is compounded with at least one-half of one per cent of chromium and at least one per cent of tungsten of molybdenum. The percentage of carbon has little or no effect on the result, steels containing from 85 C. to 200 C. having the same efficiency. The tool is cooled rapidly from the high heat to a point below the breaking down temperature in a lead bath, then slowly in the air or in lime. It is essential that the temperature should at no time rise, as in such case the tool would be seriously impaired. After the tool is cooled off its efficiency is found to be further increased by subjecting it to what is termed the low heat for about ten minutes, this temperature ranging from 700 F. to 1,200 F. As a result of experiments by the committee the relative efficiency of the treated steel and of the best untreated steel is placed at 3.5 to 1 on soft forgings and 1.3 to 1 on cast iron. The great uniformity of this tool steel has made possible the compilation of reliable and highly important data on speeds, feeds, etc. In conclusion, the sub-committee recommends the award of the Elliott-Cresson Medal to Messrs. Taylor & White.

WIRELESS TELEGRAPHY IN CANADA.—It is announced that the Marconi Wireless Telegraph Company of Canada will begin the erection of a wireless station at Montreal.

WIRELESS FIRE ALARMS.—It is stated from London that a fire alarm was recently transmitted from Streatham-green to Mitcham lane by Marconi wireless telegraph in advance of the regular firm alarm systems, by means of which a great saving of time was effected.

NEW YORK-MONTREAL TROLLEY.—A newspaper item is going the rounds to the effect that the first step in the completion of trolley connection between New York and Montreal has been taken by the Vermont Legislature in granting a charter to the Franklin County Traction Company to build an electric railway from Swanton to Vergennes, a distance of 72 miles.

GENERAL MEETING A. I. E. E.—At the recent meeting of the American Institute of Electrical Engineers it was announced that the general meeting of the Institute will be held at Niagara Falls June 29 to July 3. The movement to hold a joint meeting at Sault Ste. Marie or Mackinac with the American Electrochemical Society and possibly other related bodies failed, it appears, to receive sufficient support to carry it into effect.

BLACK SEA CABLES.—A dispute has arisen concerning the concession held by the Eastern Telegraph Company for a cable between Constantinople and Odessa. The Russian Government bought up the stock of the company, whose concession expires June 1. At the same time the Turkish Government has decided not to renew the concession, but to take over the line and work it by its own telegraph administration. The original agreement gives the telegraph company a preferential right, and it is on this point that the Russian Government will press for a continuation of the concession.

CONTRACTS IN EUROPE.—A cable dispatch from London of February 26 says: The Birmingham *Post,* in an article in its issue of to-day, calls the attention of British manufacturers to the fact that contracts involving the sum of $65,000,000 have been obtained by American interests during the last few weeks for the construction of electric traction systems in England, Russia and Holland. These contracts include the conversion of all of the horse tramways of St. Petersburg into electric roads, the construction of an underground railway, and the erection of sixteen iron bridges across the Neva.

SUBURBAN TRACTION IN ENGLAND.—A cable dispatch from London of February 26 says: Important conferences between the consulting engineers of all the railroads of Great Britain are being held, with the object of deciding on a uniform scheme for electric equipment, whereby the rolling stock and electric motors of the various companies will be able to travel indiscriminately on all the lines. All the trunk companies have practically decided to use electric motors, and the suburban lines are only awaiting an agreement on the subject of uniformity of plant. Six officials of the traffic and engineering departments of the London and Northwestern Railroad sailed for New York on the White Star Line steamer *Oceanic* to make a further study of American methods.

LODGE WIRELESS TELEGRAPH SYSTEM.—According to a press dispatch, a Lodge-Muirhead wireless telegraph system is about to be exploited commercially in competition with the Marconi system. The announcement adds that Marconi and others are using Lodge's invention and also one, at least, of Lord Kelvin's invention. It is stated that Prof. Lodge's new coherer, which is the integral feature of the system, consists of a small steel disc rotating in light contact with a column of mercury through an oil film. It is claimed that the sensitiveness of the coherer is remarkable, as are its extreme simplicity and freedom from derangement. Moreover, it does not require a decoherer or relay circuit. It works direct upon the Kelvin-Muirhead siphon recorder, giving, it is said, signals almost equal to the best submarine telegraph work. It is added that the submarine cable companies have so far abandoned the reserved attitude shown toward other systems as to take a practical interest in the Lodge-Muirhead system.

IN THE CASCADE TUNNEL.—Plans are in hand for applying electric locomotion to the Cascade Tunnel. The change will come none too soon, as the following incident shows: A train stalled in the Cascade Tunnel, on the Great Northern Railroad, near Wellington, Wash, not long ago, endangered the lives of every one on board. The tunnel is 13,283 ft. long, and on such a grade that a helper (steam locomotive) is required to get trains through. The helper and regular engine became separated in the tunnel, and the crews were afraid to risk proceeding with the train. The helper was sent ahead for aid, and the train remained in the tunnel. The gases from the two locomotives had so poisoned the atmosphere, however, that most of the trainmen and many of the passengers were overcome. Had it not been for an extra fireman, who happened to be on the train, and backed the engine down the mountain, it is probable that many lives would have been lost.

EXPLOSION AT EDISON CEMENT WORKS.—A serious explosion occurred this week at the Edison cement works near Easton, Pa., established by Mr. T. A. Edison. Four men were killed outright. Among those seriously and perhaps fatally burned were Mr. E. A. Darling, the chief engineer, and Mr. R. H. Goodnilley, the chief electrician. Mr. Darling was at one time mechanical superintendent at Columbia University. It appears that just before quitting time on Monday it was noticed that coal in a bin was afire. Hand extinguishers were used and it was thought that the fire had been put out. Automatic buckets carry this coal to the blower house and in this building the atmosphere is charged with pulverized coal. In some way fire in the bin was picked up by one of the buckets and as soon as it reached the blower house a crackling sound gave warning of impending danger. The day foreman seized a bucket of water to throw on the fire, but before he could do it an explosion occurred. More than a score of men were in the blower house preparing to quit work, and all were more or less injured and burned. Some were hurled through doors and windows.

MARTINIQUE-GUADELOUPE WIRELESS TELEGRAPH.—Under date of January 24, 1903, Consul L. H. Aymé, of Guadeloupe, reports: "Regular daily communication has been established between this colony and Martinique by a system of wireless telegraphy. The station in Guadeloupe is situated near to Gosier lighthouse, and that in Martinique, I am informed, somewhere on the peninsula of La Caravelle, on the east side of that island, so that the air line between the two stations passes entirely over the sea. These stations have been installed by a detachment of army engineers, and only official messages between the governors of the two colonies have thus far been exchanged. The officer in charge informs me that the system used is not the Marconi, but is one devised by the French engineer corps. The spark used is about 4 inches long, and the current is obtained from a small dynamo driven by an engine using vaporized naphtha. Four wires are used, separated at the top and bottom, forming a long, rectangular cage. The mast is said to be 170 feet high. As all cable communication with Martinique has been interrupted for several months, this is the only means of sending telegraphic messages."

ST. LOUIS EXPOSITION RAILWAY.—Mr. Charles V. Weston has completed the plans and specifications for the Intramural Railway for the Executive Committee for final modification or approval; after which the construction and operation may be undertaken by a concessionaire. The plans contemplate an elevated and an enclosed surface track. The road is to run west along the north line of the Fair Grounds from the vicinity of the northeastern entrance past the Administration Building and University group to the Athletic Stadium and Gymnasium; thence by a winding southward course past the various points of interest west of the Skinker road to the southern part of the grounds; thence bending east and north to the Art Palace; thence southeast to the Plateau of States, winding on to the Government Building and thence back to the beginning, the course touching all points of interest accessible from twelve stations. Transit over the entire route will require from twenty to thirty minutes, the trains all running one way, about one and a half minutes apart. The motive power will be supplied from the Exposition power house by third-rail system. Passengers will enter from a receiving platform on one side and leave by way of a discharging platform on the opposite side. The estimated cost is $650,000, and it is further estimated that a charge of ten cents for the round trip will pay the cost of construction and maintenance and a reasonable profit besides.

LETTER TO THE EDITORS.

Power Required to Drive Machine Tools.

To the Editors of Electrical World and Engineer:

Sirs.—The interesting article in your issue of February 21 entitled "Power Required to Drive Machine Tools in Locomotive Shops," while giving much valuable data, unfortunately omits any statement of the cutting speeds, depths of cuts and rates of feed, and the tests do not appear to include the case of the new high-speed steels. The data referred to are very necessary in comparisons and to those who would benefit from tests made; and the increasing part played by the latter material renders any information relating to it of much practical value. The conditions under which the tests were made are not so severe as in some cases which the writer has in mind, in one of which the group line shafting is running at 155 to 160 r.p.m., and in another where the minimum speed of group shafting is 200 r.p.m. It is to be hoped that tests will soon be reported covering high-speed steel, and in any event including all of the data necessary to render the tests of full value. CHAS. P. SANDS.

MONTREAL, CANADA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

The Air-Gap in Induction Motors.—BRESLAUER.—An account of an experimental investigation of the influence of various values of the air-gap in induction motors. It is well known that it is generally assumed that the air-gap should be very small in order to avoid a large no-load current and a large phase difference; but a small air-gap is very inconvenient for mechanical reasons. The author has made experiments to find whether an increase of the air-gap really has so great a disadvantage concerning power factor and overload capacity. He used a four-pole, three-phase motor of 240 mm rotor diameter and 110 mm rotor length. The motor had originally an air-gap of 0.5 mm; afterwards its rotor was turned off and the air-gap was thus increased to 0.65, later to 0.8, and finally to 0.9 mm. The results are given in diagrams and tables and prove that the smallest value of the air-gap—0.5 mm—was not the best one, but that an air-gap of 0.65 gave better results with respect to straying, and that even one of 1 mm is not prohibitive. The important result for practice is the fact that the conditions of straying do not become worse to the same degree as would correspond to the increase of the air-gap, and that it is possible by increasing the air-gap, to increase the overload capacity; according to the measurements this was in the ratio of 52 : 65, i. e., by more than 20 per cent. He remarks, however, that the stator of his motor had only two slots per pole and phase, i. e., less than what corresponds to the best construction according to modern practice, which requires at least three slots. He therefore suggests that other engineers might repeat these experiments with more modern motors. Nevertheless, he believes that from his experiments he can draw the practical conclusion that even in small motors the air-gap should not be below 0.5 mm and may be 0.6 to 0.7 mm.—*Zeit. f. Elek.*, January 18.

Testing Non-Synchronous Motors.—MEUNIER.—An article on a method of testing induction motors, similar to the Hopkinson-Potier method for direct-current dynamos. Two identical three-phase motors are connected electrically to the same network; each motor is provided with a pulley, but they have different diameters, and they are coupled together by means of a belt. When both motors are supplied with current from the network, the one motor acts as generator, the other as a motor; the relative speeds and the values of the current in the station depend upon the two diameters of the pulleys. He first describes a test in which the different currents and powers are measured by ammeters and voltmeters and gives an analytical and graphical representation of the phenomenon which take place. He then describes a method in which only ammeters are used for measuring the currents in the supply network and in the stators of the two machines; by plotting a diagram it is then possible to find the efficiency and the power factor without the use of wattmeters. This method may be useful in some cases.—*L'Eclairage Elec.*, February 17.

REFERENCE.

Non-Synchronous Motors.—ROSENBERG.—The first part of an article illustrated by diagrams, on the analysis of the no-load current of non-synchronous motors.—*Elek. Zeit.*, February 12.

TRACTION.

Passenger Traffic in Greater New York.—WHEATLY.—A continuation of his serial in which the author reviews the general condition of transportation facilities in Brooklyn, which is laid out on the radiating plan, and explains the requirements growing out of these conditions. A distinctive feature of the problem is that the city has grown into somewhat of a fan shape with long main lines tending toward and converging at a few congested points along its water front, where the business districts are located or where there are outlets by bridge or ferries to Manhattan. The chief transportation problem is to move the population not only to its own business district but also to move a considerable portion through that business district and across the East River into Manhattan. At present the transportation problem of Long Island City and the Borough of Queens has not reached an important point, but the possibilities of development with the completion of the present additional bridges spanning the East River, the building of the Pennsylvania Railroad tunnel, and the extension of the Subway, are clearly pointed out. Permanent relief can only be secured by very extensive improvements and extensions of the present railway facilities, the widening of streets, additions of tracks, inclines and other connections, and the provision by subway or elevated structures for distributing and collecting in the business districts of Manhattan, the traffic for Brooklyn and suburban Long Island without throwing the greater part of it upon the local lines. Some idea of the present condition may be gained by the statement that upwards of 300,000 passengers patronized the cars crossing the present bridge in both directions on November 10.—*St. R'y Jour.*, February 7.

Freight and Express on Electric Railways.—COOPER.—An article in which he points out that the development of electric roads from actual street railways into interurban systems extending through several States in some instances has naturally led to the building up of a considerable freight and express business as well as passenger service, and this has created an entirely new condition from that which the promoters of these properties originally planned. The present outlook indicates that interurban roads generally will have to interchange traffic among themselves and with the steam railroads; the necessity for adopting a standard traffic agreement and some method of establishing rates for general use between connecting electric roads similar to that in effect among steam roads is urged.—*St. R'y Jour.*, February 7.

Alleged American Conservatism.—An anonymous communication in which the writer claims that because there are more miles of electric track and cars in the United States, American engineers are prone to denounce some of the recent experiments with high-potential railways abroad as impractical. He believes that a greater variety of electrical engineering practice in America would result in a greater advance. The editors do not agree with him.—*St. R'y Jour.*, February 7.

REFERENCES.

Berlin.—The first part of a detailed illustrated description of the electric line construction of the Great Berlin Tramway Company.—*Elek. Anz.*, February 8.

Shaft Straightener.—A description of a device used in the Lake Shore Elevated shops in Chicago for straightening the shaft of the motor when it is bent after taking off the pinion. The shaft is usually bent just inside of the pinion. A sectional drawing of the device, and the appearance of the finished apparatus are shown.

The outer part, which is slipped on to the shaft first, is of such shape as to fit under the overhanging armature of the motor which is used. The second part slips inside of the first. The two are then forced apart by a jack screw. The parts are made of cast steel.—*St. R'y Jour.*, February 7.

Motor Lubrication.—An article stating that the Columbus Company is using oil in place of grease for lubricating motor bearings; a light oil is used in winter and a heavy oil in summer. When the motor is not in use the supply of oil can be shut off by a valve.—*St. R'y Jour.*, February 7.

Railway Signals.—An article discussing the general question of the use of fixed signals on side of the line *vs.* signals carried in locomotives.—Lond. *Elec. Rev.*, February 13.

Installations, Systems and Appliances.

Polyphase Work in 1903.—Eborall.—The conclusion of his article the first part of which was abstracted in the Digest last week. Concerning the present practice in power station equipment, he says that the increase in size of the generating plant and the standardization of the revolving field polyphase alternator, are perhaps the most striking features. It is considered as satisfactory that the direct generation of the high-pressure current in the stationary armatures of the alternators is the usual practice in England. With large plants, the limit of the working armature pressure is about 20,000 volts at present, for above this the insulating properties of slot insulations cannot be absolutely depended upon, while it is a difficult matter to insulate the ends of the coils properly, and in any case the machine becomes very costly to build. For pressures above 20,000 volts, step-up oil-cooled transformers must be used in conjunction with the generators, such transformers giving excellent results even with much greater pressure. If the turbo-alternator fulfills the expectations which led to its introduction, certain modifications will be introduced in the design of the revolving field polyphase generator. High engine speed is exceedingly favorable for alternating-current work, especially in conjunction with pure rotary motion. Gas-driven generators can quite well be operated in parallel at low frequencies, such as 25 cycles and thereabouts, and can be successfully built in sizes up to 1,000 kw, yet they are at the present better suited for use in private power stations, such as steel works, etc., than for really large work; no experience is as yet available with regard to the operation of synchronous sub-station machinery from gas-driven alternators. The experience of the next two or three years will show whether the very large steam turbine is a practical possibility; that is, whether its steam consumption, governing, and, above all, general reliability, are equal to the corresponding performance of the best slow-speed steam engines; should this turn out to be the case, it can only be a question of time before the use of the steam turbine will become general, at any rate for alternator driving. The large gas engine and its producing plant have been enormously improved of late. For future large schemes it looks as if it would be a difficult matter for the slow-speed steam engine to hold its own. Concerning the Heyland machines he makes the following remarks: "A type of polyphase generator that will undoubtedly come to the front before long is the asynchronous machines, and the recent invention of Heyland for improving the power factor of induction motors will have led to this. To Heyland must be given the full credit of discovering the means of practically getting rid of the wattless currents of such motors, by producing the rotary flux by means of low-frequency rotor currents drawn from the line through a simple rotor commutator. This again has led up to the self-exciting induction generator, now a commercial possibility, and actually on the market. Such asynchronous induction generators require no exciter, and operate as perfectly in parallel as shunt-wound, direct-current dynamos, to which, indeed, their manner of working is quite analogous. In addition, they have the enormous advantage of having a pressure drop of the order of 3 per cent., irrespective of the power factor of the load; in fact, they can be even over-compounded. This is a very great step in advance, as will be readily seen when it is remembered that a standard revolving field polyphase generator has a drop of 16-18 per cent., even when the power factor of the load is no lower than 0.8." He then gives some notes on high-pressure switchgear. Concerning polyphase transformers, he says that "The increasing use of the core type of transformer, especially for power work, is noteworthy as being a case of the survival of the fittest; the modern three-phase transformers are, of course, always of this type. In the latter connection, it is worthy of note that in America one of the two large concerns has recently started a line of three-phase transformers, following the practice general on the Continent during the last eight years. The three-phase transformer is superior to three single-phase transformers, each having one-third of its output, mainly on account of the great help it gives in balancing the system, and its want was probably not felt in the States, because it is not until very recently that pure three-phase systems for supplying light and power have been put down there." He thinks Heyland's compensating arrangement will come into use for the case of very large motors. In connection with the three-core cable, paper-insulated, he does not recommend the use of an auxiliary copper sheath beneath the armoring, because it is expensive, inconvenient, and not always effective. He thinks the right way of protecting such a cable is by means of a maximum-current oil circuit-breaker at the home end, and a reverse-current circuit-breaker at the far end, which could be arranged without difficulty to cut out the whole cable, should a fault develop in any one core.—Lond. *Elec. Rev.*, February 13.

Manchester.—The first part of a well-illustrated description of the Bloom Street Station of the Manchester Corporation electricity works. This station was erected upon the advent of electric tramways in Manchester required new generating plant for supplying power within the city area. There are four continuous-current generating sets, which constitute the entire generating plant of the station. The engines are vertical compound condensing and run at the slow speed of 75 r.p.m.; each engine gives 3,000 hp. The dynamos are compound-wound for traction, but the shunt winding only is used when working on the lighting load. Each generator has a capacity of 1,800 kw and withstands an overload of 25 per cent. for long periods or 50 per cent. for a short time. They generate direct current at 410 to 440 volts for lighting and 500 volts for traction. The armatures are 12 ft. in diameter, of the drum type, and are lap-wound; the commutators are 10 ft. in diameter, and each machine has 20 poles.—Lond. *Elec.*, February 13.

REFERENCE.

High-Tension Switches.—An illustrated description of various types of high-tension switches and circuit-breakers.—*L'Ind. Elec.*, February 10.

Wires, Wiring and Conduits.

Wiring for Ship Lighting.—Broadbent.—The conclusion of his article. He thinks the fact that "double" wiring is often preferred to "single" wiring, is the result of sentiment and an erroneous idea of what "single" wiring really is. Properly carried out, a good single-wire installation, far from being cheap and nasty, is not cheaper than a double-wire one, but is safer, more mechanical and costs less for up-keep. The chief objection urged against the single-wire system, is that it affects the ship's compasses, but this objection is based principally upon imagination, and very few actual instances of compass deviations due to this system of wiring could be cited. All the lamps lighting the compasses, and all others within 20 or 30 ft., should be double-wired. "In fact, single wiring as such is only used in the engine and boiler rooms, where the wires are steel-sheathed, and for the mains to the distributing centers. The whole of the cabin work is practically double-wired on a single-wired installation." The ideal system of wiring for ship work is a complete distribution system in which a separate circuit from a sub-distribution board is run for each individual light; there should be absolutely no soldered joints in any cable or wire. He concludes with some remarks on fittings and accessories.—Lond. *Elec. Rev.*, February 13.

Calculating Networks.—Wilberforce.—A short note on a (Brit.) Phys. Soc'y paper on an elementary treatment of conducting networks. He shows that the well-known reciprocal relations between the parts of a conducting network, can be readily established without an appeal to the properties of determinants. The fact that there is no continuous accumulation of electricity at any point gives a series of equations of a certain type, and the application of Ohm's law to every branch of the network gives a second series of another type. These equations are written down for two different sets of external currents and internal e.m.fs and a general equation is obtained from which the ordinary reciprocal relations follow as particular cases.—Lond. *Elec. Rev.*, February 13.

ELECTRO-PHYSICS AND MAGNETISM.

Abnormal Cathode Fall.—STARK.—An account of a theoretical and experimental investigation of the abnormal cathode fall in vacuum tubes. According to the ionic shock theory, the amount of ionization near the cathode depends essentially upon the number of neutral molecules in the unit of volume. This number, called the "specific number of molecules," is of importance in a number of formulas governing vacuum phenomena, and the author proposes to use it for formulating the abnormal cathode fall of the glow current. If that is done, it appears that theoretically the relation between cathode drop and current should not be linear. Since a linear relation has been, however, found by some observers, he made new measurements with platinum electrodes in a vacuum "free from fat." The uniform result is that there is no linear relation between cathode fall and current strength. The fact is that the self-heating of the cathode often stimulates a linear relation. The electric work in the dark cathode space is equal to the product of the cathode fall into the total current. The work spent on the positive ions is converted into heat at the cathode. With a constant pressure, and an increasing temperature, the normal cathode fall remains constant, but the abnormal cathode fall increases while the normal current density at the cathode diminishes.—*Ber. Deut. Phys Ges.*, November 1; abstracted in Lond. *Elec.*, February 13.

REFERENCES.

Diffraction of Rontgen Rays.—HAGA AND WIND.—An article in which they reply to a criticism of Walter and offer further evidence of a true diffraction effect of Röntgen rays. The values of the wave length of Röntgen rays deduced from their photographs, differ widely, but are in any case extremely small, and more of the order of the size of a molecule than of the order of the length of light waves.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 13.

Rapid Electric Vibrations.—SEIBT.—A well-illustrated paper read before the Berlin Electrotechnical Society, in which he describes experiments well suited for the lecture room, for demonstrating the properties of rapid electric vibrations.—*Elek. Zeit.*, February 5.

ELECTRO-CHEMISTRY AND BATTERIES.

Physical Character of Metal Deposits.—BURGESS AND HAMBUECHEN.—An article illustrated by many interesting photographs showing the peculiar forms of metallic "vegetation," or growths obtained under different conditions of electrodes. The factors determining the forms of deposits and those which the electroplater has in his power to regulate, are the chemical composition, concentration and temperature of the solution, the current density and circulation; the most important of these is the composition of the solution. Aluminum sulphate added to a zinc sulphate solution affords a marked improvement in the quality of the zinc deposit, although the aluminum sulphate itself undergoes no chemical change. There seem to exist at present few guiding principles showing what substances may be introduced to a metal solution to advantage, and what substances should be avoided. It seems that the viscosity and surface tension of a solution has some relation to the quality of the deposit, and that if a substance is added to a metal salt, which will alter the above properties, the quality of the deposit may be influenced thereby. The authors mention the peculiar fact that the kind of deposit which was obtained from a zinc sulphate solution prepared by dissolving crystals of zinc sulphate in water, was materially different from the deposit obtained under similar conditions of temperature, current density and contents of solution, but in which the solution was prepared by dissolving pure zinc in diluted sulphuric acid until it became of the same neutrality as the solution obtained by dissolving the crystals. The fact, as shown in the preparation of metal alloys, that certain metals have greater affinity for each other than have certain other combinations, seems to make itself evident in the cohesion or attraction between the metal which is electrodeposited and the metal receiving it, and some claim that a good electrolytic deposit requires the formation of an alloy (see the abstract of Kahlenberg's paper in the Digest last week); but the authors think that this alloying phenomenon cannot be held as a universal one. They believe there is a direct cohesion established when solid particles are brought into intimate contact. The deposited metal should be brought into as intimate contact with the surface below as is possible; the adherence of a coating, therefore, depends upon the amount of surface which is brought into contact; a somewhat rough surface receives a more adherent coating than a polished one, because the former is really the larger. The solution should wet the entire surface thoroughly; this property can be imparted to various solutions of metallic salts by the addition of certain other soluble substances, and it is for this reason that such additions are frequently practiced. They finally discuss the causes of the formation of grooves and perforations and of the peeling off of nickel coatings.—*Electrochem. Ind.*, February.

Electrodeposited Metals.—JOHNSON.—An article in which he discusses from the point of view of the electrolytic dissociation theory, the physical characteristics of electrodeposited metals. He calls attention to the fact that double salts are often used to advantage in electroplating. He believes that these good results are due to two reasons: they require a higher cathode voltage and they furnish the catholyte with a good supply of cations by its continuous decomposition, so that there is always a sufficient supply of cations at the cathode. The term electrode-voltage is discussed at some length. He also gives some notes on the influence of concentration changes in electroplating, and on the reasons why electrodeposited nickel curls up.—*Electrochem. Ind.*, February.

Electroplating.—HAAS.—An article on the abuse of electroplating. He describes the very crude methods which electroplaters formerly used in setting up their solutions and performing the plating operation. An electroplater should know exactly what his solution consists of; he should weigh the different materials; he should measure the e.m.f. and the current; he should observe the distance between the electrodes, etc. The size of the anodes depends upon their solubility; gold and silver anodes dissolve rapidly in cyanide solutions, hence only small anodes are required in order to keep the strength of the solution at the proper standard. On the other hand, a nickel anode is only slightly soluble in sulphate of ammonia—which is the regular solution used for nickel plating—hence a large surface of the anode should be used; this is the reason why corrugated nickel anodes are used. He advocates that all plating solutions should be made as simple as possible, to avoid mistakes of the electroplater. —*Electrochem. Ind.*, February.

REFERENCES.

Electrolytic Nickel Refining.—ULKE.—An illustrated article on the history and present development of electrolytic nickel refining. The author gives critical notes on the various processes which have been introduced into practice or have been suggested. The following processes are discussed: Vivian's electrolytic nickel-copper separating works. Balbach nickel refinery; Cleveland nickel and copper refinery (Browne); Hamilton nickel-copper refinery; Papenburg nickel-copper refinery (Hoepfner); proposed Sault Ste. Marie copper and nickel refinery.—*Electrochem. Ind.*, February.

Storage Battery for a Laboratory.—HUMPHREYS.—An article illustrated by a diagram, on a convenient storage battery installation for a physical laboratory.—*Phys. Rev.*, February.

Biographical.—The continuation of the serial on pioneers of electrochemistry contains a biographical sketch, with portrait, of Wilhelm Ostwald.—*Electrochem. Ind.*, February.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Magnetometer Free from Magnetic Disturbance.—KOHLRAUSCH AND HOLBORN.—A description of a suspension for a magnetometer, which is intended to obviate disturbance by electrical railways and similar causes. This is accomplished by means of an astatic combination, in which two magnets, 6 cm long and 7 mm thick, are connected by means of a brass rod about 1 meter long, and suspended by a platinum-iridium torsion wire. Thus the earth's field and its disturbances are completely eliminated, and the authors show that it is quite possible to carry out magnetometric measurements with the lower needle alone up to distances of 1 meter when the vertical distance between the rods is not less than 127 cm. But this is only possible in the "first chief positions" of Gauss, while in the "second chief position" the influence of the deflecting magnet upon the upper needle is very marked. In the first or "end-on" position, the lines of force of the deflecting magnet pass through the upper needle in a slanting direction, and it is easy to arrange meters so that the horizontal force upon it is negligible.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 13.

Quadrant Electrometer.—WALKER.—An abstract of a (Brit.) Phys. Soc'y paper on the theory of the symmetrical quadrant electrometer. Hopkinson has pointed out the imperfection of the usual formula given by Maxwell, and has given an empirical formula which closely represented his experiments. The general result is that the sensibility of the electrometer rises to a maximum as the potential of the needle is raised, and that any further increase in the potential of the needle reduces the sensibility. The author's experiments have been made with a sensitive electrometer which shows a maximum sensibility when the potential of the needle is about 100 volts. The sensibility seems to go on diminishing after this, at least until very high voltages are used. The formula for a quadrant electrometer is rigidly investigated and an equation is arrived at which is practically identical with the empirical formula of Hopkinson and which represents exactly the results obtained in the author's measurements. The equation contains a constant which must be positive to explain the results, and it is shown that this is the case. An investigation is then undertaken to obtain a numerical value for this constant. The solution of the electrical distribution for a system like the quadrant electrometer is very difficult, but he discusses and solves a similar two-dimensional problem which confirms his view that the air-gap is sufficient to account for a maximum sensibility depending upon the potential of the needle. The ordinary formula would be more nearly obeyed with a small air-gap. It is pointed out that, although diminishing the air-gap raises the potential of maximum sensibility, it does not follow that higher sensibility is obtained by reducing the air-gap. He then discusses the results obtained by Ayrton and Sumpner with a White electrometer having a bipolar suspension in which the variation in sensibility is shown to be due to want of symmetry.—Lond. *Elec.*, *Elec. Rev.*, February 13.

Large Inductance Coils.—IVES.—A theoretical article on the best dimensions for large inductance coils. He arrives at the following conclusions: A coil of maximum inductance must have a square cross-section. The inductance of a coil, with a given length of wire, increases rapidly, as the mean radius is increased, up to the maximum inductance, and then, as the mean radius is increased still further, decreases very slowly; therefore, it is better to make the mean radius too great than too small. For coils of maximum inductance, the inductance increases very rapidly as the length of wire used increases; not quite as fast as the square of the length.—*Phys. Rev.*, February.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Earth Current Disturbances and Telephones.—TAYLOR.—An abstract of a Royal Soc'y paper dealing with the disturbing effects produced by rapidly varying earth currents on a telephone receiver connected in a short line of telegraph having both ends earthed in the sea. The sounds produced have certain well-marked characteristics. In these latitudes they are stronger and of more frequent occurrence in summer than in winter; they are daily in evidence for a few hours at, or about, the time of sunset, while daylight is fading; they are readily precipitated by a state of electrical tension in the atmosphere which may culminate in a thunderstorm. Several characteristic forms of disturbances are described. It is suggested that the changes of ionization of the atmosphere offer a reasonable explanation of the greater night-time efficiency in signalling observed by Marconi with Hertzian wave telegraphy.—Lond. *Elec. Rev.*, February 13.

MISCELLANEOUS.

The Genesis of Lightning.—WALTER.—An account of an experimental investigation of the way in which lightning originates. He proved some time ago that an electric spark originates chiefly at the positive pole and is preceded by a number of preliminary sparks of increasing length, following each other at very short intervals and feeling their way towards the negative pole. Some very successful photographs of lightning flashes taken with a moving camera have since enabled him to demonstrate that the genesis of lightning is accomplished by a precisely similar process. Every flash is preceded by a number of minor flashes, branching out towards the earth. The path remains the same in all its ramifications during the succeeding flashes, though the various branches are not always equally illuminated, and further branches are added. A path once made through the air becomes conducting and is then utilized for further discharges. One of the pictures is that of a flash consisting of three main flashes with time intervals of 0.0177 and 0.0489 seconds respectively. Another discharge consisted of five equal flashes lasting altogether a quarter of a second. One photograph shows evidence of an alternating discharge, but as a rule it may be taken for granted that the lightning process is a series of continuous discharges, and proceeds practically from the cloud to the earth.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 13.

Manufacturing Plant.—A well-illustrated description of the Wilton Works of the (English) General Electric Company, Ltd., which have been in operation for about 6 months, as the main plant at Manchester could not fill all the orders. The new plant is devoted chiefly to the manufacture of dynamos and motors, but comprises in addition a small factory for interior conduits and one for carbons. The demand at present for direct-current motors being greatly in excess of that for polyphase, it was decided to adopt direct instead of three-phase current for power distribution in the plant itself, and to put down a power station equipped somewhat on the lines of a public supply station. Therefore, the generators give 460 volts on a three-wire network, the smaller amount of three-phase testing being provided for by a motor-generator.—Lond. *Elec.*, February 13.

New Books.

GALVANIC BATTERIES, THEIR THEORY, CONSTRUCTION AND USE. Comprising Primary, Single and Double-Fluid Cells, Secondary and Gas Batteries. By S. R. Bottone. London: Whittaker & Co. 376 pages, 144 illustrations. Price, 5 shillings.

The plan of the book is in general that of the ordinary works on this subject. The first chapter opens with a short historic sketch of the galvanic cell, then goes on to describe the simplest form of cell, gradually building up the more complicated forms in the subsequent chapters. There is a pretty thorough account of the different cells in use, besides some proposed and some obsolete ones. The theories and explanations of the reactions are the ones that have been doing duty for years; some are adequate and some are not.

An example of the latter class is the "nascent hydrogen" hypothesis. On page 143 we read, "As soon as the nitric acid begins to be decomposed by the nascent hydrogen, so soon are the irritant and noxious fumes of nitrogen trioxide given off." If no nitric acid, or other "depolarizer," be present, hydrogen is set free at the cathode. If nitric acid be present, hydrogen is not set free, but nitrogen trioxide is. These are the facts, but the nascent hydrogen hypothesis adds the purely gratuitous assumption that hydrogen is first set free in the nascent state, and then by virtue of the peculiar chemical activity of the nascent state, it recombines with part of the oxygen of the nitric acid. In other words, water is decomposed into oxygen and hydrogen by virtue of the e. m. f. of the cell, but having once been set free the hydrogen becomes so energetic that it immediately recombines with some other oxygen in spite of the e.m.f. Is it not more rational to assume that when nitric acid is absent, water is decomposed into oxygen and hydrogen, but when nitric acid is present water is not decomposed but nitric acid is? The nascent hydrogen hypothesis asserts that copper is reduced on the cathode of a gravity cell by the nascent hydrogen. The more sane theory is that when the cathode is surrounded by sulphuric acid, that is hydrogen sulphate, hydrogen is deposited on the cathode. When the cathode is surrounded by copper sulphate, copper is deposited; when by silver sulphate silver is deposited; when by ferrous sulphate, iron is deposited.

The criticism of this and other old theories or hypotheses, of course, applies to most other works of the class of the one before us, so we do not wish to be unduly severe, yet we think it not out of place to suggest that in writing a new book on batteries it would be a good idea to exercise some editorial discrimination in quoting current theories, retaining only those that have withstood the test of criticism. Furthermore, laying aside theoretical considerations, we have a word to say regarding additional facts. It is a fact, long ago established by Dr. Wolcott Gibbs, that if the nitric acid be saturated with ammonium nitrate, the noxious fumes are entirely suppressed; the only gas liberated being nitrous oxide, an entirely innocuous substance. We find no mention of this fact in the remarks before cited, in which the advantages and disadvantages of nitric acid and nitrates are discussed.

On the whole, the book is a good one, containing a considerable amount of reliable information.

Elementare Vorlesungen über Telegraphie und Telephonie. By Richard Heilbrun. Berlin: Georg Siemens. 61 pages, 44 illustrations. Price, 1.60 marks.

This is a charmingly written little elementary treatise in the German language, written for the technical instruction of practical telegraphers and telephonists. It is divided into four chapters, as follows: I. On the Electric Current and its properties, with Ohm's law. II. Electrical Units. Also electric heating, Joule's law. III. Magnetism, magnetic fields and elementary magnetic laws. IV. Electromagnetism and the elementary principles of the magnetic circuit.

The illustrations are simple and the description in the text is clear. A few simple equations are employed to symbolize the laws enunciated. There is very little said about either telegraphy or telephony in the pamphlet; but everything that is described and stated bears upon the essential principles of those industries.

Isoliermaterialien und Warme (Kalte) Schutzmassen. By Eduard Feltone. Leipzig: A. Hartleben. 320 pages, 38 illustrations. Price, 5 marks 30 pf.

This is a treatise on the manufacture and use of material for heat non-conductors, irrespective of whether such appliances are used to keep hot bodies warm, such as steam boilers, steam pipes, etc., or whether they are used to keep cold bodies cool, as in refrigerators, safes, etc. The 150 first pages are devoted to a description of the various artificial compounds used for this purpose, particularly the various magnesia and asbestos preparations, together with the chemical reactions that accompany the processes of manufacture. Next the various methods and kinds of machinery employed to convert raw material into convenient and desirable form for practical application are described. The latter part of the volume deals with some of the methods involving the employment of heat-resisting materials. This latter portion of the book seems quite at variance with the prevailing American customs, which, in many respects, appear to be somewhat in advance of the methods abroad.

Electrical Dictionary: English, German, French. By Paul Blaschke. Leipzig: S. Hirzel. 226 pages. Price, 5 marks.

The German appellation "Wörterbuch," or "word book," describes this volume much better than the English term "Dictionary." It is in truth a sort of phrase book, in which electrical terms in the three languages—English, French and German—are correlated, so that one may readily obtain the expression in either language for an electrical idea. In this respect it is rather more than a dictionary, but there is no attempt at definitions. The typographical plan is excellent. The phrases in three languages are arranged alphabetically in large type, while their correlative expressions are printed in smaller type. One may, therefore, look alphabetically in either English, French or German, finding opposite the same the corresponding equivalents in the other two languages. The book in its plan follows closely the excellent word book of Prof. Hospitalier, which appeared about three years ago.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Electrical Contractors' Association of New York State, Secretary, Wm. J. Davis, Ithaca, N. Y.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Interstate Independent Telephone Association, Secretary, E. M. Coleman, Louisville, Ky.

Iowa Telephone Association, Secretary, C. C. Deering, Des Moines, Iowa. Next meeting, Des Moines, March 10 and 11, 1903.

Kentucky Independent Telephone Association, Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

British Westinghouse Works.

We illustrate herewith the new works of the British Westinghouse Company, which are situated at Trafford Park, a suburb of Manchester, England. Those who have visited the Pittsburg Westinghouse works will see the resemblance between the two great manufacturing establishments. The British works have an advantage over the American establishment in its situation with respect to water shipping facilities, being bounded on two sides by the Bridgewater Canal and but a few hundred feet distant from the Manchester Ship Canal. One feature of interest is the location in the immediate vicinity of the works of a town of 500 houses built for the workmen.

Fig. 2 gives an idea of the interior of the main aisles of the machine shop, and Fig. 3 is a plan of the works. In the erection of the works 17,000 tons of steel, 9,000,000 ft. of timber and 300,000 sq. ft. of glass were used, and 3,000 workmen employed. About 12 months elapsed between the laying of the corner-stone and the opening of the works. The total area occupied is 130 acres, and there are no less than 20 miles of standard railroad track laid within this area.

The office building, which is 6 stories high, has 75,000 sq. ft. of floor space. The entrance halls are empanelled and staircases paved entirely with white marble. All furniture and woodwork is of polished oak, and each office is provided with a small lavatory and wardrobe. Records, drawings and similar valuable property are stored at one end of the building, which has been rendered entirely fireproof, and divided into strong rooms. On the various floors are the rooms of the heads of departments, draughtsmen, accountants, shipping and general clerical staff. On one of the upper floors is a dining-room furnished in mahogany, which is for the use of those occupying the more important positions in the works, and adjacent to it is a kitchen replete with every modern appliance. Confusion is reduced to a minimum. On the extreme east is situated the iron foundry, 600 ft. in length by 180 ft. in width, containing at present two cupolas, one having a capacity of about 18 tons. Outside this foundry, and at the east side, is built a store, entirely of iron, which has a plate floor on a level with the charging platform. Underneath the store is a railway track, and by means of a hydraulic lift the pig or scrap iron can be conveyed directly from the railway wagon to the charging platform. Running down the center bay are two electrically-operated overhead cranes, each capable of raising and carrying a load of 50 tons. Each is also provided with a lifting gear for weights not exceeding 10 tons, and the respective motions are controlled by three separate motors. There are also in this foundry the usual sandmills, sieves, grinding and scouring machines, all driven electrically. Lighting is carried out by means of Bremer arc lamps placed on brackets from the main steel pillars, and a standard gauge track runs from one end of the building to the other.

In the next building to the west all the brass and malleable iron casting is carried on. The northern end, about 170 ft. in length and 75 ft. in width, is occupied by the brass foundry, where parts of arc lamps, instruments, terminals, brush-holders, etc., are cast. Another part of this building consists of a store for all kinds of brass work, and is isolated from the foundry by means of a brick wall with fire-proof doors. Both portions of this building are provided with galleries, and that above the stores is used to accommodate the printing and bookbinding department. There is also a chemical research laboratory railed off with expanded metal.

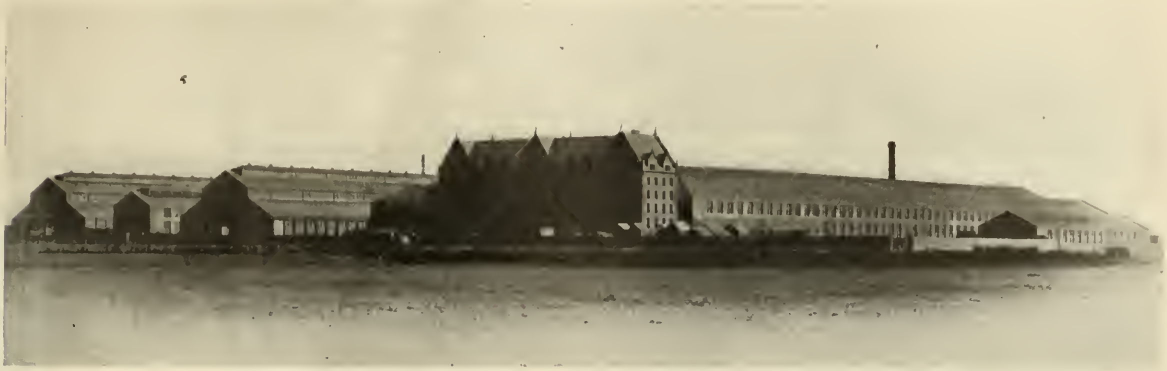


Fig. 1.—General View of the Works, Trafford Park.

The third block from the left contains, under one roof, the steel forge and foundry. Running down the center of the building there is, however, a brick wall 12 ft. high with an 18-ft. break in the middle to allow of railway and crane communication. Two 20-ton Wellman patent tilting open-hearth furnaces have been installed, and are operated by five Duff gas-producers. By means of electric power metal is conveyed up an inclined approach from the railway to the charging platform. Electric motors also provide the necessary rolling motion of the furnaces, and owing to the reduction in the gearing no difficulty in control is encountered when dealing with large masses of molten metal. This steel foundry is also provided with two 50 ton overhead traveling cranes, and there are in addition, a large number of smith's hearths, etc.

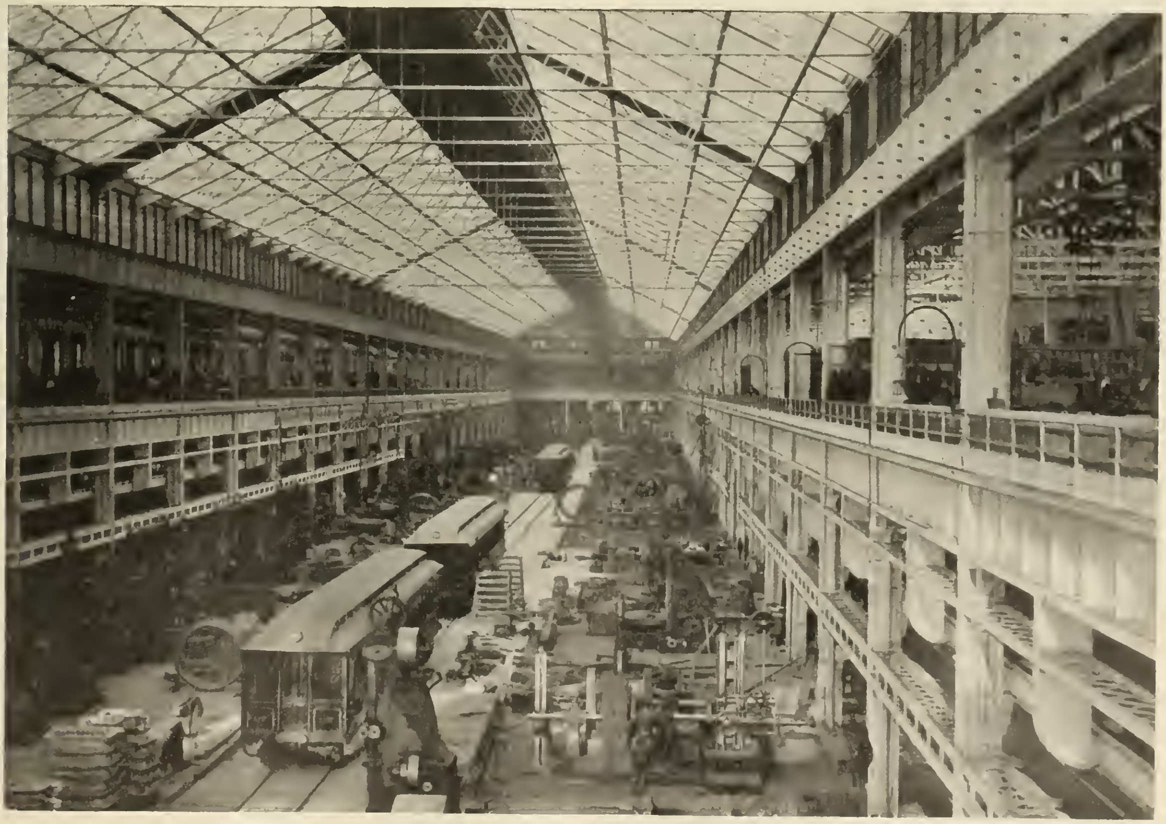


Fig. 2.—View of Main Aisle of Machine Shop.

The carpenters' and pattern shops are distributed over three floors and accommodate about 250 men. The most modern tools for use in connection with wood-working have been installed and are electrically driven from countershafting in the case of small machines which are frequently used, while the larger ones are separately driven.

The largest and most interesting building of the whole works is the machine shop. The total length is 1,000 ft. and the width 450 ft., thus bringing the superficial area up to approximately 10 acres. There are five bays which run throughout the entire length of the building and are lettered A, B, C, D and E. Two of these extend from floor to roof, while the others are two stories high with an intermediate or mezzanine floor on which are provided lavatories, etc., for the convenience of the workpeople employed in this particular shop. The preparation of insulating material, the winding of small coils and other lighter work is performed by girls in the upper galleries, where the machining and working necessary for component parts of instruments, arc lamps, etc., is also carried on. Although so far from the floor these galleries are by no means close or stuffy, the ventilating arrangements being so complete as to prevent such a condition. In aisle A on the ground floor are the punching machines for armature stampings, etc., and the guillotines which shear off sheet metal of considerable thickness. These are not to be numbered by twos or threes, but by whole rows containing dozens. In the other bays are numerous machines, several of which may be attended to by one man. They are entirely automatic in their action, so that it is merely necessary to fix the rod of metal in the chuck, make the adjustments to the various tools and start the machine, when it will, without any further attention, continue to turn out finished articles until the metal runs out, when it stops automatically. In this way an enormous amount of labor is saved, and at the same time the possible output is considerably increased. Comparatively small work, such as the construction of traction motors, is carried on in the side aisles. Each section of the shop has a separate store and timekeeper's office, to which are affixed the automatic clocks for checking the arrival and departure of each man.

The floor of the shop has a foundation of solid concrete 12 in. thick, over which asphalt bricks are laid, thus rendering it quite impervious to oil and fire. The roof is constructed almost entirely of glass, and the illumination of the shop, whether during the day or at night, is rendered all that is desirable by the pale green shade of the paint which has been used. The heaviest work is carried on in the two main aisles, which contain some very interesting and modern tools of an exceptionally large size. Individual driving by motors is mostly resorted to here, but where it is not, motors are belted to shafting. Space has been economized as much as possible by fixing motors to the ceiling, to girders, or, in fact, to almost anything so long as they are not on the floor. The galleries are well and substantially constructed without joists. The floors consist of boards 2 in. by 10 in., placed edgewise, side by side, and spiked together. A light flooring is then laid on this and the whole supported by steel girders.

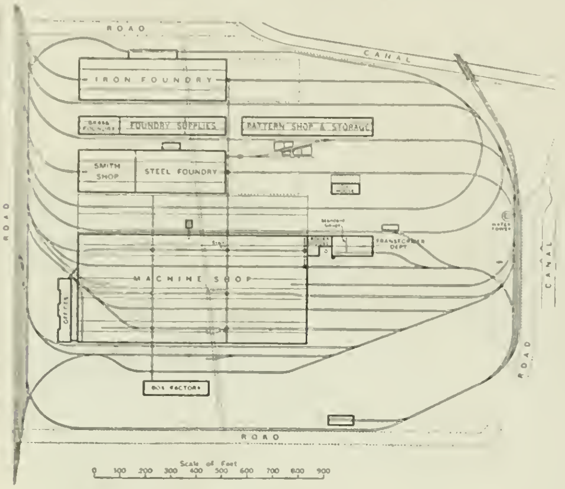


FIG. 3.—PLAN OF WORKS.

When it is inconvenient to move large work frequently from one tool to another, the plan of bringing portable tools to the work has been adopted. Motors are fixed to these tools, and the whole equipment, weighing many tons in some cases, is lifted bodily by a crane and deposited on the exact spot at which it is to be used. Overhead cranes, with a span of 90 ft., run the whole length of the shop; each is capable of lifting 50 tons, and is operated and controlled electrically by a man situated in a suspended cage. Similar cranes of varying capacity are installed in the other bays of the same shop, on both the ground floor and galleries, and every appliance is there for the conveyance of work, etc., other than by hand. Down the center of the building runs a standard gauge railway track, which allows of work being brought almost straight to the machine, where it can be lifted off and deposited in the required position by the overhead cranes. The works has its own steam locomotives for use on the sidings and within the works area.

An interesting feature of the organization of the works is the very perfect system of fire alarms which has been adopted. Fixed to walls at frequent intervals are small iron boxes with glass covers, under each of which is a switch handle. These boxes are numbered, and when the switch lever is pulled over a large bell, situated near the switchboard controlling the whole of the works, is rung. A practical demonstration was given on box No. 15, and the bell immediately struck once and, after a short interval, five times in succession. This, however, was not the only indication; a small indicator, numbered 15, fell and a tape machine printed a single dash and five successive dashes on a tape. The attendant, on observing this, immediately pulls the whistle string for the correct number of times, and every employee is made at once aware that a fire is in progress and of its locality.

The power station, from which energy is derived for the lighting and driving of the entire works, is situated at the south end of aisle B in the machine shop. There are four double-drum Babcock and Wilcox boilers fitted with Roney mechanical stokers, and each has a heating surface of 4,020 sq. ft. Steam is delivered to two 750-kw, three-phase alternators, directly coupled to Westinghouse vertical steam engines. The alternators generate current at 440 volts and at a frequency of 25 periods per second. There are also two 250-kw three-phase generators and two 62½-kw exciters, all directly-coupled to steam engines. Throughout the works three-phase motors are used for driving, with the exception of the testing departments, where it is, of course, necessary to have continuous current. This is obtained from 500-kw rotary converters situated near the main generators.

All the buildings are connected by tunnels, constructed of concrete, which carry the pipes and wires used for various purposes. After a period of about two years it is intended to replace the steam generating plant by gas engines, when it is expected that the capacity will have to be considerably augmented. The existing boilers will then be used entirely for heating purposes.

Outside the works, at the south end, is a water tower 210 ft. high, on the top of which have been placed two tanks, each having a capacity of 30,000 gallons. These tanks are connected with a network of pipes which run all over the buildings, and in the event of a fire occurring the Grenell sprinklers fixed to the pipes immediately and automatically commence to quench the outbreak by means of water from the tower. It will thus be seen that extreme precautions have been taken against the destruction of the works by fire.

The company has introduced a feature new in Great Britain in receiving apprentices in its shops without premiums, and, moreover, paying them wages from the commencement of their time. Each candidate is examined as to his technical and general knowledge and is drafted into either the "college" or "school" course, according to ability. The former extends over three years, and embraces rather more advanced work than the latter, which covers four years. Apprentices are permitted to enter nearly all the different departments during the three or four years, as the case may be.

Hydro-Electric Power Development in Italy.

The Maschinenfabrik Oerlikon of Oerlikon near Zurich has recently received a contract which covers the development of the water power of the Caffaro River and its transformation into electrical energy. The river has its rise on the Alps, which form the frontier between Italy and Tyrol, and discharges its waters into the Chiesa River.

The complete installation is calculated for a total output of 15,000 hp., measured at the turbine shafts, and comprises two separate power stations. The up-stream station, which will be built later on, will supply 5,000 hp, whilst the hydro-electric power station, about to be erected and situated within the Italian township of Bageline, will make some 10,000 hp available. In both central stations three-phase currents of 9,000 volts, 42 cycles, taken from the generator terminals, will be transformed up to 40,000 volts.

The current at this pressure will be transmitted to Brescia, some 16 miles distant, where it will be partly used for power and light distribution in the Province of Brescia, and partly for operating large electrochemical works.

The down-stream station, which is now in course of construction, commands a water power with a head of 254 meters, which corresponds to an effective turbine output of 10,160 hp. The upper-water channel has a length of 4,500 meters and passes three tunnels, one of which is 2,300 meters long.

In the down-stream central station five hydro-electric groups of a capacity of 2,500 hp each, will be installed. Each group consists of a turbine directly coupled to a three-phase generator making 315 revolutions per minute. Besides these large groups there will also be two smaller turbines of 160 hp output each and with a speed of 600 revolutions per minute. They are coupled each to an exciter generator. One exciter suffices for four three phase generators, so that the other exciter and the fifth hydro-electric group will serve as a reserve.

The three-phase generators are calculated for absorbing 2,500 hp with a power factor of .75 and will have an output of 2,340 kw. The three-phase currents generated by them have, as stated above, a voltage of 9,000 and a frequency of 42 cycles.

Five step-up transformers, each of 2,340 kw., will bring the pressure of the current up to 40,000 volts, which, after transmission, is by an equal number of step-down transformers lowered to the working pressure.

This installation is of special interest, as being the first plant in Europe making use of 40,000 volts with transformers of a capacity exceeding 2,000 kw.

Italian Recording Wattmeters.

The Italian Valtellina electric railway has in operation two large recording wattmeters for its three-phase circuits. manufactured by Camillo Olivetti, of Ivrea, Italy, a description of which we give below:

The principle on which the instrument is based for its action is the same as that which controls the working of a torsion electrodynamometer, viz., that in a magnetic field produced by a current traversing a fixed low resistance coil connected in a series with the main circuit to be measured, there is placed and allowed to move a high resistance coil connected across the main. When the instrument is completely connected the moving coil will be urged by a force which is proportionate to the energy of current. This effort is counterbalanced by the torsion of a spring which has a tendency to move the coil equipment towards zero position, the spring being forced at one end by the action of a small electric motor which is at rest so long as the torsion effort of the spring is balanced by the action of the current. As soon, however, as this state of equilibrium is disturbed and the action of the current on the equipment is superior or inferior to the torsion effect of the spring this brings to zero point the moving equipment.

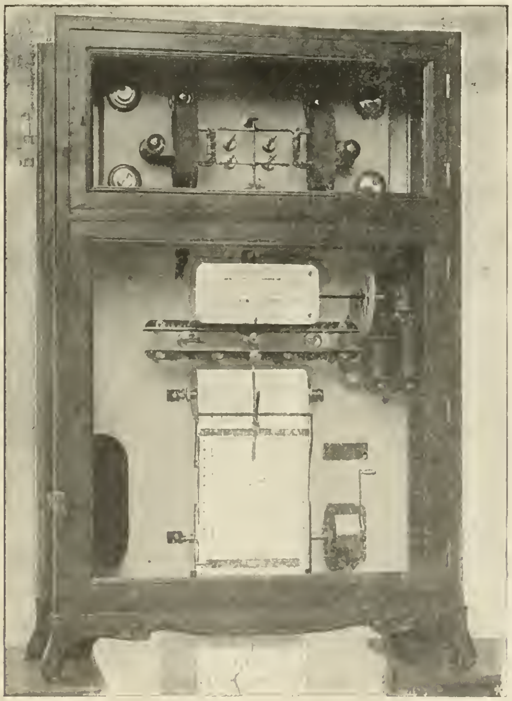


FIG. 1.—COMBINED INDICATING AND RECORDING WATTMETER.

As it will be understood the principle is general and can be applied to any instrument having a movable equipment returning automatically to zero point.

Referring to Fig. 3, which gives a schematic representation of the apparatus and to Fig. 4, which gives a diagram of connections, it will be seen that the high-resistance coils, 1, 2, of identical construction, are connected across the mains by means of two flexible connections, 6, 7, through two additional non-inductive high resistances, 10, 11, with a temperature co-efficient practically nil.

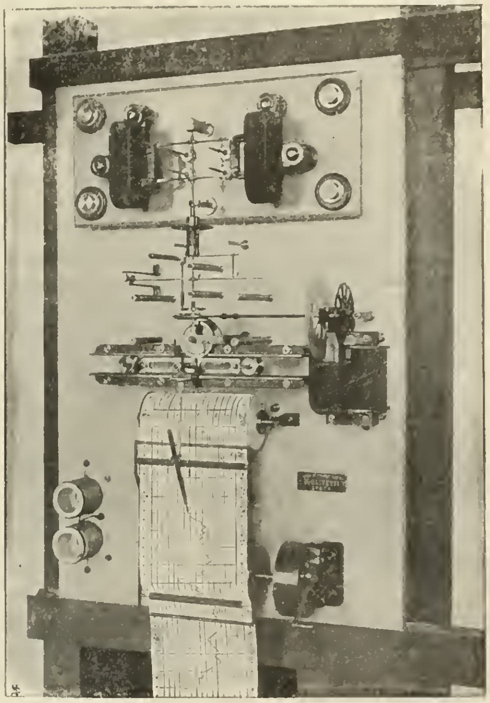


FIG. 2.—WATTMETER WITH CASE REMOVED.

The two coils are of wire insulated, but mechanically and rigidly held together by a frame, 3, this latter being supported by a vertical spindle, 4. The spindle and the coils are capable of deflecting within a small space, and the former is pivoted on two supports, 5, 5_1. The high-resistance coils are for half the length within the two coils, 8, 9, connected in series with the line and as shown on diagram Fig. 4.

The spindle, and with it the equipment, as described above, can be made to deflect by means of a spring, 13, connected at one of its extremities by means of a rigid pin, 14, and the other extremity to a small shaft, 15. The axis of this is on the same axial line of the shaft, 4, and carries a small tooth wheel which can be made to rotate by means of a worm wheel, 17, driven by a small electric motor, 18. A third shaft, 19, co-axial with the former ones and connected to the spindle, 4, by a spring, 20, and the small arm, 21, carries a rigid pin, 22, fitted with a thin silver ribbon. This ribbon can oscillate between two fixed points, 23, 24, which are also of silver, and is so placed that an electric contact can be made between the pin, 22, and either of the other two points, 23, 24. The worm wheel, 17, is connected to a second tooth wheel, 25, which, by means of another wheel, 26, operates a rack, 27, as shown on Fig. 3. This rack carries a pointer, 28, which gives readings on a divided scale, 29. To the pointer structure is fixed a pen, 30, which records the readings on a divided strip of paper revolving on a drum, 31, which is operated by a clock-work system, 32. In non-recording indicating wattmeters the wheel, 26, the rack, 27, the drum, 31, and the clock-work, 32, are eliminated, and the pointer is fixed right to the wheel, 25, the range of rotation of which is within 300°.

By means of a flexible conductor, 33 (Fig. 4), the spindle, 22, is electrically connected to one brush, 18, of the small motor, while the other brush, 18, is connected by means of the conductor, 34, to an intermediate point of connection of the two resistances, 35, 36, which are connected in series with the series field winding of the motor and in a parallel with the line (if necessary through a small transformer, 39). The contact point, 23, is connected by means of a conductor, 37, with one end of the resistance, 35, and the point, 24, by means of a conductor, 38, with the other extremity of the resistance, 36. The two resistances, 35, 36, are connected in such a manner that at their extreme connections the current has a different polarity in respect to the point of union, and accordingly, if the spindle, 22, comes in contact with the point, 23 or 24, the direction of the current in the armature is in one or in the opposite direction. The motor is so constructed that by reversing the current in the armature the rotation of the latter is reversed, and therefore by means of a screw wheel, 17, and a gear wheel, 16, the spring, 13, becomes tightened or loosened according to the direction of rotation of the motor. When the spindle, 22, is in an intermediate position, no current passes through the armature and the motor is thus at rest.

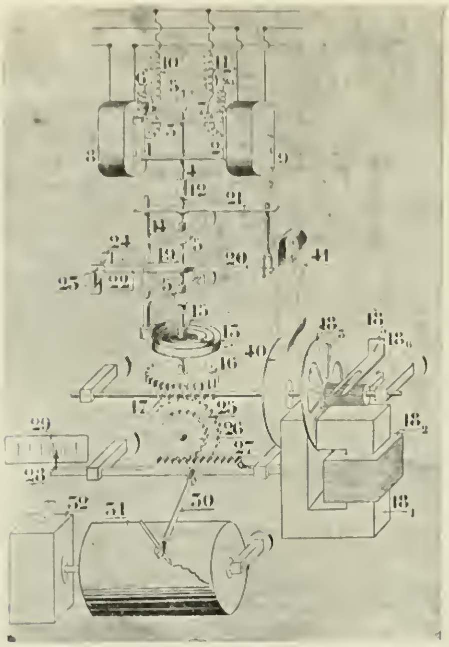


FIG. 3.—SCHEMATIC REPRESENTATION OF WATTMETER.

For the sake of illustration suppose that the instrument is connected to a live circuit. Between the windings, 1-8 and 2-9, electrodynamic actions take place, and in one direction, so as to deflect the moving frame with a torque proportionate to the total energy of the three-phase circuit. This deflection, which covers a very small angle, is transmitted by means of the shaft, 4, and of the spindle, 21, to the spindle, 22, which comes then into contact with one or other of the contact pins, 23 and 24. For the sake of further illustrating the action of the instrument, suppose that the spring, 20, makes contact with the pin, 23. As soon as this takes place the motor starts and by means of the screw wheel, 17, the motion is transmitted to the gear wheel, 16, and consequently to the extremity of the spring, 13. The equipment, 16, will have then rotated within a limit proportionate to the energy of the circuit and also the rack, 27, will have moved on for a distance proportionate to this energy. If the electro-dynamic action between the coils is reduced, the motor will reverse so as to again equilibrate the new value of such actions. Through the co-efficient of elasticity of the spring being constant, the divisions on the scale will be absolutely uniform.

A Faraday disc, 40, makes the instrument aperiodic in its action and also regulates the speed of the motor. By multiplying the number of the shunt moving coils and the series fixed coils, the instrument can be made to measure the power of two or more alternating or continuous current circuits. The same apparatus described with suitable connections, might also be used to measure the power of a polyphase alternating current system or direct current system of supply and with other suitable connections give the aggregate power of two separate circuits.

It is claimed that in this instrument all the theoretical and practical conditions of a precision instrument are practically observed. Friction being nullified by the positive and instantaneous action of an especially designed motor has practically no influence. The measuring part of the instrument contains no iron. The inductance and temperature co-efficient of the shunt coils are rendered practically nil by very high series resistances, so that the instrument is independent of the nature or frequency of the current form and temperature. The same instrument can be used for direct as well as for alternating circuits.

The energy wasted in the series coils is from 16 to 20 watts, and in the shunt coils and resistances from 2 to 4 watts for every 100 volts, the former figure being for high-potential, the latter for low-potential instruments. The energy wasted in the relay motor is from 30 to 50 watts. The small current in the shunt coils, .02 ampere, permits the insertion of the instrument direct in high-potential circuits without the intermediate use of potential and current transformers, which have a tendency to impair the exactness of readings. The scale is perfectly uniform, and in recording instruments has a length of 6 inches.

The paper used in the instrument has a length of 120 ft. and a width of 7½ in., of the latter, 6 being for recording purposes. The speed of paper can be changed from 1 to 12 inches per hour, and the change of speed can be readily obtained, changing a gear on the clock.

On the same principle and about on the same dimensions, Signor Olivetti makes also a continuous-current recording ammeter and voltmeter similar to the wattmeter above described. In these instruments the fixed coils are replaced by permanent magnets. The moving coils swing on the air-gap of the same and are connected to shunts or series resistances, according the instrument is an ammeter or voltmeter. On the same princjple, he constructs an electrodynamic voltmeter having two fixed and one movable coil connected in series to a inductionless resistance. The scale follows the law of the squares. The instrument can be made direct-reading or recording. These instruments, if made for high-potential, require a current of 0.05 amp.

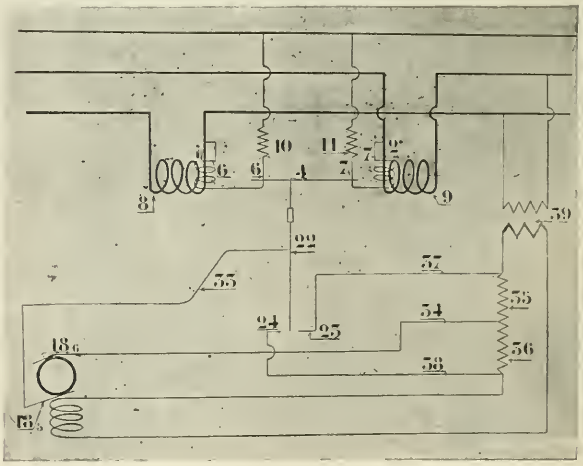


FIG. 4.—DIAGRAM OF CONNECTIONS FOR WATTMETER ON THREE-PHASE CIRCUITS.

One of these direct-reading voltmeters having a large round scale of 15 inches diameter and 300° amplitude, provided with a set of resistances for reading from 1,000 to 20,000 volts, is used in Signor Olivetti's laboratory for standardizing direct-reading voltmeters.

The Henry Train Lighting System on the Chicago and Alton R. R.

As early as 1893, the late John C. Henry, one of the pioneers of the electric railway, took out a patent on an electric regulator. After working for ten years upon the subject of train lighting by electricity, in 1901 Mr. Henry settled on a direct-connected system of train lighting, doing away with all belts, gears or other devices used to drive the generator from power derived from the axle. This system of train lighting has been further developed by his son, D. Carl Henry. As now used on the Chicago & Alton Railroad, it consists of the following devices: On the axle of the train or car to be lighted a direct-connected generator is placed, Fig. 1. The armature of this generator is built on a sleeve, the sleeve being centered over the axle, and is held in place by two taper copper plugs, which are held in place by two long bolts, which bind the sleeve permanently to the axle. After this generator is mounted, the wheels of the car are pressed on the axle. The outer fields of the generator have bearing on this sleeve and are supported by it. These outer fields remain stationary, being prevented from turning and following the internal armature by a crossbar, resting on the truck of the car. This inner armature and commutator revolves within these outer fields, cutting the magnetic lines. The entire machine is absolutely dust and water proof. After thirteen months' experimenting on the Chicago & Alton Railroad, a generator was determined on which gave, at a speed of 200 r.p.m. a minimum output of two kw. This is a 4-pole shunt-wound machine, built and insulated very much in the style of the series street railway motors of the present day, and is capable of 100 per cent. overload without too high an increase in temperature and consequent loss in efficiency. The problem of vibration is met with the novel means employed to mount this generator on the axle. After thirteen months of hard service, these generators have been found to be in absolutely first class condition, and even their commutators have shown no effect from hard usage. The machine is easy of access and is constructed so that the armature can be inspected and re-wound, if necessary, at any time. It is but a few minutes' work to place new brushes in their holders. The oiling of the machine is done by means of a chain dipping down into an oil well; and the brasses of each bearing can be replaced in a few minutes. The weight of the generator is less than 900 pounds.

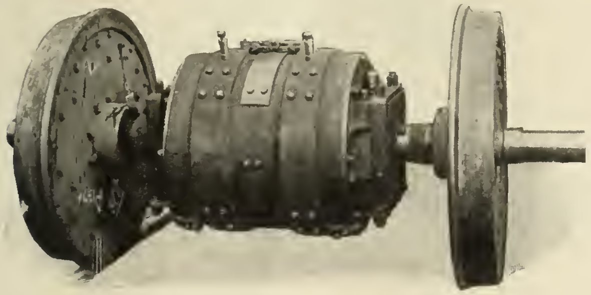


FIG. 1.—DIRECT-CONNECTED GENERATOR.

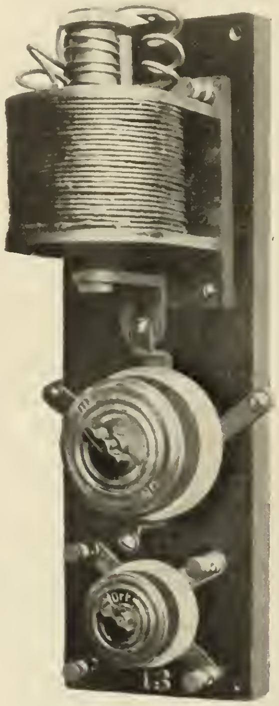


FIG. 2.—AUTOMATIC SWITCH.

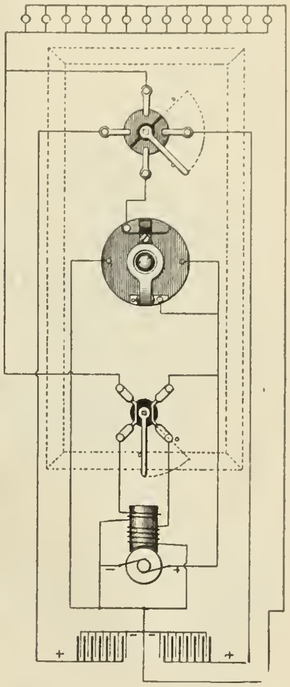


FIG. 3.—DIAGRAM OF CONNECTIONS.

The regulation is effected by means of a differentially-wound field, the major portion of this field being in shunt, and a minor winding of low resistance being in the opposite direction. The shunt field is separately excited by the storage battery. This insures, it is said, perfect excitation on starting and reliability at all times in operation. At a speed of 200 revolutions the current from the generator, which is at a voltage of 25, passes directly to one of two sets of storage batteries. Below this critical speed of 200 revolutions, which represents about 18 miles an hour, an automatic switch, Fig. 2, operated by a solenoid cuts the generator circuit in such a manner that the storage battery current cannot flow back to the generator. This switch only allows current to flow from the generator to the battery. While the generator is charging one of the two sets of batteries the other similar set of batteries is on the lamp or translating circuit. A simple hand switch is placed in the circuit and by a single quarter turn the battery which is being charged by the generator can be substituted for the battery which has been discharged. This insures at all times a constant potential, the lamps being at no time directly on the generator circuit. The batteries employed are the "Chloride" accumulator type; 24 cells of battery are used, with a capacity exceeding 30 amperes for eight hours. As these batteries are always in multiple, Fig. 3, the system has a capacity in each car of 60 amperes for eight hours, which is amply sufficient for an ordinary car. These batteries are placed in lead-lined tanks, two cells of battery in each tank.

The Henry Electric Equipment Company of Denver, Colo., of which Mr. C. F. Elliott, of Colorado, is president; Mr. D. Carl Henry, of Chicago, is secretary, and Mr. James H. Peabody, of Denver, Colo., is treasurer, has now under construction fifty of this type of generator, to be used on the Chicago & Alton Railroad. Experiments have been tried with the generator sufficiently large to light three cars. This generator is of about twice the weight of the standard form of generator used to light single cars, and a form with two armatures and eight poles has been used to produce sufficient current to light three cars or more. This type of machine has, it is claimed, given entire satisfaction and can be used wherever a number of cars are always run together, such as a train which is never uncoupled. The battery can be carried on the one car which has on its axle the generator or the batteries can be carried separate in each car, all being charged by the one generator.

Western Electric Fans.

The general appearance of the Western Electric desk fans for 1903 is similar to that of the well-known type of the past year. Fig. 1 is an external view and Fig. 2 a cross-sectional view of the desk fan.

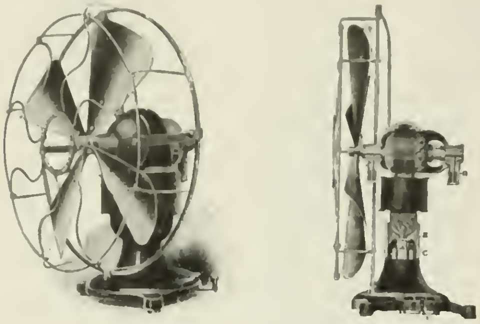
The open type of construction lends itself to pleasing appearance, accurate workmanship and high efficiency. The U-shaped field magnet with armature at the top gives a type of motor of graceful proportions. This style of construction allows a low pedestal and small encasing castings to be used, thereby making the weight of the motor unusually low, as a large proportion of the material used is "working material." The weight of the motor is further reduced by the use of a forged steel field magnet having the best magnetic properties.

The armature is of the iron clad, drum type, wound with double silk-covered wire, insulated by pressboard tubes in the slots and pressboard washers over the end plates. The field coils are wound on pressboard spools and being exposed to the direct action of the moving air, an exceptionally low running temperature and consequently a long life is insured to these important parts

The armature of large diameter, wound with double silk-covered wire. The forged steel field magnet, the field coils of small diameter cooled by the moving air, the small air gap and careful shaping of pole tips, all combine to give the highest possible efficiency.

The brushes are of specially prepared graphite, circular in cross-section, and self-adjusting. The brush holders are a modification of the cartridge type and are provided with triggers which bear upon the end of the brush, pressing it against the commutator. They allow almost the entire brush to be used up and as there is no clamping, they will not break the brushes. The brushes can be readily renewed, without disturbing any of the electrical connections.

The speed regulating rheostat consists of an iron drum upon which is wound German silver wire, embedded in and protected by a complete coating of white enamel, doing away with any possibility of short-circuiting or grounding with the adjacent frame. The drum is mounted on a porcelain base carrying the speed-regulating switch and binding posts.

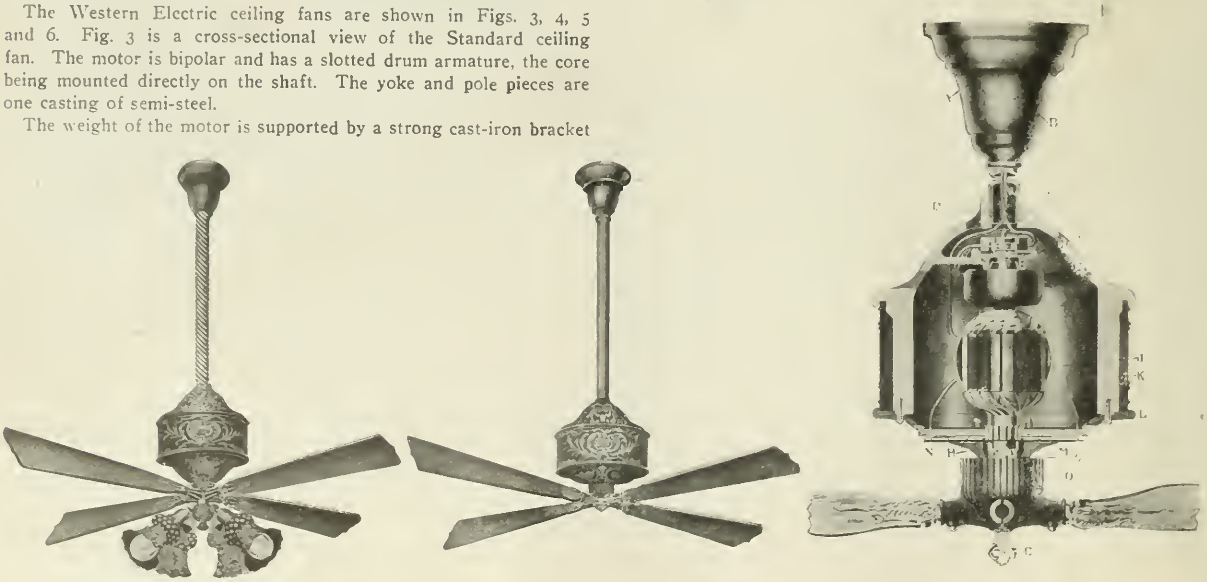


FIGS. 1 AND 2.—DESK FAN.

These motors are also made with the bracket form of mounting. The fan can be placed in any desired position by the adjustment of a single hand screw. The adjustment can be made while the fan is running at full speed. The motor frame swivels upon a ball and socket joint and has a horizontal range of 180° and vertical range of 45°.

The Western Electric ceiling fans are shown in Figs. 3, 4, 5 and 6. Fig. 3 is a cross-sectional view of the Standard ceiling fan. The motor is bipolar and has a slotted drum armature, the core being mounted directly on the shaft. The yoke and pole pieces are one casting of semi-steel.

The weight of the motor is supported by a strong cast-iron bracket fastened to the frame with machine bolts. The bracket also supports the upper bearing and a steel tube extending through the hollow armature shaft. This tube contains a six-wire cable made up of the leads for the chandelier lights and the wires connecting the speed-regulating rheostat to the switch. A rheostat gives three speeds to the fan.



Figs. 4, 5 and 6.—Ceiling Fans for 1903.

These motors are wound for 110, 170, 220, 250 and 500 volts; the 170 and 250 volt motors are intended to run in groups of three and two in series on 500-volt circuits, in which case a wall switch rheostat for three-speed control is furnished.

Figs. 5 and 6 illustrate the "Western" ceiling fan for 1903. Fig. 5 is a cross-sectional view of one type and Fig. 6 a perspective view of another type. These types are similar in all respects, with the exception that the latter is not provided with a starting switch. Both are single-speed fans. The bipolar motor has an armature similar to the standard ceiling fan. They are also equipped with oil reservoirs, but they do not have the non-spillable feature of the standard wells, although the method of lubrication is the same. Before removing the fan from the ceiling hook, the oil is withdrawn from the wells by means of a small oil pump provided for this purpose.

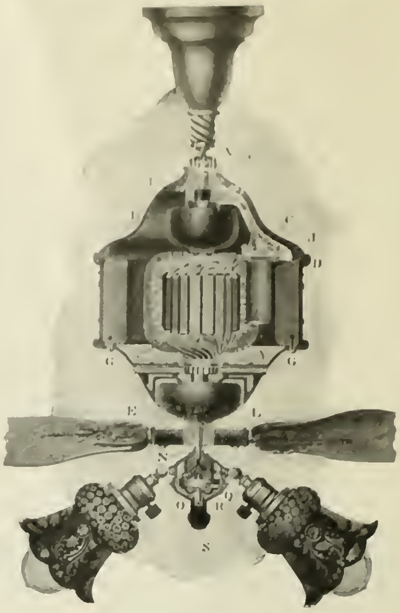


FIG. 3. CROSS SECTION STANDARD CEILING FAN.

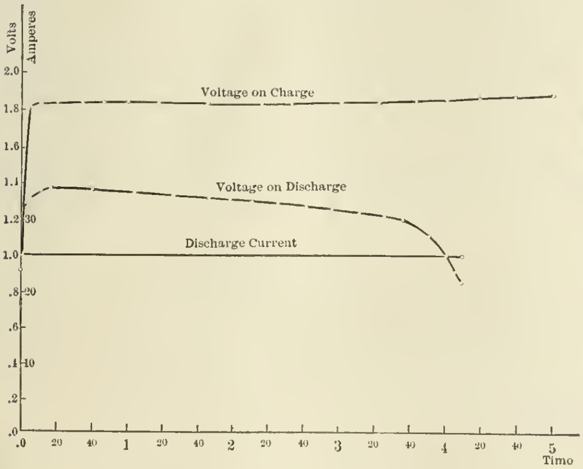
Central Station Use of "Hylo" Lamps.

A decidedly new departure has been made by the Missouri Edison Company, of St. Louis, in renewing "Hylo" lamps for their customers without charge, at the same basis as they renew ordinary 16-cp lamps of approved make. Mr. S. B. Pike is, we believe, the first central station manager to have the enterprise to adopt this practice; and the magnitude of the Missouri Edison system gives the innovation unusual importance. Writing to the Phelps Company, of Detroit, Manager Pike says: "In connection with our order to you for 500 lamps for immediate shipment and 300 lamps monthly until further notice, we beg to say that it is our intention to renew the lamps without any charge whatever on the same terms as we furnish free renewals for standard 16-cp lamps. The lamps which you send us on order should have a special distinctive label inside the stem to obviate possible fraud. In view of the advertising campaign which we now contemplate making in behalf of the Hylo lamps, we expect to need at least 10,000 of them to fully meet prospective demands."

Alkaline Storage Battery.

The Chicago Storage Battery Company, Fisher Building, Chicago, exhibited at the recent automobile show in the Coliseum Building, Chicago, an automobile of 28 cells of a new type of storage battery, for which strong claims are made. Full particulars of the cell have not been made public, but it is stated that it is of the alkaline type, that the positive elements are a combination of chemically transposed metals, that the negative element is the cell receptacle itself, and that "neither plates nor grids are used." The claim is made that a cell weighing slightly less than 6 pounds has a capacity of 100 amp-hours at an e.m.f. of 1.4 volts. Twenty-eight cells were exhibited at the automobile show in connection with a light runabout mounted on a speedometer. When the dial indicated a speed of 20 miles per hour, the battery delivered 30 amp, and it was claimed that this output could be maintained for three hours.

It is stated that the battery will receive a maximum charge in one or two hours, which feature also renders it particularly applicable to other than automobile work. For central station and street railway work, the batteries may be charged without injury to their full capacity, in not to exceed two hours, and when called upon, as occurs in central station work and street railway service, to take care of the peak of the load, they will readily and without any damage give a high rate of discharge.



TEST CURVES OF STORAGE BATTERY.

The efficiency of the battery is claimed to compare very favorably with lead, and is proportional to the rapidity of charge or discharge. For example, with a cell having a capacity of 100 amp-hours (25 amp for 4 hours), there is no disturbance whatever in the electrolyte, nor gasing in any particular, nor heat developed, nor expansion of the elements, nor damage in any way to the battery; if given a charge as high as 45 amp for nearly four hours. The accompanying curves were plotted from tests made at Armour Institute.

Keeping Labor Costs in Factories.

The use of the calculagraph in telephone exchanges has already become a well-known and familiar feature of that branch of electrical work, enabling an exact account of the elapsed time of every conversation to be kept. Mr. Henry Abbott, the president of the Calculagraph Company, of New York, is now introducing the same ingenious appliance in a modified form as an aid in checking time on work in factories, as distinguished from time keepers' work, and ordinary time-recording appliances.

One of the functions of the calculagraph and its distinctive feature is that it mechanically subtracts the commencing time-of-day from the finishing time and records the number of hours and minutes a workman is employed on a job or piece of work. One calculagraph will make such records for a large number of workmen who are commencing and finishing without reference to consecutive order. The calculagraph also, incidentally, records the time of day the work commenced. Each record is a separate and individual one and there is no possibility of confusion. The calculagraph, moreover, makes no clerical errors. It has two handles or levers, one of which is operated at the time of commencing work and the other at the finish by the clerk who issues job cards with the work given out to the workmen and the cards used are adapted for use in card-filing cabinets. All of the calculagraph record cards belonging to any one job or product may thus be brought together in a bunch, even when a large number of operatives have been employed upon it, without any posting or copying of items and the total labor cost quickly and surely ascertained. Besides insuring accuracy as above explained the calculagraph will save, in a large mill, sufficient labor to repay its cost in a short time.

A New Type of "Button" Telephone Transmitter.

Due to the efforts of Mr. Ernest B. Fahnestock, a telephone engineer and apparatus designer of many years standing, a new type of telephone transmitter is being introduced which in appearance and construction presents quite an innovation and departs from the "solid back" form, as shown herewith. This "button" is entirely self-contained and is in itself a very efficient transmitter if placed on a table and spoken to.

It carries within itself two sound diaphragms, a carbon chamber and two electrodes and is designed to slip into the sound chamber carried at the end of the pivoted arm. Two cords are carried up through the inside of the arm to make the necessary electric connection. The "button" is not a permanent part of the sound chamber and may be removed and replaced by a new one at any time by removing the face plate and loosening the cord connections.

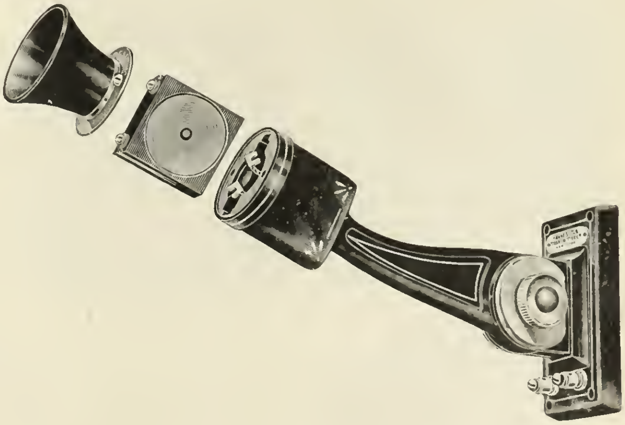


FIG. 1.—BUTTON TELEPHONE TRANSMITTER.

The "button" consists of a carbon chamber and two vibratable electrodes carried by mica washers. These washers are clamped by steel rings to opposite sides of the carbon chamber sealing it and making it moisture-proof. Each electrode has clamped to it a sound diaphragm that has no other support. This allows freedom for the periphery to vibrate, and insures the tuning of the two diaphragms to the same characteristic note. It also permits of a permanent adjustment of the electrodes, since the support of the carbon chamber and electrodes cannot be at variance with the support of the diaphragm as is sometimes the case with instruments of the solid back type.

Means are taken to secure flexibly the periphery of the sound diaphragm to the button after it has been clamped in place on the electrode. This flexible connection prevents the sound waves from impinging on its under side.

When the "button" is in place within the sound chamber the surface of the diaphragms is transverse to the line of progress of the sound waves and the "button" presents to the opening at the mouthpiece only its edge. This prevents any mechanical injury and removes the necessity of having a protective button to the mouthpiece. The sound waves on entering the mouthpiece are divided by the edge of the "button," and impinging on the beveled sides of the sound chamber are deflected against the diaphragms.

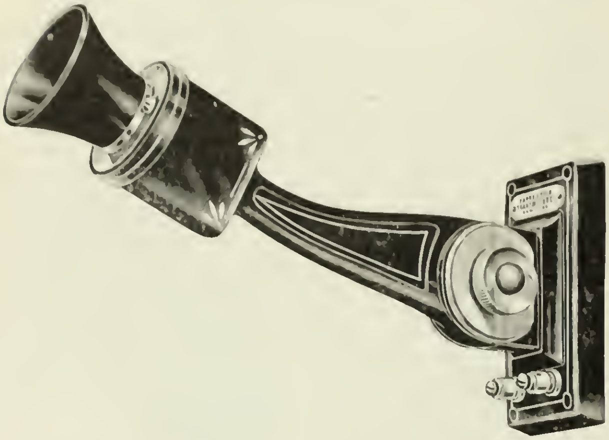


FIG. 2.—BUTTON TELEPHONE TRANSMITTER.

The transmitter is constructed throughout of a special hard non-corrosive alloy and each part is cast in a brass mould which insures accuracy and interchangeability of all parts, while the non-corrosive feature of the alloy entirely eliminates all possibility of corrosion by the moisture from the breath.

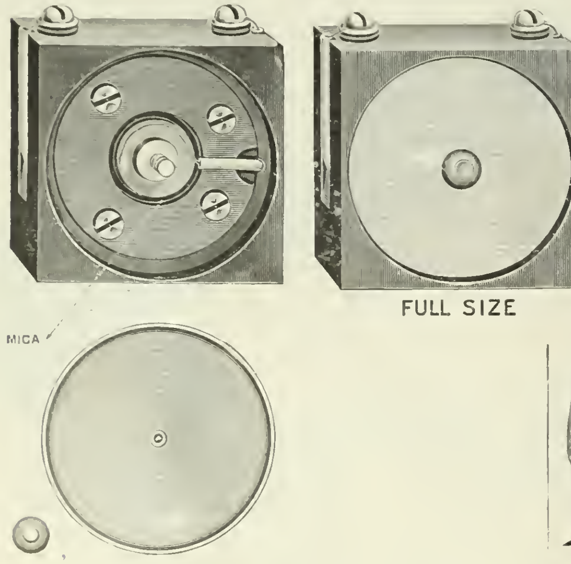


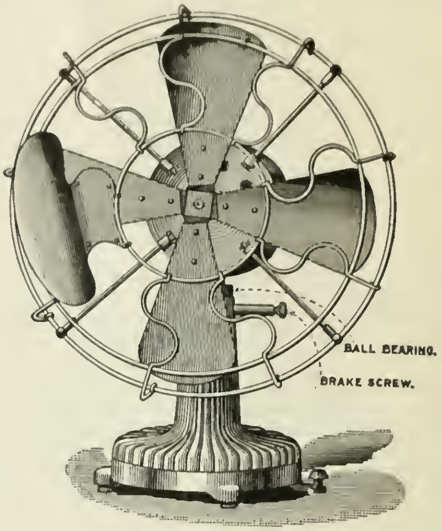
FIG. 3.—BUTTON TELEPHONE TRANSMITTER.

The finish is of black enamel, which would seem to insure a greater durability of finish than is ordinarily obtained by those instruments having extensive nickel-plated parts. The apparatus is being put on the market by the Fahnestock Transmitter Company, of 74 Cortlandt Street, New York City, which is also introducing some other telephone improvements and specialties.

* * *

New Revolving Desk Fan.

A new form of revolving desk fan motor is being introduced this season by the Geo. C. Towle Manufacturing Company, of Lancaster, Pa., as shown herewith. The motor-carrying blade and guard revolves upon a ball bearing, the base remaining permanetly in one position. The rotating motion upon its axis is produced by an air deflector mounted at a permanent angle upon the front of the guard. The perpendicular shaft of the thrust bearing extends through to the lower part of the base, where a movable contact is attached, similar to collector rings, on which run metal brushes, and mounted upon a porcelain base, which also holds the resistance used in regulating the speed of the fan motor proper. The revolving motion in connection with the motion from the fan blades distributes the air in a circular fashion. A friction brake is mounted upon the base and by screwing this in or out, any number of revolutions of the motor head can be secured. This works entirely independent of the speed regulation of the fan motor. The fan can be attached with plug and cord like any ordinary desk fan.


BALL BEARING.
BRAKE SCREW.
REVOLVING DESK FAN.

* * *

Lineman's Climber.

The Smith & Hemenway Company, of 296 Broadway, New York, is out with a linemen's new climber. It is stated to be made of a boracic steel, the toughest metal known, hardened and tempered by a secret process, and is covered with an extra heavy coating of white metal, which makes it absolutely rust-proof. The spur is welded in, making it practically one piece, and there is thus no possibility or danger of its coming loose. The loops are made in the forging.

LINEMAN'S CLIMBERS.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was firmer in tone, but at the close of the week little was obtainable at less than 5 per cent. The closing quotations were 4¾ a 5 per cent. for 60 to 90 days, and 5 per cent. for 4, 5 and 6 months. The stock market was irregular throughout the week, with alternating periods of strength and weakness. In the main, however, the tendency was towards a lower level of values. Little attention was given to the market by the public. There was a fair amount of foreign buying of good railway bonds. All of the electrics and tractions shared in the general weakness of the market and closed, with one exception, with net losses on the week's business. Of the tractions, Brooklyn Rapid Transit closed at 67⅜, a loss of 2⅛ points, and Metropolitan Street Railway at 136¼, a loss of 3½ points. General Electric closed at the lowest point of the week—195—being a net loss of 4⅝; Westinghouse lost 1 point, closing at 210, and Western Union ⅛, the last quotation being 89½. American Telephone & Telegraph was also weak, closing at 83¾, which is 1 point off. American District Telegraph made a net gain of ½, the price for the entire week being 37½. Following are the closing quotations of March 3:

NEW YORK.

	Feb. 24.	Mar. 3		Feb. 24.	Mar. 3
American Tel. & Cable	83¼	83	General Electric.	198	193½
American Tel. & Tel.	167	166	Hudson River Tel.	..	..
American Dist. Tel.	37½	37	Metropolitan St. Ry.	137¼	135½
Brooklyn Rapid Transit	68⅞	66⅝	N. E. Elec. Veh. Trns.	..	⅛
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	166
Electric Boat	20	20	N. Y. E. V. T. Co.	10	9½
Electric Boat pfd.	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	2⅞	Western Union Tel.	89⅛	89
Electric Vehicle.	6	3¾	Westinghouse com.	212	200
Electric Vehicle pfd.	11	11	Westinghouse pfd.	210	225*

BOSTON.

	Feb. 24.	Mar. 3		Feb. 24.	Mar. 3
American Tel. & Tel	167½	167	Western Tel. & Tel. pfd.	99½	99½
Cumberland Telephone	125	..	Mexican Telephone	2¼	2⅛
Edison Elec. Illum.	..	295	New England Telephone	137	137
General Electric.	199	194	Westinghouse	105	102
Western Tel. & Tel	25	23	Westinghouse pfd.	105	102

PHILADELPHIA.

	Feb. 24	Mar. 3		Feb. 24	Mar. 3.
American Railways.	52	50¾	Phila. Traction.	98¼	99½
Elec. Storage Battery.	..	..	Phila. Electric	7⅝	7⅛
Elec. Storage Battery pfd.	..	81*	Pa. Electric Vehicle.	..	..
Elec. Co. of America.	9⅛	9⅛	Pa. Electric Vehicle pfd	3	..

CHICAGO.

	Feb. 24.	Mar. 3		Feb. 24.	Mar. 3.
Central Union Tel.	..	..	National Carbon pfd.	98	96
Chicago Edison.	..	159	Northwest Elev. com.	..	29
Chicago City Ry.	222	217	Union Traction	10	9⅝
Chicago Tel. Co	158	155	Union Traction pfd.	44	42⅛
National Carbon	25	24			

*Asked.

MINNEAPOLIS GENERAL ELECTRIC.—At a meeting of the stockholders of the Minneapolis General Electric Company, held on February 20, 1903, it was voted to increase the preferred stock of the company by 2,500 shares, or from $750,000 to $1,000,000, par value, which will leave the capitalization as follows: Common stock, $1,500,000; preferred stock, $1,000,000; first mortage 5 per cent. bonds, $1,204,000; reserved to redeem underlying 6 per cent. bonds, $765,000. These 2,500 shares will be offered at par, to present holders of preferred and common stock, giving each stockholder the right to take one new share for each nine shares of stock held by him. The money thus raised will be used for the purchase of a new 1,000-kw direct-connected condensing unit and the installation of some 25 duct miles of conduit and electric cable. The earnings for the years 1901 and 1902 have been as follows:

	1902.	1901.	Changes.	
Gross	$500,586	$405,634	Inc.	$94,952
Expenses	265,444	202,345	Inc.	63,098
Net	$235,142	$203,288	Inc.	$31,853
Fixed charges	98,409	97,050	Inc.	1,359
Net profits	$136,732	$106,238	Inc.	$30,494

COMMERCIAL CABLE ANNUAL REPORT.—At a special meeting of the stockholders of the Commercial Cable Company this week it was voted that the capital stock be increased from $15,000,000 to $25,000,000. Over 100,000 shares were represented. The shareholders wished to put the directors in a position to issue new stock for the extension of the company's system as the growth of the company's business warrants from time to time and for other purposes. The annual meeting of the stockholders was held also and the annual report shows:

	1902.	1901.
Gross earnings	$10,208,192.71	$9,679,794.16
Net earnings	2,383,588.83	2,259,896.61
Last year's balance added	2,514,193.19	2,480,962.79
Interest dividends and reserve	2,366,664.00	2,350,358.43
Balance carried forward	$147,529.19	$130,604.36

Vice-President Ward was cordial in his references to wireless telegraphy, and expressed the belief that submarine cables had nothing to fear from its competition.

BELL TELEPHONE.—It is stated from Boston that the American Telephone & Telegraph Company's annual report will show for the year ended December 31, 1902, net earnings of about $10,000,000 after the payment of all expenses, interest and taxes. This sum is equivalent to about 9 per cent. on the $109,685,000 stock at present outstanding. It is alleged that Mr. J. P. Morgan, having nothing else on his mind is taking a very lively interest at the present time in the American Telephone & Telegraph Company. It is said that he represents the largest stock interests in the compauy and that next month may find one of his active lieutenants vice-president and general manager in charge of the expenditures for new construction, which it is expected will this year be the largest in the history of the company. It is said that the Morgan interest in the telephone company does not exceed $15,000,000.

ST LOUIS LIGHTING.—The Laclede Gas & Electric Company will pass into the control of the North American Company of New Jersey on March 1. On this date 10 per cent. of the purchase price will be paid, and on April 1 90 per cent. The capital stock of the Laclede Company is $11,000,000. It is reported that negotiations have been completed for the purchase of the Missouri Edison Company. At present it is capitalized at $12,000,000, but it is planned to increase the capital stock to $100,000,000 owing to varied interests that are coming into its control. The price paid for the two companies was $12,825,000. Laclede common was put in at $100 a share and the preferred at $125. Missouri Edison common sold for $25 and the preferred at $60.

UNITED STATES LIGHT & HEATING.—At the annual meeting of the United States Light & Heating Company, held at Jersey City, the following new directors were elected: R. H. Beach, Leroy W. Baldwin, Joseph Leiter, W. K. Gillette, A. Sandford Adler, C. S. Drummond. The old directors who were re-elected are Charles S. Furst, Wallace Young and John J. Gilbert. Mr. R. H. Beach was elected president of the corporation. Mr. W. J. Arkell was elected vice-president. Mr. Charles S. Furst was elected secretary and treasurer. Mr. A. Sandford Adler was elected general manager. A trial car was run successfully on the New York Central this week.

WESTERN ELECTRIC EARNINGS.—After the adjournment of the directors of the Western Electric Company, who met recently to declare a stock dividend of 20 per cent., it was learned that the gross business for the year exceeded $29,000,000, and that the Bell telephone estimate for new work in 1903 would call for at least $38,000,000 of money authorized, but probably only $25,000,000 would be spent during the year. The company now has factories in the leading cities of the world and on its pay-roll are over 13,000 employees.

DIVIDEND.—The directors of Detroit United have declared the regular quarterly dividend of 1 per cent. on the capital, payable April 1. The Chicago City Railway has declared the regular quarterly 2¼ per cent. dividend. Directors of South Side Elevated, Chicago, have declared the regular quarterly dividend of 1 per cent., payable March 31. A dividend of $2 per share has been declared on Philadelphia Traction Company stock, payable April 1.

BALTIMORE UNITED RAILWAY & ELECTRIC COMPANY reports for the year ended December 31, 1902, as follows: Gross, $5,041,275; expenses, $2,252,133; net, $2,789,141; charges, $2,637,115; balance, $152,026; dividend from lighting company, $53,405; total credited to surplus, $205,431; previously credited, $128,006; total surplus, $333,438.

KINGS COUNTY ELECTRIC INCREASE OF CAPITAL.—At a special meeting of the shareholders of the Kings County Electric Light & Power Company called for March 18, it is expected that a proposition to increase the capital stock $2,500,000 will be voted on.

RECEIVER FOR THIRD RAIL.—The Murphy Safety Third Rail Company has passed into the hands of a receiver, Dudley Farrand, of Newark, being appointed by Vice Chancellor Stevenson, of New Jersey.

RECEIVER FOR MICHIGAN TELEPHONE COMPANY.—The Union Trust Company, of Detroit, was, on February 23, appointed receiver for the Michigan Telephone Company, on the application of the Old Colony Trust Company, of Boston. The telephone company, it is stated, defaulted last July in the payment of its interest coupons amounting to $118,000 on its mortgage debt. Three months afterwards the Old Colony Trust Company filed a bill in the United States Court to foreclose the trust mortgage. On January 1 of this year the Michigan company defaulted in the second instalment of interest coupons, so that there was due for arrears of interest to the bondholders represented by the Old Colony Trust Company over $240,000.

MISSOURI & KANSAS TELEPHONE COMPANY.—A Bell sub company reports for the year ending December 31, 1902:

	1902.	1901.	Changes.
Gross	$1,228,436	$1,056,638	Inc. $171,798
Operating expenses	956,993	814,790	Inc. 142,203
Balance	$271,443	$241,848	Inc. $29,595
Depreciation	50,000	50,000	......
Net	$221,443	$191,847	Inc. $29,596

The company now has 53 exchanges, including branches, and 25,362 exchange stations.

THE CLEVELAND & SOUTHWESTERN TRACTION COMPANY, which is the consolidation of the Cleveland, Elyria & Western Railway and the Cleveland & Southern Railway, has filed a mortgage for $3,000,000 in favor of the Federal Trust Company, of Cleveland. This covers the entire bonds of the combined properties.

Commercial Intelligence.

THE WEEK IN TRADE.—The jobbing demand for goods at leading markets has been enlarged as a result of the spring-like weather conditions, and the same cause has favored expansion in retail trade. Building activity has been generally resumed with more favorable weather. In commenting upon the trade situation, *Bradstreet's* says: "Perhaps the most notable feature of the week's developments is the strength of the price situation, this not merely with regard to producers' and manufacturers' quotations, but also as to rates paid by final consumers. The one debatable element in the 1903 spring trade outlook has heretofore been the uncertainty as to how the higher level of prices would act upon consumptive demand. This situation is apparently solving itself with astonishingly little friction. In fact, the conviction seems to be growing that a higher level of quotations has been rendered necessary, and these are being accepted with little protest. Dullness in collections is noted at many centers, but this is a usual February condition. A strong demand for currency came from Western points, which caused heavy shipments from the East for this season of the year. Transportation lines have been rather favored by open weather conditions this year, as compared with February a year ago, and large aggregate gains in earnings for the month are predicted. There is yet evidence of railroad congestion in the reports that a large quantity of winter wheat still remains to come forward, being held back on account of the scarcity of cars. Prices of primary staples show a firmer tone in pig iron at home and abroad, advances in prices of iron and steel bars, wire and nails, the highest price paid for raw cotton in three years, a continuance in the advance of copper, to the highest point for over a year past, and a renewal of the advance in tin. Other staples have tended to hold their strength, and the steadiness of many of the leading commodities is second only to the aggressive strength shown by the products above mentioned. Structural material is active, and the railroads are buying freely. A large amount of construction work is looked for this year. The conditions in the copper market are unchanged. Copper shares and the price of copper have advanced simultaneously. Prices are nominal, ranging from 13⅛ to 13⅜c. for Lake and electrolytic; 12⅞ to 13⅛c. for casting stock, and 12⅝c. for Standard. The business failures for the week ending February 26, as reported by *Bradstreet's*, numbered 185, against 188 the week previous, and 204 the corresponding week last year.

WESTINGHOUSE STEAM TURBINES.—A new turbine shop has recently been put into service by the Westinghouse Machine Company, who have largely increased their manufacturing facilities in this new field of work. Particulars concerning a few of the more recent turbine installations may be of interest. Prominent among railway plants are those of the Metropolitan Railway Company and the Metropolitan District Railway, of London, aggregating 50,500 kw for operating the London Tube and surface railway systems. The former plant will employ three 3,500-kw units, and the latter eight 5,000-kw units, the largest turbine machinery on record. Two American railway installations are those of the Cleveland, Elyria & Western Railway Company and the Consolidated Railways & Lighting Company, of Wilmington, N. C., each of which will generate alternating current at a central power station, employing transmission lines and rotary converter sub-stations along the right of way. Several prominent lighting installations comprise the Hartford Electric Light Company, two 750 kw units, replacing the engine-driven units, 1,500 kw already installed; West Pennsylvania Railways & Lighting Company, Pittsburg, Pa., three 1,000 kw units, for supplying the entire district between McKeesport and Connellsville; Columbus (Ohio) Municipal Plant, three 400 kw units; Roslyn (L. I.) Light & Power, 800 kw; Citizens' Light, Heat & Power Company, Johnstown, Pa., three 400 kw units; the Rapid Transit Subway, New York, three 1,250-kw units, supplying current for lighting the entire subway, the 47 underground stations, and the immense power house at Fifty-ninth Street, Manhattan; Portsmouth (Ohio) Railway & Lighting Company, three 400-kw units, and the Rockland Light & Power Company, Nyack, N. Y., 400 kw. A number of these plants furnish considerable amounts of electric power to manufacturing establishments employing motor-driven machinery. Other installations employed exclusively for industrial power establishments comprise the De Beers Consolidated Mines, Kimberly, South Africa; two 1,000-kw units for lighting and operating mine machinery; Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., two 750-kw units for shop power; B. F. Goodrich Company, Akron, Ohio, one 750-kw unit for shop power, 400 kw already in operation; Saco & Pettee Machine Shops, Biddeford, Maine, two 400-kw units for operating shops; S. D. Warren & Co., Cumberland Mills, Maine, 400 kw for shop power, relaying steam and water plant, and the Yale & Towne Manufacturing Company, Stamford, Conn., 400-kw unit, duplicating the turbine equipment already in operation. A recent installation for the Goshen & Indiana Traction Company comprises five 400-kw units. The entire station will be operated from turbine machinery, and current will be used for light and power work.

PAWLING & HARNISCHFEGER, builders of electric traveling cranes, Milwaukee, Wis., advise that they find a very satisfactory demand for their products during the first two months of the new year. The record of an average of one crane order per day is still maintained and the use of day and night shifts in their works is still required. Orders come in freely from all sections, though the iron and steel industries of Pennsylvania and Ohio continue being the heaviest buyers. Steam railroads are more in the market than heretofore and the inquiries from electric railroads and electric lighting plants indicate a growing desire for crane equipment. The orders booked since the first of the year are partly represented as follows: Chicago & Eastern Illinois Railroad Company, Danville, Ill., 3 cranes; Western Tube Company, Kewanee, Ill.; the Westinghouse Machine Company, East Pittsburg; South Penn Oil Company, Folsom, W. Va.; the Pittsburg Plate Glass Company, Ford City, Pa.; Ansonia Brass & Copper Company, Torrington, Conn.; Fairbanks, Morse & Co., Beloit, Wis.; St. Paul Foundry Company, St. Paul.; the Ingersoll-Sergeant Drill Company, Phillipsburg, N. J., 14 cranes; American Bridge Company, Ambridge Plant, Economy, Pa., 5 cranes; the Standard Steel Works, Burnham, Pa.; City of Boston Water Department, Boston; Beloit Iron Works, Beloit, Wis.; International Steam Pump Company, Laidlaw-Dunn-Gordon Works, Elmwood Place, Ohio; Wheeling Steel & Iron Company, Benwood, W. Va.; the Coe Brass Manufacturing Company, Torrington, Conn.; the McConway & Torley Company, Pittsburg; the Ironton Engine Company, Ironton, Ohio, 2 cranes; Joseph T. Ryerson & Son, Chicago; Hammond Iron Works, Struthers, Pa.; Cambria Steel Company, Johnstown, Pa.; American Bridge Company, Pencoyd Plant, Pencoyd, Pa.; C. A. Lawton & Co., De Pere, Wis.; Perry-Mathews-Buskirk Stone Company, Bedford, Ind., 2 cranes; the Toledo Machine & Tool Company, Toledo; American Sheet Steel Company, Wellsville Works, Wellsville, Ohio; Landis Tool Company, Waynesboro, Pa., 3 cranes; Goodman Manufacturing Company, Chicago.

SUPPLIES WANTED FOR TURKEY.—Mr. Simon W. Hanauer, United States Deputy Consul General, reports that the administration of the postal and telegraphic service at Constantinople is open for bids on materials required by it, among which are 60,000 kg iron wire, 4 mm diameter; 20,000 kg bronze wire, 2 mm diameter; 27,000 insulators, partly with and partly without iron; 480 American machine augers and numerous other articles for telegraphic purposes. On awarded contracts 10 per cent security will have to be furnished by the successful bidder.

MOTORS FOR SAW FACTORY.—The Northern Engineering Company, Incorporated, has secured a contract for the installation of motors in the saw factory of the Jennings & Griffin Manufacturing Company, Port Jervis, N. Y. The motors are of General Electric induction type. There will be one 75-hp, one 20-hp, one 15-hp, one 5-hp and one 2-hp machine. Power will be derived from the new hydraulic plant at Rose's Point.

FRANK B. COOK, of Chicago, has been making a great success of the business of manufacturing telephone protective devices, switchboards and distributing terminals, which he started about eight months ago. It was at that time that he secured quarters at 240 West Lake Street, Chicago, ordered machinery, and started to make the necessary special tools and patterns, but it was only about four months ago that he was able to accept orders. The Kinloch Telephone Company, St. Louis, have purchased of him 62 cable terminals and protectors, the Home Telephone Company, of Los Angeles, has ordered 295 pole-top terminals and 180,000 tubular line fuses; the Automatic Electric Company, of Chicago, has ordered 19,500 pairs of protectors; the Home Telephone Company, of Dayton, Ohio, 6,000 pairs; the Illinois Telephone & Telegraph Company, for its new exchange in Chicago, 2,000 pairs, and the Citizens' Telephone Company, of Grand Rapids, 5,500 pairs. The large telephone manufacturing companies are also favoring Mr. Cook with orders for the equipment of exchanges which they have under contract. The North Electric Company has ordered the distributing terminals and protectors for exchanges at Worcester, Ohio, Eureka Springs, Kansas, Oneonta, New York, Bellefontaine, Ohio, and several other places. The Kellogg Switchboard & Supply Company has ordered 9,000 pairs of protectors, 8,000 of which are for the Home Telephone Company, of Los Angeles. The Stromberg-Carlson Telephone Company has placed large orders for distributing boards and protectors for some ten exchanges in various parts of the country. Adding to this a number of small orders, Mr. Cook has received orders all told for 110,000 heat coils, 240,000 cable arresters and 60,000 tubular line fuses.

TURBINE PLANTS FOR NEW ENGLAND.—The Massachusetts Electric Companies have contracted with the General Electric Company for ten 3,000-hp and three 1,000-hp steam turbines, direct connected to electric generators. The ten 3,000-hp turbines will be installed in three stations—Fall River, Quincy Point and Danvers, Mass.—superseding 13 of the engine-driven stations now operated by the concern. The turbines are of the Curtis vertical type run at only 750 r.p.m., taking steam at 175 pounds pressure at the turbine nozzle. The generators are mounted directly on the upper end of the turbine shaft, without gears or reducing mechanism, and are rated at 2,000 kw each. Adjoining their old power house at Newport, R. I., the companies have built a new one, 101 ft. square, in which the three 1,000-hp turbines are being installed for lighting and railway power work, and will replace the old plant, which contains a varied assortment of small belted Edison and Thomson-Houston units. The generators are 500-kw, three-phase, 2,500-volt General Electric machines and run at the turbine speed of 1,800 r.p.m. The boiler equipment comprises four 350-hp Aultman & Taylor water tube boilers, Green fuel economizers, and Schmidt superheaters.

COAL-HANDLING EQUIPMENT FOR LONDON.—The John A. Mead Manufacturing Company, 11 Broadway, has just secured the important contract for the belt-conveying equipment to be utilized for the handling of coal at the Chelsea power station of the Metropolitan Underground Railway, in which Charles T. Yerkes is interested. This equipment will be the largest of its description in any foreign country. There will be three belts all electrically operated. The one to be installed on the water side will be 250 ft. in length, with a capacity for handling 250 tons hourly. The two other conveyors are to run over the bunkers and are each to be 500 ft. long. They will each be capable of taking care of 120 tons per hour. The belts will be driven by alternating-current motors. The machine on the dock will be 35 hp. The motors to operate the bunker belts will be 20 hp each. The motors have not yet been purchased by the Mead people. The structural material for the plant will be purchased in England. The coal-handling equipment complete will represent an expenditure of nearly $100,000.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., reports a volume of business fully equal to the corresponding period of last year and an increasing demand for its electric traveling cranes. Among electric cranes recently installed, ranging in capacity from three tons to forty tons, are the following: C. D. Jackson & Co., 25-ton crane; Detroit Ship Building Company, 5 cranes, 5 to 40 tons; Allis Chalmers Co., Milwaukee, 12 cranes; American Ship Building Company, 3 electric cranes; P. A. Clum & Co., C. & G. Cooper Co., Macbeth Iron Company. It has also installed hand-power cranes of the traveling or jib type in the works of the Carpenter Steel Company; Insurance Stove & Range Company, Western Gas Construction Company, Mathewson Alkali Works, Colburn Machine Tool Company, 5 cranes; American Car & Foundry Company, Berwick, Pa., 24 cranes. It reports an increased demand for cranes and foundry machinery for export, as compared with the corresponding period of last year.

RECENT WESTINGHOUSE PLANTS.—The Great Northern Portland Cement Company, of Detroit, will equip its new plant throughout with electrical apparatus and has recently purchased from the Westinghouse Electric & Manufacturing Company 23 direct-current motors, ranging in size from 5 to 50 hp. These motors will be applied to driving cement machinery of all kinds. The Cleveland Hardware Company is installing a complete electrical equipment for the operation of its plant, and has recently purchased from the Westinghouse Electric & Manufacturing Company one 75-kw and one 100-kw, two-phase alternators, together with exciters, switchboard, ten 20-hp motors and two 10-hp motors. The plant is already in operation and is doing very satisfactory work. George S. Rider & Co. are the engineers.

LIGHTING OUTFIT FOR BRAZILIAN DOCKS.—The Lidgerwood Manufacturing Company, 96 Liberty Street, which concern recently secured a valuable contract for cableways, etc., in connection with the Manaos harbor improvements at the mouth of the River Amazon, has placed an order for a small lighting equipment for shipment to that Brazilian port. Mackenzie & Quarrier, 203 Broadway, have obtained the order for a 65-hp Harrisburg standard simple engine. The generator will be 37½ kw, Westinghouse direct-connected. Considerable electrical equipment will be used at Manaos before the dock improvements are finally completed. The work is being undertaken by a British concern in which Carlos Booth, of the Booth Steamship Line, 88 Gold Street, New York, is primarily interested.

BULLOCK EQUIPMENT FOR RAILROAD SHOPS.—The Bullock Electric Company, through its New York offices in the St. Paul Building, has taken a contract for two Bullock 750-kw, 25-cycle, three-phase alternating generators, engine type, 94 revolutions, for installation in the New York Central & Hudson River Railroad shops at Weehawken. There will also be two Bullock exciters of 50 kw capacity each. Through the Cincinnati office a contract has been obtained for 45 motors of various sizes for installation in the Columbus (Ohio) shops of the Pennsylvania Railroad.

STROMBERG-CARLSON TELEPHONE CONTRACTS.—The Calhoun County Telephone Company, of Kampsville, Ill.; the Kilbourn Telephone Company, of Kilbourn, Ill.; the Shelby County Mutual Telephone Company, of Strasburg, Ill., have purchased their telephones and switchboards from the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The Secor Telephone Company, of Secor, Ill., has purchased an equipment from the Stromberg-Carlson Telephone Manufacturing Company, also the Danforth Telephone Company, of Danforth, Ill.

NEW YORK RAPID TRANSIT ORDER.—The Interborough Rapid Transit Company, of New York City, awarded the contract for the electrical equipment of the trains on the Underground this week. The General Electric Company received the order for all of the train control, which will be substantially the same as that now used on the Manhattan Elevated Railway. The contract for the motors on the cars was divided equally between the General Electric Company and the Westinghouse Company. The total amount involved was about $2,000,000.

EQUIPMENT FOR STONE-CUTTING PLANT.—Senator W. A. Clark's stone-cutting plant at Ravenswood, L. I., is to be electrically operated. The Westinghouse Electric & Manufacturing Company will supply the generators—one of 100 kw and another of 75 kw capacity. These machines will be direct-connected to 150-hp and 120-hp Harrisburg standard simple engines. Several Westinghouse motors have also been ordered. The equipment is intended to be utilized for both power and lighting purposes.

EQUIPMENT FOR PERU.—F. A. Mitchell, of Iquitos, Peru, is now in New York with a view to purchasing equipment for the Iquitos Electric Light & Tramway Company, which is to erect a plant for the purpose of lighting the city of Iquitos. An electric traction system about 6 miles in length is also to be constructed between the docks and the heart of that Peruvian city. Mr. Mitchell may be found during the early part of the day at the office of the Export Club of America, 82-88 Wall Street.

LIGHTING EQUIPMENT FOR NEW KNICKERBOCKER HOTEL.—Mackenzie & Quarrier, 203 Broadway, have secured the contract for the engines to be installed in connection with the lighting plant for the Knickerbocker Hotel, now under construction, at Forty-second Street and Broadway. There will be three Harrisburg 300-hp tandem compound engines. The generators, direct-connected ones, are to be of 200-kw capacity each. They will be built by the Sprague Electric Company.

AFTER JAMAICA LIGHTING FRANCHISE.—The West India Electric Company, Limited, a London concern, is seeking a concession for the electric lighting of the city of Kingston, Jamaica, British West Indies.

CONTRACTS FOR RARITAN RIVER PLANT.—The National Fire Proofing Company, 170 Broadway, is contemplating the erection of an extensive electric plant for the purpose of operating its works along the Raritan River, N. J.

CONSTRUCTION WORK BEGUN ON NEW CUBAN LINES. The Insular Railway Company, which was recently incorporated under the laws of New Jersey with a capital of $2,500,000 for the purpose of constructing and operating an extensive system of light railways in Cuba, has begun work on the first section of the lines which will all radiate from Havana. The line now under construction will operate between the Cuban capital and Mariel, a favorite seaside resort, 30 miles west from Havana. This section is to be completed in June. German steel rails are being laid 4 ft. 8½ gauge. The other lines to be constructed will run to Congrejeras, Managua and Guines. In all more than 100 miles will be built. Both passenger and freight traffic is intended to be handled. The Insular Company is controlled by the interests identified with the Havana Electric Railway Company. Power to operate the Mariel section will be derived from the Havana company's central power station, which will ultimately be enlarged so as to furnish current for the other insular lines to be built.

THE ALBERGER CONDENSER COMPANY, 95 Liberty Street, New York, has acquired control of the Newburgh Ice Machine & Engine Company, Newburgh, N. Y. This engine company has been long and favorably known as builders of Corliss engines, ice machines and similar high-class machinery. It is understood to be the intention of the Alberger Condenser Company to devote this works principally to the manufacture of improved condensers, vacuum pumps and Corliss pumping machinery, which they are using extensively in connection with high-vacuum condenser installments. The recent developments in this class of work all tend toward the improvement of the parts that make up the condensing equipment. The Alberger Condenser Company still retains close connection with the Quintard Iron Works, foot of East Thirteenth Street, New York City, but rapidly-increasing business has made it necessary to obtain additional facilities for the manufacture of special lines of work.

EQUIPMENT FOR ALABAMA PLANT.—Some of the contracts for the equipment to be installed in the plant which is to furnish light, power and water for Sheffield & Tuscumbia, Ala., have just been awarded through L. H. McIntire, at one time manager of the Savannah (Ga.) street railway system, who may be found at the offices of Henry Parsons in the Morris Building. The boiler contract has been allotted to Wickes Brothers, Saginaw, Mich. There will be two units of 300 hp, vertical type. The engines, one 450-hp tandem compound condensing and another of similar type, having a capacity of 375 hp, have been ordered from Woolston & Brew, 39 Cortlandt Street. They will be of Brown (Milwaukee) build. The contract for a triple-expansion pumping engine, capable of handling 4,000,000 gallons, together with the condensers and small pumps, has been let to the Worthington branch of the International Steam Pump Company, 114 Liberty Street, New York.

NEW GENERAL ELECTRIC POWER STATION.—The General Electric Company is to construct a new central power plant at Schenectady, N. Y., which will be equipped with the Curtis vertical turbines. The plans drawn up will permit of a boiler capacity of nearly 20,000 hp. The initial boiler equipment, however, will only comprise eight units of 517 hp each. This contract has been secured by the Stirling Company, of Chicago, Ill., through its New York offices. The boilers will be high-pressure, with attached heaters. The condensers and pumps have been ordered from the International Steam Pump Company, 114 Liberty Street. The contract for the coal and ash-handling plant, which will be built so as to handle both materials simultaneously, has been awarded to John A. Mead & Co., 11 Broadway. This equipment will have an hourly capacity of 90 tons. The structural material for the building is to be supplied by the American Bridge Company, of New York.

EQUIPMENT FOR INSULATED WIRE PLANT.—The Hungerford Electric & Manufacturing Company, of which concern John Beaver, of the Metropolitan Street Railway, is president, and H. C. Willis, connected with the American Steel & Wire Company, is secretary, has let the complete contract for the equipment of its temporary power plant at Essex, N. J., to H. B. Coho & Co., Engineering Building. The Essex plant will manufacture insulated wire on an extensive scale. The contract calls for a 200-hp high-pressure boiler, which is to be built by the Stirling Company. The De Laval Steam Turbine Company, 74 Cortlandt Street, has been allotted the order for a turbine of 125 hp capacity. The contract also calls for the installation of 80 motors of 5 hp each. These machines will be manufactured by the Keystone Electric Company, of Erie, Pa. The Hungerford Company is to build a permanent power plant having a capacity of 1,000 hp.

AMERICAN BALL ENGINE ORDERS.—The American Engine Company, Bound Brook, N. J., through its New York offices, E. S. Boyer, manager, has secured an order for a 120-hp American Ball duplex compound engine for direct connection to a 75-kw Westinghouse dynamo. The equipment will be used for both light and power in the Hoboken (N. J.) shops of the Keuffel & Esser Company, 127 Fulton Street, New York. The H. A. Matz Color Works, Newark, N. J., are to be equipped with a 12-in. x 11-in. American Ball simple engine for direct connection to a Crocker Wheeler dynamo of 50 kw capacity. A 11 in. x 12 in. simple engine is to be furnished the Standard Rock Candy Company, New York, for direct connection to a 35 kw Triumph dynamo.

BALL ENGINE ORDERS.—The engines for the electric plant of the new First National Bank Building, of Chicago, will be furnished by the Ball Engine Company, Erie, Pa. There will be four 350-hp vertical cross-compounds, direct connected to Crocker-Wheeler generators. This building will be one of the finest in the country. Mr. R. T. White, Bayonne, N. J., has recently purchased from the Ball Engine Company a 160-hp direct-connected outfit for electrical purposes. A new direct-connected outfit of 80 hp will soon be installed in the Bijou Building, Pittsburg, Pa., the Ball Engine Company furnishing the engine and the Westinghouse Electric & Manufacturing Company the generator. The Diebolt Brewing Co., Cleveland, Ohio, have recently purchased a direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine, the Triumph Electric Company, Cincinnati, the generator. The electric light plant at Carrington, N. D., has placed in operation a direct-connected unit, the Ball Engine Company furnishing the engine, and the Northern Electric Manufacturing Company, Madison, Wis., the generator. Two 200-hp horizontal tandem compound, direct-connected engines have been ordered for the Mercantile Library, Cincinnati, Ohio, from the Ball Engine Company.

BRITISH CONDUIT FOR JAPAN.—Takata & Co., 10 Wall Street, have secured the contract for the supplying of the interior lighting conduit to be installed in the new Yokohama Specie Bank at Yokohama, Japan. The material will be purchased in England in view of better prices having been submitted by a London concern—the Conduit & Insulation Company—than were offered by firms on this side. The building referred to will be one of the largest and most elaborate in the far east. The structural material—about 1,500 tons—is being furnished by the American Bridge Company. The contracts for the electrical equipment are still pending and are not expected to be awarded before fall.

BIG ELECTRIC COAL-HANDLING HOIST.—The Robins Conveying Belt Company, Park Row Building, has placed a contract with the Lidgerwood Manufacturing Company, 96 Liberty Street, for a large coal-handling hoist, which will be operated by electricity. The equipment is intended to be installed in the Kingsbridge (N. Y.) power station of the Union Railway Company, the entire contract for the coal-handling plant for which has been undertaken by the Robins Company. The hoist will be of direct-acting, double-drum type. It will be operated by a 200-hp General Electric motor.

J. G. WHITE & COMPANY, LIMITED, of London, England, have received the contract for the complete construction of the Shipley tramways, including permanent way, overhead line, tramcars and equipments and cables. This contract amounts to £65,000. The Shipley contract is the first section of the Mid-Yorkshire scheme, for which powers are at present being obtained. The total estimated cost amounts to £450,000.

JAPANESE ELECTRIC TRACTION PROJECTS.—An electric traction system is to be constructed between Osaka, the principal commercial city in the Japanese empire, and the city of Kobe. The road will be about 20 miles in length. It is also proposed to build an electric line in Kobe. T. Ikeda, chief engineer of the Osaka Electric Light Company, is primarily interested in both projects.

FIFTY CARS ORDERED FOR HAVANA ROAD.—The Havana Electric Railway Company, 52 Broadway, has just placed a contract for fifty cars. The bodies will be built by the Niles Car Company, of Niles, Ohio. The trucks will be supplied by the McGuire Manufacturing Company, of Chicago, Ill. They will be equipped with 25-hp, double motors of General Electric 52 type.

CHINESE ELECTRICAL PROJECT.—Arnhold, Karberg & Co., of China, with offices at 50 Wall Street, are acting as agents for a Tien-Tsin syndicate, which proposes to furnish current for lighting and general power purposes in the City of Pekin. In the first instance it is intended to confine operations within the legation quarter of the Chinese capital.

HAVANA SYSTEM TO BE EXTENDED.—The Havana Electric Railway Company, which at present operates 36 miles of electric road in the city of Havana, Cuba, contemplates an extension of six miles to its system within the city. It is proposed to construct a steel viaduct about 1,500 ft. long.

ANOTHER JAPANESE TRACTION CONTRACT AWARDED.—The Japanese house of Takata & Co., 10 Wall Street, has been awarded an important contract for the complete equipment of a new Japanese electric traction enterprise. Details will be given in due course.

General News.

THE TELEPHONE.

WALCOTT, ARK.—The Walcott Telephone Company has been incorporated with a capital stock of $5,000.

FORT THOMAS, ARIZ.—The Gila Valley Telephone Company has decided to commence immediately the construction of a telephone line to Fort Thomas.

DENVER, COL.—At the regular annual meeting of the stockholders and board of directors of the Colorado Telephone Company the following officers were elected: President and general manager, E. B. Field; vice-president, Alonzo Burt; treasurer, Edw. B. Field, Jr.; secretary and auditor, H. W. Bellard. At the meeting of the Board of Directors it was voted to expend $1,000,000 for the extension and improvement of the plant throughout the state during 1903, and the president was authorized to offer to the stockholders for this purpose $1,000,000 in treasury stock.

TITUSVILLE, FLA.—The Indian River Telephone Company has been incorporated with a capital stock of $5,000, by W. H. Harris, H. Jennings, Geo. E. Coon and others.

MOULTRIE, GA.—The war between the Moultrie Telephone Company and the Bell Telephone Company has been brought to a settlement by which the local company will install Bell instruments if so required by the subscriber.

MOUNT CARMEL, ILL.—The Mount Carmel Telephone Company, capital $7,000, has been incorporated by H. J. Leach, C. W. Leach and John Coleman.

PROPHETSTOWN, ILL.—The Whiteside Farmers' Mutual Telephone Company, of Prophetstown, has been incorporated; capital, $10,000. Incorporators: W. E. Reynolds, J. H. Mosher and Millard F. Hill.

CHICAGO, ILL.—The City Council has granted a permit to the Illinois Telephone & Telegraph Company to make underground connections from its tunnels to various downtown buildings. The company's officers say they will have 10,000 telephones in operation in the downtown district by July 1.

NEW CASTLE, IND.—Extensive improvements have been decided upon by both telephone companies operating in this city.

LOOGOOTEE, IND.—The Central Telephone Exchange building in this city was completely destroyed by fire on Feb. 20.

KNIGHTSTOWN, IND.—The Knightstown Six Mile Telephone Company has incorporated, capital $200. I. White and Chas. Mattix are the principal officers.

GREENTOWN, IND.—John C. McCabe, of Huntington, has bought the independent telephone exchange of this city and will make extensive improvements at once.

CASTLETON, IND.—The Castleton Telephone Company, of this city, has incorporated with a capital of $2,000. C. S. Irwin is president and William Herrin, secretary.

GREENFIELD, IND.—The Hannah and Jackson Telephone Company has been incorporated. The capital stock is $10,000. Coleman Pope and John W. Jackson are officers.

CLAY CITY, IND.—The Harrison Township Telephone Company has incorporated. Capital stock $5,000. J. H. Horton, John Willen and E. R. Oberholzer are the incorporators.

WILKINSON, IND.—The Farmers' Co-operative Telephone Company, of Wilkinson, has incorporated with a capital stock of $10,000. Samuel M. Overman is president and B. H. Cook, secretary.

INDIANAPOLIS, IND.—The Home Telephone Company, of Hancock County, has filed articles of incorporation. John A. Anderson, O. L. McGee and W. D. Wilbert, Greenfield, Ind., are directors.

MILLERSBURG, IND.—The Farmers' Mutual Telephone Company has removed its exchange from Clinton Township to this place, and R. J. Davenport has succeeded to the presidency. The plant will be enlarged and improved.

INDIANAPOLIS, IND.—The Winona Telephone Company, of Knox, has filed incorporation papers. The company is capitalized at $30,000. The directors are Samuel Tomlinson, A. B. Diggs, W. S. Daniels, R. A. and S. A. Tomlinson.

BLOOMFIELD, IND.—The directors of the Home Telephone Company have been working toward a reorganization. The idea is to enlarge the system. The plan is to reincorporate with a capital stock of $100,000. John F. Slinkard and John Davidson are effecting the reorganization.

EVANSVILLE, IND.—Representatives of five or more construction companies are here making plans and estimates of the proposed municipal telephone system. Mayor Covert expects to be ready to advertise for bids in a short time. Only $16,000 remains to be subscribed when a franchise will be granted by the Board of Public Works.

INDIANAPOLIS, IND.—A large number of telephone men, headed by Hon. Hugh Dougherty, of Bluffton, appeared before the legislative telephone committee a few days ago, and urged the killing of the bill requiring telephone companies to connect their switchboards in towns where two or more companies are operating and furnish service over each other's lines. They argued that the bill would work the greatest hardship on them while it would do but little good for the people of the State.

WARSAW, IND.—An attempt was made on Feb. 16 to wreck the toll cable lines and blow up the office of the Commercial Telephone Company at this place. Dynamite was inserted near the top of a pole where the cables lead into the company's office. The explosion shattered the windows of all the surrounding buildings. The upper part of the pole was smashed but the cables were damaged but little. The telephone system is owned by Strauss Brothers, of Ligonier.

NEW ALBANY, IND.—A bitter war has been declared against the Cumberland Telephone Company by the union labor organization and its sympathizers. The linemen for the Cumberland, the Home and the United Gas and Electric Company struck for more wages. The latter two companies acceded to the demands, but the Cumberland, it is said, refused to make any sort of settlement. Many sympathizers have had their telephones taken out, the city council has ordered the instruments out of the police stations and fire houses, and the county commissioners revoked the line franchise of the company giving it the privilege to use the public highways. Unless a settlement is effected litigation will grow out of the acts of the commissioners.

OCHEYEDAN, IA.—A franchise for a telephone exchange was voted by the people.

BIDWELL, IA.—The Bidwell Telephone Company has been formed and will build a line to Blakesburg.

GARRISON, IA.—The Garrison Mutual Telephone Company has been incorporated, with a capital stock of $10,000, by James Grayson and others.

WATERLOO, IA.—The Commonwealth Telephone Company, of this city, has been incorporated, with a capital stock of $900,000, by H. C. Wood and others.

IOWA CITY, IA.—The Johnson County Telephone Company's line in this city has been sold to C. H. Brown, of Grinnell. The company will be reorganized as the Iowa City Telephone Company, and will be capitalized at $100,000.

RED OAK, IA.—At a recent meeting of the Red Oak, Climax and Coburg Telephone Company these officers were elected for the ensuing year: Lloyd Cole, president; Henry Bruce, vice-president; John McGreer, secretary; Edward Cole, treasurer; Thomas Birbeck, manager.

CUMBERLAND, MD.—The Western Maryland & Hyndman Telephone Company has been organized by De Warren H. Reynolds, U. G. Carl and G. W. Randall, of Cumberland, and B. F. Madore, of Bedford. Mr. Reynolds is president and Mr. Carl, secretary.

POCOMOKE CITY, MD.—The stockholders of the Pocomoke Telephone Company elected directors as follows: J. H. Merrill, president; E. James Tull, vice-president; W. H. Walters, secretary and treasurer; E. G. Polk, W. S. Schoolfield, A. E. Tull, J. Shiles Crockett, R. J. Lambden, Joseph S. Clogg, John W. Ennis and Jas. P. Blaine.

CONCORD, MICH.—It is proposed to reorganize the Concord Telephone Company into a mutual concern.

JACKSON, MICH.—The Citizens' Telephone Company, of Jackson, now has 1,400 telephones in operation and is installing new instruments at the rate of ten a day.

BENZONIA, MICH.—The capital stock of the Benzie County Telephone Company will be increased to $50,000. The company paid an 8 per cent. dividend for the year 1902. The officers elected for the coming year are: President, W. A. Young; secretary and treasurer, H. B. Woodward.

HOKAH, MINN.—The Union Valley Telephone Company has been formed to build rural lines.

NORSELAND, MINN.—The Nicollet County Telephone Company will extend its lines from Lafayette to Gibbon.

WESTBROOK, MINN.—The Southwestern Minnesota Telephone Company, of Pipestone, Minn., will establish a local exchange here and rural lines.

BLOOMING PRAIRIE, MINN.—The Steele County Telephone Company will extend its lines to Geneva, Ellendale, Hayfield, Waltham and other points.

JOPLIN, MO.—An independent telephone line is to be built, at a cost of $15,000, connecting Joplin with Kansas City. The Home Telephone Company, of this city, and an independent company in Kansas City are backing the enterprise.

GRAND ISLAND, NEB.—The Home Telephone Company seeks a franchise for a local exchange.

DANVILLE, NEB.—The Danville Mutual Telephone Company has incorporated with $5,000 capital.

OMAHA, NEB.—The Green Center Mutual Telephone Company, of Iowa County, has been incorporated with a capital stock of $2,000 by S. D. Miller and others.

DEMING, N. MEX.—The Luna County Telephone Company, of Deming, has been incorporated; capital, $3,000. Incorporators: C. B. Bosworth, S. Lindauer, J. J. Jeffers, C. F. Reynolds and W. H. Greer.

GLOVERSVILLE, N. Y.—Fire a few days ago destroyed the building occupied by the Glen Telephone Company in Johnstown. The loss is between $15,000 and $20,000, which is practically covered by insurance.

ALEXANDRIA BAY, N. Y.—The Alexandria Bay Telephone Company, of Alexandria Bay, has been incorporated; capital, $2,000. The directors are: A. C. Cornwall, J. F. Fuller and G. L. Olds, of Alexandria Bay.

ALBANY, N. Y.—The West Shore Home Telephone Company, of Catskill, has been incorporated, to operate in Ulster, Greene and Albany counties; capital, $100,000. Directors—S. R. Rawson and T. M. Brush, Elyria, Ohio, and Howard Hendrickson, of Albany.

NEW YORK, N. Y.—A new telephone building, to cost about $70,000, is to be built for the Greenpoint branch of the New York and New Jersey Telephone Company, in Greenpoint, in a short time. The Greenpoint central office serves Williamsburg, Greenpoint and Long Island City.

RIVERHEAD, L. I., N. Y.—The Baiting Hollow & Roanoke Telephone Co. is to extend its lines to Mattituck. The line will also be extended to South Jamesport and may possibly go to Greenport. This company was organized a few years ago by a few farmers to connect their homes with a railroad station. It has since grown rapidly and has proved one of the best things that the farmers ever thought of as a money saver and aid in farming.

TOWER CITY, N. D.—Priewe & Dalrymple contemplate building a telephone line to Page.

LITCHVILLE, N. D.—The Valley City Telephone Company may extend a line to this place and put in a local exchange.

CELINA, OHIO.—The Celina and Mercer County Telephone Company, of Celina, capital stock $80,000, has been incorporated.

ST. MARY'S, OHIO.—The St. Mary's Telephone Company will rebuild its system during the coming summer. Manager J. R. Longworth is securing estimates.

BRADFORD, OHIO.—The Bradford Telephone Company has been incorporated, with a capital stock of $20,000, by Z. T. Myers, J. H. Miller, Stephen Day, W. Day and W. E. Williams.

KIDRON, OHIO.—The Kidron Telephone Company has been incorporated, with a capital stock of $15,000, by Valentine M. Gerber, Jacob P. Sommer, Elias Gerber, J. F. Amstutz and John J. Bisler.

CLEVELAND, OHIO.—The Independent Telephone Traffic Company, of this city, has been incorporated, with a capital stock of $10,000, by Jerome Penn, Carl C. Curtis, Frank L. Beam, H. H. Robinson, G. P. Thorpe, W. G. Thompson and S. S. Henkle.

LEWISTON, PA.—The United Telephone & Telegraph Company will expend $250,000 in extensions and improvements.

PHILADELPHIA, PA.—The stockholders of the Bell Telephone Company have re-elected President James E. Mitchell and Winfield S. Piersol secretary and treasurer, and the entire present board of directors.

PITTSBURG, PA.—The Union Telephone & Telegraph Company will be incorporated with a capital stock of $3,000,000. It will make traffic arrangements with many of the independent companies in western Pennsylvania.

YORK, PA.—The York Eastern Telephone Company, capital $8,000, has been incorporated. The directors are: A. M. Grove, of Muddy Creek Forks; W. H. McCall and John H. Wilson, of Gatchelville; Henry S. Merryman and Benjamin F. Norris, of Fawn Grove; Joseph A. Gailey, of New Park, and Calvin M. Shaw, of Stewartstown.

PITTSBURG, PA.—The Central District Printing & Telegraph Company, of Pittsburg, Pa., has increased its capital stock $1,250,000, thus making the total capitalization $10,000,000. The funds thus realized will be expended in additions and improvements to the service and plant. The company proposes to erect an addition to its building on Seventh Ave., for which $171,000 of the new funds has been set aside. New buildings will also be erected in East Liverpool and Newcastle. The company now has a total of 46,859 stations and sub-stations. The officers elected for the ensuing year were D. Leet Wilson, president; D. F. Henry, vice-president; F. M. Stephenson, treasurer; George L. Herron, assistant treasurer; J. G. Stoaked, secretary and purchasing agent, and M. H. Buehler, general manager.

NEWBERRY, S. C.—It is reported that J. A. Blackwelder is interested in a proposed independent telephone company at Newberry.

VERMILLION, S. D.—A company has been formed in Norway township to build a telephone line to this city.

CANISTOTA, S. D.—J. J. McKinnon and R. H. Armstrong propose to install a local telephone exchange.

NASHVILLE, TENN.—The Tennessee Telephone & Telegraph Company has applied for a franchise in this city. It is stated that Mr. Harvey Myers, of Covington, Ky., is interested in the new company.

MEMPHIS, TENN.—The Southwestern Telephone and Telegraph Company is constructing the following new lines in Arkansas. Bridge Junction, at Memphis, Tenn., to Hoxie, 85 miles; Walnut Ridge, to Newport, 30 miles; and Jonesboro, to Paragould, 20 miles. The company's purpose is to extend the system over the entire State. Exchanges have recently been completed at Atkins, Plumeville, Cabin Creek, Coal Hill, Mulberry and a number of other places. The company now has over 5,000 miles of long distance lines in the State of Arkansas.

AUSTIN, TEX.—The Texas Telephone Company, of Wichita Falls, has been incorporated with a capital stock of $48,000. The incorporators are J. J. Lory, C. B. Felder, A. Zundelowitz, A. H. Carrington and J. H. Hardin.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has added over 300 telephones to its service in Salt Lake City during the past two months.

ROANOKE, VA.—It is now said to be settled that the Southern Bell Telephone Company, which operates an exchange in this city, with long-distance connections, will absorb the Virginia and Tennessee Telephone Company.

ONANCOCK, VA.—The Diamond State Telephone Company, of Delaware, will spend $150,000 in betterments. The company recently bought out the Atlantic Telephone Company and the Onancock Telephone Company, and it is understood that it will soon come into possession of the Peninsula Telephone Company, which operates about 175 telephones.

LA CROSSE, WIS.—The Vought-Berger Co. will enlarge its telephone factory.

WAUSAUKEE, WIS.—The Wausaukee Telephone Company will extend its line from Ellis Junction and Crivitz to Pembine.

ROCHESTER, WIS.—The Burlington, Rochester & Kansasville Telephone Company, of Rochester, has been incorporated; capital stock, $2,500. Incorporators, George W. Rountree, Brook Sheard and George W. Waller.

FOND DU LAC, WIS.—F. H. Sweet, receiver for the Little Wolf River Telephone Company, has entered an application in Circuit Court for an order to sell the company's property at public auction. The sale will probably take place within a few weeks. The Wisconsin Telephone Company will probably be a bidder. The stockholders in the original Little Wolf Company, however, are anxious to reorganize the company and are making every effort to raise the necessary funds.

VANCOUVER, B. C.—The New Westminster & Burrard Inlet Telephone Company, of this city, has arranged to lay a cable across the Gulf of Georgia connecting Vancouver and Victoria. The estimated cost is $170,000.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—The Birmingham District Coal & Light & Power Co. has been incorporated, with a capital of $100,000, by T. H. Aldrich, Jr., and V. Spear. The company proposes opening the mines and building an electric plant at the mines for supplying electric power and lighting in Birmingham and vicinity.

CALHOUN, GA.—J. T. Black is soliciting stock for a company proposing to erect a $11,500 electric light and power plant near Calhoun.

ATLANTA, GA.—The International Steam Engineering Company, of Atlanta, has made a bid to erect a plant for municipal lighting at a saving of $83,000 annually in the cost of lights.

CARTERSVILLE, GA.—Michigan and Chicago capitalists are considering the utilizing of the power of the Etowah River near Cartersville. It is estimated that 17,000 horse power is available.

DENVER, COLO.—The New Century Light & Power Company has been formed, to supply power to manufacturing plants in Denver and also towns and cities of this state. The site of the reservoir and power plant is near Kremmling. The probable cost of the work is $6,000,000. R. G. Munn is President and Fred W. Hart Chief Engineer.

BYRON, ILL.—John Whitaker is reported interested in the construction of an electric light plant.

EAST PEORIA, ILL.—It is stated that the East Peoria Heat, Light & Power Company is to construct a plant, to cost about $50,000.

CANNELLON, IND.—The city council has bought the local electric lighting plant and will make it a municipal affair.

MARION, IND.—The Citizens Electric Light Company, of this city, has organized and incorporated with $50,000 capital. The company will construct a modern plant and will compete with the Marion Light & Heat Company.

LAFAYETTE, IND.—The Wabash Oil & Gas Company, in connection with Lafayette and Chicago capitalists, will, it is reported, soon begin to construct dams and a $250,000 electric light plant at Horseshoe Bend on Tippecanoe River.

SYRACUSE, IND.—The Syracuse Power, Light & Manufacturing Company has incorporated with a capital of $60,000. The company will construct a dam in Elkhart river to generate electric power. J. P. Dolan, of Syracuse, is secretary of the company.

RICHMOND, IND.—Application has been made by a company which desires to buy the municipal electric light plant. The citizens are divided on the advisability of selling, one faction insistng on a sale because the muncipal plant is running behind each month; the other faction opposes the sale because the plant has been running only a few months and not had a fair municipal test.

DUBUQUE, IA.—The Union Electric Company will erect a new station building and install a complete power plant, including two 2300-volt 3-phase alternating direct-connected units, each of 500-kw capacity, and two direct-current railway units of the same capacity.

BOWLING GREEN, KY.—The City Council has authorized the establishment of an incandescent service in connection with its arc light system.

ST. FRANCISVILLE, LA.—P. H. Porter, of Clinton, Ky., has secured the contract for constructing the municipal electric light plant for $6,300.

NORTH ANSON, ME.—Lockwood, Greene & Co., Boston, Mass., have been employed by W. A. Bailey, of North Anson, to develop a water power on the Carrabassett River to serve manufacturing interests at that point.

PORTLAND, ME.—The United States Light & Traction Company has been organized at Portland, with $100,000 capital stock. The officers are: President, H. P. Sweetsir, of Portland; treasurer, Edward W. Guptil, of Portland.

STANDISH, MICH.—The House has passed the bill to authorize this village to issue bonds for the purchase or construction of an electric light plant.

CHINOOK, MONT.—Attorney J. N. Booth, of Great Falls, has petitioned the City Council of Chinook for a franchise for an electric light and power plant.

FREMONT, NEB.—L. D. Richards and Fred W. Vaughan have petitioned the City Council for a franchise to install a subway and conduit system in Fremont.

LITTLETON, N. H.—The Littleton Light & Power Company will equip a complete steam plant at the lower electric light station. The contracts for equipment have all been placed.

TRENTON, N. J.—The General Light, Power & Pump Company has been incorporated; capital, $300,000. Incorporators—Charles King, S. C. Woodhull and C. F. Woodhull.

SARATOGA, N. Y.—The Hudson River Water Power Company, of Saratoga Springs, has increased its capital from $2,000,000 to $5,000,000.

COHOES, N. Y.—The Hudson River Electric Light Co. has petitioned the Council for a franchise to furnish heat, light and power in Cohoes.

OXFORD, N. C.—Oxford will issue $25,000 bonds for an electric light plant and water works.

HIGH POINT, N. C.—The Senate has passed on second reading the bill to allow this city to issue $90,000 for electric lights, etc.

TOLEDO, OHIO.—The Lucas county commissioners are planning to establish a lighting plant to supply light for all the county buildings in Toledo. J. M. Osgood is securing estimates.

SCHOOLCRAFT, OHIO.—A special election will be held March 9 to vote on a proposition to issue $11,500 in bonds for the purpose of building an electric light system.

FINDLAY, OHIO.—The City Light, Heat & Power Company has organized with E. Wanamaker, president; F. J. Pogue, vice-president; W. V. Coons, secretary-treasurer; J. Bash, A. L. Davis, J. E. Bicknell and T. H. McConica directors. The company will establish a plant and will make a bid for the city lighting contract which is now held by the Toledo, Bowling Green & Southern Traction Company.

PERKASIE, PA.—The citizens have voted to expend $8,000 for a duplicate electric light plant.

SHENANDOAH, PA.—The Town Council has granted the People's Artificial Light Co., of Shenandoah, an electric light franchise.

STROUDSBURG, PA.—The Munroe County Water, Power & Supply Company, capital stock $10,000, has been incorporated. Treasurer, W. S. Shafer, Stroudsburg. Directors—W. S. Shafer, Van C. Peters, N. H. Shafer, J. H. Shull, S. E. Shull, Stroudsburg.

BEAUMONT, TEX.—Hal. W. Greer, Walter J. Crawford and others have petitioned the Council for a franchise for an electric light and power plant.

ROCK ISLAND, TENN.—It is reported that Philadelphia capitalists will probably invest $1,000,000 in developing the falls of Caney Fork near Rock Island, in White County, Tenn., near the point where the Great Falls Power Company will soon begin a similar undertaking. Eight thousand two hundred and fifty horse power are said to be available. The company will probably offer the power developed to the neighborhood.

SALT LAKE CITY, UTAH.—Plans for the Mackay Idaho Light & Power Company's dam and ditch, which are to cost $125,000, are now being made. The dam is to be built at the head of the narrows above the town where the fall of the water is 100 feet. The plant will generate 3,000 horse power for the development of electric current which will be used to light the town, in the smelter, and for operating the electric road.

LYNCHBURG, VA.—The Lynchburg Water Power Company has let the contract to Geo. O. Tenny, of Spartansburg, S. C., for the building a dam across the James River. The power will be used for operating the electric railways and lighting the city. The work will cost over $100,000.

READSBORO, VT.—W. D. Howe, of Readsboro, and E. W. Kelly, of Providence, R. I., are reported to be planning to build a dam in Readsboro to generate electric power to be transmitted throughout upper Deerfield Valley and to North Adams, Mass.

KALAMA, WASH.—Atkins & Watson, it is stated, have secured a franchise for an electric light plant.

WATERTOWN, WIS.—It is stated that the Watertown Electric Light Company will make alterations at its two power houses and will soon install new machinery.

SHEBOYGAN, WIS.—It is stated that the Sheboygan-Elkhart Lake Railway & Electric Company is about to petition the Council for the privilege of doing an electric lighting business in this city.

EVANSTON, WYO.—Articles of incorporation have been filed by the Box Elder Power & Light Company. The headquarters of the company are at Evanston. The capital stock is $100,000.

BERLIN, ONT.—A vote on the by-law for $100,000 to take over the gas and electric light plant resulted favorably. The town took possession on March 1.

THE ELECTRIC RAILWAY.

HARRISON, ARK.—The Arkansas Traction Company has been incorporated with a capital stock of $500,000. The charter permits the company to generate electricity for commercial purposes. The officers are Thomas Helm, of Harrison, president; R. M. Fellows, of Harrison, secretary and treasurer; C. Irving Page, of Rochester, N. Y., vice-president.

MONTEREY, CAL.—R. C. P. Smith has secured a franchise for the construction of an electric railway in Monterey.

LOS ANGELES, CAL.—Articles of incorporation have been filed by the Bakersfield & Ventura Railway Company, capitalized at $1,000,000. The directors are Eben Smith, J. W. Burson and Gervalse Purcell, of Los Angeles.

LOS ANGELES, CAL.—The Kern River Power Company, of Los Angeles, Cal., has recently purchased from the Westinghouse Electric & Manufacturing Company two compound-wound, 150-kw generators to be installed in its power house.

MONTVILLE, CONN.—The Montville Street Railway Company proposes extending its line to Oakdale.

ROCKVILLE, CONN.—The Rockville and Broad Brook Street Railway Company is about to be formed. C. E. Harwood, of Rockville, is interested.

HARTFORD, CONN.—The Meriden & Middletown Traction Company has applied for a charter. The preliminary capital of the company is to be $25,000, with the privilege of increasing to $500,000. Among the incorporators are I. E. Palmer, W. W. Wilcox, of Middletown, and Francis Atwater, of Meriden.

NEW LONDON, CONN.—The East Lyme Street Railway Company, which has secured a special charter for an electric railway from New London to East Lyme has organized with Richard C. Morris as president and treasurer, and Calvin S. Davis as secretary. The capital stock of the company is $100,000.

BRUNSWICK, GA.—A number of business men have applied for a franchise for an electric railway system.

ATLANTA, GA.—The Chattahoochee Terminal Company, of Atlanta, has been chartered by Thos. A. Gramling and others. The road will be 20 miles long. The capital stock is $250,000 to begin with.

AUGUSTA, GA.—Jas. U. Jackson, of Augusta, and others will apply for a charter for the Augusta and Columbia Electric Railway.

POCATELLO, IDAHO.—I. B. Perrine has applied for a street railway franchise.

RICHMOND, IND.—J. Morgan & Co., of Toledo, are promoting a traction line from Toledo to Richmond.

TERRE HAUTE, IND.—The Terre Haute Street Railway Company will make extensions and construct some interurban lines.

HARTFORD CITY, IND.—The Muncie, Hartford & Ft. Wayne Traction Company has made application for a lighting franchise in Hartford.

MARION, IND.—C. H. Bundy, John E. Clark and Everett W. Trook have been granted a franchise for the construction of an electric railway through Howard County.

BROWNTOWN, IND.—The name of the Greenwood interurban railway has been changed to the Indianapolis, Columbus & Southern Traction Company and the capital stock has been increased from $150,000 to $285,000.

INDIANAPOLIS, IND.—The Indianapolis & Cincinnati Traction Company, capital stock $1,500,000, has been incorporated by C. L. Henry, W. L. Taylor, T. F. Rose, Ephraim Marsh, Wm. Frazee, E. M. Johnson and J. F. Fesler.

TERRE HAUTE, IND.—The Indiana Coal Belt Traction Company has been incorporated with $100,000 capital stock by Charles L. Davis, W. H. Crowder, Ward Hawkins, W. Paul Stratto, L. A. Stewart and others, of Sullivan, Ind.

TERRE HAUTE, IND.—The city council has granted a 50-year franchise to the Terre Haute Street Railway Company for a consideration of $78,000, $16,000 cash in hand, and $16,000 annually after 1918. The company says it will now make extensions and construct some interurban lines.

DES MOINES, IA.—The Des Moines City Railway Company will spend $500,000 in improvements.

OELWEIN, IA.—The Oelwein & Northwestern Interurban & Street Railway Company has organized, with John Jamison president, and Wm. A. Reed secretary.

CEDAR RAPIDS, IA.—The City & Southern Railway Company proposes to construct an electric railway from Cedar Rapids to Iowa City, a distance of 30 miles. Estimates are now being made on electrical equipment.

MARSHALLTOWN, IA.—The Marshalltown Electric Street & Interurban Railway Company has been organized with a capital stock of $25,000. The directors of the company are H. E. Sloan, H. P. Deusel, Charles Glick, E. L. Will, George R. Estabrook, F. E. Glick and A. G. Glick, of Marshalltown.

CLINTON, IA.—A company has been organized here to build an electric railway between Clinton and Davenport, a distance of 42 miles. The capital stock of the company is $10,000 and the officers are John U. May, president; Mary Harrah, vice-president and treasurer; J. J. Melchert, secretary. The officers constitute the board of directors.

LOUISVILLE, KY.—A special meeting of stockholders of the Louisville Street Railway Company has been called for the purpose of voting on a proposition to increase the preferred stock of $2,500,000 and the common of $3,500,000, by 40 per cent. each. The company will, it is reported, make an extension to its power house.

SHREVEPORT, LA.—The Shreveport & Suburban Traction Company has been incorporated with a capital stock of $400,000. The incorporators are John R. Miller, William S. Lambert, Herman Hedberg, Austin Miller and Cecil L. Blaud.

ELKTON, MD.—The City Council has granted a franchise to the Kent & Cecil Electric Railway Company.

TOWSON, MD.—The Towson & Cockeyville Electric Railway Company is to be incorporated with a capital stock of $100,000. The incorporators will include Joshua F. Cockey, William H. Wright, E. Herman, James S. Nussear and Milton W. Offutt.

GRANBY, MASS.—It has been decided to extend the Hampshire & Worcester Street Railway from South Hadley Center to Granby.

SHELBURNE FALLS, MASS.—Herbert Newell, of Shelburne Falls, is said to be interested in the construction of an electric railway from Shelburne to Ashfield and Buckland.

NEW BEDFORD, MASS.—The Horseneck Beach Railway Company has applied to the Legislature for incorporation. The company is to be capitalized at $300,000. E. G. Gifford and C. F. Gifford, of Westport, are among those interested.

DETROIT, MICH.—The Detroit United Railway Company has placed a contract with the Westinghouse Electric & Manufacturing Company for 214 50-hp motors.

GRAND RAPIDS, MICH.—The Grand Rapids Street Railway Company has elected these officers: C. M. Clark, president; L. J. Ringe, vice-president and general manager; B. S. Hanchett, secretary-treasurer.

MUSKEGON, MICH.—The present officers of the Muskegon Traction & Lighting Company have been re-elected except J. J. Howden, who retired as vice-president in favor of Liddon Flick. One hundred thousand dollars preferred stock will be issued to retire outstanding bonds and provide funds for betterments.

MANKATO, MINN.—Herd & Keator have been granted a franchise for the construction of an interurban electric railway through the county toward St. Peter.

ST. PAUL, MINN.—A double-track trolley road from Duluth to Texas, with a capital of $70,000,000, is being projected here. Capitalists, among whom are W. D. Washburn, John W. Gates and otbers, are said to be interested. Application for charters in each State will be made soon.

GREENVILLE, MISS.—The Delta Electric Light, Power & Manufacturing Company is said to be in the market for the equipment for the electric railway that it proposes to build here.

GREAT FALLS, MONT.—J. F. Shepard, of Austin, Minn., is reported interested in the construction of an electric railway from Great Falls to Choteau, a distance of 60 miles.

PATERSON, N. J.—The Paterson & State Line Traction Company has secured a franchise in Hawthorne Borough.

TRENTON, N. J.—The Philadelphia & Langhorne Street Railway Company proposes an extension over the turnpike from Somerton to Feasterville and Willow Grove.

TRENTON, N. J.—The Cuba Eastern Railroad Company has been incorporated to operate railroads or traction lines in Cuba. The authorized capital stock is $1,000,000, and the incorporators are Louis N. Wheaton, Stallo Vinton and Frederick B. Mearkles.

UTICA, N. Y.—The Utica & Mohawk Valley Railway Company may erect a new power plant.

CHENANGO FORKS, N. Y.—The Binghamton Railway Company will extend its line to Chenango Forks, Port Crane and Owego.

TRUMANSBURG, N. Y.—H. F. Bell, representing promoters of an electric railway between Ithaca, Seneca Falls and Waterloo, is about to apply for a franchise here.

FARGO, N. D.—The Fargo & Moorehead Street Railway Company is said to have contracted with the Electrical Installation Company, of Chicago, for the construction of its proposed line to connect Fargo and Moorehead.

DELAWARE, OHIO.—The Delaware, Bellefontaine, Ft. Recovery & Wabash Traction Company will be incorporated.

DAYTON, OHIO.—A party of local capitalists have about decided to introduce trackless electric street cars in this city.

NEW INDUSTRIAL COMPANIES.

THE WESTERN ELECTRIC DRILL & MACHINERY COMPANY has been incorporated at Helena, Mont.

THE PITTSBURG FINANCIAL COMPANY, of Pittsburg, has been incorporated to erect, construct, maintain and operate telephone and telegraph lines; capital, $1,000,000.

THE STAR DYNAMO BRUSH COMPANY, New York, has been incorporated; capital, $1,000. Directors: W. L. Webb, Karl Ambrock and Alexander Schilling, New York.

THE CONTRACTORS' ELECTRICAL COMPANY, New York, has been incorporated; capital, $5,000. Directors: J. S. Ross, Brooklyn; F. Kling and H. W. Redfield, New York.

THE PUEBLO ELECTRIC METALLIC EXTRACTION COMPANY, of Pueblo, Col., has been incorporated; capital stock, $100,000. Incorporators: John H. Johnson, J. W. Tanner and C. H. Dolly.

THE J. F. KELLY ENGINEERING COMPANY has been incorporated in New Jersey with a capital of $50,000. The incorporators are: Walter Fairfield, Theodore W. Kloman and George E. Griswold.

THE HUNTER ELECTRIC ADVERTISING SIGN COMPANY, of Cincinnati, Ohio, has been incorporated, with $20,000 capital. The officers are: President, George B. Riley; vice-president, Samuel Cohn; secretary, John F. Ankenbauer; treasurer, James C. McWilliams.

THE SWAN ELECTRIC COMPANY has been organized at Portland, Me. The capital stock is $100,000. The promoters are: Frederick A. Swan, Saugus, Mass.; Frederick L. Fisher, Somerville, Mass.; Ernest O. Hiler, Boston; Walter A. Morgan, Llewellyn Carleton, Portland. Walter A. Morgan is president and Ernest O. Hiler treasurer.

LEGAL.

LAMP SOCKETS.—A suit has been filed by the General Electric Company against the Crouse-Hinds Company, of Syracuse, for the infringement of incandescent lamp sockets. This suit is based upon the Tournier patent No. 559,232.

LIABILITY FOR TELEGRAMS.—Justice Davy, in the special term of the Supreme Court at Rochester, N. Y., recently handed down a decision to the effect that the addressee of a telegram cannot hold a telegraph company liable for delay or failure to deliver a message; that the sender of the message is the only person that can recover under the statutes.

INDEPENDENT TELEPHONES IN LOUISVILLE.—In the case of the Cumberland Telephone Company vs. the Home Telephone Company, of Louisville, the Court of Appeals has decided that the Cumberland Company did not have the exclusive right to the streets of Louisville, and that the Home Company, although chartered in Delaware, had the right to do business in Kentucky and that the state or city government and not the Cumberland Company had the right to question in court its right to operate in the state.

TELEPHONES IN DETROIT.—The Michigan Supreme Court has handed down a decision upholding the Wayne Circuit Court in granting a mandamus to compel the Michigan Bell Company to give to John Mahan, a subscriber of the Detroit Telephone Company (which the former company absorbed) telephone service at the old Detroit Company's rate and connection with the Michigan switchboard. This, it is held, in effect fixes telephone rates in Detroit at $40 per year for business telephones and $25 per year for residences—the old Detroit rates.

BELL TELEPHONE TAX.—A bill has been passed by the Massachusetts Legislature which officially recognizes the passing of the Bell Telephone Company to New York from Boston. It appropraites $1,350 to be paid to the company to satisfy a judgment entered in the Superior Court against the Commonwealth for refund of its franchise tax for 1901. "This bill," said Commissioner of Corporations Trefry, "dates back to the transfer of the company to New York. We tried to tax some of the stock held here. The company resisted and the case was taken to court and decided."

WIRELESS SYSTEM IN HONOLULU.—A report from Honolulu, S. I., of February 18 states that the Circuit Court there has found that Marconi was not entitled to pay for the installation of his wireless telegraph system in Hawaii, and that the system in use was an improvement upon the one he had attempted to establish. The case was that of Marconi's Wireless Telegraph Company against F. J. Cross, wherein Marconi sued for $5,500, half of the purchase price of the patent, and for $2,500, one year's royalty upon the use of his system. Cross, who is a citizen of New York, alleged that the system installed by Marconi three years ago was a farce, that it did not work and that the one now in use here was an improvement upon the Marconi system and was installed by himself. He testified that Marconi had agreed to place the system in perfect operation for $11,000, that after the contract had been made the experts who came out were frightened by the plague and returned home, leaving the system useless. Then new experts were sent from South Africa by Marconi, who discovered that the failure was due to the placing of the poles in dry earth instead of near the seashore. A complete change of the system was then made, and the experts instructed a class of Hawaiian girls as operators. Then the coherers gave out and the line failed again, and Cross asserted that Marconi had not kept his contract by furnishing a duplicate set of instruments. Again the system had to be abandoned, and finally Cross gave up Marconi's idea, and went off on his own hook. He secured a duplicate set of telegraph keys, manufactured a new kind of coherers, which he says did the work much better, and also made new condensers. With the improvements made by himself, the system was a success, and has been working now satisfactorily for over six months. The jury was out only two hours in deciding that the contract had not been carried out. A verdict for the defendant was returned. An appeal was taken on behalf of Marconi by his attorneys and if necessary the case will be carried to the United States Supreme Court, as the inventor believes the stability of his patent rights is involved. The suit was brought by Marconi's Wireless Telegraph and Signal Company, the English corporation which has control of all the patents.

OBITUARY.

F. L. HOMER, president and treasurer of the Homer Commutator Company, Cleveland, Ohio, died recently. The business will be continued under the old name.

MR. A. M. PENNOCK.—Mr. Allen M. Pennock, who was connected with the electrical department of the Western Union Telegraph Company for several years, died of pneumonia last week in Brooklyn, at the age of forty-five years. He was a native of Bordentown, N. J.

PERSONAL.

MR. T. A. EDISON and family are making their usual winter trip to Florida, where he has a plantation.

MR. EDWIN HAWLEY has been elected a director in the Postal-Telegraph Cable Company to succeed the late Mr. John W. Mackay.

COL. GEO. W. DUNN, of Binghamton, has been elected Chairman of the State Railroad Commission, vice Ashley W. Cole, retired.

MR. A. N. NIELSEN, the assistant treasurer of the Kings County Electric Light & Power Company, of Brooklyn, has been promoted to the treasurership.

MR. S. S. SUMMERS, consulting engineer of the Denver, Colo., electric traction system was in New York last week securing figures for equipment, etc., to be installed in the extensive power house addition.

MR. JOSEPH E. LOCKWOOD, president of the Michigan Electric Company, of Detroit, was in New York City the past week as a participant in the municipal ownership convention, on the part of Mayor Maybury.

MR. EDWARD A. LESLIE has been elected second vice-president of the Kings County Electric Light & Power Company, of Brooklyn, which controls the Brooklyn Edison system, of which he has been manager for some time past. The office is a new one.

MR. W. J. FLANNERY, recently with the Western Electric Company in New York and formerly with the Stanley Instrument Company, has accepted the position of sales manager with the Electrical Material Company of Baltimore.

MR. LUTHER STIERINGER, who has been traveling for his health in the extreme Southwestern States for some time past has reached California and reports from the Edison stronghold at Los Angeles as well as other electrical centres in the State.

MR. GEO. F. GREENWOOD, general manager and chief engineer of the Havana Electric Railway Company, whose proposed extension is referred to elsewhere in this issue, has been in New York since the beginning of the week. He returns to Cuba Saturday.

MR. JOHN A. ABBOTT has resigned as vice-president and general manager of the Consolidated Railway Lighting & Refrigerator Company. He has also dissolved his connections with the subsidiary companies, including the Consolidated Lighting & Equipment Company.

MR. S. S. BOGART.—At a meeting of the board of directors, Mr. S. S. Bogart, for sixteen years identified with the Western Union Telegraph Company, and formerly superintendent of that company, has been elected a director of the American De Forest Wireless Telegraph Company.

MESSRS. DODGE & DAY, the modernizing engineers of Philadelphia, have been commissioned by the Ingersoll-Sergeant Drill Company to report on variable speed motor equipment for the new Phillipsburg plant, and have been awarded the contract to equip with motor drives a number of the large machine tools.

PROF. JOHN E. SWEET, of Cornell University, lectured before the Automobile Club of America at the clubhouse, New York City, last week, on "Steam as a Motive Power for Automobiles," and described in detail the results of his experiments in devising a steam engine for use in motor vehicles. It cannot be said that great enthusiasm as to steam automobiles marked the occasion.

HENRY NOYES, of the Australasian electrical engineering and contracting firm of Noyes Brothers, Sydney, N. S. W., which represents the interests in that part of the world of Westinghouse, Church, Kerr & Company, J. G. Brill Company, etc., is now in New York. He is at the Waldorf-Astoria. Downtown he may be found at the Westinghouse offices, Maritime Building.

MR. CHARLES M. SCHWAB, the president of the U. S. Steel Company, in a recent interview said: "There's too great a tendency toward what is called 'gentle callings' or 'learned professions.' We need physicians and lawyers, but not so many. The youth who is a practical electrician can earn twice as much as the average doctor or lawyer."

MR. WALTER G. CLARK, of the firm of Kilbourne & Clark, Seattle, Wash., has been a visitor to New York City during the past few weeks. Among the large number of agencies handled by this firm is that which it recently secured for the Nernst lamps, embracing representation on the entire Pacific Coast. Mr. Clark speaks in glowing terms of the immense electrical development in the Northwest, in which, incidentally, his firm has had no little part.

MR. HENRY HALSEY, a young lawyer, is reported by the *New York Herald* to be working on the uphill job of perfecting a primary battery for automobile work. "Stripped of technicalities, the lawyer's battery is nothing more than an ordinary battery, in which the carbon disk is made to revolve in the sulphuric acid and water. The zinc plates are, as in the common batteries, stationary. From the disc the element of power is taken by brushes against which it revolves. These connect with posts through which wires are passed leading to the motor. Contradictory as it may appear, the motor run by the battery in turn revolves the disks by which the sustaining power is furnished."

MR. CHARLES S. POWELL, who has been associated with the Westinghouse electric interests since 1893, and who, for the past six years, has been manager of the Cleveland office of the Westinghouse Electric & Manufacturing Company, has changed the scene of his activities from the United States to Europe. He has been appointed assistant manager of the British Westinghouse Electric & Manufacturing Company, Limited, and has already entered upon the duties of his new position. Mr. Powell, who is one of the most popular men in the electrical business in the United States, is sure to be equally well liked in Great Britain. His headquarters will be in the Westinghouse Building, Norfolk Street, London, W. C.

THE JOHN F. KELLY ENGINEERING COMPANY.—Mr. John F. Kelly, who needs no introduction to the electrical public, has associated with him Mr. T. W. Kloman and Mr. W. L. Fairchild for the conduct of a consulting and contracting engineering business, under the firm name of The John F. Kelly Engineering Company, Incorporated. Mr. Kelly is president and consulting engineer of the company, Mr. Fairchild, vice-president and secretary, and Mr. Kloman, treasurer and manager. Like Mr. Kelly, Messrs. Fairchild and Kloman have been prominently identified for years with the Stanley Electric Mfg. Co., the latter more recently as manager of the New York office and Mr. Fairchild as sales engineer. The new firm starts out with considerable transmission work in the West and in Mexico, and is understood to have strong financial support for any large projects it may undertake. Mr. Kelly, who will remain consulting engineer of the Stanley Instrument Company, has won his spurs in every department of electrical engineering, and since the development of electric power transmission has been a potent factor in that field, as the success of the several great installations he has planned abundantly testifies. As both Mr. Fairchild and Mr. Kloman unite strong business capacity with engineering knowledge, the combination is one which meets the conditions of the day, and a successful future for the new company can safely be predicted.

Trade Notes.

OIL FILTERS FOR FOREIGN COUNTRIES. The Burt Mfg. Co., of Akron, Ohio, has made a shipment of oil filters to Sydney, Australia, and one of five filters to Stockholm, Sweden, also five to Johannesburg, South Africa.

THE BABCOCK & WILCOX COMPANY is issuing to the trade copies of the decree and injunction secured by it from the U. S. Circuit Court, Southern District of New York, protecting it against infringement of the trade name of its famous water-tube boilers, whether the full name or such abbreviations as "B. & W."

MESSRS. W. M. SHEEHAN & CO., 136 Liberty St., New York, are meeting with a large demand at present for Nernst lamps. A test made by this firm showed by wattmeter readings, that a 50-cp Nernst lamp consumes 92 watts while a 50-cp standard incandescent lamp consumes 155 watts. This certainly shows economy.

DAYTON FANS.—The Dayton Fan & Motor Company, Dayton, Ohio, has this year revived its original type of Dayton fan, which was once very popular and bids to become so again. Otherwise its product for 1903 will be practically the same as that of last year. The company has taken its license under the ceiling-fan patents of the Diehl Company.

THE HOMER COMMUTATOR COMPANY, Cleveland, Ohio, at a recent meeting elected the following named officers: President, John H. Simpson (vice F. L. Homer, deceased); J. C. Kraus, vice-president, and Fred J. Baird, secretary and treasurer. The business has grown so rapidly that it will soon be necessary to build an addition to the factory.

THE AMERICAN ELECTRICAL SUPPLY COMPANY, of Baltimore, has moved its offices and manufacturing plant to No. 10 E. Pratt Street. It is now in possession of increased facilities for manufacturing its line of porcelain specialties, which includes combination fuseless rosette moulding and cleats, wall receptacles, fuseless rosettes, receptacles and sockets, sign receptacles, main and branch cut-outs, plug cut-outs and fusible attachment plugs.

THE FOSTORIA INCANDESCENT LAMP COMPANY, Fostoria, Ohio, informs us that it has received the contract to furnish the entire supply of train lighting and standard lamps for the New York Central & Hudson River Railroad Company, for all its leased and operated lines. Fostoria lamps have been used in the New York Central's train lighting service for about four months and they have been found so satisfactory that the contract above referred to was the result.

THE HUGHES TELEPHONE MANUFACTURING COMPANY, Baltimore, Md., has recently located offices at 123 Hanover Street, in connection with its new manufacturing plant. This company makes a specialty of manufacturing and installing complete telephone systems for hotels, apartment houses, public buildings, etc. These systems are both of the intercommunicating type and for use in connection with switchboards. Its new plant gives it superior facilities for turning out high-grade work promptly.

THE OTIS ELEVATOR COMPANY has been awarded the John Scott Legacy Medal and Premium by the Franklin Institute for its electric elevator for private residences, which dispenses with the services of an attendant and is operated by merely pushing buttons at the various landings and in the car. The Committee on Science and the Arts, which recommended the award, made a thorough inspection of several existing installations and their report is highly commendatory of the ingenuity of design, the safety of operation and the substantial construction.

BELTS FREE. The offer of Graton & Knight Manufacturing Company, Worcester, Mass., to send, free of charge, one of its superior oak tanned belts to any manufacturer who would like to test it, is attracting a good deal of attention. The reputation of this old house is a guarantee of the excellence of its belting, and that it will in every minutest respect do exactly as they agree. Any of our readers who are interested in securing the best of belting at the lowest possible cost should write immediately to the Graton & Knight Manufacturing Company, and ascertain further details.

THE COLD WAVE ACCOUNTED FOR.—The well-known business establishment of Messrs. E. B. Latham & Co., 39 Vesey Street, New York, believes that they unintentionally created a very unpleasant state of affairs throughout this country on February 17. The cause of this was several large shipments of Tuerk alternating current ceiling fans made to all points of the compass simultaneously. The ability of the fans to "raise the wind" in hot climates is universally conceded, and Mr. Latham desires to apologize for his thoughtlessness in moving so large a number of the fans at this season of the year, when the supply of coal to neutralize the effect is limited.

THE ROBBINS & MYERS CO., Springfield, Ohio, will take extra care of its fan trade this year, and will do its best to keep as many of the 76,000,000 inhabitants of this country as cool as possible during the Summer. Last year's types of fan will be reproduced this year, which fact may be taken to indicate that there is little room left for improvement in its goods. Its fans, both the ceiling and desk types, are favorably known in the trade, the highest skill in science and industry being represented in their design and production. The company is bringing out this year, as already noted, a 500-volt ceiling fan which consumes .2 ampere of current, running at a speed of 200 r.p.m. This fan is provided with extra heavy insulation to withstand the high pressure.

CONDUIT COMMENTS.—Under this title a handsome advance circular has been recently issued by the Standard Vitrified Conduit Company, 39 Cortlandt Street, New York. It gives some well-condensed information on this type of conduit, which is made single and multiple, of vitrified clay, salt glazed, and possesses some advantages which cannot fail to interest all who use underground conduits. The company also manufactures third-rail insulators, of which make 60,000 have been delivered to the Manhattan Railway Company, New York. The company's factories have an annual capacity of 25,000,000 feet of conduit. The company installs conduit systems complete. All persons interested can obtain a copy of the company's new illustrated catalogue on application.

EMERSON FAN MOTORS.—This year's styles of fan motors and ceiling fans for alternating current manufactured by the Emerson Electric Manufacturing Company, St. Louis, Mo., are described and illustrated in an excellent manner in a handsome 80-page catalogue recently issued by the company. A list of types and sizes shows that there are 29 different sizes of desk, bracket, ceiling and exhaust fans for high and low frequency; column fans for low frequency and direct-current exhaust fans. The catalogue contains 23 illustrations of as many different styles of fans, and three other illustrations showing, by means of section views, the constructional details of these well-known machines. The text is brief, but very comprehensive, a code accompanying the description of each style. The catalogue has an attractive cover, and is printed very tastefully.

NERNST LAMPS.—One of the highest tributes given to the Nernst Lamp is the fact that the Frick Building, in Pittsburg, although fitted with a complete power plant of its own, has at considerable cost contracted wih the Allegheny County Light Company for alternating current solely to make the use of the Nernst lamp possible. The corridors, and bankers' and brokers' offices on the first floor are lighted by six-glower lamps of the Nernst patent, which very satisfactorily answer the difficult proposition involved in illuminating apartments with very high ceilings. The draughting rooms of the Engineering Department, Pennsylvania Railroad, in the Union Station, Pittsburg, have also recently been fitted throughout with the Nernst Lamp. The quality of this illuminant is peculiarly suited to the requirements of draughtsmen, having a perfect downward distribution of light of daylight quality, with an absence of shadow or flicker.

CALCULAGRAPH SERVICE. The Calculagraph Company, of 9-13 Maiden Lane, New York, states that in October, 1902, sixteen calculagraphs were purchased by a telephone company and installed, one each, in sixteen different exchanges. The records of toll messages made by those sixteen calculagraphs during the month of November were analyzed for comparison with manual records made in the same sixteen exchanges during a previous month. It was found that while 1,663 fewer toll messages were sent in November, the receipts were larger than during the previous month and the number of "excess minutes" was increased from 6,929 to 22,846, or 15,917 more "excess minutes" were shown on the Calculagraph records than on those made with a pencil. The value of these excess toll minutes was $1,1[illegible], which represents the net earnings of the sixteen Calculagraphs for one month, or an average of $[illegible] for each instrument. This result was so satisfactory to the officials of that telephone company that it has since placed an order for 138 calculagraphs, for use in other exchanges in its territory.

"WOOD" FAN MOTORS.—The Fort Wayne Electric Works, Fort Wayne, Ind., has recently issued its 1903 fan motor catalogue, which illustrates and describes the various styles of fan motors which they are introducing this year. These fan motors are manufactured for both direct and alternating current. They are also made in two distinct types—the revolving and the desk type. The revolving type is very unique and is said to be different from anything that has heretofore been placed on the market. The desk type operates an 8-inch fan, which gives just sufficient and not too much of a breeze. Attention is particularly called to the very small amount of energy required to operate these motors. Some central stations might object to this, but against this objection is set the argument that a great many more fans will be used by certain customers and also that a great many more consumers of electrical energy will use fans simply because the fan motor is so efficient, which would practically make an even thing of it, so far as the consumption of energy is concerned. Furthermore, it is a load that is thrown upon the station at a time when the machinery is more able to handle it.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 24, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 177 Nassau St., N. Y.]

721,147. OVERHEAD TROLLEY; J. E. Byers, Butler, Pa. App. filed April 11, 1902. A device for retaining the trolley on the wire.

721,161. ELECTRIC SIGNAL FOR RAILWAYS; F. B. Cutten, New York, and A. C. Fraser, Brooklyn, N. Y. App. filed Feb. 6, 1891. A normally closed circuit carried by the locomotive and fed by a generator with a predetermined normal current, combined with a danger magnet uninfluenced by the normal current but responding to a certain increase of current to give the danger signal.

721,194. ELECTRIC SWITCH; A. W. Horn, Buffalo, N. Y. App. filed April 7, 1902. A drum is provided with sockets in which pins are removably placed, said pins being arranged to contact with circuit closing fingers to operate sign lamps.

721,202. FACSIMILE TELEGRAPH; E. E. Kleinschmidt, New York, N. Y. App. filed Feb. 7, 1900. Improvements in the various features of a facsimile system.

721,205. ELECTRIC TIME SWITCH; A. W. Lauter, Sr., Chattanooga, Tenn. App. filed May 26, 1902. (See Current News and Notes.)

721,217. FUSE BOX; J. K. Morgan, Baltimore, Md. App. filed April 7, 1902. Details of a magazine fuse-box.

721,229. MOTOR; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Sept. 20, 1901. An alternating-current motor in which the speed is controlled by the employment of an induction winding in shunt with the armature brushes, regulation being accomplished by varying the turns on the inductive winding.

721,270. ELECTRIC HAND OR FOOT HEATER; A. Zeckendorf, Cincinnati, O. App. filed Dec. 22, 1902. A mitten or slipper having a heating resistance wire threaded through the fabric.

721,273. CIRCUIT BREAKER; H. P. Ball, New York, N. Y. App. filed Jan. 29, 1902. The circuit breaker is provided with two independent means for actuating it, one of which is adjustable as to sensitiveness without permanently altering its normal calibration.

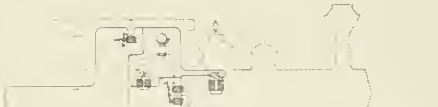
721,280. TRANSFORMER; O. J. Depp and J. P. Hunter, Dallas, Tex. App. filed June 30, 1902. The slit in the iron sleeve surrounding the core is plugged up with fibre to prevent its edges from being closed by the tension of the winding.

721,372. ELECTRIC CONTROLLER; J. H. Holland, Columbus, O. App. filed June 23, 1902. A reversing switch, a switch lever, a controller and its lever and a device carried by one lever for automatically engaging the other, so that both will move together a limited distance.

721,387. HEATER CUT-OUT FOR ELECTRIC LAMPS; H. N. Potter, Gottingen, Germany. App. filed Sept. 2, 1899. The contacts of the cut-out are controlled by energy derived from the heat of the ballast, all being closed in a sealed chamber.

721,402. ELECTROPLATING APPARATUS; J. Walters, Sumter, S. C. App. filed March 22, 1902. (See Current News and Notes.)

721,410. SWITCH FOR ELECTRIC CIRCUITS; J. J. Wood, Fort Wayne, Ind. App. filed June 23, 1901. A circuit closing lever pivoted in the middle, is connected by means of a link with an armature common to two magnets in such manner that one magnet will throw the lever in one direction while the other will throw it in the opposite direction.



721,161.—Electric Signal for Railways.

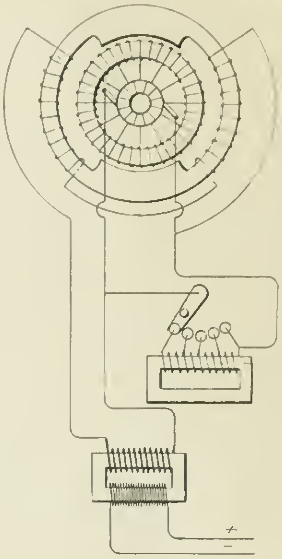
721,416. STREET RAILWAY SWITCH; W. J. Bell, Los Angeles, Cal. App. filed July 14, 1902. A lever through which the switch is moved is normally inactive to throw the switch, but electrical devices provide a fulcrum for the lever to render it active.

721,427. COUPLING FOR CONVERTERS OR RODS FOR PURPOSES OF UNDERGROUND CONDUITS; T. J. Cope, Philadelphia, Pa. App. filed May 16, 1902. Details.

721,451. THERMOSTAT; J. M. Latimer, Philadelphia, Pa. App. filed July 27, 1901. A spring contact is held out of engagement with its mate by fusible material.

721,481. SAFETY DEVICE FOR HOISTS; S. S. Wales, Munhall, Pa. App. filed Oct. 9, 1902. The device is applied to any shaft of the hoisting machine and embodies a reducing gear which causes a cut-out to be operated when the hoist reaches the end of its movement in either direction.

721,490. ELECTROMAGNET FOR SEPARATING METALS; G. H. Young, Elmira, N. Y. App. filed Feb. 12, 1902. A horse-shoe magnet in which the back yoke serves as a handle for manipulating it and a push button is conveniently located on the end of one spool.

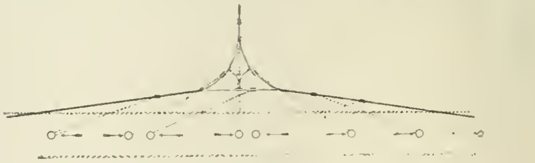


721,229.—Motor.

721,520. FIRE ALARM SYSTEM; B. P. Ketcham, Carthage, N. Y. App. filed March 13, 1902. Details.

721,529. TROLLEY POLE REVERSER FOR ELECTRIC TRAMWAYS; F. E. Ward, Cheltenham, Eng. App. filed Dec. 22, 1902. A branch or shunt from the main wire is formed with a V-shaped, upwardly pointing track on to which the trolley wheel runs and which permits the pole to occupy a vertical position when the wheel reaches the apex of the track, so that the car can then move in either direction and the pole will automatically incline to the rear.

721,559. BINDING SCREW FOR ELECTRICAL CONNECTIONS; G. W. Goodridge, Bridgeport, Conn. App. filed Dec. 2, 1902. The washer under the head of the screw is carried upward with the screw to save the trouble of lifting it with the finger or the point of a screw driver in order to place the wire beneath it.



721,529.—Trolley Pole Reverser for Electric Tramways.

721,602. HEATER CUT-OUT FOR ELECTRIC LAMPS; H. N. Potter, Göttingen, Germany. App. filed Aug. 9, 1899. The expansion of the ballast wire is made use of to operate a circuit-breaker through which the circuit to the heater is closed when the glower is not in operation.

721,646. ELECTRIC HEADLIGHT; J. Kirby, Jr., Dayton, O. App. filed Dec. 26, 1901. Improvements in construction whereby the size of the lamp is reduced and its cost lessened. Auxiliary means are also provided for establishing the circuit in the event of the failure of the current to perform this function.

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CONTENTS.

Editorial 433
Coming A. I. E. E. Meetings in Chicago 436
The American Street Railway Association 436
Lighting the St. Louis Exposition 436
Hydraulic Developments and Electric Installations 436
The 22,000-volt Transmission Installation of the Northern California Power Company 437
Some of the Problems of Electric Train Lighting. By Geo. D. Shepardson 439
Electricity as a Motive Power in Mechanical Flight. By Dr. T. Byard Collins 440
The Heyland Induction Motor—I. By Boy de la Tour 442
Recent Electrochemical Developments. By Clinton Paul Townsend..... 444
Ries Patents Sold at Auction 444
New Telephone Patents 445
Telephony in New Jersey and Long Island 446
Inverted Third Rail Conductor 447
Michigan Independent Telephone Companies 447
Method of Making Rates at Cleveland 447
Central Missouri Telephone Association 447
Current News and Notes 448
Letters to the Editors:
  Three-Phase Measurements. By H. L. Wallace and Leslie L. Perry.... 449
Digest of Current Electrical Literature 450
New Books 453
A Modern Theatre Installation in New York City. By Irving B. Smith.. 455
Switchboard Circuit Breakers 458
Interchangeable Arc Lamp 459
Watson Ball-Bearing Motors 459
Departments:
  Financial Intelligence 460
  Commercial Intelligence 461
  General News 463
  Trade Notes 467
  Record of Electrical Patents 468

Cables and Coherers.

Those who have attended the dispatch of wireless telegraph messages across the Atlantic have described the use of wool in the ears in order to deaden the sound caused by the disruptive discharge across the gap, that sets the ether in a tingle and might burst an ear drum, so violent is the shock to the auditory organs. According to the wireless advocates this plugging of the ears with wool has been characteristic also of cable managers in regard to the news of wireless work; and we do not think they are likely to find much material for sympathetic comment in the remarks of Mr. George Gray Ward at the annual meeting of the Commercial Cable interests. That veteran cable manager maintained his cheery and optimistic attitude in addressing the stockholders and said: "Nothing has occurred since I last addressed you to cause us to modify the conservative estimate then expressed, and which I confidently repeat, that telegraphy by means of wires has little to fear from the competition of telegraphy without wires. For the benefit of those who do not share my confidence, I may say that the etheric waves will be as obedient to us as to anybody if it should ever be found practicable to dispense with cables and wires." In fact, Mr. Ward fears neither wireless nor wireful competition, but if necessary is ready to do without wires as well as anybody else.

By one of those coincidences of which all history is full, it happened that just as Mr. Ward was standing up for cables, the first cable should be abandoned for wireless methods within view of the room where he was speaking—namely, the government cable from Fort Wadsworth across the harbor to Sandy Hook. Not much of a stretch, perhaps, but still a cable, lying where some of the earliest cablework in this country was done. As a matter of fact, the claim for the first supersession of cable by wireless might be made for the Guadeloupe-Martinique service, where the volcanic eruptions have broken all the cables, sunk the cable ship and rendered the wireless essential for communication. Possibly the cable may be renewed there, but West Indian lines have always been a nuisance in the way of frequent interruptions, whereas the lineman's job on a wireless system is easy.

Municipal Telephony.

One of the papers presented at the recent municipal ownership convention in New York City, on the subject of municipal telephony in Great Britain, by Mr. A. R. Bennett, betrayed an extraordinary absence of financial common sense. And yet the word extraordinary seems rather out of place when we consider how common is the tendency of advocates and statisticians for municipal ownership to leave depreciation out of their estimates. In speaking of the Glasgow system and its financial year, Mr. Bennett remarks naively: "No depreciation was allowed for because the system was entirely new." As if conscious that something is wrong, he goes on to say that a depreciation fund is to be created. The notion here exhibited as to the nature of depreciation and the purposes of a depreciation fund does not give much weight to any of Mr. Bennett's other statements, which but for it might possibly be entertained with respect. But it is easy to see how remarkable municipal economies may be arrived at by such free treatment of unavoidable items in the cost of telephone service. Only a week or two ago we had occasion to point out in regard to the electric lighting plant at Detroit that not merely did the Commissioners fix a very small rate of depreciation, say 3 per cent., but they did not take into account the wholesale depreciation due to the substitution of new apparatus for old. This criticism is just as true of telephone exchanges in large cities, which are replaced once or twice in every decade, as in New York, for example.

Speaking of New York, reminds us that in his reference to the sale of the municipal telephone exchange at Tunbridge Wells, Mr. Bennett says: "The transaction has been denounced as the first Tammany operation in Great Britain." What a funny idea of Tammany to foist on pretty, classic little Tunbridge Wells! The Tammany plan is to municipalize everything, so as to handle more public money and dispose of more offices and votes. "Prof." Frank Parsons, in discussing the same subject under the title, "Reasons for Public Ownership of the Telephone," sees the danger lurking in any allusion to Tammany, and argues that if a municipal plant is run corruptly, it is, therefore, not under municipal control; while if it is well run, then it really is under municipal control. To quote his own words in regard to Philadelphia: "Public ownership of the government is essential to any real public ownership of anything else. We are told, for example, that the gas works of Philadelphia were allowed to get out of repair under public ownership. But the truth is that Philadelphia did not have public ownership of the gas works any more than Russia has public ownership of her railways. The essence of ownership is control, and the Philadelphia gas works were controlled by the councils, and the councils were controlled by the corporations," etc., etc. In other words, any municipal plant that fails is not municipally owned; with the corollary that "city councils" ready to make vicious deals with corporations, are angels of light when operating public utilities that will yield more to the councilor or aldermen if not sold out. We don't quite follow Mr. Parsons, but still we have long been expecting an ingenious scheme for disclaiming municipal failures. Here it is.

PROCEEDINGS OF THE A. A. A. S.

The volume of *Proceedings* of the American Association for the Advancement of Science at the Pittsburg meeting in July, 1902, is just out. It contains 620 pages, a number of interesting and important addresses, and some grievous faults. In the first place, the pages are uncut, which is barbarous anachronism. It is not presumptuous to suppose that this volume is intended to be opened and read by scientific men These men are virtually expected to spend their time cutting pages, a task that could be much better performed by the binder's machine, at no appreciable extra cost. In the second place, no less than 263 pages, or about 42 per cent. of the volume, is trivially occupied in a catalogue of membership. It is well to know that there were 3,474 members of all classes on the roster of the association. It is not well, however, to occupy nearly half the volume of proceedings with the list. Members' names are of far less scientific importance for publications than their papers. In the third place, the published papers in the working half of the volume are limited to the addresses of the retiring president and of the vice-presidents of Sections A, B, D, E, F, G, H and I. In a certain sense these official addresses are functions rather than papers. The only real paper comes squeezed into an appendix at the end of the volume.

Taking Section B on Physics, the subject in which the readers of this journal take most interest, it appears that 58 papers were communicated to the meeting in the Physical Section. Of these, 25, or 43 per cent., were on subjects connected with electricity and magnetism. No publication is given of these papers beyond their titles. It is like the list of a horse-race after the first leaders—"also ran." Twelve of the papers have been rescued and published, seven of them finding record in the *Physical Review.* The other titles are virtually "Hic jacet"'s. Eighty per cent. of the papers in Section B have been put to death. Verily, the A. A. A. S. should be called the Association for the Abortion of Additions to Science. Even assuming that all the members of the association attended the meeting, and that all the members of this section listened to the communications, the permanent value of the papers would be enormously increased by printing and publication It may be urged that the expense of printing all these papers would be prohibitive. For the association itself, this might be true, but at least the wasted half of the proceedings now occupied by membership might be utilized to advantage by keeping the list of members at home, and publishing some of the papers instead. Then, an organized effort should be made to interest the technical press of the country in printing at least an abstract of the remainder. But in the past there has appeared to be an organized resistance to the efforts made by the technical press to obtain a report of meetings. This heartless murder of innocents ought to be stopped. It is an insult to the writer of a paper to invite him to read it, and then deliberately to bury it and put up a headstone to its untimely demise. The remedy for this deplorable situation appears to us not difficult to discover or to apply. As we have repeatedly pointed out, the unsatisfactory state of affairs is largely due to the absence of a permanent secretariat such as those of the national professional organizations. A result of this condition is that the Association is entirely lacking in business management, there is no proper preliminary preparation for meetings and at meetings no facilities are provided for those who would report the papers and discussions. At times it has seemed that attempts to give prompt publicity to the proceedings were resented, but we believe such a suspicion unjust, the want of encouragement to such efforts being most probably due rather to sheer inability to appreciate what the real function and influence of a body purporting to represent American science should be. Next to a permanent secretariat would be the constitution of an active governing body, the members to consist of men of proven administrative capacity, such as college presidents, with long and overlapping terms of office.

SCIENCE ABSTRACTS.

It is interesting to observe that our friend and contemporary, *Science Abstracts,* after five years of life, has multiplied by cross-division, and assumed a dual existence, like an adult bacterium. It is now issued in two sections like an overgrown railway train. The first section is marked A and devoted to physics or basic science. The second section is marked B and is devoted to engineering or applied science. The plan is likely to meet with general favor, and has taken effect from and with the January number this year. The color of our friends is as vehement as ever, and puts all neighboring objects to the blush. Surely, the tint of one of the recent twin sisters might be subdued a little with advantage, if only for the purpose of readily distinguishing them. Otherwise we shall have to use ribbons of different hues, according to the time-honored geminate custom.

SPARKS AND SHOCKS FROM INSULATED WIRES.

In the recently issued No. 159, of the *Journal* of the British Institution of Electrical Engineers, is a short paper read by Mr. F. Gill, before the Dublin Local Section on a remarkable hydro-electric phenomenon. It appears that one of the linemen of the National Telephone Company was at work on a pole carrying 17 overhead wires running through a rural district near Glasgow. He reported that on touching the topmost wire he received a severe electric shock. On investigating the matter, a member of the engineering staff of the company ascertained that sparks could at certain times be drawn from this wire. The wire was about half a mile long, of copper, about No. 12 B. & S. gauge, insulated and dead-ended at each end. Nevertheless this dead wire was at times very much alive. The height of the wire above the ground was 26 feet, and its total capacity about 0.0087 microfarad. The remarkable phenomenon was traced to the exhaust steam from a colliery engine. The exhaust pipe extended to a height of 18 feet, with a diameter of three inches at the top. The top of the pipe was, therefore, about 8 feet lower than the wire, and about 23 feet away. On a dry day, when the wind blew the exhaust steam from the top of the pipe against the wires, a hydro-electric charge was communicated to them. The topmost wire, being insulated, was able to accumulate the charge for the benefit of the lineman working innocently at some distance away. The wire would thus act like a Leyden jar of very uncomfortable dimensions.

It is a common thing in the electric business to get shocks from a steam dynamo, but shock from the steam of a colliery engine is a novelty that can, no doubt, be best appreciated by being felt. From subsequent experiments made by Prof. Maclean, it would seem that the electrification communicated by the steam was positive, which would be according to the rule in connection with hydro-electric machines. These machines were investigated by Faraday, Armstrong and others. They were evidently regarded as a great wonder and novelty at that time. The steam-boiler was mounted on insulators, and the steam generated was allowed to escape through a special form of vent. The issuing steam-jet became strongly electrified positively, by friction against the walls of the vent, and the steam boiler strongly electrified negatively. The apparatus formed a sort of electric steam-calliope. The principle does not seem to have been put to any useful application, and we have more important tasks for our steam-boilers. But if anyone complains of receiving shocks from a well-insulated and dead-ended wire, a search for the cause of disturbance should be extended not merely to solid bodies, but also to gases coming into contact with the wire.

Prof. Maclean is stated to have drawn a continuous stream of sparks ½" to ¾" in length from a wire terminating near the escaping steam of the exhaust pipe referred to, and indicating a potential of about forty thousand volts. The potential of the air, six feet above the ground, is stated to have been 1,100 volts when about 12 feet from the issuing steam, and 900 volts when 30 feet away. Consequently, the dead-ended wire on the poles may readily have received an electrostatic charge under a potential of several thousand volts, at 26 feet above the ground.

THE TRAIN LIGHTING PROBLEM.

The communication from Prof. Shepardson, published elsewhere in our columns, is one of the most complete resumés of the subject which we have had the pleasure of seeing. It is a very striking evidence of the practical difficulties of electric train lighting, that while the art is relatively old—as old indeed as the incandescent lamp—it has made so little progress toward general adoption. Railroads are, of course, conservative, particularly so when new expenses are involved, but the difficulties are genuinely serious. Yet electric light is so desirable that every one prefers it and it must make its way in train lighting as it has everywhere else. As to methods, their name is legion, by many inventors and in many countries, but they may be roughly divided into those in which the unit is the train and those in which the unit is the car. By far the easiest task is the lighting of a train as a whole, particularly a definite train made up in a regular manner. In such case it is a relatively simple matter to set up a little direct-connected unit in the baggage car and to light the train with a little aid from storage battery auxiliaries. The troubles inherent in this simple method are those that come from the use of small steam engines. Here it seems to us there is an excellent chance for improvement. The advent of the automobile, even if it accomplished nothing else, would be of very material use to humanity in stimulating progress in small prime movers. With modern automobile engines or with steam turbines the efficiency of a small direct-connected generating set may be raised very considerably above the maximum which would have been possible even four or five years ago, and trouble from unsteady speed and from vibration is reduced to a minimum.

Train lighting by this method demands comparatively small batteries but requires some extra labor which can be avoided by some other methods. It is, however, remarkably effective and has very little chance of going wrong. Of the schemes which make the car a unit, there are practically two varieties, one depending wholly on storage batteries the other on storage batteries plus axle-driven dynamos. The former is limited to runs of moderate length by the weight of batteries required, but within this limitation is the simplest plan possible. Its economic position depends entirely on the question of depreciation of the batteries—always a mooted point in electrical engineering. Batteries in such use are subject to serious mechanical risks, but otherwise work efficiently enough. With a judicious planning of the lights installed, the weight of battery can be kept within very reasonable limits and the electrical efficiency of the method is high. Still, the depreciation is or may be considerable, and we are not aware that as a whole the system is cheaper than that employing a dynamo on the train. In any method of train lighting batteries must be used if the cars are to be uncoupled at night, and we are disposed to think that granted the necessity of some battery, a full battery equipment has a good many points in its favor. We should much like to see a complete comparison between the cost of such operation, and that incurred on the system previously mentioned, the two being tried side by side under similar conditions. Such comparisons have several times been made, but they have usually been somewhat vitiated by the fact that the engineer had a bias one way or the other which affected the soundness of the comparison. Certainly both methods can and do give excellent practical results on a considerable scale.

Of lighting from the car axle as a motive power there have been many varieties, of which some have already come into successful use. The mechanical difficulties are, however, very great, both in the drive itself and in the devices intended to give constant voltage at varying speed of the dynamo, or constant dynamo speed at varying axle speed. Batteries are, of course, required to ensure continuity of service. In spite of the fact that axle-driven plants have been able to give good service, and the ingenuity displayed in overcoming the great difficulties involved is admirable, there is a suggestion of extreme technical versatility rather than a practical conservatism. It is a sort of *bravura* passage in electrical engineering which evokes our applause for its command of technique. But even a variety of successful methods does not imply electric train lighting upon a large scale. The car stove and the oil lamp still hold sway over a large part of the country and count up their victims month by month. Railroads fought against steam heating as long as they dared, and some of them are fighting still. So long as kerosene is cheaper than electric light, some railway managers will use it at whatever risk, but the public is gradually being educated to demand electric lights and they will steadily make their way. As between gas and electric light, there is very little to be said for the former, particularly in sleeping cars, except that it will cost good money to put aside the former for the latter. But after all, electric lighting has steadily forced its way against gas even when gas has been materially the cheaper, and in the long run train lighting will be no exception to the rule. When the long-distance electric road has once got a firm hold, the whole question will become a dead issue.

Coming A. I. E. E. Meetings in Chicago.

The Executive Committee of the Chicago branch of the American Institute of Electrical Engineers has held several meetings lately and has arranged a very attractive programme for the rest of the season. It contains several special local features which seemed desirable modifications of the regular Institute programme. The informal smoker and meeting for discussion of train lighting papers, held March 10, was announced last week. March 24 Mr Bion J. Arnold will present a resume of his recent exhaustive report to the Chicago City Council, on the Chicago transportation problem. This is a special local meeting and has been provided for by the local committee because of the general interest taken by the engineers and public in Chicago in Mr Arnold's report, and the desire of many to hear Mr. Arnold personally present a review of the report. A number of lantern slides have been prepared by Mr. Arnold, to assist him in presenting this subject. A discussion will follow Mr. Arnold's remarks. In order to accommodate the large number of people that will probably wish to attend this lecture, it will be held at Fullerton Hall, in the Art Institute Building, Michigan Avenue and Adams Street, 8 P. M.

April 7, "High-Tension Lines" will be discussed at the regular meeting place in the Western Society of Engineers' rooms in the Monadnock Block, 8 P. M., as usual. May 5, "Tendencies of Central Station Development" will be taken up. Papers in these last two cases are the same as those mentioned for the general meetings of the Institute.

May 19 will be a telephone meeting. The Chicago branch held no meeting in February, and instead postponed its telephone meeting until the last of the season. Owing to the fact that the Chicago branch numbers among its members some of the best talent in the country in the independent telephone and engineering field, as well as some of the best Bell talent, it is thought that the scope of the telephone meeting could with profit be enlarged from that of the New York meeting held in February, which was mainly a discussion of Bell practice. At the Chicago meeting telephone engineering as developed by the independent companies, will be taken up more fully than at the New York meeting. Mr. Kempster B. Miller, of the local Executive Committee, will arrange for discussion by the leading independent telephone engineers, and Mr. Angus S. Hibbard, of the same committee, will see that the Bell interests are properly represented at the meeting. It is not the idea of the committee to make this meeting a fight between independent and Bell men, but to bring out in a manner becoming to scientific engineers the various methods of treating telephone engineering problems by all the various companies, both Bell and independent. Chicago has material for an excellent telephone meeting of this kind, because of the location of the majority of the great independent telephone factories there, as well as large Bell manufacturing and operating interests.

The American Street Railway Association.

As already noted, the twenty-second annual meeting of the American Street Railway Association will be held at the Grand Union Hotel, Saratoga Springs, New York, Wednesday, Thursday and Friday, September 2, 3 and 4, 1903. Papers will be presented on the following subjects: "Electric-Welded Joints," "The Evils of Maintenance and Champerty in Personal Injury Cases," "Train Orders and Train Signals on Interurban Roads," "Freight and Express on Electric Railways," "The Manufacture and Distribution of Alternating Currents for City Systems," "Comparative Merits of Single and Double-Truck Cars for City Service," "The Right of Way."

A fine exhibition of street railway supplies will be made at the hotel. The annual banquet will be held Friday evening, September 4, when the officers-elect will be installed. The headquarters of the association will be at the Grand Union Hotel, which is said to be the largest hotel in the United States. No rooms will be assigned prior to April 15, but those intending to be present should make application to the hotel early, as they will be assigned in the order in which received. Other first-class hotels are the United States, American-Adelphi, Congress Hall, Worden and Kensington. Railroad rates will probably be as in former years.

The following resolution was unanimously adopted by the committee: "The secretary is directed to request the chief executive officer of the different companies to notify all delegates and heads of departments attending the convention that they are expected to be present at all sessions of the meeting and take part in the discussions."

Saratoga friends are very anxious to have a large delegation of both members and their ladies and promise all a very enjoyable time. Another circular will be issued later, giving particulars regarding the meeting, by Mr. T. C. Penington, secretary.

Lighting the St. Louis Exposition.

The keynote of the lighting of the Exposition is given by the plans of Chief Rustin for lighting the Varied Industries Building. The effort will be to make the night picture of the Exposition entirely different from the day picture, so that two distinct artistic compositions will be presented to visitors. By day the columns which form the colonnades around the central avenue will be the most noteworthy feature of the main picture. They will stand out white and majestic. At night these columns will be silhouetted darkly against walls of light. This effect will be produced by inserting in the rear fluting of the column a close line of 8-cp incandescent lamps, and by peppering the recessed ceiling of the cloister closely with lamps of similar power. These lamps will not be seen from the outside. The front of the columns will not be lighted except by the diffused lamps in the avenue. To a spectator at a moderate distance the columns will be dark projections on the white of the screened wall. During the day this wall and the recessed ceilings of the cloisters will attract little attention because they will be in deep shadow. Here it is proposed to install mural paintings and to use color which cannot be used without detriment to the picture on the exterior walls.

This is the plan for the Varied Industries Building. The architect has supplied plastic decoration which will lend itself well to the illuminator's work. The frieze of the cornice which runs completely around the building has at regular intervals a gigantic white wreath enclosing the letters in a monogram "N. J."—the initials of Napoleon and Jefferson. This forms an attractive day picture. A 3-cluster lamp will be placed in the center of each wreath. The cornice lines will be marked with lamps at regular intervals, so disposed as to light the cornice throughout its height.

The plan for lighting the domes has not yet been decided and cannot be until the staff decorations are more fully developed. The interior lighting of the big exhibit buildings of the Exposition will be by arc lights.

Hydraulic Developments and Electric Installations.

Mr. William B. Jackson, of Madison, Wis., presented a paper on the above subject before the Western Society of Engineers at Chicago, March 4, 1903, which was read by his brother, Prof. D. C. Jackson. One of the principal purposes of the paper was to call the attention of hydraulic engineers to the differences in the requirements of a hydraulic plant for electric work, as compared to mill work. One of the chief differences is due to the fact that in a hydraulic plant operating electric generators for commercial purposes, it is not feasible to shut down part of the plant when there is low water and resume operations when the water is high, unless steam plant reserve is provided. An electric generating plant calls for a continuous output, although the output may vary from one hour to another. The 365-day power he considered the cream, and all the other power only a valuable by-product.

The cutting down of the head of the water power, on account of high water conditions was given considerable attention, and various plans illustrated for overcoming the variation in power of the water wheels due to this cause. He considered that usually poor workmanship had more to do with the failure of a dam than poor design. It was not considered possible to calculate the minimum flow of a stream from the area of the water shed and rainfall. This latter conclusion was also borne out by those who participated in the discussion of the paper.

The 22,000-Volt Transmission Installation of the Northern California Power Company.

THERE has just been completed in Northern California another high-tension power-transmission installation for supplying electric service to the Counties of Glenn, Shasta and Tehama. The Northern California Power Company own and control the Keswick Electric Power Company, the Redding Electric Light & Power Company, the Redding Water Company and the Tehama Electric Company. The officers are H. H. Noble, president, and W. W. Marvin secretary, the main offices being in San Francisco, Cal.

The main power house, which is located at Volta, Shasta County, Cal., is connected by transmission lines carrying three-phase alternating currents of 22,000 volts, with sixteen sub-stations located in the counties above referred to. The current is utilized for not only arc and incandescent lighting in the various towns, but also for supplying power to numerous large users. Among these may be mentioned the Great Mountain Copper Company, receiving current from the Iron Mountain and Keswick sub-stations, and the Bully Hill Mines, using current from the De La Mar sub-station.

About 30 miles from the power house at Volta, near Shingleton, there is a sub-station at Redding, and others are located at Horsetown, Palo Cedro, Cottonwood, Vina, Orland, Germantown, Willows, Red Bluff, Anderson, Tehama, Winthrop and Corning. The current is used with motors of various sizes all along the transmission line at the different villages and towns.

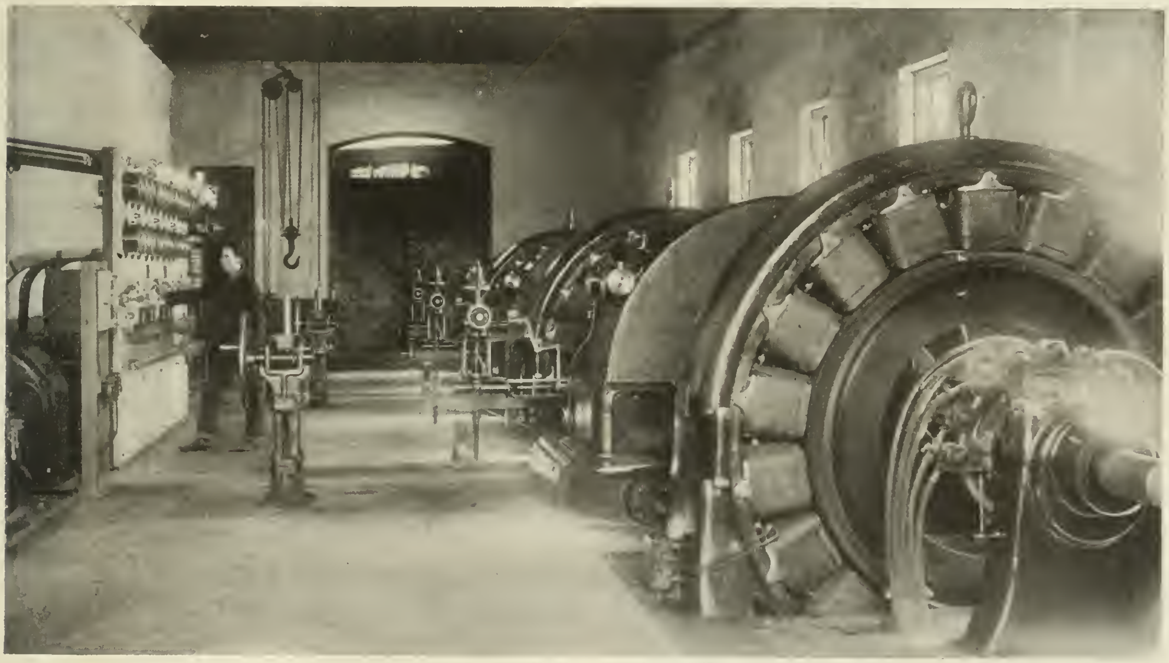

Fig. 1.—View of Interior of Power House at Volta.

The water supply for the power station is very constant, being obtained from springs delivered through Mill Seat Creek, which alone will supply 3,000 hp at low water periods. Water rights have also been secured from Berry, Battle and Galpin Creeks and connections have been made by lateral ditches with Mill Creek.

The water is carried through a ditch 3,500 ft. long from Mill Creek several miles from its source to a reservoir, known as Lake Nora, on an elevation above the power house; this reservoir is capable of taking care of the full load of the station for half a day if repairs should be necessary. At the intake there is a rock-filled timber crib and a head gate which allows the water to pass to the pipe line. The water is here screened by a fine and a coarse set of wire and bar screens. The head gate is operated by a hand wheel, roller or ball bearings being employed for ease in working.

For nearly 300 yards the water is conveyed in a wooden pipe about 3½ ft. in diameter, and for the remaining distance of a trifle over a mile a 30-in. steel pipe is employed varying in thickness up to ⅝ in. near the power house, where the head is over 1,000 ft. There are half a dozen automatic air valves in the steel pipe line about 1,000 ft. apart. The line ends in a lap-welded receiver 12 ft. in diameter.

In the power house, which is built of stone and iron, there are three turbines of 1,500 hp located in one room, each driving a Westinghouse three-phase alternator by flexible insulating couplings. In an adjoining room there are ten step-up transformers for raising the pressure of the generators from 500 volts to 22,000 volts for transmission to the various sub-stations.

A pair of cranes of 20,000 pounds capacity each are located in each of the two rooms of the power house for handling the heavy parts of transformers, generators and turbines. The water pipes connecting the turbines with the mains as well as the nozzles are placed in cement, the covers of the latter being flush with the floors. There are two other turbines which drive the exciters, which operate under a head of 400 ft., the water being carried by a separate ditch to the forebay located near the main line of pipe. This water is taken from streams below the first diversion of the water from Mill Creek. These small 18-in. Pelton turbines are supplied from the forebay by a pipe 6 in. in diameter, and drive the 22-kw Westinghouse exciter dynamos at a speed of about 1,000 r.p.m. A deflecting nozzle is used for regulating the load of the exciter, by operating which by a hand wheel the excitation of the alternators may be effected.

The large turbines are supplied with water from the receiver through three lap-welded steel pipes. The water is controlled by two high-pressure valves, one near the wheels with steel roller bearings and worm gearing capable of standing a pressure of more than fifty tons on the disc; and the other near the receiver, which is in reserve for an accident. There are heavy ball-and-socket deflecting nozzles for handling the various loads, different tips being used when necessary. Three Lombard governors are employed for operating the nozzles on the three 1,500-hp Pelton water wheels, holding their speed practically constant, regardless of the load on the generators. Each of the three deflecting nozzles are a foot in diameter, and there is a 30-ton pressure on each of the ball joints. A factor of safety of about 20 is employed in the construction of most of the hydraulic materials used in these connections.

The buckets and wheel centers of the Pelton wheels are of cast steel, having an elastic limit of about 20 tons per square inch and a tensile strength of about 35 tons. The buckets are driven on the wheel center discs and bolted in place with special turned steel bolts; for when the water wheels operate at 800 r.p.m. they have to stand an impact from a 4 in. stream under the enormous head of 1,204 ft.

The water wheels as well as the alternators have automatic oil bearings, bronze rings carrying a flood of oil continuously over the top of the shaft. The three 750 kw alternators supply three-phase currents of 500 volts, which are conducted to the three generator panels of the main switchboard. This main switchboard consists of four panels with the necessary measuring instruments, switches and pilot lights, the last panel being connected with the exciter dynamos.

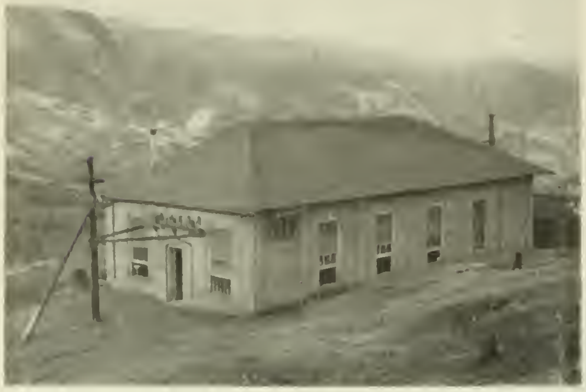

FIG. 2.—SUB-STATION AT KESWICK.

From the main switchboard the cables carry the current to the three sets of transformers, which raise the voltage from 500 to 22,000 for transmission over the long distance line. There are in all ten transformers, each having a capacity of 250 kw, one being held in reserve for use in case of an emergency.

One high-tension transmission line consisting of three No. 4 B. & S. copper wires connects the power house with the sub-station at Keswick, a distance of 37 miles, where a number of smelters are in operation. Another line of the same size and number of conductors proceeds to Redding about 30 miles from the power house and several miles further to the sub-station at Iron Mountain, which latter supplies current to the mine of the Mountain Copper Company. Still another transmission line conducts current 20 miles from the power plant to Palo Cedro. Branch circuits connect the other sub-stations with the generation station.

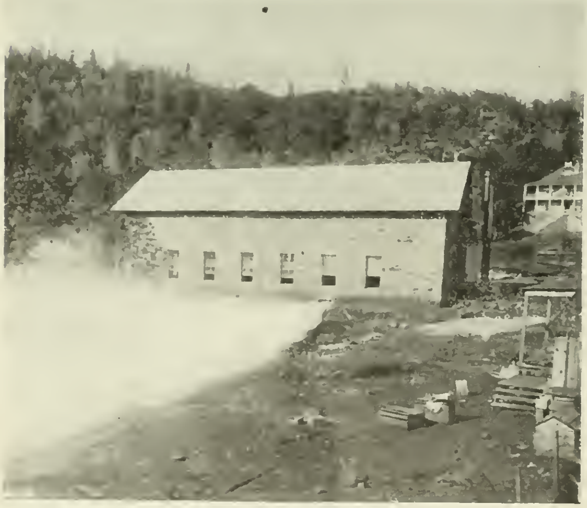

FIG. 3.—POWER HOUSE AT VOLTA.

The bare conductors of high conductivity copper are mounted on glass insulators tested to 50,000 volts potential, and mounted on eucalyptus pins one foot in length, fixed to Oregon pin cross arms. The poles are of cedar and redwood, the former 30 ft long and the latter 40 ft long, the cedar being used in the country.

The sub-station at Iron Mountain is constructed of iron and stone and is equipped with 6 step-down transformers, each having a capacity of 75 kw. The current is reduced from 22,000 volts to 2,000 volts and is used to operate induction motors in the mine of the Mountain Copper Company.

Near the smelting works of this same mining company, located at Keswick, there is another sub-station of much larger capacity. The transformers at the Keswick sub-station are of the Westinghouse oil-insulated type and each of the 6 installed at this plant has a capacity of 150 kw. These transformers also reduced the 22,000-volt transmission line pressure to 2,000 volts. The current is utilized not only in the mine for operating induction motors, but also for supplying energy for the arc and incandescent lights of the town. The switchboard equipment of this sub-station includes six marble panels, four of which are used as feeder panels and the remaining two connected with the sets of transformers.

The Northern California Power Company has acquired the Redding Water Company, and near the waterworks is located the Redding sub-station, which is constructed of iron and rubble stone. There are two transmission circuits passing through Redding and special 22,000-volt, high-tension, two-way switches are provided, so that this sub-station may be supplied from either high-tension line. The transformer installation consists of 75-kw transformers, five in number, arranged with Scott connections, so that the three-phase, 22,000-volt currents may be transformed and lowered to a 2,000-volt, two-phase current. Provision is made for operating large motors for driving an immense pump for supplying the town with water should the two-million-gallon pump now operating by water power become disabled in any way.

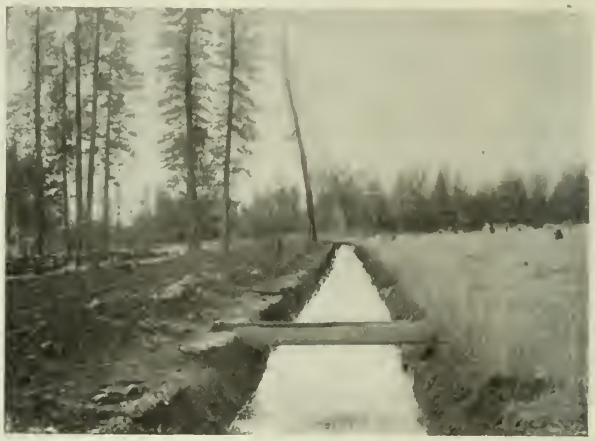

FIG. 4.—MAIN DITCH LEADING TO RESERVOIR.

Another new power plant of 4,000 hp is now under construction taking water from Cow Creek about 20 miles away, and in this plant two 1,500-kw Westinghouse revolving field generators will be employed, each driven by a 3,000-hp Pelton wheel. The head will be about 1,200 ft., similar to that at Volta, and about a mile of pipe line will be employed in feeding the turbines with water. This plant is expected to be in operation some time during the coming summer.

National Electric Light Association.

The twenty-sixth convention of the National Electric Light Association will be held at Chicago, Ill., May 26, 27 and 28, 1903. The headquarters of the association will be at the Auditorium Hotel, and hotel rates will be as follows: Room with bath for two people, $5 to $6 per day; single room with bath, $3.50 per day; rooms without bath (for each person) $1.50 per day and upward. All on the European plan. A combination breakfast will be served in the Auditorium proper at a fixed price. Table d'hote luncheon will be served at sixty cents and table d'hote dinner at $1.25. Rooms should be reserved as early as possible, as there is likely to be a very large attendance, and application should be made direct to the hotel management. Mr. James B. Cahoon, secretary, 136 Liberty Street, New York, should be addressed for further information.

Some of the Problems of Electric Train Lighting.*

By Geo. D. Shepardson.

THE use of electric light in transportation is no new thing. The first commercial plant sold by the Edison Company to be operated by outside parties was installed on the steamship *Columbia*, in 1879, at Chester, Pa., and began operation in May, 1880. Another of the very early isolated plants was used for lighting the shops of the Manhattan Railroad, beginning in the fall of 1881. At about the same time a plant was installed in the Baldwin Locomotive Works. The first Edison central station started at Appleton, Wis., about August 20, 1882, and the larger Pearl Street Station, in New York City started on September 4, 1882, were antedated nearly a year by the application of electric lights to a Pullman sleeper running between London and Brighton, England, in October, 1881. The latter had 12 small lamps supplied from 32 Faure cells. This was so successful that by December of the same year the whole train of 8 cars were equipped with 29 Edison lamps of 9 to 10 cp, supplied from 80 cells of storage battery. An electric headlight operated by steam engine and dynamo mounted on the locomotive was used on the Kronprinz-Rudolf-Bahn on the night of March 19-20, 1881, and was followed in December of the same year by others in France. As early as 1879 Hinkefus and Wesel took out a German patent on a train-lighting system in which a dynamo driven from the car axle operated incandescent lamps. Even before the Pearl Street Station was in operation, the Pennsylvania Railroad began experimenting with incandescent lamps operated by storage batteries under the cars, importing Faure cells from France in the spring of 1882, and installing them on a car in August of the same year; although this experiment was not a conspicuous success, the company renewed its experiments in 1884, and in the following year began the regular operation of electric lighted cars. From the beginning, the company has continually increased its electrical equipment, until recently it has adopted the electric light as standard for all passenger service.

From the standpoint of the railroad man, the requirements for a system for train lighting are reliability, safety, freedom from features objectionable to passengers, cheapness in first cost and low cost of maintenance. All of these requirements are matters of degree. For absolute safety from fire and explosion, nothing can equal the incandescent electric lamp when installed and maintained in accordance with established practice. The voltages used on trains are invariably low and well within the limits of danger or even discomfort to persons who might by some unusual way come into contact with the conductors. That the service may be made reliable is attested by the fact that many cars provided with no auxiliary light whatever are in use on such roads as the Chicago, Milwaukee & St. Paul, which has been using electric lights since 1890. The Pennsylvania road, which was the first in America to experiment with electric lights for car lighting, is now equipping all of its cars west of Pittsburg with electric lights, and is reported to be throwing out all auxiliary lights. The incandescent electric light is free from the smoke, smell, vitiation of atmosphere and the possibility of fire and explosion common to all competitors, and it yields such a moderate amount of heat that it may be said to be absolutely free from features objectionable to passengers, except those of occasional dimness or of infrequent unsteadiness. Furthermore, the advantage of adaptability to local and decorative lighting, such as dining table or berth lighting, and the possibility of advertising tail transparencies, the convenience of electric fan ventilation and of electric heaters, make the electrically-equipped train the choice of fastidious travelers. In the matter of cost, electric lights compare favorably with others when quality and quantity are considered.

The application of electricity to train lighting is now over twenty-one years old and may be said to have reached its maturity. It has not ceased to develop and improve, but it has reached the age of responsibility and reliability. Like other adults, it still meets problems to be solved and looks forward to a bright future.

The application of electricity to train lighting is, therefore, in its twenty-first year, and may be said to have reached its maturity. It has not ceased to develop and improve, but it has reached the stage of responsibility and reliability. Indeed, for several years past, numbers of cars have been provided with no auxiliary light whatever, showing that the previous experience of the roads using electric light has been satisfactory. The advantages of electricity for car lighting are so thoroughly appreciated by the traveling public and by the railway officials, that no train can now be said to be thoroughly up-to-date unless it lists electric lights among its attractions. The absence of products of combustion, excessive heat, humidity and carbonic acid, the convenience of berth lights, which are impracticable with any competing source of light, the comfort of electric fans. the safety and convenience of electric heaters, their decorative effects obtainable only by incandescent electric lights, these entirely overbalance any increased cost of electric over other systems.

All of the various systems of car lighting which have been put into practical application have adopted constant-potential direct current as the only satisfactory source of supply. The voltage varies from 30 to 110. The number and strength of lights varies through wide limits, some advocating 10 to 88-candle lamps per car, or 80 to 640 cp per car, some cars having as high as 26 50-cp lamps, or 1,300 cp per car. Tests made by the writer in 1900 showed an illumination in different cars varying from 0.008 to 7.5 candle-feet. The stronger illumination is not only more pleasing to patrons and a conspicuous advertising agency, but further the flood of light effectually masks ordinary variations due to imperfect regulation.

The various plans for the supply of power for electric lights on cars may be classified as battery, dynamo and combination. The dynamo may be driven by an independent engine in the baggage car or on the locomotive, or it may be driven from the car axle. It may supply the lights directly, it may charge storage batteries or may combine the two. The battery may be large enough to supply all the lights through a single run or through a round trip, it may carry all the lights for only a few hours, or it may carry only part of the lights a short time for occasional use. Each of the various systems meets its own problems of mechanical, electrical and financial natures.

Battery Troubles.—When a battery is used without any dynamo on the train, it should have sufficient capacity to carry the load through the entire run without falling below normal voltage, a difficult task on long winter nights without excessive weight. Fortunately, the greatest amount of light is usually required when the car first leaves the charging station, and when its voltage is highest; as the battery gives up its charge, the load generally lessens and allows the voltage to remain fairly constant through the night. When properly proportioned to the load, the performance is excellent. For example, some of the Pennsylvania cars running between Chicago and Jersey City and charged only at Chicago, make the round trip with 32 to 24 volts at start and with 30 volts upon return. As the cells become old, however, their capacity decreases, and the battery lighted cars sometimes give unsatisfactory service toward the end of the run. For transcontinental service the unaided storage battery seems impracticable. The short time allowable for charging at terminal stations often involves excessive high rates of charging and rapid lowering of the electrolyte. The difficulty of close and thorough inspection of cells often results in no inspection until failure is reported. The difficulty of allowing good ventilation of the battery boxes while keeping out the dust and other dirt, involves difficulty from low insulation and from decay of the battery trays and boxes. Injury to car body and to battery boxes is minimized by liberal use of insulating paint, but seems difficult to avoid entirely. The shaking of the cells incident to railway usage causes somewhat more rapid deterioration than in corresponding stationary service. Slopping of the electrolyte is avoided by using deep jars with or without covers; the space is so fully occupied by the elements that there is comparatively little liability to slopping except in case of unusually violent handling of the cars. The weight of battery including boxes, etc., on a car with "full battery" equipment is about 3,000 pounds, which is not a very large proportion of the total 91,000 pounds weight of a coach or the 116,000 pounds weight of a sleeper. The first cost of about $600 per car for "full battery" equipment, in addition to $300 to $400 for wiring, is not great in comparison with $8,000 to $10,000, the cost of a coach, or in comparison with $16,000 to $20,000 expended for a sleeper.

When the battery is charged during the run there is more or less loss and deterioration due to the overcharging necessary to reduce the liability to failure on account of incomplete charging. The excessive charging and occasional over-discharging causes a more or less rapid deposition of mud at the bottom of the jars, which is liable to reach to the plates and so cause short-circuiting. The corrosion of connections due to the spray is frequently the cause of local action.

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* A communication read at the February meeting of the American Institute of Electrical Engineers.

Engine Troubles.—On system supplied from dynamo driven by steam engines, trouble is sometimes experienced from breaking of the flexible connection between the baggage car and the locomotive. It is common to use either the Moran ball and socket flexible joint or rubber hose strengthened by steel wire or expanded metal. The life of rubber hose varies from a few hours to several months. A blown out hose can be renewed in a few minutes at the first stop of the train. There is sometimes trouble in disposing of the exhaust from the engine, which generally passes through the roof; when a good muffler is used, the grease is retained for the most part and is led through the bleeder through the car to the track, so that it is not carried back and deposited on windows and sides of cars; sometimes in winter the condensed steam collects on the bellows of the car vestibules to such an extent as actually to break the end of the car by the motion of the train. The reciprocating parts of the engines commonly used cause some vibration of the baggage car, which is transmitted through the couplings and may be felt to the extreme end of the train when in stations; the skill of the engineer in stopping the train is a large factor in the extent to which the vibration is felt through the train, it being least when there is a medium amount of slack. The adoption of the steam turbine may remove this difficulty. When the train is lighted from a dynamo and engine, some auxiliary source of light is necessary for the short intervals caused by changing locomotives, such relay being a storage battery or gas or oil lamps. The small engines use an excessive amount of steam per horse-power-hour. The labor cost is not great; for example, on the Chicago, Milwaukee & St. Paul road each train on a run of 400 miles, between Minneapolis and Chicago, is allotted four baggagemen, who receive $10 per month additional wages on account of attending to the electrical equipment, making a cost of $1.33 for wages for 400 miles. On the Northern Pacific road the baggageman has more than one man can handle, and an electrician goes with the train to attend to the engine and dynamo and to help the baggageman when necessary.

Axle System Troubles.—One of the greatest difficulties has been to secure satisfactory mechanical connection between the car axle and the dynamo. Gearing, belting and friction drives have been attempted with some degree of success. The latitude of motion of the car axle in three dimensions imposes upon the dynamo drive very difficult conditions. This, with the difficulty encountered from the dirt and stones thrown up by the motion of the train and from the steam and snow or rain, which may freeze upon the belt, imposes a problem whose satisfactory solution has required great ingenuity and expensive experimenting. That the axle systems are being adopted extensively is a triumph indeed. Direct gearing similar to that used in electric railway practice has attracted many minds; the danger from a hot box or defective gear on a railway train drawn by a locomotive of several hundred horse-power is a very different thing from a similar defect on a car moved by the geared motor itself, which is protected by fuses and circuit-breakers. The next great trouble is the wide range of speeds met in train operation and the necessity for maintaining constant voltage from the time when the train is standing, through the point where the dynamo cuts in and takes the load, to the highest speed attainable. The problem of regulation under such circumstances is one of no mean magnitude, and many are the ingenious plans proposed for its solution. Not only must the regulation take care of the varying speed of the train, but the battery voltage changes according to the state of charge, so that resistance or its equivalent must be inserted between the lamps and the dynamo or battery, according to circumstances, in order to keep the lamps at normal voltage. When one watches the operation of an axle-lighting system which is so carefully designed and adjusted that no perceptible change occurs in the brightness of the lights between standstill and full speed, between the time when the battery is discharging and when it is charging, one cannot but admire the success of the engineers in charge.

Financial Considerations.—All sorts of figures are given in connection with the cost of electric train-lighting systems, some showing that each electric system is more expensive than any other, others showing that some particular electric system is the cheapest. The real cost varies greatly, according to the intelligence with which the whole plant is operated, this intelligence including both that of the engineer in immediate charge and that of officers of the road who limit his facilities for proper handling of the equipment. In any case, the entire cost of maintaining the electric lighting system is a very small proportion of the entire cost of running the train, including not only the "operating expenses," but also that part of the general expenses chargeable to the particular train. The latter part of the cost, which is no inconsiderable part, is not usually obtainable. From the cost of operating the electric lights should be deducted the net profit from the added traffic which is attracted from other roads, or which is created by the improved luxury of travel on electric-lighted cars. These data are difficult, if not impossible to secure with accuracy. If the added revenue created by the electric features of a train bears to the entire revenue from the train as great as or greater proportion than added cost of electric light, above other forms of light bears to the *entire* cost of running the train, then the electric light pays for itself.

Electricity as a Motive Power in Mechanical Flight.

By Dr. T. Byard Collins.

THE management of the Louisiana Purchase Exposition, soon to be held in St. Louis, is offering prizes aggregating $200,000 for the purpose of stimulating study and inducing activity in the field of dynamic flight, and for securing, as an attraction at the exposition, a demonstration of the practicability of aerial navigation. The amazing revelations of recent years made by Nature at the behest of her inquisitors, have prepared the world for a belief in the possibility of aerial navigation and rendered her expectant of the advent of some adequate means for the accomplishment of mechanical flight. Indeed, the possibility of solving the problem is almost universally admitted; it is a manageable machine that is now called for—one that may be directed and controlled in all ordinary weather, rather than one, like those hitherto constructed, which might only venture out on the most ideal of days.

Mr. Santos Dumont is just completing in Paris a large model of a dirigible balloon, in which he expects to carry passengers. During the summers of 1901 and 1902 he built and sailed several structures in succession, the most unique being his No. 4, familiar in public prints. His No. 6, with which he rounded the Eiffel Tower and won the Deutsch prize, was an elongated ellipsoid, 105 ft. by 20 in diameter at its greatest cross section. It was provided with a 13-ft. screw, which made 100 r. p. m. The motor was an 18-hp gasoline, of the Buchet type. With this structure, the Brazilian succeeded in rounding the tower and making a record of 18 miles an hour. But the mildest of breezes was blowing, and, being diagonally across his course, was utilized for tacking and was thus a great help in obtaining this favorable record. The best average the now famous balloonist ever made in a dead calm was approximately 14 miles an hour.

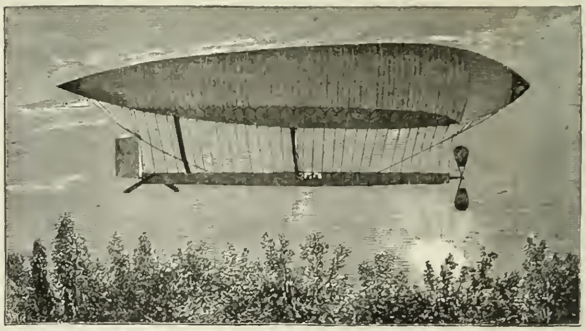

FIG. 1.—RENARD & KREBS'S ELECTRIC BALLOON.

In 1884 M. Tissandier demonstrated afresh the practicability of propelling and steering a balloon, following Giffard, who put the first model of this make on exhibition in 1852. Tissandier's aerostat was in shape not unlike the Santos Dumont No. 6. It was 90 ft. long by 30 in diameter. It was propelled by a 10-ft. screw, driven by a Siemens motor, which was actuated by four large bichromate batteries of six cells each, each cell holding about six gallons of solution. The motor made 1,800 r. p. m., the screw 180. This was the first application of electricity to the propulsion of aerial craft.

The next year Captains Renard and Krebs, under commission from the French War Office, brought out their dirigible balloon, a conception of the general outlines of which may be had by a reference to Fig. 1. This structure was 163 ft. long by 27½ in greatest diameter. It was provided with a 23-ft. screw, which made 46 turns per minute. In this case also the power was electrical, thirteen elements being employed and developing the equivalent of 8½ hp on the shaft.

The first route chosen was from north to south over the plateau from Chatillon to Vervières. Between Choisy and Versailles the direction was changed and the fore end was pointed toward Versailles so that the balloon should not get entangled with the trees. Over Villacoublay the aeronants decided to retrace the track. The balloon made its half turn to the right by giving a very slight angle to the rudder—11 degs.—and presently was back again to its starting place, having made the distance of 4½ miles in 23 minutes. Several subsequent trips were made, all equally successful, the speed sometimes attaining 14½ miles an hour. The results obtained were, therefore, about the same as those achieved by the recently renowned aeronaut of the Paris Aero Club.

The engineering objections to this form of flight are not only well known, but are almost obvious to everyone. It requires approximately 14 cu. ft. of hydrogen gas to lift a pound. By the time an envelope has been made large enough to hold sufficient gas to lift any considerable weight the cross-section presented for the pressure of the atmosphere upon it while in progress, or for resistance to the air when the air itself is in motion, is so great as to render aerial navigation by this method impracticable.

A grave objection also to the prevailing method of propelling a balloon is the position in which it has been found necessary to place the propelling instrument—from 15 to 20 ft. below the center of resistance, it being found impossible hitherto to attach any portion of the machinery directly to the fabric of the gas holder. And finally, it is pointed out that an aerostat of this character is necessarily so frail as to render it incapable of withstanding the buffetings to which a practicable machine would be subjected.

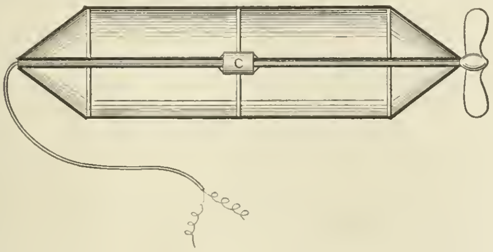

FIG. 2.—PROPOSED FORM OF AIRSHIP.

It is to be remembered, however, that this method of flight is not without its advocates in the engineering world—advocates of indisputable ability—that at this moment Captain Renard is reliably reported to be designing another "dirigible" for his government, and that the British military authorities also have recently commissioned Dr. Barton to construct for army uses a propellable balloon, in which work he is at present engaged. The question of motive power for aerial navigation becomes, therefore, a matter of interest.

Comparing the work of M. Santos Dumont with that of Tissandier, Renard and Krebs, it would appear that the Brazilian has made almost no advance upon the achievements of his predecessors, and this, notwithstanding the greatly improved facilities which might be supposed to have been, after a lapse of eighteen years, at his command.

One of the most serious difficulties encountered in the 1902 experiments was with the engine, which was continually failing to work, constantly threatening disaster, and always exhausting its fuel and thus altering the ascensional power of the aerostat; and which, by its vibrations, so disturbed at times the equilibrium of the entire system, as to threaten the prevention even of the limited success which was eventually attained.

With the electrical equipment of the "La France" of Renard and Krebs, none of these difficulties made themselves manifest; and when it is remembered that the earlier balloon was very much larger than the later one; that, with a lifting capacity more than three times as great, the speed attained was approximately the same, and that considerable improvement has been made in the construction of motors and batteries during recent years, it would seem that electricity is a source to which we may reasonably look for the motive power of the coming aerostat.

The theorem of low speed for the propellable balloon is capable of easy demonstration, and must be accepted as proven. With the resistance increasing directly as the expanse of surface exposed and as the square of the velocity, we come presently to a point where progress is impossible. It may be possible to obviate other disadvantages, but this form of air ship will always be a slow sailer.

As to the disadvantages of the propeller's present position, the electric motor offers the only method of removal. The late M. Severo sought to do this by swinging his great balloon in an immense frame and placing the propeller at its upper end, so that the line of traction would correspond with the center of resistance; power being transmitted to the screw by means of gear wheels and shafting from a gasoline engine, which stood but three feet below the bottom of the balloon. The consequence was that on the very first ascent, at an elevation of more than a thousand feet, the balloon exploded, precipitating the unfortunate aeronauts to a terrible death.

For rendering the envelope of the aerostat rigid and less frail, it is proposed to construct a frame consisting of a horizontal axis of steel tubing to which rims are attached at certain intervals by means of wire stays, just as the rim of a bicycle wheel is joined to its hub. The envelope is then drawn over the frame, which offers also opportunity for the attachment of certain parts of the mechanism. (See Fig. 2.)

Now, while hydrogen gas is combustible, it is only so in the presence of oxygen, and it is itself not a supporter of combustion. A familiar experiment in our college laboratories is the filling of a test tube with hydrogen gas, setting fire to the gas escaping from the mouth of the tube, and at the same time extinguishing the taper by thrusting its lighted end into the depths of the tube. It shows that in the handling of hydrogen there is a zone of danger from fire, but passing beyond this zone to the interior of the containing vessel, combustion cannot take place; so that the interior of the gas bag is the safest place for the motor.

There is thus offered a basis for an advantageous plan of construction. The propeller may be placed at the center of the resistance, as shown by the lines, *a* and *a*, in Fig. 3. A minimum amount of shafting running down the tubular axis would connect the screw with the motor, which would be placed at *c* in the interior of the balloon. Proper packing would preclude the admission of air. Conductors would lead to the motor through the posterior portion of the axial tubing, thence to the batteries in the car below, which could be in such proximity to the body of the balloon and so attached to it as to render the entire structure a unit instead of a system, the advantage of which is too obvious to need comment. But, however, obvious the advantage of the above arrangement, it is also obvious that only an electric motor may be placed in the position proposed, all others requiring oxygen in their operation, the more common forms involving the use of fire also. But with a rigid balloon having its propeller operating in a line with its center of resistance and an electric motor swung to the framework of its interior, the power available would be greatly conserved and the aerostat might be expected to make much better headway than has heretofore been attained.

Two plans are proposed for the accomplishment of mechanical flight, properly so called, i. e., aviation in which the gas bag plays no part, the structure performing its purpose by mechanical means alone. One of these is the flying machine, in which flight is achieved by the direct reaction obtained by means of its moving parts, as vertical screws, vibrating wings and the like; the other is the soaring machine or air runner, depending for its support upon plane surfaces, aero planes, at a small angle of inclination, driven rapidly through the air by means of screws or some other form of propulsion. Of these methods, the flying machine is less developed, not having received, as it seems to the author, the time and attention it deserves.

The most successful machine of the other make is Professor S. P. Langley's Aerodrome, the first authoritative account of which was given in this country at the Conversazione of the American Institute of Electrical Engineers in 1901, a complete report having been recently issued by the Smithsonian Institute. The Aerodrome had 54 square feet of sustaining surface disposed as rigid wings. They measured 14 ft. from tip to tip, and the weight of the entire structure was 30 pounds. It was driven by twin screws placed amidships, as shown in Fig. 3, the power being provided by a steam engine of 1½ hp capacity, the equipment complete—engine, boiler, firegrate and all, weighing less than 7 pounds. This, of course, is much lighter in proportion to power than we may hope to obtain with an electrical equipment, but the items of fuel, water, etc., must be added in the case of the engine, whereas, in computing the weight of electrical motive power, these items are entirely eliminated; this should go a long way, in a practical machine, towards equalizing the two systems, considered only from the viewpoint of weight.

The matter of vibrations will always be of importance in the motive mechanism of airships, since the stability, difficult enough to attain even under the most favorable conditions, will be greatly affected thereby; and on account also of the fact that the flying structure will necessarily be as frail in framework as is consistent with safety, it will be particularly important that all such vibrations be eliminated. Only the electric motor offers the smooth running conditions called for. Moreover, the exhaustion, en route, of the fuel, water, etc.—the continual alteration in load with the progress of the journey, as would be the case if an engine were used, would be a possible disadvantage in any form of airship, as it certainly is with the balloon as built at the present time.

The sole objection to electricity as a motive power for aerial navigation is the weight involved; in every other respect it is the ideal power for the purpose. Regarding this feature, two observations may be made. One of these is that extraordinary lightness is not a *sine qua non* of successful flight; and the other is that we probably have not yet reached the limit of lightness possible in the construction of batteries and motors.

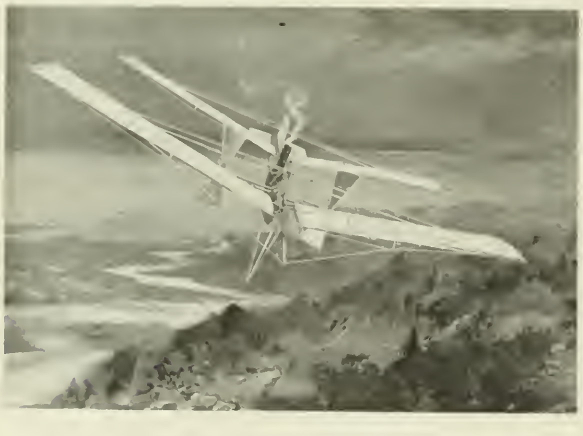
FIG. 3.—LANGLEY'S AERODROME.

The weight of the average pigeon is one pound, and the measurement of its muscle development shows it to possess 1-83 of a horsepower. The wild goose has a weight of 9 pounds, with a muscle development of only .026 of a horse-power, or 1 hp to every 346 pounds. This, of course, includes the flying creature complete; but suppose, in the case of the airship, that a large margin be allowed for the weight of the structure, we would still have from 150 to 200 pounds to put into every horse-power. This is at present within the limits of possibility. It is claimed that the new Edison battery weighs less than 61 pounds per horse-power, and it is not apparent at present how this can be improved upon, though even such an achievement is not inconceivable; but motors might very readily be reduced one-half in weight by using aluminum wherever practicable and cutting away all surplus metal in the make-up. The fact is that the demand for lightness in electrical power construction has not been such as to induce inventors to strive for the attainment of this object. When the time comes they will not be found wanting. In the meantime, the statement still stands that electricity is the ideal motor power in mechanical flight.

Wireless Congratulations to the Pope.

On the occasion of the recent jubilee celebration of the Pope at Rome, Cardinal Gibbons transmitted a congratulatory message to the Pope by wireless telegraph across the ocean. The message was sent from this side and received at Poldhu in England, and thence transmitted by wire to Rome.

The Heyland Induction Motor—I.*

By Boy De la Tour.

MUCH has been said, of late, concerning a new arrangement devised by Mr. A. Heyland, which makes it possible to design induction motors having a power factor equal to unity.

The articles published in various scientific periodicals by the inventor himself confine themselves to a summary description of the construction of the new machine, without attempting to discuss the theoretical considerations involved, and without seeking to explain the operation of the machine by means of diagrams.

The author has thought it expedient and opportune to discuss the nature of this invention, and by showing what modifications it introduces in the operation of the ordinary induction motor, and also by giving a method of calculation for a machine of that type designed to meet certain given requirements.

In order to avoid complicating matters too much at the outset, we will suppose that we are dealing with an ordinary induction motor having a stator winding of negligible ohmic resistance.

We will also assume, and for the same reason, that there is no magnetic leakage, and that the diagram of operation is represented by Fig. 1, wherein, for a motor in normal operation, $O A$ represents the magnetizing effect M_2 of the rotor winding, while $A B$ represents the magnetizing effect M_1 of the stator winding (the relative directions being indicated by the arrow heads), and, finally, $O B$ represents the resultant of these two effects. $O B$ will consequently indicate, but according to a different scale, the amount and direction of the resultant single magnetic flux, ϕ, passing through the cores of both the rotor and the stator.

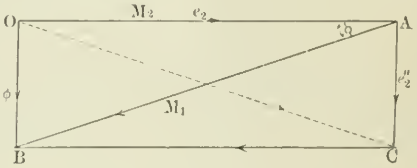

FIG. 1.—DIAGRAM OF OPERATION.

Since the primary current, i_1, is in phase with $A B$ (on the assumption that there are no losses in the iron), and since the e.m.f., e_1, induced in the primary winding by the resultant magnetic field, may be represented by a distance on the line $O A$, then (the resistance, R_1, being assumed to be negligible) the angle of lag will be represented by the angle $O A B$.

If we now wish to neutralize this angle of lag, it is indispensable that the straight line, $A B$, should become parallel to $O A$, or, in other words, that the primary current, i_1, should be in phase with the difference of potential applied at the motor terminals, E_1, whose direction (phase relation) is exactly opposed to that of e_1, the e.m.f. induced by the resultant magnetic field.

But the difference of potential at the motor terminals being constant, such is also, of necessity, the case with e_1, the induced e.m.f., and, consequently, it is also the case with the magnetic field, Φ, which produces this e.m.f.

We know that this magnetic field (Φ) is produced only by the resultant magnetic effects of the primary and secondary windings. It follows that if the current, i_1, or the primary m.m.f., M_1, undergoes a change in phase relation until it is directed along the line $B C$, the secondary m.m.f., M_2, will have its inclination changed from $O A$ to $O C$.

The same result might be obtained if there were sent in the secondary winding, by any means whatsoever, a current, i''_2, whose phase is the same as that of the vector, $A C$.

This auxiliary current, i''_2, will combine with the current, i'_2, produced by the resultant magnetic field, Φ, to give, in the rotor, a resultant magnetizing effect, represented in magnitude and in direction by $O C$.

It would seem, at first glance, as if we should arrive at the same result by producing the magnetizing effect $A C$ in the stator.

Such is not the case, however; for the diagram shows, in fact, that the lag of the current $B C$ would be 0°, while that of the current

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* Reprint of a chapter specially written for the American edition of the author's work on "Induction Motors," a translation of which book by Mr. C. O. Mailloux is now on the press.

A C would, on the contrary, be 90°.

The resultant of these two currents would be *B A*, and the final power factor would be

$$\cos \phi = \cos O A B,$$

as before. Nothing would, therefore, have been gained thereby.

The current *B C* would, by itself, produce the whole output, while the current *A C* would produce the resultant magnetic field, the magnetizing effect of the secondary being, all the time, neutralized by that of the primary component, *B C*.

We will see, later on, that by producing, in the rotor, the fictitious magnetic flux, *A C*, the result is no longer the same.

Let us first note that if we want the torque to be the same as it was before changing anything in the machine, the point *C* must be placed at the intersection of the straight line, *B C* (which is parallel, to *O A*), and of the straight line, *A C* (which must retain the same direction as *O B*).

The pull producing the torque is, in fact, proportional to the product of the magnetic field by that component of the resultant current of the rotor, which is perpendicular thereto. This pull is, therefore, proportional to the area of the triangles such as *O B A* and *O B C*.

We might also reason in the following manner:

Since the lag must pass from $\phi°$ to 0°, we must have for the same output $B C = A B \cos \phi$. The diagram, *O A C B*, is, therefore, a rectangle.

It is evident that the application of the Heyland principle will not modify, in any respect, the importance of the slip.

In order to introduce the current i_1'' into the secondary, the inventor has made use of a rotor arranged like the armature of a direct-current dynamo; that is to say, provided with an ordinary wave winding and with a commutator.

By applying to this commutator three sets of brushes placed 120° apart, it is possible to produce, in the armature, the effect of a three-phase winding with delta connection, which will remain fixed in space, notwithstanding the rotation of the conductors. On the end of the rotor opposite to the commutator, the winding is connected, at three points, to three collector rings; hence, if we remove the three sets of brushes, above mentioned, there remains only the armature of an ordinary induction motor.

The same rotor winding is thus made to combine the characteristic features of two distinct windings.

It is evident that in analyzing what takes place, we can study separately the effects of the two windings thus arranged, and then superpose the results.

The "first winding," being the ordinary winding, which connects with the three collector rings and which is already well known, will not require extended study.

It is not at all fixed in space, but takes part in the rotation of the rotor. It therefore slips slowly in the magnetic field of the air-gap and produces a reaction, or, to put it differently, a fictitious flux, *O A*, which moves with the same speed as that of the stator field, and which, naturally, has an equal number of poles.

In thus slipping in the field *O B*, it gives rise to an e.m.f., e_2', producing, in each of the three branches, a current,

$$i_2' = \frac{e_2}{R_2}$$

In this equation, R_2 = the ohmic resistance of each winding, and e'_2 is given by the well-known relation,

$$e_2' = 0.826\ Z\ B\ L\ V\ 10^{-8} \text{ volts,}$$

wherein

Z = the number of actual conductors connected in series, in each phase,

B = the effective density of the magnetic field of the air-gap, in gausses,

L = the axial length of the core of the rotor in cm,

V = the peripheral velocity of the rotor in cm per second, and

0.826 = a coefficient which applies to three-phase armatures having wave windings.

The fictitious flux produced by the reaction of this winding would cause, in the air-gap, an effective magnetic density,

$$B = \frac{S \times i_2'}{3\ p \times d} \text{ gausses,}$$

where

S = the total number of active conductors of the rotor,

p = the number of poles,

i_2' = the effective current, in amperes, in each of these conductors,

d = the (radial) distance across the air-gap, in cm, slightly increased to make up for the reluctance of the iron, and for the openings (slits) between the outer ends of the teeth of the cores.

The "second winding" is the same as a winding having delta connection, owing to the three sets of fixed brushes.

As already stated, this winding is the same as if fixed in space; and its position is, therefore, independent of the rotation of the armature (rotor).

Since the brushes are supplied by the same source of current as the winding of the stator, this rotor winding tends to produce a magnetic flux, revolving with the same velocity as that of the stator, or that in the air-gap, which is the only magnetic field resulting from the combination of all the magnetizing effects brought into play.

Since each of the branches of the second winding has a number of active sides equal to that of the phases of the first winding, the e.m.f. induced by the magnetic field of the air-gap will be the same in both cases, for the velocity of the conductors in this magnetic field always remains equal to that of the slip.

The currents in this second winding are naturally in phase with the reaction *A C*, whose direction is that of the magnetic flux, *O B*, in the air-gap.

It follows that the e.m.f. induced by the magnetic field in this second winding will have a lag of a quarter of a phase behind *A C*, and its direction will be along the line *A D* (Fig. 2).

If we plot the values of the product $i''R_2$, along *A C*, according to the scale of volts, we will find, by completing the parallelogram of vectors, the magnitude and direction of the e.m.f. which should be applied to the brushes in order to produce the required current, i_2'', in the second winding aforesaid.

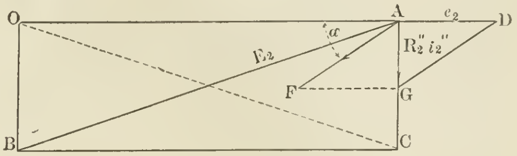


FIG. 2.—DIAGRAM OF OPERATION.

The potential difference, E_2, applied at the brushes, however, is obtained from the primary source of current, and, consequently, cannot have any phase difference with respect to the right line, *O A*, which indicates the phase of the primary current at the instant of time under consideration. The e.m.f., E_2, as indicated in Fig. 2, lags by an amount equal to the angle *O A F* behind the e.m.f. in the primary circuit.

Automatic Telephony at Westerly, R. I.

The Westerly Automatic Telephone Company has issued lately the following data about its work and progress:

A little over a year ago, when the Automatic Company was first proposed, the Providence (Bell) Company had about 75 subscribers in Westerly. By a reduction of 25 per cent on all rentals and vigorous canvassing it increased its exchange list to about 110 subscribers in Westerly, with rates ranging from $18 upward. The Automatic Company's rates are $20 for house, and $30 for business telephones. To-day the Automatic Company has 180 subscribers connected, with 200 names on the list and additional ones constantly coming in.

The entire capital stock, $25,000, was underwritten at the start, but the project has grown so rapidly away from and beyond the original expectations that the company has petitioned the Legislature for right to increase its capital stock from $25,000 to $100,000. In addition to our own pole lines throughout the town equipped with ample cable capacity and with strictly first-class construction, the company has built five miles of line to Watch Hill, and has obtained from the town the right to build to Noyes Beach (Weekapaug, six miles), where connections will be made with lines to Narragansett Pier and Peacedale. The company has petitioned for rights to build a line through Potter Hill, Ashaway, Niantic, Wood

River Junction and Carolina to Kenyon (17 miles), a very prosperous territory now entirely without telephone facilities.

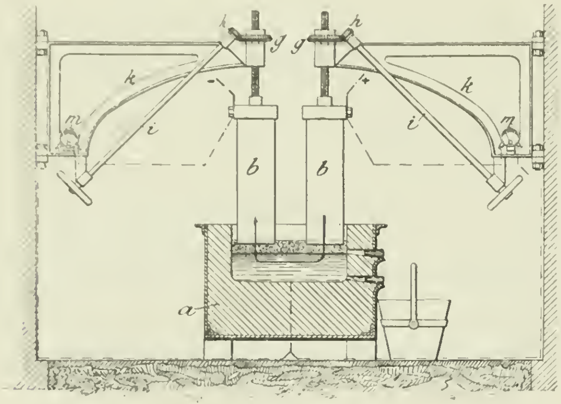
A careful estimate of the reasonable expectations of the business actually in sight is, that by next summer, when the Watch Hill sub exchange and the country toll lines are in operation, the company will have at least 300 subscribers on its exchange list. The gratifying promptness with which the quarterly rental bills are paid in advance fully confirms the universal expression of entire satisfaction with the quality of the service.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

ELECTRIC FURNACE.

In general construction an electric furnace recently patented by M. Paul Louis Toussaint Héroult follows the lines of the early device of Slawianoff. That is to say, it comprises a crucible for containing molten metal, two electrodes above the surface of the metal, and electrical connections for striking two arcs in series. The electrodes are separately adjustable, and two voltmeters are used for the guidance of the operator in controlling the resistance between either carbon and the bath. The accompanying diagram shows a crucible, *a*, provided with a tap hole and slag spout, and two vertical carbons, *b b*, the electrical connections being such that the path of the current is from the first carbon to the bath and from the bath to the second carbon. The electrodes are mounted upon swinging brackets, *k*, and provided with means, *g*, *h*, *i*, for their independent manual adjustment. Voltmeters, *m*, are interposed as shown in circuits between each carbon and the bath. The electrical connection of the voltmeter circuits to the bath of molten metal is made through a rod of the same metal projecting through the refractory lining of the crucible; this rod may become fused at its inner end in operation, but the electrical connection is sufficiently maintained.



HÉROULT ELECTRIC FURNACE.

A layer of slag or ore is shown as overlying the metal and interposed between it and the carbons. The arcs are described as playing through this insulating layer, whereas a truer conception of the action would probably be gained by considering the furnace as of the resistance type, the heat being developed in this slag. The composition of the slag, or rather resistance-heater, should be related in some manner to the process which is being carried out in the furnace. In reducing operations it may be merely the unconverted charge; for dephosphorizing iron it may be the basic reagent of the Thomas' process; and for the production of chromium, nickel or tungsten-steels it may be either a neutral silicate or any basic or acid reagent required for the purification of the metal.

EDISON BATTERY.

The latest modification of the Edison battery comprises insoluble active materials, briquetted and retained in perforated pockets in a metal frame—the construction rendered familiar by the earlier patents. The patent now issued deals particularly with the element, which is oxidized on discharge and reduced in charging. Essentially this element, as now described, consists of the oxide of cobalt, and is produced by the cautious calcination in air of the corresponding oxalate. The conductivity of the oxide being low, it is advisable, for the purpose of insuring the electrical activity of the entire mass, to mingle with it a better conductor, for which purpose mercury, copper or foliated graphite are suggested. If mercury be used it is added as an oxide and reduced in charging the battery, whereas copper is added in finely divided metallic form. The average voltage of such an electrode, opposed in a 20 per cent. caustic potash solution to the electrode heretofore described as consisting of nickel hydroxid and graphite, is given as 1.10.

PLATING BATH.

Josepha Chiele, of Brussels, proposes a new plating bath for an old purpose. As is well known, objection has often been made to the use, particularly in surgical instruments, of an intermediate coating of copper between the steel of the tool and the (usually silver) final coating. A very slight amount of wear upon points or edges will lay bare the intermediate coating, and the toxic qualities of copper render its presence, if not positively injurious, at least undesirable. The substitute metal in the present case is tin, which is said to be deposited from a bath of the particular composition given below in a form which is not only adherent to the steel, but to which, in turn, the silver adheres with all the tenacity which it displays toward copper.

The bath used for electrodepositing tin is made by dissolving in nine liters of water 500 gm of sodium pyrophosphate, and 100 gm of stannous chloride, and adding to this solution 50 gm of aluminum nitrate and an equal quantity of magnesium nitrate dissolved in a liter of water. Anodes of aluminum and tin are used during the plating, and the patentee asserts that both aluminum and magnesium enter into the composition of the deposit and determine its unexpected properties.

Ries Patents Sold at Auction.

At an auction sale in Baltimore, March 3, there were sold in accordance with a court decree, the rights to 47 patents and 18 patent applications in the name of Elias E. Ries, the purchaser being Arthur G. Thompson, of New York, and the price paid, $60,000. The decree followed a lengthy litigation on a bill of complaint of Albert H. Hutchinson, praying for the dissolution of the co-partnership of Ries & Henderson and the liquidation of its affairs by receivers and an accounting of the business by its co-partner, Mr. Ries.

According to the terms of the decree, the patents were first offered by groups, there being 13 groups. The separate bids aggregated $59,700, or $300 less than the bid for the entire lot. There was considerable competition for some of the patents. For those covering conduits for electric and cable railways there was a bid of $10,500 by the United States Electrical and Development Company, which also bid $35,000 for the patents on railway systems, and $12,200 for the patents on induction railway. The distribution of the patents in groups was as follows:

Automatic signaling device for railroads, one patent (1886); electric welding and tempering, 10 patents (1887-1896), and 5 applications (1888-1893); electric riveting, 4 patents (1889-1891); electric soldering, 1 patent (1892); electric heating, 5 patents (1888), and 3 applications (1888); induction coils, generators and motors, 5 patents (1888); overhead conductors for electric railways, 1 patent (1888), and 1 application (1887); brake and traction systems, 4 patents (1887-1891), one of which is subject to a license to the Otis Elevator Company; conduits for electric and cable railways, 8 patents (1886-1889); electric railway systems, 4 patents (1888-1889), and 4 applications (1886-1891); railway systems, transformers, 3 patents (1889-1899), and 2 applications (1887-1889); the 1899 patent is subject to an agreement dated November 22, 1893, between the then owners and Mr. George Westinghouse; induction railway, 1 patent (1891), and 2 applications (1892); apparatus for removing snow and ice from railway tracks, 1 patent (1888).

Almost all of the patents were issued prior to 1889, and therefore have but a short remaining life. The applications are probably all forfeited for lack of prosecution during the statutory period. It is rumored that the purchaser represented one of the large electrical manufacturing companies.

New Telephone Patents.

The Patent Office issue of February 24 is rather noteworthy, as it contained no telephone patents. On the other hand, the issue of the next week, March 3, as if to make up for the previous deficiency, appears with no less than seven such patents. Of these three are for transmitters, an apparently never-failing subject for the efforts of inventors. One of these new transmitters is of the microphone type, one is of the Hunning's or granular type, while the third is nondescript. Two views of each of these transmitters are shown in Fig. 1.

At the left of this figure the new granular transmitter appears. This is the invention of A. F. Lawson, of Buffalo, N. Y., the chief novelty consisting in arranging the button within a resonating chamber partly formed of the diaphragm or diaphragms. The idea is that sound waves of a given intensity passing into the closed chamber will effect a greater change in the transmitter button than they do in the usual types of transmitter where they impinge on the diaphragm from without. The construction is very simple, but the diaphragms appear to be too much exposed to damage from external sources Damage from any undue internal pressure is guarded against, the milled head adjusting screws acting as stops.

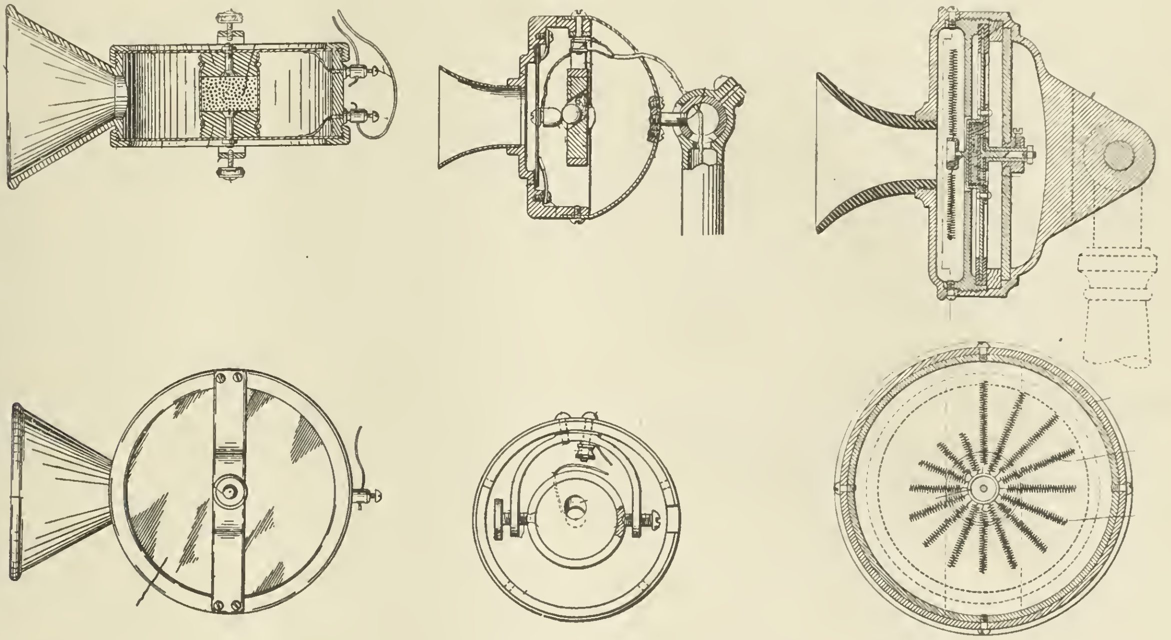


Fig. 1.—Three New Telephone Transmitters.

The transmitter in the middle of the figure is an adjustable microphone. Within the usual enclosing shell at the rear of the diaphragm a small carbon cylinder with a hemispherical head is mounted. Just to the rear of this there is mounted upon trunnions a carbon block having a circular aperture rising from the center of the front face to a point somewhat above the center of the rear face. Within this hole a small carbon ball or pellet is placed resting, as shown, partly within the hole and against the rounded end of the carbon cylinder. A loose buffer of cotton wool is put in the hole behind the pellet, to avoid breaking the circuit under excessive excitation. The sensitiveness of the microphone depends upon the initial pressure at the contacts, which may be varied at will in this case by revolving the carbon block upon its trunnions. Thus, for very sensitive working the axis of the ball guide or hole is brought toward the horizontal, and vice versa. the axis is made to approach the vertical as the requirements for volume decrease. Charles Holmok is the inventor of this transmitter.

The third transmitter, that at the right of the figure, is very novel in that no diaphragm is employed. Instead, what the inventor, Mr. Lemuel Mellet, of Somerville, Mass., terms "harmonic vibrators" are provided. These are helical springs tuned to various notes of the scale so that they will take up naturally their fundamentals and overtones and impress them upon the transmitter button, instead of having to be forced into an unnatural vibration, as is the diaphragm of ordinary practice. In the cut springs for two octaves are shown. It seems highly improbable that such a device will transmit speech with great success, although for less complicated vibrations it is conceivable that with proper design it might be made more efficient than the diaphragm transmitter.

In Fig. 2 there is shown the circuit of a delightfully simple central energy system in which with a minimum of apparatus all the signals usual with this type of system are provided. As may be seen from the figure, the transmitter current is fed directly to the subscribers' lines through retardation coils in the form of relays. The talking wires of the cord circuit, therefore, serve merely to loop the two lines together. The signal wire of the cord circuit contains no apparatus but the two supervisory lamps. The operation of the system is as follows: When the subscriber, X, desiring to make a call, removes his receiver from the hook, completing, as usual, a circuit across between the two sides of his line, relays, A', both operate, as both are in series in a battery circuit completed by X's action. The lower relay, A', through its contact, connects X's line lamp to battery, while the upper A' completes the circuit to the grounded side of the battery. The line lamp, L, thus lights, notifying the operator that X desires to talk. Now when the plug, P', is inserted into one of the jacks of line X, in answering, it will be noted that a second circuit from the battery extending through the lamp, L^3, is completed. It will also be noted that this circuit uses the same ground connection as L'. Now this joint use of the ground connection serves to extinguish both lights. This can readily be accomplished by making the lamp for a voltage considerably lower than that of the battery and inserting in the ground connection a controlling resistance, r', of such a size that when in series with one lamp the potential drop within it will be just equal to the difference between the normal lamp voltage and the battery voltage. When the two lamps are in parallel, if the voltages have been properly chosen, neither will get sufficient current to glow on account of the excessive drop in r' under these conditions. Whenever a plug is in the jack and the circuit is not completed at the subscriber's premises, the supervisory light only glows, as while the ground connection remains at the back contact of the unactuated relay, A' (upper), the line lamp circuit is open at the relay, A' (lower).

While the idea of this system is ingenious, it can be improved to advantage. Thus it will be seen that the relay is superfluous, as both its front and back contacts are connected to ground and, therefore, it does nothing in its operation. It would be far better to permanently ground the jack testing rings and combine the two relay windings upon one core, that of A' (lower). Again, condensers should be placed in both talking wires of the connecting cords, for two reasons. First, a good distribution of current to lines of unequal length would otherwise be impossible, and second, a study of the circuit shows that a busy test is now impossible, as the tip of one of the plugs is connected to battery as soon as the other is inserted in a jack. Further, a reversal of the jack connections to obviate this difficulty, would be of no service, as if the calling station telephone receiver were off the hook, the battery connection would be completed through it to the testing plug tip. Mr. S. B. Fowler is the inventor of this system.

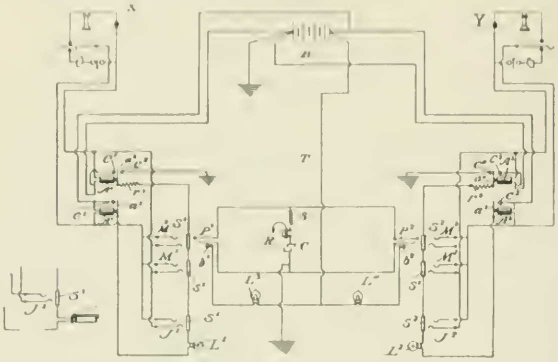


FIG. 2.—FOWLER CENTRAL ENERGY SYSTEM.

Under the title, "Trouble-Test for Automatic Telephone Systems," Frank N. Reeves has patented an attachment for the Faller "mechanical operator," which will call an attendant in case of failure of the machine to operate satisfactorily. In order to explain Mr. Reeves's invention a word about the "mechanical operator" is necessary. This is a machine having among other elements subscribers' line terminals and the equivalent of connecting cords. When a call comes in on one of the lines the machine operator picks it up, receives from automatic devices at the subscriber's station a record of the number desired, selects the line of that number and then connects the two lines to any available pair of connecting cords or, more properly, bars. Now these several operations are all timed and controlled by a master shaft, which, as the machine as a whole is constantly driven at a uniform speed, requires under normal conditions approximately the same length of time to complete each connection.

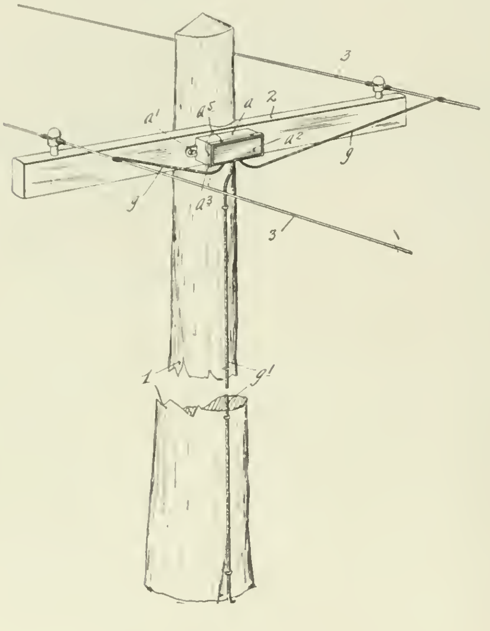


FIG. 3.—CHAPMAN LIGHTNING ARRESTER.

The present invention is based upon the constancy of this time of connection, and in case the time is too long, indicating trouble, the repair man is automatically called. This is accomplished by providing the master shaft with a cam, the wiper of which, if allowed to descend, will operate a trouble key. The descent of this wiper, however, is controlled by a dash pot, and under normal shaft rotation it will never descend sufficiently to operate the key. If, on the other hand, the cam stops too long, or goes too slow, the key will be operated. The Faller system has already been described in these pages.

The sixth patent of the present issue describes a lightning arrester or air cut out for aerial telephone lines exposed to lightning discharges. Within a closed metal box having an insulating bridge, as shown in Fig. 3, there are mounted two carbon discs each with a biserrated face opposed to and a short distance from a carbon slab. Each of the discs is electrically connected to one side of the line to be protected, while the carbon slab is grounded. The arrester is adapted to be mounted upon a pole, in which position the grooves in the carbon plates are well adapted to allow carbon dust generated by the passage of discharges to fall out, thereby removing the resulting accidental ground connection. This patent has been granted to W. J. Chapman.

In the reissued class, W. W. Dean's invention of a busy test system suitable for use with the two-wire central energy switchboards of the Kellogg Company, reappears. As this test system was described under this heading in these columns January 17, 1903, no further mention seems necessary at this time.

Telephony in New Jersey and Long Island.

A number of interesting statements are made by President Cutler in his recent annual report on the affairs of the New York & New Jersey Telephone Company, showing to what extent storms and other disasters may play havoc with telephone lines, if overhead. He says: "The early part of the year 1902 was a season of unusually destructive storms which for a considerable period seriously crippled all overhead telegraph and telephone lines in the territory operated by your company, and entailed heavy expenditures for repairs and replacement of destroyed plant. The disastrous conflagration which swept over the business section of the city of Paterson, N. J., on February 9th, was followed on March 2d by an overflow of the Passaic River, which completely flooded the lower part of the city, causing loss of life and great damage to property. Fortunately, your company's valuable building, lately completed, was situated outside the devastated district, but a considerable amount of the plant in the streets was destroyed or seriously damaged, causing some interruption to service of local subscribers.

"On the night of February 21 the territory was visited by the most destructive sleet storm in the history of the company. The overhead lines of your company, as well as those of the telegraph, electric light and trolley systems, were almost completely prostrated. In the larger nearby cities the damage was much lessened by the predominance of underground lines, but the southern part of New Jersey and the middle section of Long Island were completely cut off from telephone communication for a period of from four to six weeks. While every effort was being put forth to secure an early restoration of the crippled plant, substantially our whole force of linemen left our service without a moment's previous notice, and without any intimation of dissatisfaction on their part. This added greatly to the difficulty and delay in the restoration of service, and to some extent increased the cost of the work. The actual cost of repairing and rebuilding the prostrated lines was $267,505, and the loss of revenue through the interruption of service is estimated at about $100,000. The entire cost of repairs has been charged against the earnings of the year, which fact will account for the large increase in the maintenance account over former years. Under normal conditions the net earnings of the year 1902 should have been at least $365,000 above the amount shown.

"The increase in number of stations served would probably have been considerably larger, as canvassing for new business was necessarily suspended during the time in which the service was interrupted. The last previous sleet storm which seriously affected our business occurred in 1891, in which year we were forced to encroach upon our surplus account to pay our usual dividend rate. Through the use of the underground trunk line leading from Jersey City to Newark your company was enabled to furnish to its patrons uninterrupted communication between New York, Brooklyn, Jersey

City and Newark during the time when other lines were disabled.

Regarding competition, it may be said that while the few unimportant systems heretofore established still keep up a struggling existence, there are no evidences of new life or further development. In fact, on the whole, there are less stations connected to those systems than at the date of our last report.

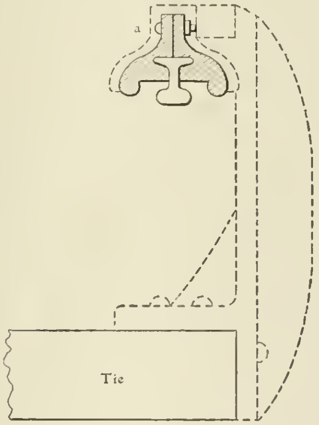
The report of the New York & New Jersey Telephone Company for the year ended December 31, 1902, compares as follows:

	1902.	1901.	Changes.
Gross	$3,962,597	$3,376,432	Inc. $586,165
Operation and maintenance	2,823,458	2,294,633	Inc. 528,825
Net	$1,139,139	$1,081,799	Inc. $57,340
Charges, tax and division	873,977	790,390	Inc. 83,617
Surplus	$265,162	$291,409	Dec. $26,277

The company shows assets of $17,592,792 and a surplus over liabilities of $2,633,181.

Inverted Third Rail Conductor.

The accompanying illustration shows some details of a modification of the inverted third-rail way conductor and trolley recently patented to L. E. W. Walkins. The object of the modification is to fit the system for telephone service to and from moving trains on railways, experiments on which are to be made by one of the large telephone interests. The way conductor is fully protected against weather conditions, such as sleet, snow and rain, which condition was lacking at the tests made during the past winter on the State Railway near Frankfort, Germany, and on the Dedham branch at West Roxbury, on the New York, New Haven & Hartford Railroad, with corresponding unfavorable results.



INVERTED THIRD RAIL.

The inventor claims that tests he has made show that his inverted third-rail system can be used for railway train telephone and signal purposes with results of a very satisfactory character. Plans which have been prepared for installation show that it will not be costly to install in blocks of five or ten miles in length, using a composition iron bracket made by a Taunton iron foundry. The insulation of the inverted third rail is accomplished by a cheap yet efficient insulated hood containing no iron or other metal, made in lengths of 15 ft. each and bolted together every 8 inches.

Michigan Independent Telephone Companies.

Managers of many of the independent telephone companies in Michigan, to the number of 70, met at Lansing on February 26. President J. B. Ware delivered an address in which he reviewed the progress made by the independent companies in Michigan and elsewhere, and declared that everything was in a condition highly satisfactory to the independent interests.

Mr. R. F. Johnson, of Saginaw, read a paper in which he favored a clearing house similar to the system employed by banks, where the toll-line accounts of the companies might be adjusted. Mr. C. E. Tarte, of Grand Rapids, advocated establishing night rates, and Mr. S. E. Parkill, of Owosso, discussed the necessity for independent connection with the business houses of Detroit. Mr. H. E. Adams, of Toledo, described the Toledo independent exchange, and Mr. W. O. Hunt, of Adrian, discussed Rural Telephone Business. A discussion followed the reading of the various papers, and the meeting was considered a profitable one to all concerned. Mr. E. B. Fisher, of Grand Rapids, was elected president of the association, Mr. C. F. Brown, of Alma, secretary, and R. F. Johnson, of Saginaw, treasurer.

Central Missouri Telephone Association.

The Central Missouri Telephone Association, comprising all of the independent telephone lines of Missouri and Western Kansas, held its annual convention at Sedalia, Mo., February 27. President G. W. Schweer, of Windsor, presided over the meeting. Delegates were present from St. Louis, Kansas City, St. Joseph, Western Kansas and Missouri towns. The chief work accomplished was the perfecting of plans for long-distance metallic connections between St. Louis, Kansas City and intermediate points, with connecting lines, including scores of farm circuits. Rules and regulations were also adopted governing the independent companies in the associations.

The following-named officers were elected for the year: President, G. W. Schweer, Windsor; vice-president, F. A. Churchill, Sedalia; second vice-president, W. B. Scruggs, Harrisonville; secretary, M. L. Golladay, Holden; treasurer, C. E. Betts, Fayette.

Method of Making Rates at Cleveland, Ohio.

The Cleveland Electric Illuminating Company charges for current on what it terms a "two-rate" system. This is not the two-rate meter system with which readers of this paper are probably familiar, but derives the name "two-rate" from the fact that electrical energy is charged for at one rate until an amount of electrical energy has been used equivalent to burning all of the lamps a certain number of hours. The rates are 12½ cents per kilowatt-hour, until an amount of electrical energy has been used equivalent to burning all of the lamps connected to the meter fifty hours in each month. The rate is 5 cents per kilowatt-hour for all energy used in excess of that amount. As in any other meter system, the customer pays for only the actual amount of current used. The fifty-hour use rule simply specifies the amount of electricity to be used at the regular rate of 12½ cents, before the five-cent rate begins to apply. This arrangement, however, is somewhat modified for residence lighting. In making the residence rate only 40 per cent. of the lamps connected to the meter are counted as a connected load, from which to calculate the fifty hours' use per lamp, upon which the two-rate system is based. This is considered fair to both customer and company, because a residence seldom has all the lamps in it lighted at the same time. On special occasions a large number of the lamps are lighted simultaneously; but experience shows that when such is the case less than the usual amount of light is used in several other houses; and for this reason only 40 per cent. of the lamps connected to the meter are reckoned as connected load in making the meter rate. Further than this, lamps connected in closets, servants' quarters, attic and basement, are left out of the residence count.

In making up the residence rating a card is used, on which are marked the lamps affecting the residence rating, and the lamps, heating pads, flat-iron heating, etc., which do not affect the rating. Mr. Scovil, vice-president of the company, has given the question of rates much thought, and has some clear and forcible ways of presenting the justice of a system of rates where the investment and readiness-to-serve charges are properly taken care of.

The literature prepared by Mr. Scovil for public distribution in connection with this work is very interesting, and explains to the customer the idea of the separate cost of "getting ready" to do business and the further cost of supplying service or the "actual making" cost of current—coal, labor, oil and other elements.

CURRENT NEWS AND NOTES.

MASTERS OF DEPORTMENT.—The Brooklyn Rapid Transit Company has issued a circular to the guards, conductors and motormen in its employ urging courtesy and helpfulness to all passengers.

LIMA (PERU) TROLLEYS.—It is stated that a concession from the Peruvian Government has recently been applied for by capitalists at that city for a system of electric tramways between the watering places of Miraflores, Barranco, and Chorillos, and to connect them with Lima. It is proposed to lay a double track for the whole distance, about 20 km (16 miles).

THE UNIVERSITY OF CINCINNATI has been developing its engineering departments during the last three years, and this year graduates its first class in electrical engineering. The equipment in this department includes a standardizing laboratory, in which it is expected to do calibrating on a commercial scale, the lack of facilities for calibrating having been greatly felt, in the past, by the many electrical companies located in Cincinnati and vicinity.

MARCONI WIRELESS TELEGRAPHY IN ENGLAND.—Arrangements have been concluded, at last, between the British Government postal telegraph lines and the Marconi wireless system whereby business will be interchanged between the government lines and the Marconi stations. This will enable the Marconi system to transmit messages direct from any interior point in Great Britain to Canada and the United States without delay, as soon as the Poldhu station is equipped for long-distance transmission.

ELECTRIC BILLIARDS, as played in Paris, should interest American electrical votaries of the cue. The game is said to be played on a table, in the center of which is placed a plate of some easily electrified material. The billiard balls are of compressed pitch, and the cue is a short rod with a cork tip, prepared chemically. The balls are of course subject to the influence of the electrified plate in the center of the table, and owing to this fact it is difficult to make caroms. It is said to be purely a game of skill, which is likely to become popular among billiard players who are thirsting for new difficulties to conquer.

PENSIONS FOR PROFESSORS.—Announcement is made of a plan for pensioning Cornell University professors who are to be retired after attaining the age of 70 years. One hundred and fifty thousand dollars has been given the university for this purpose, and this amount will be placed at compound interest until 1914, when it will amount to $250,000. Each professor retired will receive an annual pension of $1,500, three-fourths of which will be paid from the pension fund and one-fourth of which will be contributed by the professors. It is expected, however, that professors who reach the age limit before 1914 will also receive the benefits of the pension scheme.

LACHINE RAPIDS PLANT.—The annual report of the Lachine Rapids Hydraulic & Land Company shows that at the end of 1902 the circuits of the system carried 71,500 incandescent lamps, 205 arc lamps and motors aggregating 2,716 hp. Exclusive control has been secured of the power transmitted from Shawinigan Falls to Montreal for a period of 25 years, with right of renewal. A section of the report is devoted to inspection, from which it appears that the company makes its own inspections of interior wiring. During the year 364 consumers have consented to repair defects pointed out, while 36 have refused to do so. Complaint is made of dereliction on the part of insurance companies, which necessitates the company having its own inspection service.

CHICAGO ELECTRICAL ASSOCIATION DINNER.—About forty-five members and guests of the Chicago Electrical Association met for an informal dinner at the Albion Cafè, Pullman Building, on the evening of March 6. After dinner Mr. S. G. McMeen gave a few minutes talk on "Middle West Engineering: An Optimist's View." Mr. McMeen's address was both thoughtful and witty, giving the young engineers present something to think of and something to laugh about, The evening was very much enjoyed by all those attending and gave an opportunity for social intercourse and better acquaintance between members not afforded by the regular meetings. The next meeting will be held Friday evening, March 20, at 1736 Monadnock Building, when S. J. Larned, general superintendent of the Chicago Telephone Company, will lecture on telephone service.

NEW YORK ELECTRICAL SOCIETY.—The 233rd meeting of the society will be held in the lecture room of the American Institute, 19 West Forty-fourth Street, Wednesday, March 18, at 8 P. M. Prof. R. H. Thurston, of Cornell University, will lecture on "The Steam Turbine to Date." Prof. Thurston will give the members of the society a definite and invaluable review of the actualities and possibilities of the situation. The course of the argument will comprise: 1. The beginnings of the steam turbine. 2. The fundamental ideas of its theory. 3. The turbine is not a thermodynamic machine. 4. The economies and the wastes of the turbine. 5. The present status of the machine in design. 6. Simple vs. compound turbines. 7. Performance of the turbine to date. 8. Opportunities for Improvement. 9. Characteristic advantages. 10. Trend and promise for the immediate future. The lecture will be illustrated by lantern.

POPOFF COHERER.—Prof. Popoff, of Cronstadt, Russia, who made perhaps the first practical application of the coherer, was granted March 3 a patent on what is described as a self-decohering coherer system. The end electrodes of the usual glass coherer tube contain each a metallic pin, one being displaced above and the other below the axis of the tube, and overlapping each other about one-half the length of the tube, but slightly separated. There are three insulating partitions in the tube, one at the end of each pin and the third midway between. The chambers thus formed contain a granular filling consisting of grains of hard steel having their surfaces of various degrees of oxidation; or steel grains having portions of their surfaces smooth and polished and portions angular with fractured cleavage; or crushed steel beads, which retain their rounded polished surfaces as well as the acquired angular fractured surfaces. A coherer thus constructed is stated to regain its sensitiveness without any shock or being tapped.

NEW YORK FRANCHISE VALUES.—Transportation and lighting companies furnish the chief values which resulted in the increase from $220,620,155 to $235,142,825 in the valuations of special franchises in New York City by the State Tax Board. On the larger corporations these advances were made: Brooklyn City Railway, from $11,109,000 to $12,502,000; Brooklyn Union Elevated, from $5,485,000 to $6,125,000; Broadway line, Manhattan, from $6,359,000 to $6,540,000; Metropolitan franchise, as it existed before consolidation, from $16,110,000 to $18,413,000; Third Avenue line, from $10,086,000 to $10,316,000; Manhattan Elevated line, from $44,600,500 to $47,100,000; Brooklyn Union Gas Company, from $8,724,450 to $9,350,000; Consolidated Gas Company, from $16,275,000 to $17,985,000; New York Edison Company, from $9,610,000 to $10,175,000; New Amsterdam Gas Company, from $4,413,000 to $4,505,000. The State Board of Tax Commissioners has valued the franchises at their full value, instead of following the rule of local assessors in placing a valuation on other classes of real estate, and in some cases assessing franchises at only a certain percentage of their valuation.

WIRELESS TELEGRAPHY IN ALASKA.—It is stated that after waiting nearly a year for the Marconi Wireless Co. to inaugurate its system in Alaska in accordance with the bid submitted to the Signal Corps, Gen. Greely has decided to give them one more opportunity and will call upon them to immediately install their apparatus. In the event of continued failure, the contract will be annulled. Notwithstanding the apparent success of the wireless system commercially, none of the companies offering to install a system between Cape Nome and St. Michaels in Alaska has succeeded in getting its system to work. Officers of the Signal Corps say that the De Forest Company has given some evidence of sincerity in its proposal, but that up to the present time Marconi has accomplished nothing so far as the Alaska wireless proposition is concerned. Unless some one of the companies succeeds within a short time, it is the intention of the Signal Corps to establish its own system, and the officers are of the opinion that it will give satisfaction, as it has already worked well between the army posts about San Francisco. Meantime a contract has been awarded for the cable to be laid between Seattle and Sitka, a distance of 1,100 miles, and from Sitka to Juneau.

GERMAN ATLANTIC STEAMERS are the subject of an appreciative note, as to their electrical equipment, from Mr. E. L. Harris, commercial agent at Eibenstock, Germany, to the United States State Department. It will be remembered that some time ago we described and illustrated the power and lighting plant on board the "Deutschland." As to the "Kronprinz Wilhelm" it is stated that she has 59 power motors for various purposes, and has 104 electric heaters in her first class cabins.

GUTTA-PERCHA IN GERMAN NEW GUINEA.—Under date of February 3, 1903, Consul-General O. J. D. Hughes writes from Coburg: Gutta-percha trees of a very good quality have just been discovered in abundance in German New Guinea. These are said to yield an excellent quality, equal to "gutta merah" and the other finer grades. Samples sent for analysis to Germany are now undergoing a detailed technical investigation. It is already being predicted that in future German New Guinea will supply the trade with appreciable quantities of gutta-percha, which will be welcome news to the cable industry, the supply of the better qualities having steadily declined. Mr. Oldemeyer, the discoverer, secures the prize of $750 offered by a Bremen merchant to the explorer finding a wild gutta plant in any of the German colonies.

LETTERS TO THE EDITORS.

Three-Phase Measurements.

To the Editors of Electrical World and Engineer:

SIRS: I should like to ask some further information concerning the article on "Three-Phase Measurements," by Mr. Leslie L. Perry, which appeared in your issue of January 10.

Referring to Fig. 4 of the article (appearing herewith as Fig. 1), the projections of the three-current vectors upon the delta of the e.m.fs scale are approximately as follows:

$$a_2o_1 = 10.4 \qquad a_3o_2 = 25.7 \qquad b_1o_1 = 33.4$$
$$c_2o_3 = 43.6 \qquad b_3o_3 = 28.4 \qquad c_1o_2 = 20.9$$

Mr. Perry's values are given as

$$a_2o_1 = 33.8 \qquad a_3o_2 = 10.4 \qquad b_1o_1 = 26.3$$
$$c_2o_3 = 20.2 \qquad b_3o_3 = 43.6 \qquad c_1o_2 = 27.7$$

It will be noticed that that these do not correspond even roughly with the scaled values, although the totals of both sets taken in properly selected groups of two are equal within about 2 per cent. If Mr. Perry's values are correct, how are they obtained? Certainly not by "projecting the currents on their corresponding voltages as we did before," that is, under non-inductive conditions. Again, how can the value of the projection a_2o_1 ever equal 33.8 amp when the value of the vector itself, *o a*, is only 26.45 amp? I have tried to apply the method for determining the power factor of some unbalanced three-phase circuits and have been confronted with the following conditions:

Upon superposing the Y of the currents upon the delta of the e.m.fs and measuring by this means the power under non-inductive conditions, I have found that the power thus determined was less than the sum of the wattmeter readings taken simultaneously with the current and the voltage readings; in other words, the power factor was greater than unity. Here are a few of the cases:

Ampere per phase			Volts bet. phases.	Kilowatts by wattmeters.
A	B	C		
34	25	10	2280	115.2
18	13	10	2280	79.2
20	26	21	2280	136.8

In the first of these, for instance, the three sums of the current projection upon the delta of the e.m.fs taken in proper groups of two was 34.3 amp, which, multiplied by 2,280 volts, gives 78.2 kw, or a power factor of 147.5 per cent., which is absurd. Perhaps Mr. Perry can show me where I am in error, or it may be that the method has a limit and that when the unbalance exceeds a certain amount the method becomes useless.

I am certain that the readings taken are correct within 5 per cent., and that both of the wattmeter readings were positive, so that the error is not due to a power factor of 50 per cent. or under and an arithmetical instead of algebraical addition of the two readings, even with the combined error of 20 per cent. in the readings, the power factor would still be in the neighborhood of 107 per cent.

CLEVELAND, OHIO. H. L. WALLACE.

To the Editors of Electrical World and Engineer:

SIRS: Regarding Mr. H. L. Wallace's questions as to the method of measurement given in my article in your columns, I can readily solve his first difficulty, since it is due to a careless misarrangement of mine in tabulating the results. For Fig. 4 the sets of numerical values should be interchanged to give

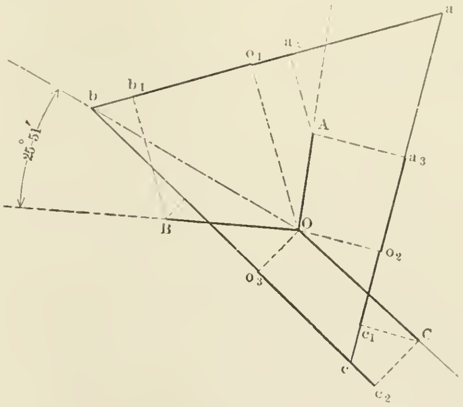


FIG. 1.—CURRENT AND VOLTAGE DIAGRAM.

$$\begin{aligned}
a_2o_1 \times a\,b &= 10.4 \times 100 = 1{,}040 \\
c_2o_3 \times c\,b &= 43.6 \times 100 = 4{,}360 \quad 5{,}400 \\
a_3o_2 \times a\,c &= 26.3 \times 100 = 2{,}630 \\
b_3o_3 \times b\,c &= 27.7 \times 100 = 2{,}770 \quad 5{,}400 \\
b_1o_1 \times b\,a &= 33.8 \times 100 = 3{,}380 \\
c_1o_2 \times c\,a &= 20.2 \times 100 = 2{,}020 \quad 5{,}400
\end{aligned}$$

With this correction the table and diagram will check.

Instead of applying the method of superposition the following accurate construction may be employed: In the Y diagram of currents (see Fig. 2) calculate angles *A O B* and *A O C;* upon *a c* as a chord construct a circle such that the radial angle *a D c* equals to twice the angle *A O C:* then any angle whose vortex is in this circle, and whose base is *a c*, will equal *A O C*. Similarly, on *a b* construct circle *a O b*, using angle *A O B*. The intersection of these circles gives the zero point *O*, and the diagram can then readily be completed. I am confident the method applies to any three-phase circuit, no matter how unbalanced.

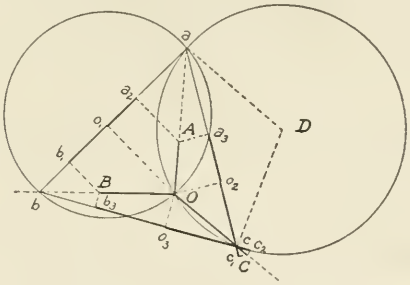


FIG. 2.—CURRENT AND VOLTAGE DIAGRAM.

If a strictly algebraic method of calculation is desired the formula for *cos O b c* can be developed from the geometrical construction into

$$\cos O\,b\,c = \frac{\cos a\,b\,c - \dfrac{\sin a\,b\,c \times \sin A\,O\,B}{\sin a\,c\,b \times \sin A\,O\,C} \times \cos\,(a\,c\,b + B\,O\,C)}{\sqrt{1 + \left(\dfrac{\sin a\,b\,c \times \sin A\,O\,B}{\sin a\,c\,b \times \sin A\,O\,C}\right)^2 - 2\,\dfrac{\sin a\,b\,c \times \sin A\,O\,B}{\sin a\,c\,b \times \sin A\,O\,C} \times \cos\,(a\,b\,c + a\,c\,b + B\,O\,C)}}$$

Regarding the particular cases Mr. Wallace cites, I would say that usually it is necessary to measure all three voltages, as a comparatively small difference will distort the voltage diagram; and in writing my article I did not show them unbalanced, as I took the figures from Mr. McAllister's article. This may be one source of Mr Wallace's trouble; but I suspect the kilowatt readings are incorrect, for I note in the second set of readings that assuming a power factor of 100, even were the other two currents equal to the largest, the power would not equal that of the wattmeters.

Thus, $$\frac{18 \times 2{,}280 \times \sqrt{3}}{1{,}000} = 71.1 \text{ kw},$$

as against 79.2 kw indicated by the wattmeters. A similar difficulty is found with the third set.

LESLIE L. PERRY.

NEW YORK, N. Y.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Synchronous Converters for Charging Storage Batteries.—THORNTON, MARCHANT, WOODHOUSE.—Three letters referring to the article of Banti, recently abstracted in the Digest. Thornton discusses the oscillatory effect of armature reaction in sigle-phase synchronous converters, and shows that all phenomena described by Banti can be accounted for by the fact that the magnetic circuit of the machines is too sensitive to variations of armature current, and that the low resistance of the cells facilitates the resultant change in the voltage and current relations in the armature. The conclusion is that for charging storage batteries, care must be taken to prevent the unavoidable impulses of armature reaction disturbing the whole magnetic circuit. This can be most readily done by using solid poles provided with damping coils, for he has observed that short-circuiting the series winding of a converter with solid poles reduced the magnetic oscillations proceeding from armature reaction to a negligible quantity. Marchant explains the effect observed by Banti in the following way: In a synchronous motor or synchronous converter driven by alternating current, the driving torque varies periodically. This varying torque produces a variation in the speed of the converter, so that the generator, representing the direct-current side of the machine, rotates not uniformly but in a series of jerks, the jerks being in most cases imperceptible. This varying speed gives rise to a varying potential difference at the brushes, and if the converter is used to charge storage batteries, any small variations of the voltage produces a comparatively large variation in the current, such as was actually observed. Woodhouse thinks that the real cause lies not with the converter, but with the generator which drives it, and that this pulsation, while magnified by the condenser action of the battery, is in the first place an overtone on the wave of the generator.—Lond. *Elec.*, January 30.

LIGHTS AND LIGHTING.

REFERENCE.

Determining Illumination.—LANSINGH.—A communication illustrated by diagrams, in which he describes an analytical method for determining the illumination on a surface from a given hemispherical candle-power curve of a lamp.—*Eng. News*, February 19.

POWER.

Electric Power for Shops.—FLATHE.—An illustrated article on electric driving of machines. The well-known advantages of the electric drive, are discussed. Concerning the use of individual motors, it is said that for isolated machines and for heavy machines which may be in occasional use, the individual motor is particularly adapted, as it consumes power only when in operation. For ordinary machine-driving, however, especially with small machines, short lengths of light shafting may be frequently employed to good advantage, and the various machines, arranged in groups, may be driven from one motor; by this method fewer motors are required, and each may be so proportioned to the average load that it may run most of the time at its maximum efficiency. Speed control is very often of great importance. The three-wire, 220-volt system offers many advantages both for power and lighting systems, and is very frequently used; variations of speed may be obtained with this system by using a combination of field regulation with either voltage, and, in rarer cases, the use of a double-commutation motor. A method which has been used recently with considerable satisfaction, involves the use of a three-wire generator, with collector rings, connected to an armature winding, similar to that of a two-phase rotary converter. Balancing coils are used, and the middle points of these are connected to the third wire, which is thus maintained at a voltage half way between the outer wires. This system is simple and economical, and possesses all the advantages of the ordinary three-wire method, which permits similar variations in speed by field regulation with either voltage; and if still wider ranges are desired, a double commutator motor may be used. In other recent installations the four-wire, multiple-voltage system is used, which permits of very wide variations of speed in the operation of the tool; its advantages appear to outweigh its drawbacks. In the second part of the article the use of compressed air is discussed.—*Cassier's Mag.*, March.

REFERENCES.

Electric Power in Steel Works.—MACCOUN.—An article on the use of the electric motor in modern steel works and blast furnace plants.—*Sc. Am. Sup.*, March 7.

India.—THOMSON.—An illustrated article on electric power in India, describing the Cauvery Falls plant and the transmission to the Kolar gold fields.—*Cassier's Mag.*, January.

TRACTION.

Steam Railroad Converted to Electric System.—An article on the change of the Cincinnati, Georgetown & Portsmouth Railroad from steam to an electric one, operating with the trolley system. While operated by steam it failed to do much more than pay the operating expenses. When it was decided to change it to an electric system, it was also determined to adopt standard gauge. The road has been completely rebuilt and equipped throughout for electric traction. It operates through a prosperous country and depends largely upon freight business for support. The company conducts its freight and express business on the same lines as steam railroads, but has added some features, such, for example, as regular delivery and collection systems at the important points, which it is hoped will aid in the development of this branch of the business. Sub-stations have been established at several points along the line, and in these are combined the passenger, freight and power plants. In the main power plant two cross-compound condensing engines of 1,400 hp are directly connected to alternating generators of the revolving field type. There is also one engine-driven, 50-kw generator used as an exciter and a motor-driven exciter set of the same capacity. The engine-driven exciter set is used for starting, and when the engines are up to load it is shut down and the motor-driven exciter set is thrown in. There are also two rotary converters in the main power plant and six step-up transformers of 200 kw each. Each of the sub-stations has two 250-kw synchronous converters and three 200-kw step-down transformers, together with the usual switchboard equipment. Each passenger car has four motors. Two large electric locomotives are being built for the purpose of hauling freight trains. They will have a capacity for handling ten loaded cars on a 3 per cent. grade.—*St. R'y Jour.*, February 21.

Third-Rail Operation.—An article on the third rail operation on the Aurora, Elgin & Chicago Railway. Brine is used for cleaning the sleet off the third rail. It is carried in a tank on the front platform and fed to the rail through a rubber tube ¼ in. in diameter. Eight gallons are required for a run of 24 miles. A solution of calcium chloride is to be tried. A new type of shoe consisting of a light bar held down by spring pressure is being used instead of the standard shoe on a few cars. No decision has yet been made as to the method of lighting these cars while passing highways and other places where the third rail is interrupted. Storage batteries, gas and a short overhead trolley section have been considered.—*St. R'y Jour.*, February 14.

Lancaster.—An illustrated description of the Lancaster (England) electric tramways. The trolley system is used; the power plant contains two 200-kw steam dynamos, two 300-kw steam dynamos, one 60-kw motor generator and one 23-kw balancer. A refuse destructor and boiler is working alongside the station at a steam pressure of 200 pounds per square inch; the steam from the destructor is taken through a reducing valve at a pressure of 135 pounds per square inch.—Lond. *Elec. Rev.*, February 20.

Grades.—Hering.—A table of reduction factors for reducing grades stated in any one kind of units to those stated in the other, the reduction being in almost all cases made by a mere multiplication. This is followed by another table giving the actual numerical equivalents of each grade from 1 to 15 per cent., in all the different units in which grades are stated, thus avoiding all calculations. There are quite a number of different units in terms of which grades are stated, but the more usual and more rational one in the opinion of the author is to give it in per cent., and this unit is made the chief one in his tables, all others being reduced to it. In these tables the reduction factors are given accurately for both the sine and the tangent functions, so that the slight difference between them may be taken into account if desired. Every known method of stating grades is believed to be included, so that a grade stated in any unit can readily be reduced to that in any other. —*St. R'y Jour.*, March 7.

Telephones in Electric Railway Service.—Daniell.—An article in which the writer says that where there is a good local telephone exchange in the city it is more satisfactory for a company to lease telephone wires from the telephone company than to install its own system. Telephones should be stationed along the lines in locked iron boxes. Keys can then be carried on the cars in a box with a glass over it. Every time a telephone is used the glass must be broken and the key returned in an envelope to the main office. It is necessary to keep a close watch on keys, as instances have been known where keys have been sold to persons living near the pole boxes, who use the telephones and even secure long-distance connections at the expense of the railway company. On a long line telephones can be carried on the car and can be connected to the boxes every ¼ mile on the poles when necessary. Where boxes are carried on poles in this way, they should be so arranged that closing the door opens the circuit to prevent all possibility of lightning entering the instrument. Where a large number of instruments are hired from the telephone company, the usual rental is one-half the regular rates.—*St. R'y Jour.*, February 21.

REFERENCES.

Storage Battery Installation.—A description of the battery installation in the Bordeaux Tramway power plant. The plus end of the battery is connected directly to the plus bar, but the minus end has three connections, so that the two end cells can be thrown on either side of the negative bus as desired. The object of the arrangement is to maintain the load on the generators constant.—*St. R'y Jour.*, March 7.

A Decade of Interurban Railways.—Bell.—A review of the improvements made during the last ten years in interurban practice. These lie in all parts of the equipment; the motor is not only more powerful, but it represents an entirely different type of construction. The third rail has come into general use, and four-axle cars and air brakes are universal.—*St. R'y Jour.*, February 28.

Electric Locomotives.—A description of the electric locomotives used on the Western Railway of France. These locomotives were built to operate between Paris and Versailles and possess a number of novel features, the principal one being that the motors are not connected directly to the axle, but to a hollow shaft which surrounds the axle and is flexibly suspended to it by six helical springs. Both geared and gearless motors are used.—*St. R'y Jour.*, February 28.

Multiple-Unit Trains.—An article on the multiple-unit trains for the Buffalo interurban service. This is the first example of the use of the multiple-unit system in surface railway operation in the United States, and has just been put in operation. As the cars are used for both city and interurban service, a special switch is installed on the cars by which higher speeds can be secured in interurban work.—*St. R'y Jour.*, February 28.

Reducing Congestion.—Bell.—An article in which a number of suggestions are made as to methods for relieving city congestion; stress is laid on the importance of arranging the terminals of the lines so that cars do not interfere with each other.—*St. R'y Jour.*, February 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Five-Phase System.—Ehnert.—A mathematical article illustrated by diagrams, on the properties of a five-phase alternating-current system. At the end he gives a numerical example for a comparison of a three-phase and five-phase system, the energy transmitted, the distance, the voltage between the conductors, the loss of energy, and the power factor being assumed equal in both cases. He finds that in the five-phase system the weight of line wire is smaller by 50 per cent.; but the cost for installing and for insulators, etc., is greater; nevertheless he thinks that the resulting saving amounts to 40 per cent. The voltage loss in the line in a five-phase system is smaller than in three-phase. In spite of these advantages, the five-phase system may come into use only for long-distance transmission. The five-phase system would be suitable mainly for motors, but it may also be used for lighting, if a neutral wire is used.—*Zeit. f. Elek.*, February 15.

WIRES, WIRING AND CONDUITS.

Electric Transmission Lines.—Adams.—An article in which he compares the relative advantages of different materials for transmission lines. Conductivity is of primary, tensile strength of secondary importance. Aluminum wire requires 1.66 times the section of copper wires for a wire of equal resistance; phosphor bronze, 3.84; iron, 7.14; steel, 9.09. It is not desirable to use a copper wire smaller than No. 4 B. & S. gauge for transmission lines, because of lack of tensile strength in small sizes; when the conductivity of a copper wire smaller than No. 4 is ample, an iron wire will give the required conductivity with a strength far greater than that of the copper. The relative strengths of wires with equal sectional areas compared with soft copper, are for hard-drawn copper 1.32 to 2.06; silicon bronze, 1.76 to 2.94; phosphor bronze, 2.94; iron, 1.62; steel, 2.94; aluminum, 0.88. Comparing wires on the basis of equal resistances for equal lengths, the tensile strength is as follows: A hard-drawn copper line has 2.10 times the strength of a soft copper line; silicon bronze, 6.38; iron, 11.56; steel, 26.70; aluminum, 1.46; phosphor bronze, 11.29. For a line of given cost, length and resistance, soft copper has the least cross-section and tensile strength; steel the greatest cross-section, weight, tensile strength and lowest price per pound; aluminum the least weight and highest price per pound.—*Cassier's Mag.*, March.

REFERENCE.

Line Calculations.—Koenig.—An article illustrated by diagrams, on a new and more general graphical method of calculating electric lines.—*Elek. Zeit.*, January 28.

ELECTRO-PHYSICS AND MAGNETISM.

Determining Dielectric Constants.—Billitzer.—A description of a method of determining dielectric constants based upon the fact that in a non-uniform electric field a non-uniform system of dielectric media experiences displacement, since the positions of the system having a greater dielectric constant are subjected to a stronger impulse towards the points of highest potential. The author uses the substance under investigation in the form of a thread or small sphere; he attaches it to a quartz fibre and suspends it in a liquid of known dielectric constant. To avoid polar effects, an alternating current is sent through the liquid by means of two platinum electrodes. The pendulum then shows a deflection unless its dielectric constant is equal to that of the liquid; any liquid may be used which does not attack the body. The author uses a mixture of acetone and hexane in various proportions, which give a variation of the dielectric constant from 2 to 24. If the dielectric constants of liquids are to be determined, various pendulums of known dielectric constants may be used in those liquids. A set of glass pendulums with dielectric constants varying from 4 to 10 may be constructed, and would probably prove very convenient.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Edison Phenomenon.—Allegretti.—An account of an experimental investigation of the Edison phenomenon, consisting of the passage of electricity from the extreme negative end of the filament of an incandescent lamp to a metallic plate introduced into the bulb. According to the author, this phenomenon has not yet been fully explained, although much work has been done upon it by Preece, Fleming and others. The main question is, whether this is a phenomenon of ionization or a true projection of negative particles. The author prepared a special vacuum tube having three openings by means of which the two electrodes and the metallic plate could be easily replaced. He found that the current between the electrode and the metallic plate decreases rapidly as the distance increases, and less rapidly as the area of the plate diminishes. The phenomenon produces no effect upon a sensitive plate wrapped up in black paper. A magnetic field weakens the current perceptibly, especially at the lower pressures. The author believes that the phenomenon is primarily due to ionization, but that at the higher vacua it is enhanced by the production of cathode rays which may be deflected in the same way as the ordinary cathode rays by a magnet.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Electric Dissipation in Fog.—Gockel.—An account of a study of the effect of fog upon the distribution of atmospheric potential and upon the mobility of positive and negative ions. He comes to the conclusion that ascending air currents, such as are prevalent in cyclonic areas, carry with them negative ions. These give rise to the formation of clouds, as a rule, since the negative ions are the most effective condensation nuclei. At Freiburg the author has observed a quicker dissipation of positive electricity with a falling barometer. A surplus of positive ions, as always exists near the mountain tops in fine weather, may be reversed by fog. During snowstorms there is a quicker dissipation of positive electricity and therefore a prevalence of negative ions. The low-lying fogs occurring in autumn and winter are almost always produced by descending air currents, such as prevail during anti-cyclones. These descending air currents take down with them a quantity of positive ions. This gives rise to the strong surplus of positive ions in the layer above the fog, as found by Ebert in his balloon voyages. The author suspects a close relation between dissipation and atmospheric pressure.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Stationary Wire Waves.—Borgmann.—A description of a method of producing visible waves along a wire. Arons had devised a method of making wire waves visible by stretching two aluminum wires along a glass tube 2.5 meters long and exhausting the air down to a pressure of a few millimeters. Later Coolidge obtained similar but feebler luminous phenomena in the open air. The present author obtains them on a single wire, mounted along the axis of a tube and connected with the secondary circuit of a Drude apparatus for determining dielectric constants. He used a Tesla transformer and a Blondlot vibrator fed by an induction coil of 3 cm spark length. Spindle-shaped luminosities are seen on the wire itself where the ventral segments of the vibrations are. On varying the position of the first bridge wire, the length of the waves is altered, and hence also the number of luminous stretches on the wire; photographic records can be obtained in about eight minutes; the diameter of the tube is of no consequence. But the tube must not be too highly exhausted, otherwise the glow fills the whole tube, nodes and all. A curious circumstance is that the glow does not set in at once, but two or three minutes after the current has been turned on; the interrupter must work uniformly and rather rapidly, otherwise the phenomenon may fail entirely.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Electro-Chemistry and Batteries.

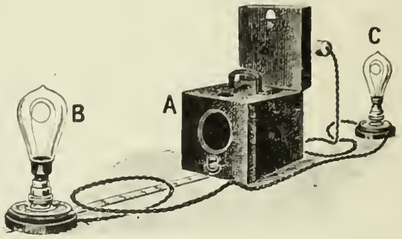
Electrolytic Superoxides.—Hollard.—An account of a chemical investigation of the lead peroxide deposited at the anode of a solution of a lead salt. The present author has found that the weight is too great for the peroxide and that higher oxides are deposited; the proportion of these higher oxides is greater the smaller the concentration of the lead in solution. It is probable that very high oxides are formed, but the author has not determined their exact nature. Lead is not the only metal which shows this phenomenon; an alkaline solution of nickel pyrophosphate yields a similar oxide, as does also a solution of sulphate of bismuth containing a little nitric acid and copper sulphate. These have been obtained only in dilute solutions, as the salts are rather insoluble.—*Comptes Rendus*, January 26; abstracted in Lond. *Elec.*, February 20.

Electrons and Ions.—Reinganum.—An article on the mechanism of electrochemistry; he attempts to formulate a theory of the distribution of the electrons in the molecules entering into electrochemical reaction. He assumes that each molecule, say of H Cl, contains two pairs of electrons, the H atom being provided with one pair and the Cl atom with another pair. Electrolytic "dissociation" might then be represented by the giving off of one negative electron from the H atom to the Cl atom, so that the H atom has now one positive electron, while the Cl ion has one positive electron and two negative electrons, and thus is negatively charged. When Cl is set free at the anode, each Cl ion gives off one negative electron and thus becomes neutral, having one positive and one negative electron; similarly with the H at the cathode. Through the external connection the negative electrons pass from the anode to the cathode, thus completing the circuit. The author works out this idea for the different compounds and shows why the dissociation constant is a measure of chemical affinity. It is probable that the transfer of the supernumerary electron is accomplished even before actual electrolysis takes place.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 13.

Change of Volume and E.M.F. with Pressure.—Ramsey.—An account of an experimental investigation of the change of volume in Clark and cadmium cells and its relation to change of e.m.f. due to pressure. When a Clark or a cadmium cell is put under pressure, its e.m.f. is increased. The values found experimentally for the Clark cell are in good agreement with those calculated, but for the cadmium cell they are smaller than the calculated value.—*Phys. Rev.*, February.

Units, Measurements and Instruments.

Portable Photometer.—A description of a portable photometer made by an English firm. As shown in the adjoining diagram, the standard lamp, *B*, which forms a part of the set, is placed at a point on the graduated tape corresponding to its candle-power. Another lamp, *C*, is then shifted backwards and forwards until the photometer spot, when viewed through the small hole at the top of the box, just disappears. The lamp, *B*, is then removed and replaced by the lamp to be tested, which is in turn moved up and down the tape until balance is again obtained. The reading in the scale under the lamp when in this position will then be the candle-power. As both the lamps, *B* and *C*, are connected in parallel, and therefore are worked at the same voltage, and as the candle-power of an incandescent lamp depends on the voltage, the candle-power of each will increase or decrease in the same proportion for a given change of voltage. Therefore, the candle-power read off on the scale is that which the lamp would give at the voltage for which the standard lamp is marked. Owing to the fact that the standard is only in use for a few minutes at a time, it can be relied upon to keep its candle-power for an indefinite period. The photometer can be used in an ordinary room without any special precautions being taken to exclude stray light. This is because the method amounts to a kind of double weighing, so that the effect of any external light is automatically compensated for.—Lond. *Elec.*, February 20.



PORTABLE PHOTOMETER.

Photometry.—An editorial discussion of some points raised in Fleming's recent paper. Attention is called to the uncertainty in the definition of the photometric units. The unit of luminous intensity, which is the fundamental unit, is the candle. A British standard candle is considerably larger than a Hefner candle, the unit used in Germany, and the "bec Carcel," the French official standard, differs from both. The Geneva Congress of 1896 fixed the "bougie decimale" as a unit; this, as Fleming says, is neither a bougie nor decimale, being the twentieth part of the light emitted normally by 1 sq. cm of platinum at its melting point—a difficult and costly standard to reproduce, and one which can only be maintained with absolute accuracy for about one minute at a time. Concerning photometry itself, the question arises, how are lights of different colors to be compared, for whatever light we take as the standard, other means of illumination will differ from it in color to a greater or less extent. The main question at the moment is how these points are to be decided and by whom. In this respect Germany is in a good position, as it has the Reichsanstalt, and there the Lummer-Brodhun photometer occupies already a semi-official position. Until an international agreement is reached, it is urged that the National Physical Laboratory should supply this want for England.—Lond. *Elec.*, January 30.

Slip of Induction Motors.—MEYNIER.—A description of a new stroboscopic method for measuring the slip of an induction motor. On the axle of the induction motor a circular disk is mounted, one semi-circle being black, the other white. A small synchronous motor is placed so that its shaft is approximately the prolongation of that of the induction motor; on the shaft of this synchronous motor a black semi-circle is mounted. The observer looks on both disks in the direction of the axis. There are two cases, the first being that the rotation of both motors is in the same direction; in this case the observer counts the number of times that the two disks together appear entirely black in a certain time interval; it is easy to count up to 150 such moments in a minute which would correspond to a 10 per cent. slip of a 4-pole, 50-periods motor. For very small slips the full disk of the induction motor may be divided into two *n* sectors, black and white, and the axis of the synchronous motor bears *n* black sectors, corresponding to the white sectors of the other disk. The second case is that both motors rotate in opposite directions; here the observer sees a cross, the number of arms depending on the number of sectors; two white and two black sectors give an ordinary cross. For synchronism this cross is fixed in space, while for any slip it rotates, and it will revolve through 180° when the number of turns differs by 1 revolution.—*L'Ind. Elec.*, December 25.

An Optical Pyrometer.—HOLBORN AND KURLBAUM.—A description of an instrument consisting of a telescope which produces an image of the source under investigation in the plane of vision, in which is also mounted the filament of an incandescent lamp. Under ordinary circumstances a simple red surface is seen through the eye-pieces owing to a red glass which is inserted, and on it is seen the black filament. The lamp current is then increased until the filament can be no longer distinguished. The photometer or pyrometer is calibrated by means of a radiating black body, as described by Lummer and Pringheim.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCE.

Telephone Tunnels.—A well illustrated article on the methods of work adopted in constructing the network of tunnels, aggregating 60 miles in length, in down-town Chicago.—*Eng. News*, February 19.

MISCELLANEOUS.

Metric System.—An account of a long discussion before the (Brit.) Institution of Elec. Eng. on the question of the introduction of the metric system. There were numerous speeches on both sides.—Lond. *Eng'ing*, January 30 and February 13.

The discussion is summarized in a long editorial and it said that with the exception of Alexander Siemens' speeches in favor of the metric system, the discussion consisted more of statements of individual likes and dislikes than of arguments. The two arguments raised by speakers against the metric system were, first, that it is less costly to bear the evils we have than those involved in a change, and second, that if it is necessary to abandon the present system, we might adopt one that involved less dislocation of our ideas and habits than the metric system. Parker advocated a system founded on the inch and on the weight of the cubic inch of water. Stoney suggested that a meter of 40 in. should be adopted to render it possible to convert inches into meters without awkward decimals. Editorially it is pointed out that the needs of the export trade will necessitate the introduction of the metric system. To the engineer the introduction bears two aspects, according as he views it as a professional man or a manufacturer; to the former it offers enormous advantages; the manufacturer has large sums invested in linear measures, but these sums should not be exaggerated. "There are many works that would be the gainers for a wholesale scrapping of patterns and the introduction of new ones." But really there are very few cases that a pattern will not serve equally well for either system. "When our American friends have overstocked their home market and turn to export, it will not take them long to decide if a change is necessary; and if they do so decide, they will make it without unnecessary delay, whatever it may cost. It will be somewhat late for us to follow them then."—Lond. *Eng'ing*, February 20.—The speech by which Siemens opened the discussion and advocated the compulsory adoption of the metric system, is reprinted in full in Lond. *Elec.*, February 20.

Electric Heating Apparatus.—A note on a new form of electric heating apparatus, designed by Rivers. With a view to obtaining a large heating surface at a moderate temperature, a layer of very fine carbon powder is held between two enamelled iron plates and retained in position by a bordering of asbestos cardboard. Copper strips are led in, one at either end of the plates and a third in the center, and continuous current at 200 volts is then passed from the latter to the former. The bolting together of the plates gives the requisite amount of compression to the carbon, which is said to be an important feature. The first radiator built was in the nature of an experiment, and had an effective heating surface of 25 sq. ft., the average temperature of the plates being 190° F. The average current taken is 8 amp at 200 volts.—Lond. *Elec.*, February 13.

New Books.

ALTERNATING CURRENT MACHINES. By Samuel Sheldon, Ph. D., and Hobart Mason, E. E. New York: D. Van Nostrand Company. Pages, iv-259. Price, $2.50.

This little work is a real addition to the text-book literature of electricity. It is a companion volume to "Dynamo-Electric Machinery," published two years since, and follows for alternating-current machinery, practically the same line of treatment and arrangement. The book will decidedly fill a place especially its own, and meet a real want which so far there has been no serious attempt to satisfy. It is not so scholarly a work as that by Franklin and Williamson, but it will prove of service to those who find the other work too advanced and exhaustive.

The book is marred by the authors' abrupt and nervous style, though the materials have been selected with excellent judgment and a concise knowledge of the requirements of practice. This second volume of the serial possesses decidedly more merit than the first, and takes rather more advanced ground in its treatment. The subject is a difficult one to present adequately within the narrow limits of this little book, for the range of topics is not only large and their literature voluminous, but there are numerous and widely different methods for their discussion.

The preface states that "the use of all methods in connection with every point, leads to complexity." The earlier text-books on this subject, not properly recognizing this, confused the reader and left the impression that their authors were not clear in their own grasp of the theory attempted. The result was an uncoordinated mass, which obscured rather than elucidated, and left the student with no means of employing principles in practice. In the present case the authors have selected the method which they judged clearest and most concise, with the result that they have written an excellent, practical and clearly discussed book. A happy omission on their part has been the non-use of the complex imaginary quantity both in discussion and problems. However interesting such methods are to advanced students, and in despite of the overzealous insistence of a few writers, complex quantities are superficial, indirect, and do not lend themselves to a true, physical analysis of alternating-current phenomena. They are a clever shorthand medium for treating problems and theory, but they lack a vital connection between the process and the fact, and cannot be rationally practical. Insistence upon their use in technical text-books adds complexity with no gain in power.

The authors do not hesitate to employ concise mathematical discussion where he considers it essential. The book frequently resorts to the analysis of the calculus, but the processes are usually indicated with such clearness that the mathematics of the book should present no difficulties. Occasionally there is an abrupt statement of an equation, or its modification is given with too much brevity.

The book is admirably adapted for reference and the use of students in advanced manual training schools, or the more elementary of the schools of technology. The selection of matter, the lucid treatment and the intensely practical spirit that pervades the book, have combined to produce one of the most excellent of recent text-books.

however much it is out of sympathy with more thorough scholarship. This latter defect will make it of transient value where its method should warrant it a more permanent place.

The matter of the book is of such an elementary and well established character, that it does not require an extended notice. The properties of the alternating current and the alternating current circuit are presented in the opening chapters. Since the author has resorted to concise mathematical treatment, it is singular that he has omitted the statement of the formal fundamental equations of harmonic circuits. The various terms in these equations are given and applied, but the book would have gained much in force had the author not been so hasty and brief at this point in his work. This discussion is followed by the conventional chapter of problems, which is excellent in its way but rather too brief. There is too little numerical illustration to make the application of formulas clear, but the reader is relieved at not finding the customary array of exercises for solution.

The chapter on alternators is suggestive, but scarcely adequate and fails decidedly to sustain the method intended by the plan of the book. Where it should be precise, it is descriptive, and beyond presenting the most rudimentary elements of this class of electrical machinery, it leaves the reader with no comprehensive and but little practical knowledge. As an illustration, the topic on armature reaction gives no means for ascertaining this quantity numerically, and merely describes the phenomena involved with bare suggestion of the elements which enter into it. As a further illustration, revolving field alternators are treated entirely from the catalogue standpoint; the type is not differentiated, nor are its characteristics discussed or stated with the exception of one simple diagram.

Another fault in the book is apparent in its mention of the Scott phase-changing transformer. This is well described, but no reference is given in the recital. This bare mention would gain decidedly for the student, if a reference had been made to the clever paper of the inventor, in which the device was originally described. The present author, in common with many others, does not seem to realize that the mere statement of such facts is inadequate. A text-book of this character should be a suggestive guide to the literature of its subject matter so that it may enable the student to use his knowledge with a precision that can never be gained from a small book on a large subject. Insufficiency of treatment may also be instanced in the section describing the constant-current transformer; and again, though of a different nature, in the topic dealing with the synchronous motor.

The short chapter on rotary converters and the concluding chapters on power transmission, and testing, though lacking and unsatisfactory in many respects, yet gives an excellent discussion of many practical matters.

The diagrams are numerous and clearly drawn, and the book as a whole is well illustrated. The publishers, rather than the author, must be taken to task for the excessive size of many of the catalogue illustrations, which coarsely detract from the otherwise neat appearance of the text, and which are as blurred and blotched as is usual with the second derivative of a half-tone print. There are but few lapses into bad taste in evidence, but the most flagrant is that of Fig 63*a*, where a rakish appearing individual serves to impress the size of a particular dynamo.

Les Theories Electriques de J. Clerk Maxwell. By M. P. Duhem. Paris: A. Hermann. 228 pages. Price, 8 francs.

This critical study of Maxwell's contributions to the theory of electricity and magnetism by one who has done so much in other branches of theoretical physics, particularly in thermodynamics, is a very welcome addition to scientific literature. Especially should it be welcome to French students who have shown such great reluctance during the thirty years past to accept the theories of Maxwell.

The author gives a very comprehensive survey of the development of electrical theory, including the theories that preceded Maxwell, and his study of Maxwell includes all of Maxwell's earlier memoirs as well as Maxwell's great treatise, which appeared in 1873.

In writing of the theories of Maxwell in 1890, the eminent French scientist, Poincaré, said: "When a French reader opens Maxwell's treatise a sentiment of dislike, and even of defiance arises, which is dissipated only after prolonged study and at the cost of great effort. Some eminent minds indeed always retain this initial sentiment."

"Why is it," asks Poincaré, "that the ideas of Maxwell have been with so much difficulty acclimated in France?" It is without doubt due to the influence of the writings of the great French scientists of the early part of the century. "All our masters," says Poincaré, "from Laplace to Cauchy, have proceeded in the same manner. Starting from hypotheses neatly stated, they have derived all the consequences with mathematical rigor, afterwards comparing them with experience. The French have seemed to wish to give to each of the branches of physics the same precision as is shown by the Mecanique Celeste."

The reluctance which the French have shown in their acceptance of Maxwell's theories throws much light upon the characteristic features of electromagnetic theory; a theory which is confronted with a vastly greater variety of phenomena to be correlated than is presented in any other single branch of physics. Laplace needed only to start with the fundamental notion of universal gravitation and the fundamental notion of inertia. Maxwell had to start with a great variety of fundamental notions. Laplace's "Mécanique Céleste" is solely an algebraic development entirely independent of conceptual helps. Maxwell's theory on the other hand is principally a conceptual development with detached algebraic helps. A student determined to find in Maxwell either a repetition of Laplace's method or nothing at all would certainly find nothing at all, and this is what the French found in Maxwell during a period of twenty years.

United States Automobile Patents. Supplement to Digest of United States Automobile Patents (1789-June, 1899). July, 1899, to January, 1902. Compiled by James T. Allen. Washington: American Patents Publishing Company. 748 pages. Price, $10.00.

This volume forms a supplement to the compilation by the same author of the automobile patents prior to July, 1899, and covers all patents granted since the earlier volume was printed up to January, 1902, since which latter date these patents have been digested in the *American Electric and Automobile Patents Monthly* (which publication also includes air and gas engines). The volume thus bridges the period covered by the earlier volume and that now being covered by the monthly publication. The book includes every patent relating directly or indirectly to the art issued within the dates noted in the title, every sheet and figure of the drawings, no matter how numerous, the claims in full, and a brief description when necessary to properly interpret the claims.

One of the most valuable features of the work, which is also a feature of the *Monthly*, is the reference index. This is not merely an index in the ordinary sense of the term, but in addition to the patent number, the patentee, the title of the invention and the plate and claim folios, it gives also a list of the references cited against each application while pending in the United States Patent Office, thus indicating the previous state of the art when the patent was granted.

The inventions are plainly classified in the text according to the different sub-classes. While in the Digest only ten sub-classes were established, yet in the shorter space of time covered by the Supplement the art has grown and expanded to such an extent that it was necessary to establish eleven new sub-classes, making twenty-one in all; one of these is entirely new, that of mufflers, or noise-quieting devices, which has been brought down from 1789 to January, 1902, as it did not appear in the Digest.

The work is printed by the photolithographic process, thus insuring absolute accuracy as to plates and text. The edition is limited to 500 copies.

Notes on Laying, Repairing, Operating, and Testing Submarine Cables. By Captain Edgar Russel, U. S. Signal Corps. Washington, 1902: War Department Document 172. 70 pages, 30 illustrations.

This is an elementary hand-book for the guidance of Signal Corps officers concerning the laying, operating and repairing of shallow-water submarine cables. A chapter is devoted to the construction, laying and repairing of cables, as effected in the Philippine Islands. Then follows a good chapter on the operation of the cables in the Signal Corps service. Next comes a chapter on normal cable testing. Then a chapter on locating faults in cables. The Fisher cable testing set used in the service receives a relatively long chapter, and the last chapter, by Col. Reber, is a very good one on factory testing of cables.

The book as a compendium of testing officers' notes is well condensed and designed. It would be benefited by the prefacement of a chapter index and by the addition of a subject index at the end. Doubtless these will be added in a subsequent addition.

Directory of Electrical Societies, Etc.

American Electrochemical Society, Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

American Street Railway Association, Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Electrical Contractors' Association of New York State, Secretary, Wm. J. Davis, Ithaca, N. Y.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Iowa Telephone Association, Secretary, C. C. Deering, Des Moines, Iowa. Next meeting, Des Moines, March 10 and 11, 1903.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 26, 27 and 28, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York. Next meeting, American Institute, March 18. Lecture by Prof. R. H. Thurston on "The Steam Turbine to Date."

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

A Modern Theatre Installation in New York City.

By Irving B. Smith.

One of the latest and most interesting electrical theatre installations in New York City is that of Belasco's Theatre, at Forty-second Street and Seventh Avenue. The electrician of the theatre, Mr. Louis Hartman, is responsible for the entire electrical work, having planned it, laid it out and superintended its construction, including both auditorium and stage.

The theatre secures its current from the Edison 110-220-volt three-wire service. The auditorium is on a two-wire distribution, the stage on a three-wire distribution. From the main distribution center in the basement front run two sets of feeders, one to a distribution panel in the lobby, from which are controlled the lights on the stairways, smoking-rooms, reception rooms, lobby, box office, etc. The second set of feeders runs directly to the stage switchboard. All wires are run in iron conduit, there being no cleat or moulding work. No smaller wire than No. 6 B. & S. is used. All lights are in fixtures, drop cords not being permitted. All fuses are of the enclosed arc type and all distributing panels are in slate-lined oak cabinets.

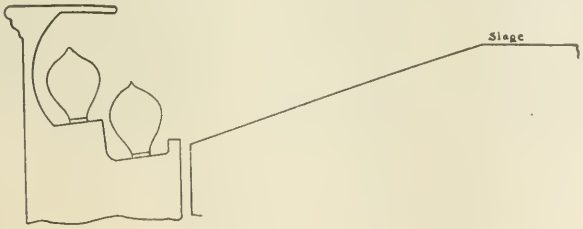


FIG. 1.—SECTION ACROSS FOOTLIGHTS.

The auditorium lights, excepting the chandelier and a few brackets, are concealed. The orchestra is situated in a pit below the auditorium floor level. Each musician has a light enclosed in a rotating cylinder, permitting him to have either diffused white light or a blue light. The light is ample, and quite invisible from the auditorium.

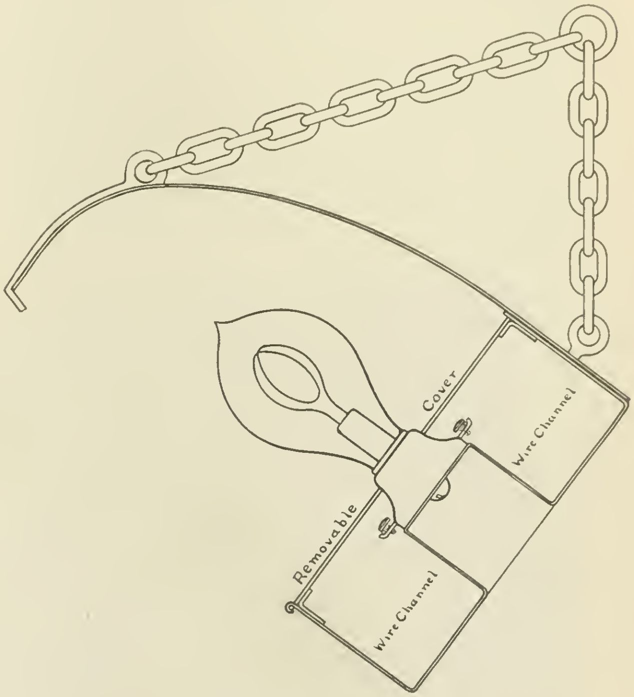


FIG. 2.—SECTION OF BORDER LIGHTS.

Each dressing-room has a swiveled mirror, lighted by two side lights, there being also bracket lights. In the dressing-room used by Mrs. Leslie Carter is a pier glass, with three sets of lights in three colors, permitting the effect of colors upon the make-up to be determined. The dressing-rooms have also electrical curling irons, and electrical paint-warming plates. The red fire escape lights are, of course, connected back of the main distribution center and not controlled by the main switch. A telephone system of nine stations connects all parts of theatre with the box office, including the main office on the third floor.

The stage board, which is the important feature of the installation, is elevated about 9 ft. from the stage floor and located nearly against the proscenium wall; in fact, just far enough from the wall to permit of access behind. The elevation of the board prevents blocking the first entrance, and there seems to be no disadvantage in so placing it, providing, of course, that the board is so planned as to permit a single operator to easily control all circuits from one position. The gallery upon which the board is placed allows ample room for the operator, and the elevation often affords him an unobstructed view of the borders and foots, which could not always be obtained were the board on the stage floor. His duties occupy him constantly at the board and he is not troubled with the necessity of climbing up and down since everything is at hand at the board. One advantage gained is that the operator has his own place entirely to himself, and is not crowded by the many who are often awaiting their cue at the wings.

The stage board controls all auditorium circuits, including gallery and balcony lights; also all stage circuits in all colors, including dressing-rooms, entrances, etc. The stage has four borders, and there are also eight bunch pockets for bunches and strips, which pockets are, of course, let into the stage floor. There are also twenty-four stage outlets in the floor and on the bridges for arc lights, or as they are more familiarly known, electric calciums

The arc outlets as well as the bunch pockets are independently controlled from switches on the stage board and the bunch pocket circuits are also supplied with dimmers.

The footlight pan is so designed as to prevent the lights being observed even by those in the boxes, which are unusually near the stage. Fig. 1, a section across the footlights, shows the general arrangement. As will be noted the lights are arranged in two rows, the back row containing 50 red lights and 50 blue lights, and the front row containing 75 white lights, or more properly speaking, amber lights, since all white lights both in auditorium and on stage are dipped to a light amber to avoid the harshness of white lights.

All of the sockets are so arranged as to give the lamps a backward rake to throw the greater portion of the light in the desired direction. The back of the footlight pan and shield acts as a reflector. It may be noted also that the row of colored lights is somewhat higher than the white lights to avoid interference. A 9 in. shielding overhang effectually cuts off all light from the auditorium and boxes. The inclined apron in front has a drip to carry off any water that may run down from the stage when the floors are washed.

Fig. 2 shows a section of a border. A galvanized iron box is formed into a double channel having a flat space between, upon which the sockets are mounted. The two troughs so formed carry the wires. The three colors of lights are arranged in a single row in alternate colors, 50 white, 50 red and 50 green, each color three-wire. A removable metal cover protects the wires and sockets. On the top of the first border is a footway, permitting an operator to stand there to produce special mechanical or lighting effects. Double reflecting partitions between each pair of lamps aid in the proper distribution and prevent undesirable reflections between the different colors. The borders need not be tied off in position, as they are counterbalanced, and they are easily operated by one man.

Movable strips are provided, 24 in all, for side lighting. These are and switches. The strips are extremely substantial, and carry the lamps in a vertical position instead of presenting the lamps end on, as so often occurs. The bunch lights are of the usual construction, with eight lamps and a reflector mounted upon an adjustable stand.

On each side of the stage are located four bridges for electric calciums. These bridges are easily accessible from the stairways and don't require ladders to reach them. They are also well located to meet any requirement. The dressing-rooms have entrances off of landings on the stairways, two from each landing.

The controlling stage board is shown in Fig. 3. There are two white Italian marble panels, the left one containing 16 branch circuit switches for house branch circuits, all three-pole, back-connected. It carries also two operating levers for the two house dimmers, a main house switch shown in the extreme lower left hand corner, and a main stage switch shown adjacent thereto. The fuse arrangement is particularly worthy of notice. There are used on all branch circuits "Noarc" enclosed plug fuses. These are let into the face of the board, screwing into a special back connected receptacle. One pole of this receptacle forms a copper link directly connected to the clip side of the adjacent switch arm. The other pole forms a somewhat longer copper connecting bar making direct connection with a set of horizontal busses. A better idea of the arrangement of fuses can be gained from Fig. 4, which is a sectional view of switch and fuse receptacle. The extreme directness in connection from horizontal bus through fuse to switch is evident. It will be noted also that on this panel there are four sets of horizontal busses, all being fed from a single set of vertical busses from the main house switch, necessary enclosed arc fuses being interposed between the switch and the service. These fuses, not shown on the face of the board, are readily accessible at the end of the board. This panel measures approximately 33 in. in width and 75 in. in height, having a thickness of 1½ in. The second panel measures 81 in. in width and 75 in. in height, and contains all stage circuit switches and dimmer levers for these circuits.

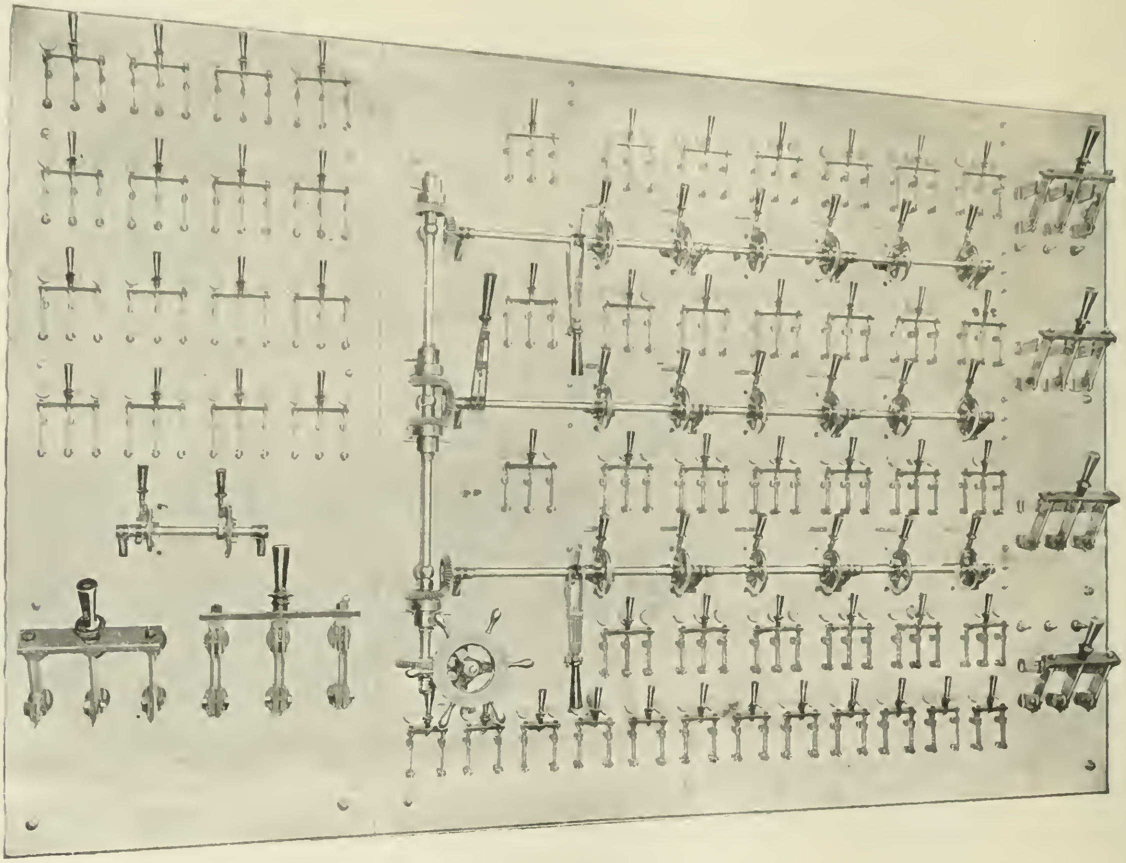


Fig. 3.—Controlling Stage Board.

There will be noted in the illustration three horizontal interlocking dimmer shafts, each with six individual dimmer levers and a master lever. Referring to these six levers, from left to right on the top shaft, which is for controlling white lights, they are marked as follows: Bunch No. 1, foots white, border No. 1, border No. 2, border No. 3, border No. 4. Referring to the second or middle horizontal interlocking shaft the six dimmer levers control the following dimmers: Bunch No. 1, foots red, border No. 1, border No. 2, border No. 3, border No. 4. Lastly the bottom shaft controls the following dimmers: Bunch No. 3, foots blue, border No. 1, border No. 2, border No. 3, border No. 4. Fig. 5 shows the dimmer mechanism more in detail with three positions of a single dimmer lever, which may be briefly described as follows: On the back of the board is located a dimmer plate. On the face of the board, the operating dimmer lever, the interlocking mechanism, the master lever and the interlocking shaft. On the interlocking shaft is a loose sheave connected by means of a very flexible steel cable to a smaller sheave rigidly attached to the shaft of the dimmer plate. This latter shaft also carries the dimmer switch. The lever and handle are attached to the loose sheave for operation of this dimmer switch independently of other dimmers. A slotted cam permanently attached to the interlocking shaft near each loose sheave engages with a spring plug on the corresponding dimmer lever (providing the lever handle is so turned as to permit of such engagement). By giving the handle a quarter turn the spring plug is disengaged from the cam and the lever is free to move, thereby allowing the operator to raise or lower the lights controlled by that particular dimmer, irrespective of the others. In this way any circuit may be controlled independently of all other circuits.

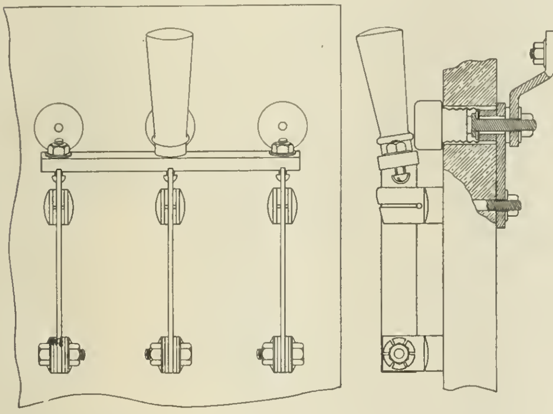


FIG. 4.—SECTIONAL VIEW OF SWITCH AND FUSE RECEPTACLE.

If, however, it is desired to operate several of the dimmers on one interlocking shaft at one time, the corresponding lever handles are not turned. For example, this board has on the white light shaft dimmer levers for bunch lights, foots, borders, Nos. 1, 2, 3 and 4. It may be necessary to lower only the foots, the first and third borders. To do this, the operator leaves the handles of these dimmers so turned as to permit of engagement with their respective cams. This interlocking shaft operates by means of its master lever, and the desired dimmers will be picked up by their cams in whatever positions they may have been left, and the corresponding lights raised or lowered simultaneously.

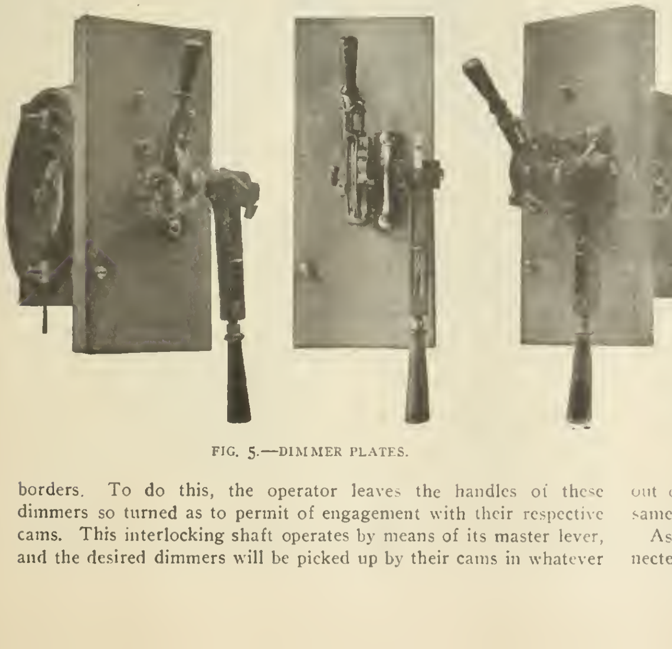


FIG. 5.—DIMMER PLATES.

In this installation the dimmer plates were not located directly back of the board as shown in Fig. 5, but some distance above the board and against the proscenium wall (Fig. 6). The steel operating cables passing over idlers go direct to these dimmer plates. In many instances it is found advisable to mount the bank of dimmers beneath the stage floors, in the basement. In this instance, however, there was ample room against the proscenium wall and the presence of the numerous arc light bridges and stairways made them readily accessible. This bank of dimmer plates including in all twenty dimmers, is mounted on slate, the opposite polarities being carefully insulated. This arrangement insures against any general disablement of the dimmers due to accident.

Referring to Fig. 3, there will be seen a vertical gang shaft provided with mitre gears and friction clutches, also a worm gear operated by a pilot wheel for slow motion. As will be noted, the middle horizontal interlocking shaft for red lights has a double set of friction clutches and mitre gears, enabling this shaft to be run in opposition to either the white or the blue lights or enabling it to be run in the same direction as either of these. It will be also noted that the mitre gears on the white or top shaft are in a reversed position with those on the blue or bottom shaft, thereby permitting these two shafts to be run in opposite directions. This combination of gears secures all desired combination of colors, and the use of friction clutches instead of positive clutches enables any one or more of these horizontal shafts to be thrown into or out of operation at any time, and without stopping the motion of the vertical gang shaft.

Adjacent to each dimmer lever there is a three-pole back-connected knife switch, fused with enclosed arc plug fuses directly above the switch. This fuse arrangement is the same as referred to on the house panel for branch circuits. All branch circuit switches including the 39 branch stage switches are of 75 amp capacity, not because of any electrical requirement, but simply to gain the necessary mechanical strength. These switches are thrown in and out suddenly several times each night, and often handled without much regard to their safety. It has been learned by experience that a small switch is useless in such cases. All switches were made by the Frank Adam Electric Co., St. Louis, Mo. In each instance the switch that is adjacent to a dimmer lever controls the same circuit. We find, therefore, all together, the fuses, the dimmer and switch for any one circuit. Comparing this with the usual method of having a fuse panel for all branch fuses, it would seem that in case of trouble this arrangement is far superior. You don't have to hunt around amongst a lot of fuses wondering which one belongs to the circuit you are after, nor do you in your haste put your screw driver across another one and blow that, too. In case of trouble on any circuit, the fuse can be quickly removed and examined or a new one inserted. If there is any question as to whether the line is alive, the operator can place a finger across the fuse receptable terminals and find out. The master lever on each shaft referred to above, when not in use, may be thrown into a clip on the board and kept entirely out of the way. They interlock on the interlocking shafts in the same manner as do the individual dimmer levers.

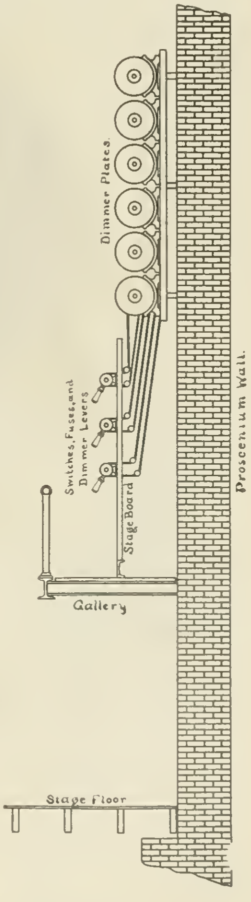


FIG. 6.—ARRANGEMENT OF DIMMER PLATES.

As indicated on the house panel, these fuse receptacles are connected on the one side to the branch circuit switch clips and on the other side to horizontal bus bars. There are, therefore, five sets of horizontal bus bars feeding from a set of vertical bus bars through the breakdown switches shown on the extreme right of the board. The function of these switches is to permit of a dark change, that is, a sudden change, from one set of one color of lights to perhaps a different set of a different color of lights. The top breakdown switch feeds all white light circuits on the stage through the above mentioned horizontal bus bars. The second breakdown switch feeds the red lights and in the same manner the third feeds the blue lights. The bottom breakdown switch feeds two sets of circuits, one the branches, dressing rooms, fly galleries, etc., from the lower row of three pole switches, the other the arc outlets on the stage from the 12 two-pole arc switches. The necessary enclosed arc fuses are interposed between the main feeders and the breakdown switches. These are readily accessible from the right end of the board. The entire board is enclosed in a case with sliding front.

This is the first time in the history of stage lighting, to the writer's knowledge, that a theatre board has been designed and planned with the idea of simplifying the wiring and circuits to the utmost. The usual method is to place below the stage panel a separate fuse panel, and wire everything from the service to the fuses, from the fuses to the switches, and from the switches to the circuits. This invariably produces a confusion of wires and circuits in the back that is simply appalling if any trouble necessitates tracing out a circuit.

Stepping behind this board, however, it will be noted that there is absolutely no wiring from the service to the hinge side of the branch circuit switches, and from this side a wire leads off in a direct manner and without confusion to the proper circuits. These wires are run in circular loom conduit to the point overhead where they reach the iron conduit. All bus-bar work has ample capacity for an enormous overload. All switches are equally capable of taking care of a heavy overload. The entire stage board was designed and manufactured by the Wirt Electric Company, of New York City.

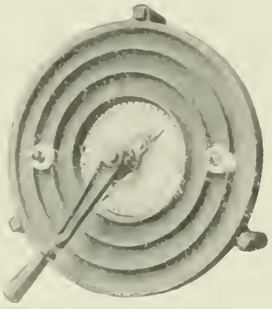


FIG. 7.—SINGLE DIMMER PLATE.

A word might be interesting as to the type of dimmer used in this installation. Referring to Fig. 7 is shown a single dimmer plate. It is supplied, however, with a sheave instead of the lever indicated, and requires less than a half revolution on the shaft in order to cut in or out the entire number of 50 steps. One interesting feature in the construction of this dimmer is that not only are the resistances in the individual steps graded in a manner to secure imperceptible jumps in the lights, but the contact points from which the switch carries its current are also graded to secure a uniform rating in ampere capacity per square inch of brush contact. The brush is of the laminated type, insuring a good contact with a light pressure. It was endeavored to give every dimmer ample capacity, and avoid the trouble usually arising from the almost inevitable overload that a dimmer gets some day when it is required to carry an unusual load to produce some novel lighting effect. The many other electrical features are perhaps not of general interest or at least offer nothing special or novel in the way of electrical work. It might be interesting to state that the entire installation was so carefully planned and executed that neither the fire underwriters, the city department nor the New York Edison Company required a single change.

Switchboard Circuit Breakers.

The General Incandescent Arc Light Company, having occasion to use a great number of circuit-breakers on its various installations, has made a thorough study of the principles of circuit-breaking. For example, the matter of using laminated contacts for carrying the current, a very small portion of which passes around the shunt to prevent the arcing at the laminations when the circuit was open, seems a simple thing to accomplish, and yet up to recently there has been more or less arcing at laminations. As the result of experiments, it was found that the trouble did not lie in the laminated contacts themselves, but existed in the method of shunting the current around them when the circuit was opened. It was discovered that to do this effectively, it is necessary to have a shunt of very low resistance, and this implied a metallic shunt supplemented by a carbon shunt, the circuit being successively opened, first, by the laminations and then by the metallic shunt, and then finally by the carbon shunt.

One of the advantages of laminated contacts over those of the knife blade principle is that every portion of the surface of contact is made available for carrying current, whereas in knife blade contacts the surface of contact is very much less than the total surface available. This defect in the knife blade contacts is simply due to the fact that two plane surfaces cannot touch each other at all points, unless they are ground absolutely true to a plane surface, which is impracticable, both commercially and owing to the flexibility of the clips and the heating of the parts tending to destroy perfection of contact.

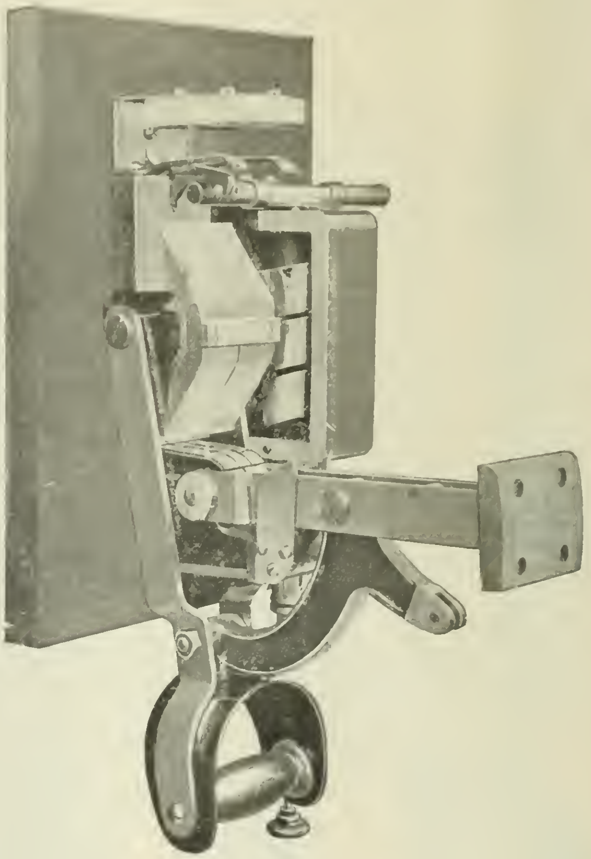


FIG. 1.—SINGLE-POLE SWITCH.

Another advantage of laminated contacts is that they always exert an effort to release themselves and thereby open the circuit, whereas the knife blade contacts tend to hold themselvs shut, often requiring a very strong initial hammer blow or effort to overcome what might be called the "friction of rest." The laminated form of contact on the other hand requires no effort of any kind, much less a hammer blow to start it to open the circuit. The General Incandescent Company has, therefore, adopted the laminated form of contact exclusively in all of its circuit-breakers of whatever sizes, ranging from 25 amp up to 12,000 amp. Fig. 1 shows a 2,000-amp, single-pole switch and Fig. 2 an 800-amp, double-pole. The General Incandescent circuit-breaker has its laminations mounted entirely independent of the rest of the apparatus, so as not to be a drag on the moving parts, the laminations being supported on a bearing which is equipped with a spring assisting to throw the laminations open.

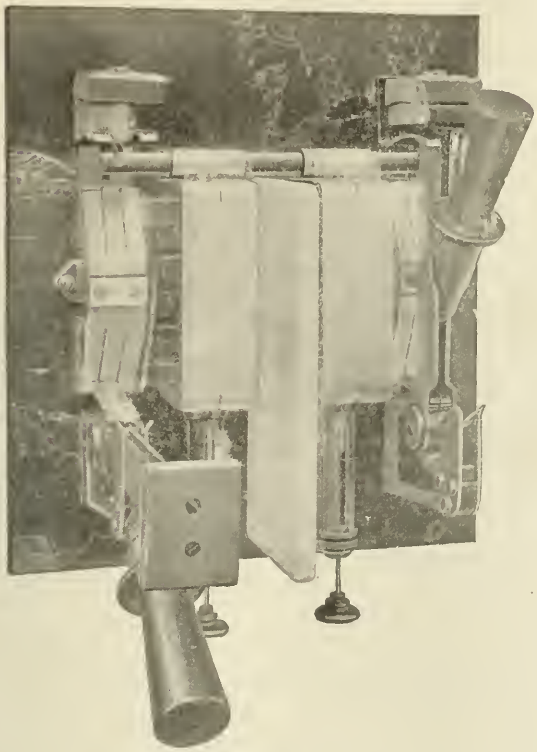
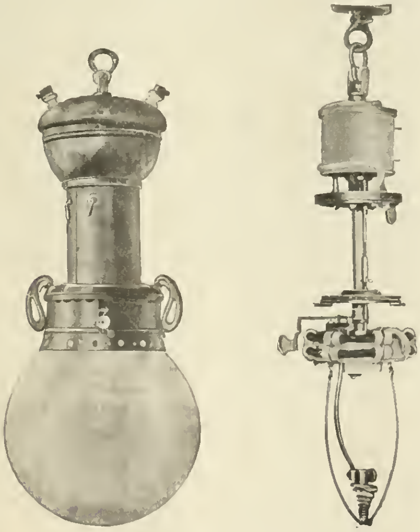


FIG. 2.—DOUBLE-POLE SWITCH.

The device is held closed by means of a latch, which is practically frictionless. When the circuit-breaker operates, the latch is released with a minimum pressure.

Interchangeable Arc Lamp.

The Osborn-Morgan Company, Cleveland, Ohio, will make a feature of a constant-potential interchangeable arc lamp. The change from direct to alternating-current work can be effected without any changing of parts, a feature which will readily be appreciated by central station managers, since it necessitates the use of but one style of lamp for all circuits.



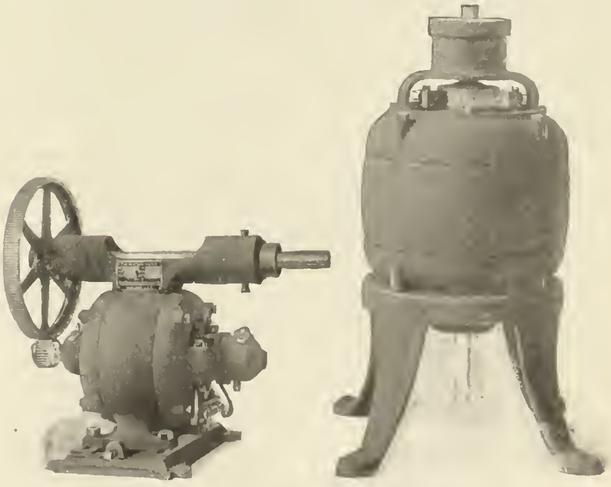
FIGS. 1 AND 2.—ARC LAMP.

The lamp is of the enclosed type and the case, which is thoroughly weather proof, is made of sheet copper of sufficient thickness to insure stability and strength, so that the lamp may be used for outside as well as for inside work. The body of the case is composed of two doors, which may be thrown open by turning a latch, thereby exposing to view the entire working mechanism and making accessible all parts of the lamp. The clutch is of a simple ring type working directly upon the carbon. The portion in direct contact is of special insulated material insuring a steady clutch hold and freedom from burning out. Flexible cable contact is in use, thereby eliminating sliding contacts.

The actuating mechanism is a laminated horseshoe magnet in the head of the lamp, at a safe distance from the heat of the arc, which performs the functions of the customary reaction or choke coil of the alternating lamp and the solenoid in the direct-current lamps. It is claimed that it works equally well under any variation of voltage from 16,000 to 6,000 alternations per minute. Between the poles of the choke coil is the dash-pot and directly below this a laminated armature attached to the dash-pot plungers. The connection from armature to clutch contains a flexible member in the form of an asbestos tube, which prevents the vibrations of the alternating current from reaching the clutch and thereby jarring the carbon loose. A double-throw switch situated on the porcelain base changes the lamp from alternating to direct, or cuts the current off entirely. The resistance wire is coiled around the porcelain base of the lamp, in the path of a current of air, as shown in Fig. 2, thus insuring good ventilation. It is removable without disturbing other portions of the lamp. The lamp is claimed to be simple, efficient and economical in operation and noiseless on either class of circuit.

Watson Ball-Bearing Motors.

The Mechanical Appliance Company, of Milwaukee, has recently brought out a line of back-geared, vertical, ball-bearing motors in sizes ranging from 1/8 to 3 hp. The most prominent feature of these motors is the adoption of ball bearings, which not only decrease friction and increase efficiency and durability, but eliminate the objections heretofore held against ordinary vertical motors on the score of the impracticability of oil lubrication, there being no way to prevent the oil used for lubricating the top bearing from leaking onto the commutator and armature, thereby ruining the insulation. In these new motors the field frames are made of a special cast dynamo steel and are provided with a solid cast pole shoe. Each piece is machined at one operation to insure accuracy and interchangeability. The armature is of the form-coil ventilated type, thereby reducing the liability of heating to a minimum. Fig. 1 shows the standard back-geared motor, which is built on five frames, giving 20 different horse-powers at different speeds on all three voltages, namely, 110, 220 and 500. Speed reductions are obtained from five to one. Fig. 2 shows the vertical motor, which is built on four different frames of various speeds and for voltages from 110 to 500.



FIGS. 1 AND 2.—BALL-BEARING MOTORS.

NEWS OF THE WEEK.

THE WEEK IN WALL STREET.—Money hardened materially during the week, closing at 5 a 5¼ per cent. for 60 to 90 days, and 5¼ to 5½ per cent. for four, five and six months. In the stock market there was some activity, but the course of prices was generally toward a lower level, due to the disappointment over the failure of the Aldrich bill and the advance in the rates of money. The traction stocks showed some independent strength, as a result of the increased dividend declared by the Manhattan directors, the increase being to 1¾ per cent., which, together with an extra dividend of 1 per cent., places the stock upon a 7 per cent. basis. At the same time, Manhattan, although vigorously supported, shared in the general depression, and while inclined to improve sold off with the rest of the market. The announcement of the United States Steel bond issue fell rather flat, and the bonds which the preferred stockholders are invited to subscribe for at par sold at below 90 in the outside market. Metropolitan Street Railway showed some strength, and an effort to advance Brooklyn Rapid Transit, based on a report of an increase in its earnings, found little support. On Saturday prices in the general market broke heavily upon the publication of the bank statement, which was generally interpreted as a very weak showing. The entire list became depressed on average declines of from 1½ to 3 points. In the tractions Brooklyn Rapid Transit closed at 65½, being ¼ higher than the lowest price of the week, and representing a net decline of 1⅞ point. Metropolitan Street Railway closed at 135 after having reached 134⅜, the lowest, and 137 the highest, being a loss of 1¼ point. General Electric lost 4½ points net, closing at 190½, the range of prices being 190, the lowest, and 197½, the highest. Western Union fell off 1 point, closing at the lowest figure—38½. American Telegraph & Telephone closed at 168¼, being a loss of ¼ point. In Boston this stock showed a decline of 3 points for the week. Following are the closing quotations of March 10:

NEW YORK.

	Mar. 3.	Mar. 10
American Tel. & Cable	83	80
American Tel. & Tel	168	163
American Dist. Tel	37	37
Brooklyn Rapid Transit	66⅝	63⅞
Commercial Cable	..	.
Electric Boat	20	21
Electric Boat pfd	35	30
Electric Lead Reduction	2⅞	2¾
Electric Vehicle	3¾	8
Electric Vehicle pfd	11	13¼
General Electric	193½	190¼
Hudson River Tel.	..	..
Metropolitan St. Ry.	135⅛	132⅝
N. E. Elec. Veh. Trns.	⅛	.
N. Y. & N. J. Tel.	166	..
N. Y. E. V. T. Co.	9½	9
Tel. & Tel. Co. Am	.	..
Western Union Tel.	89	88¼
Westinghouse com	200	195
Westinghouse pfd	225*	200

BOSTON.

	Mar. 3	Mar. 10
American Tel. & Tel	167	163¾
Cumberland Telephone	.	.
Edison Elec. Illum.	295	..
General Electric	194	192½
Western Tel. & Tel	23	23
Western Tel. & Tel. pfd.	99½	99
Mexican Telephone	2⅛	2⅛
New England Telephone	137	138
Westinghouse	102	100
Westinghouse pfd.	102	102

PHILADELPHIA.

	Mar. 3.	Mar. 10
American Railways	50¾	50
Elec. Storage Battery	.	..
Elec. Storage Battery pfd.	81*	.
Elec. Co. of America	9⅝	8⅞
Phila. Traction	99⅝	97
Phila. Electric	7⅛	6⅞
Pa. Electric Vehicle	..	..
Pa. Electric Vehicle pfd		

CHICAGO.

	Mar. 3.	Mar. 10
Central Union Tel		.
Chicago Edison	159	159
Chicago City Ry	217	210†
Chicago Tel. Co	155	..
National Carbon	21	24
National Carbon pfd	96	96
Northwest Elev. com.	29	..
Union Traction	9½	9½
Union Traction pfd.	42½	42

*Asked. † Ex Dividend.

CONSOLIDATION IN NEW JERSEY.—A certificate consolidating eight South Jersey gas companies, under the name of the South Jersey Gas, Electric & Traction Company, has been filed with the secretary of state. The consolidated company has an authorized capital stock of $6,000.000 and by the terms of the merger is to issue at once $9,000.000 of bonds for the retirement of stock and bonds of the merged companies. Most of the concerns forming the consolidated company are gas companies, but the Stockton Electric Light & Power Company is included in the deal. The officers and directors of the new company are: President, Anthony R. Kuser, of Trenton; vice-president, William J. Bradley, of Camden; secretary, Forrest F. Dryden, of Newark; treasurer, Charles G. Cook, of Trenton. Directors—Attorney-General Thomas N. McCarter and Uzal H. McCarter, of Newark; Barker Gummere, Jr., Henry C. Moore, Richard Stockton, Jonathan H. Blackwell, ex-Judge Robert S. Woodruff and State Treasurer Frank O. Briggs, of Trenton; John J. Burleigh and Charles Watson, of Camden; John L. Kuser, of Bordentown; William J. Thompson, of Gloucester; Herbert W. Johnson, of Merchantville; Frank Bergen, of Elizabeth; Thomas C. Barr, of Orange; Stephen Peabody, of New York, and Robert C. Pruyn, of Albany.

DIVIDENDS.—Manhattan Elevated directors have declared a quarterly dividend of 1¾ per cent. and an extra dividend of 1 per cent. The last dividend declared was 1½ per cent. The Manhattan dividend of 1¾ per cent. covers the quarter ending March 31 and the extra dividend of 1 per cent. will be paid out of surplus earnings from nine months ending March 31. Both dividends are payable April 1st. The extra dividend on Manhattan will be paid out of the earnings of the past nine months. The dividends of Manhattan for the past nine months have been as follows: September, 1 per cent; December, 1½ per cent.; March, 1¾ per cent., and 1 per cent. extra, making a total of 5¼ per cent. It is probably the intention of the directors to declare 1¾ per cent. in June, making the total for the year 7 per cent., which is the dividend guaranteed under the sale to the Interborough Company. At a meeting of the directors of the Commercial Cable Company the old officers were re-elected and a quarterly dividend of 2 per cent., an increase of ¼ of 1 per cent., was declared, placing the stock on an 8 per cent. annual basis. The regular quarterly dividend of 1½ per cent. on West Chicago Street Railway guaranteed by Union Traction, will be paid April 15.

INTERSTATE RAILWAYS COMPANY.—The recent elected board of directors of the Interstate Railways Company have organized by the appointment of John A. Rigg president in the place of Frank O. Briggs, Joseph L. Caven vice-president and Remi Remont secretary and treasurer. President Rigg says: "The taking over of the United Power & Transportation Company by the Interstate Railways Company was practically a reorganization enabling us to bring in new blood and fresh capital. The Interstate Company will now proceed to build one after another, the 22 ripper electric railway charters which the United Power & Transportation Company secured under the act of 1901. Work is being done on two of them now. These 22 charters cover together a very considerable stretch of territory in New Jersey and Pennsylvania, all tributary to Philadelphia." The United Power & Transportation Company, which has recently been taken over by the Interstate Railways Company, shows the year ending December 31, 1902, credits of $899,643 and debits of $633,658, showing a balance to the credit of income account of $265,984.

NORTH AMERICAN STOCK.—Circulars have been issued to the stockholders of the North American Company, notifying them of a proposition to increase the capital stock of their company from $12,000,000 to $17,000,000. The purpose of the stock increase, according to the words of the circular, is "to pay for the stock of the Laclede Gas Light Company, of St. Louis, which the North American Company has purchased, and to enable the company to extend and increase its investment and interest in gas and electric lighting business in St. Louis and elsewhere." The project to increase the capital by $5,000,000 has received the approval and recommendation of the Board of Directors of the North American Company. The new stock will be offered at par to the stockholders as soon as it is authorized.

KINGS COUNTY ELECTRIC.—It is believed that a consolidation of the Brooklyn Union Gas and the Consolidated Company is bound to come. The first step is to get the gas and electric companies of Brooklyn under one control and from indications an effort is being made at the present time to accomplish this end. It is thought that within a comparatively short time, the Kings County Electric Light, Heat & Power Company will pass under the control of Brooklyn Union Gas and that there will be some developments in this direction at the special meeting of the Kings County Electric stockholders' meeting later in the month.

LOUISVILLE LIGHTING INTERESTS.—As forecasted in this department in our issue of February 21, the directors of the Citizens' Lighting Company, of Louisville, and those of the Louisville Electric Light Company, have resolved to consolidate these two corporations. The new company will be known as the Louisville Lighting Company, and will have a capital stock of $3,000,000. and $4,000,000 in bonds. Stock to the amount of $2,800,000 and bonds in the sum of $2,500,000 will be issued when the company is organized.

SYRACUSE LIGHTING.—Application has been made to the New York Stock Exchange to list Syracuse Lighting $2,000,000 1st mortgage 5 per cent. bonds of 1915; $1,000,000 5 per cent. non-cumulative preferred stock; $3,000.000 common stock.

ELECTRIC STORAGE BATTERY STOCK.—Application has been made to the New York Stock Exchange by the Electric Storage Battery Company to list $4,500,000 preferred stock and $11,749,400 of common stock.

LIGHTING INTERESTS ON THE PACIFIC COAST.—It is understood that Stone & Webster, of Boston, who own or control nearly all of the electric lighting interests of the Puget Sound cities, are in the field for the control of the San Francisco lighting situation. A bond issue and perhaps a pooling arrangement are contemplated. Kidder, Peabody & Co., of Boston, are also interested in the consolidation, and the Seligmans, of New York, are expected, it is said, to finance the deal. It is supposed that the California Gas & Electric Corporation, which is the latest merger company of the capitalists composing the Bay Counties Power Company, will work in harmony with the syndicate in the consolidation. They own a dozen or more electric and gas plants in various parts of California. The Standard Electric Company, which has the long-distance water power transmission line furnishing power to San Francisco, will probably be taken over. The Spreckels plants cost about $5,000,000, and it is thought, will be taken in at an advance on this figure. The San Francisco Gas & Electric Company's plants were valued last year at about $11,000,000 by its officials and at $14,000,000 this year, though local engineers say they are not now worth more than $6,500,000 owing to depreciation with age, etc. While certain capitalists seem disposed to ignore the Mutual Electric Light Company in the consolidation, their competition would be a serious matter if their plant were not absorbed. It represents an investment of $600,000 in a paying plant and $400,000 in contracts for a new plant, which is to be installed this year. D. O. Mills and P. B. Cornwall, who are the principal owners, have their own coal mines, although they are now burning crude oil; and they are supposed to be ready for a fight if necessary. The combined earning capacity of the San Francisco lighting plants under favorable conditions is estimated at $30,000,000 per year, and about $5,000,000 should be realized in profits. At present scarcely any profits are being realized over the cost of repairs and extensions needed to keep pace with the growth of business induced by competitive rates. It costs about 3 cents per kw-hour to produce electric current. The legal maximum price is 5 cents.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports received from Eastern and Western trade centers indicate that business is ahead of last year's and still expanding, and this satisfactory condition of things is confirmed by the largest February bank clearings on record, and the enormous gross railway earnings returns. Southern trade and crop preparations are somewhat retarded by heavy rains and rising rivers, but in spite of this influence receipts of cotton are heavier than a year ago. Special activity is noted by jobbers in all lines of wearing apparel. Active preparation for a heavy season's building is indicated by a large demand for material. There is also a stronger tone in iron and steel, finished products being in increased demand. A large business has been done in rails, structural plates, sheets, wire and tin plates. Structural material is very active, and the announcements of proposed large improvements to mills in the Pittsburg district create a very favorable feeling in that section. Foreign iron and steel are notably firm in price. Copper has made further advances in price, but consumers have stood aside without buying. Some little surprise is expressed at the duration of the present "boom" in prices. The closing quotations are: Lake and electrolytic, nominally 13½ a 13¾c., casting stock, 13.30 a 13.60c., and Standard 13c. Exports of copper during February were very small, and during the first two months of the year the decrease in the exports amounted to 10,312 tons, as compared with those of the corresponding period of last year. The number of business failures during the week ending March 5, according to *Bradstreet's*, numbered 171, against 185 the week previous, and 204 the corresponding week last year.

WIRELESS OUTFIT FOR ERIN.—Sir Thomas Lipton's steam yacht *Erin* will be equipped with a wireless telegraphy outfit for use during the international races this summer. The De Forest Wireless Telegraph Company wrote to Sir Thomas recently, suggesting that a wireless apparatus be placed on the yacht, so that, with the five stations of the company, including the one at 17 State Street, the *Erin* could remain in communication with shore during the whole race. Sir Thomas's cablegram, which was received last week at the offices of the company, was as follows: "Your letter 20th received. Will be pleased to arrange for De Forest wireless telegraphy on board *Erin*, as offered." In regard to this a cable dispatch from London of March 6 says: The Marconi Wireless Telegraph Company announces, apropos of the intention of Sir Thomas Lipton to allow the De Forest Wireless Telegraph Company to install its system on his steam yacht *Erin*, for use on the voyage across the Atlantic and during the races for the America's Cup, that it will sue the De Forest Company for infringements.

BRITISH EQUIPMENT FOR LORENZO MARQUEZ ROAD.—Everything, with the exception of a few odds and ends in connection with the equipment, etc., of the Lorenzo Marquez (Portuguese East Africa) electric traction system, will be purchased in England, considerably more favorable quotations and quicker deliveries having been offered on the other side than in the United States. The contract for the construction and equipment of the road was recently awarded to the British electrical engineering and contracting firm of Macartney, McElroy & Co., Ltd. The value of the contract is about $2,500,000. The initial length of the road will be 15 miles. No. 00 trolley wire will be used. The cars will be single-deck, somewhat similar to the summer ones which are operated on the Metropolitan Street Railway. Single trucks will be employed. The motors will be of double type, two of 25 hp or 30 hp each. The equipment of the power house will include two generators of 200 kw capacity each, for direct connection to high-speed engines.

GERMAN STRUCTURAL MATERIAL FOR THE UNITED STATES.—The General Supply & Construction Company, whose New York offices are in the Maritime Building, has recently placed several orders abroad—in Germany principally—for structural material for use in various buildings throughout the United States, European terms both as regards prices and deliveries being much better than those which at present exist on this side. About 600 tons of steel will be imported for use in the construction of the new Social Hall, Clinton Street, New York. The Norman Street School and the Lovejoy Wharf, now under construction in Boston, will also be built with German structural material. Six hundred tons will also be used for the extension of the St. Charles Hotel, New Orleans, La. European steel has also been ordered by the General Supply & Construction Company for utilization in two buildings under erection in Cuba.

WELLINGTON (NEW ZEALAND) TRACTION CONTRACT.—American manufacturers submitted figures, through the New York offices in the Havemeyer Building of the British electrical engineering and contracting firm of Macartney, McElroy & Co., Limited, London, for part of the equipment required to fill the contract valued at $650,000 secured by that firm for the Wellington (New Zealand) municipal electric traction system. Prices were obtained on this side for the initial car equipment which will consist of 12 double and a similar number of single cars to be furnished with single trucks, eight combination cars with double trucks, one track-cleaning and sweeping car and a freight truck. Quotations were also obtained in the United States for the overhead equipment. The power house equipment will be purchased in England. High-speed engines have been requisitioned for.

ANOTHER BIG BRITISH CONTRACT LOST TO AMERICANS.—Owing to more advantageous prices and better terms of delivery having been secured from British manufacturers, the important contract for the electrical equipment of what it is claimed will be the largest newspaper printing plant in the world will be placed on the other side. The contract refers to the new London plant of Edward Lloyds, Limited, which publishes the *London Daily Chronicle* and *Lloyd's Weekly*. George W. Mascord, the chief engineer of the concern, was in the United States for several months last year looking into the matter of equipment. The printing presses will, however, be of American manufacture, Robert Hoe & Co., 504 Grand Street, having secured the contract, which is valued at nearly three-quarters of a million dollars.

AUTOMATIC TELEPHONES FOR GERMANY.—The Automatic Electric Company, of Chicago, states that it has received an order for immediate delivery from the Imperial Telephone Exchange, which is managed by the Postal Department of the German Government, for 1,070 automatic telephones and switches to be used in extending the automatic telephone service in Berlin, the German capital. The exchange which is to be enlarged has been in operation since May 20, 1900. It was built by the American company and operated until July, 1901, under the auspices of German telephone engineers, at which time it was purchased by the government.

CHATTANOOGA LIGHTING IMPROVEMENTS.—The Chattanooga Light & Power Company is to put up a new power building to cost $17,000 and will install steam turbine capacity of 3,000 hp, with new boilers giving steam at 200 pounds pressure. A stack 200 ft. high will be erected, with an interior diameter of 10 ft. The various improvements are to cost $250,000. Mr. W. E. Boileau, of the General Electric Company, will be in charge of the installation of the electrical equipment, including a 30-panel switchboard.

THE NERNST LAMP COMPANY, of Pittsburg, having secured patents and selling rights in Canada, is now making arrangements for establishing a factory in the Dominion for the manufacture of its product. This move is not only necessary in order to conform with the Canadian laws of commerce, but is also advisable in order to meet the rapidly increasing demand for this lamp.

TELEPHONY IN PHILADELPHIA.—The Bell Telephone Company, of Philadelphia, celebrating its twenty-fifth anniversary, reports over 40,000 telephones connected in Philadelphia alone and 15,000 more in Camden. The increase in the past year was due to the new departure made by the company in installing residence telephones free of cost, and charging for each outgoing call simply. The basis on which the opposition Keystone Telephone Company entered the field was at rates one-half those of the Bell. It reports 8,700 telephones connected in Philadelphia and 1,100 in Camden, N. J. The comparative figures of capitalization, telephones connected, etc., show:

	Bell.	Keystone.
Capital stock, preferred	$12,000,000	[illegible],000,000
Capital stock, common		[illegible],000,000
		10,000,000
Dividends (8%)	960,000	[illegible]
Tels. connected, Philadelphia	40,000	8,700
Tels. connected, Camden	15,000	1,100

THE WARREN ELECTRIC MANUFACTURING COMPANY has for the past year been expending considerable sums in betterments to its general plant at Sandusky, Ohio. The capacity of its works has been doubled inside of twelve months and a fine new office building has been erected at the corner of Fulton and Market Streets, providing ample space for the various sales departments, engineering and drafting rooms and general business offices. During the past few days orders for machines have been booked by this company as follows: Milford, Mich.; Bremerton, Wash.; Laclede Gas Light Company, St. Louis, Mo. (2); Carthage, Tex.; Williamson, W. Va.; Union City, Ind. (2); Redfield, S. D.; Purcell, Ind. T.; Grand Rapids, Ohio; North Fork, W. Va.; Navarre, Ohio.; Delta, Colo.; Ritzville, Wash.; Somerset, Ky.; Dresden, Ohio; Sanford, N. C. (2); St. Clairsville, Ohio.

THE BISHOP & BABCOCK COMPANY, of Cleveland, is equipping its machine shop for electric driving. The group system has been adopted and short lengths of line shafting throughout the shops are driven by Westinghouse induction motors. Seven or eight of the latter, ranging in size from 10 hp to 40 hp, have been purchased and are now in operation, current being temporarily supplied from the plant of the Cleveland Twist Drill Company, which is also equipped with Westinghouse apparatus. The Bishop & Babcock Company, however, is installing a power plant of its own and has recently purchased a 175-kw, two-phase Westinghouse engine-type alternator, with switchboard complete. George S. Rider & Co. are the engineers for the plant.

IMPORT OF RAW MATERIAL.—The increase in the imports of raw materials of manufactures continues. According to the latest bulletin of the Bureau of Statistics, the value of these imports for the month of January was $42,328,478, which was about $5,000,000, or 14 per cent., more than for the same month of last year. Since the close of the fiscal year the increase as compared with the first seven months of the last fiscal year has been $40,000,000, or over 17 per cent. The total of these imports forms now nearly one-half, over 46 per cent., of all our imports. Up to 1899 the proportion had rarely been more than about one-third of all the imports. The increase since 1899 has been nearly 80 per cent. of the average for the previous ten years.

HUGE ELECTRIC CRANE CONTRACT.—The largest shipbuilding crane plant in the world is to be installed in the Harland & Wolff yards at Belfast, Ireland. The machinery will be operated electrically. The contract has been secured by the Brown Hoisting Machinery Company, Cleveland, Ohio, New York offices, Havemeyer Building. There will be three cantilever cranes having an average capacity of about 20 tons. Each crane will be mounted on a trestle 120 feet high and 600 feet in length. Each machine will operate over two shipways. The motors will be of General Electric and Westinghouse build. The value of the entire contract is about $300,000.

ANOTHER BUENOS AYRES TRACTION PROJECT.—Another electric traction system is to be built in Buenos Ayres, Argentine Republic, the Buenos Ayres Grand National Tramways Company, Limited, which operates the most extensive horse lines iu that part of the world having decided to adopt electricity as a motive power. The company, which has British capital, and London offices at 6 Eastcheap, E. C., operates 48 miles of road and controls the horse section of the Buenos Ayres New Tramways Company, Limited. In the first instance, 30 miles of the joint lines will be connected.

THE LAWRENCE-HALL ELECTRIC COMPANY.—Mr. F. D. Lawrence, formerly president of the Standard Electric Company, Cincinnati, one of the oldest established electrical supply houses in the West, and the firm of the Hall Electrical Supply Company, formerly known as Hubbard, Hall & Co., have incorporated a new company to be known as the Lawrence-Hall Electric Company. Mr. F. D. Lawrence is president and treasurer. Mr. William A. Hall is vice-president and general manager, and Mr. George H. Jones is secretary.

MEXICAN TRANSMISSION PLANT.—R. M. Burke, formerly United States consul in the city of Chihuahua, Mexico, who recently secured a franchise for the construction and operation of an electric power transmission plant in the State of Chihuahua, is about to award contracts in connection therewith. A dam is to be constructed across the Concho River at La Joya. The energy is to be transmitted to the city of Chihuahua, which has about 13,000 inhabitants, and to Parral, which has a population of about 8,000.

MANILA TROLLEYS.—A syndicate consisting of Westinghouse, Church, Kerr & Co., J. G. White Company, of New York, and Charles Swift, of Detroit, made the only bid for the electric street railway and light and power franchises of Manila last week. The syndicate offered 2½ per cent. of the gross receipts of both franchises for 50 years. The syndicate has already absorbed the horse railway. The German electric concern which was interested in securing the franchises withdrew at the last moment.

SERIES ALTERNATING FOR COLUMBUS, OHIO.—One of the most important contracts for series alternating equipment that has been awarded within the United States was recently let by the city of Columbus to the Western Electric Company, of Chicago. This equipment comprises 1,500 series alternating arc lamps complete, and is to be arranged in twenty 75-light circuits. The contract includes transformers, regulators and the entire switchboard for the new municipal plant.

MEXICAN TRACTION PROJECT.—The construction of an electric traction system between Oaxaca and Mitla, Mexico, is projected by Americans. The former place is located in the State of the same name. It has a population of about 30,000. Mitla is situated about 26 miles distant. It has extensive remains of ancient tombs and other edifices and is one of the show places in the Southern Republic. Colonel Hickenlooper, of Columbus, Ohio, is interested in the scheme.

THE ELECTRIC CARRIAGE CALL COMPANY, 1402 Broadway, New York City, has recently installed its apparatus at the Waldorf-Astoria Hotel. Two sets of apparatus are to be installed at the Hotel St. Regis. In Washington the apparatus has been constantly in use by the National Electric Supply Company at the White House, the Congressional Library, the new Willard Hotel and the Arlington Hotel.

MEXICAN LONG-DISTANCE TELEPHONE SYSTEM.—Mr. John Woessner, formerly United States vice-consul at Saltillo, Mexico, has been granted a concession for the construction of a long-distance telephone system throughout the Southern Republic. Work on the line between Monterey and Torreon, a distance of about 300 miles, is already in progress and is expected to be completed by May 1.

CAHALL BOILERS FOR NEW YORK CENTRAL SHOPS.—The Weehawken (N. J.) shops of the New York Central Railroad—contracts for the generators, etc., to be installed in which were noted in these columns last week—are to be equipped with four 500-hp Cahall boilers built by the Aultman & Taylor Machinery Company, of Mansfield, Ohio. The contract was secured by Thayer & Company.

WESTERN ELECTRIC CONTRACTS.—A contract aggregating over 600 kw in generators and over 1,000 hp in motors, was recently awarded to the Western Electric Company by Albert Schwill & Co., Chicago. A 300-kw, 150 r.p.m. generator was recently purchased by the Danville Street Railway & Light Company, Danville, Ill., from the Western Electric Company, of Chicago.

WESTINGHOUSE TURBINES FOR SOUTH AFRICA.—The Westinghouse shops at East Pittsburg have just shipped two steam turbo-generators of 1,000 kw capacity each to be installed in the power plant of the De Beers Consolidated Diamond Mines, South Africa, for lighting the mines and also for supplying current to light part of the town of Kimberley near by.

EQUIPMENT FOR DENVER.—The Denver Tramway & Power Company, of Denver, Colo., is at present placing contracts for equipment to be installed in a considerable extension to its plant. John A. Mead & Co., 11 Broadway, have taken the contract for the coal and ash-handling machinery, which will be capable of taking care of 45 tons per hour.

THE INTERNATIONAL HARVESTER COMPANY, of Chicago, Ill., having found the illumination afforded by the Nernst lamp so entirely satisfactory, has recently placed an order with the Nernst Lamp Company for 150 lamps in addition to the several hundred which are already installed at its plant.

AMERICAN CABLES FOR LONDON UNDERGROUND.—The National Conduit & Cable Company, Times Building, New York City, has secured the contract for the cables to be laid for the extension of the London Central Underground Railway.

General News.

THE TELEPHONE.

SAN FRANCISCO, CAL.—A. E. Smith, who has been in San Francisco for three months endeavoring to obtain a franchise for an independent telephone system, was recently given another hearing by the Public Utilities Committee of the Board of Supervisors, but no action was agreed upon. The cost of an adequate underground telephone system would be between three and four million dollars. Smith, who successfully promoted an independent telephone system in Los Angeles, has good financial backing. The applicants offered no special inducements to obtain the proposed franchise. They are willing to rest their case on the possibility that the city needs a better service than the Pacific State Telephone & Telegraph Company is now giving. There are many ten-party lines in use at present.

CANTON, GA.—J. W. Jarvis has about perfected details for installing a local telephone system in Canton to work in conjunction with the Southern Bell.

CHICAGO, ILL.—The Chicago Telephone Company reports a net gain of 1,180 telephones for February.

LAURA, ILL.—The Northern Millbrook Telephone Company has been incorporated, with a capital stock of $600, by I. M. Stowell, J. A. Shafter and E. I. Barrett.

TUSCOLA, ILL.—The Tuscola Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are Wilbur F. Murdock, F. P. Dowter, G. L. Chapman.

CHICAGO, ILL.—The committee on telephone rates of the Chicago City Council has recommended a schedule based on measured service with a minimum charge. For a single party line the rates recommended run from $60 per year minimum for 600 calls, plus five cents per call for calls in excess of this amount, up to $118, minimum charge for 2100 calls, with three cents per call for all over that amount. For a two-party line the minimum rate for 600 calls is $44, and for a four-party line $28. For a ten-party line the rate recommended is $18, for 300 calls, and five cents per call for all calls above that amount. The adoption of measured service entirely instead of unlimited service is believed by the committee to be the best method of charging and one that will improve the efficiency of telephone service, by doing away with unnecessary use of the telephone.

ANDERSON, IND.—The Anderson & Fall Creek Telephone Company, of Anderson township, has been incorporated, with a capital stock of $4,000, by H. Wertz and others.

LIGONIER, IND.—The Columbia City Home Telephone Company will, during the present season, rebuild many of its lines and install a new switchboard at a cost of over $5,000.

LINTON, IND.—The Linton Home Telephone Company has been reorganized and the capital stock has been increased to $100,000. The company expects to extend its system and greatly improve its service.

DES MOINES, IA.—The Iowa Telephone Company has appropriated $200,000 for improvements and extensions to its system in this city. A new exchange building will be erected.

IOWA FALLS, IA.—At the annual meeting of the Central Telephone Companies of Iowa the following named officers were elected: President, J. R. Skein, of Laporte; vice-president, J. H. Funk, of Iowa Falls; secretary and treasurer and general manager, W. V. Shipley, of Iowa Falls.

HILLSBORO, KY.—The Hillsboro Telephone Company contemplates extending its lines to Sunset, and will probably build a line to Grange City.

MONTVILLE, ME.—The Knox & Montville Telephone Company has been incorporated with a capital stock of $10,000. The president is J. H. Vose, of Knox, and treasurer, C. A. Hall, of Montville, Me.

DULUTH, MINN.—The Duluth Telephone Company contemplates constructing a conduit system in the business section of this city.

WHITE BEAR, MINN.—The White Bear Telephone Company has increased its capital stock from $10,000 to $30,000. Mr. J. H. Spink is president and W. Murray secretary.

PERTH AMBOY, N. J.—Three telephone companies have applied to the city council for franchises. The companies are the Hudson & Middlesex Telephone Company, Central New Jersey Telephone Company and the People's Co-operative Telephone Company.

JERSEY CITY, N. J.—The stockholders of the New Jersey & New England Telephone Company met on March 4 and elected directors as follows: Robert C. Clowry, president; George W. E. Atkins, J. B. Bertholf, Thomas F. Clark, J. B. Van Every, E. M. Mulford and B. Brooks.

WEST UNION, OHIO.—The Home Telephone Company has obtained a franchise for a local exchange.

ELIDA, OHIO.—The Elida Mutual Telephone Company has been incorporated with a capital stock of $21,000.

BLISSFIELD, OHIO.—The Hoagland Run Telephone Company, of Blissfield, has been incorporated with a capital stock of $5,000.

NORWALK, OHIO.—The Local Telephone Company has placed a contract with the Kellogg Switchboard & Supply Company, of Chicago, for a large central energy switchboard.

FITCHVILLE, OHIO.—The Fitchville Home Telephone Company is preparing to build lines to connect with New London, Greenwich, Clarksfield, Hartland and other towns.

BELLEFONTAINE, OHIO.—A number of farmers in the southern part of the county headed by J. J. Hostetler and Uriel Yoder have formed a company and will build a mutual telephone system.

MARION, OHIO.—The Marion County Telephone Company has increased its capital stock from $100,000 to $250,000. The proceeds of the sale of stock will be used to extend the system of the company.

GALION, OHIO.—John Pommert, proprietor of the Caledonia Telephone Company has purchased all the lines and rights of the Martel Telephone Company. A number of extensions will be built this summer.

CANTON, OHIO.—The Stark County Telephone Company has elected these officers: F. S. Dickson, president; H. A. Cavanaugh, vice-president; R. W. Judd, treasurer; A. S. Hillhouse, secretary and manager. It was decided to spend $48,000 in development work.

DEFIANCE, OHIO.—C. R. Shuter, of Evansport, has obtained a five-year lease on all the country lines belonging to the Northwest Telephone Company. He will organize the Home Telephone Company, of Defiance, and extend its service to adjoining counties.

SHELBY, OHIO.—Directors of the Oceana Telephone Company have declared a special dividend of 10 per cent. in addition to the 6 per cent dividend paid during the past year. After charging off $1,058 for depreciation there still remains a surplus of $1,000 from earnings.

SPRINGFIELD, OHIO.—The Bushnell syndicate, of Springfield, has acquired an interest in the Springfield-Xenia Telephone Company and will push the Springfield exchange to completion. The system will be connected with the lines of the United States Telephone Company.

NORWALK, OHIO.—The Business Men's Association has voted against paying the increase in rates demanded by the Central Union Telephone Company and if the company persists in the new rates the members of the organization will order the Bell telephones discontinued.

CLEVELAND, OHIO.—The condition of the Cuyahoga Telephone Company is improving rapidly under the new management. The statement for January shows gross earnings $32,646; operating expenses, $17,619; net earnings, $15,026; fixed charges, $9,985; surplus, $5,041.

ENOREE, S. C.—The Enoree Bell Telephone Company, capital $625, has been chartered by M. C. Poole and others.

COLUMBIA, S. C.—The South Carolina Long Distance Telephone Company, of Columbia, has completed connections with Rock Hill, 100 miles distant.

MEMPHIS, TENN.—The consummation of the big scheme of the Memphis Long Distance Telephone Co. is progressing apparently very satisfactorily. It is said that $200,000 worth of supplies have been purchased. The company is projecting one of the most extensive long distance systems in the South. Meetings have been held of independent telephone men in other cities looking to a consolidation of interests in accordance with the plans of the Memphis company. C. E. Stinson is president of the company. Those interested already own independent systems in a number of other cities.

SALT LAKE CITY, UTAH.—Whittemore Bros. & Ballinger have sold their independent telephone line between Price and Ferron, Utah, to Levi N. Harmon, A. E. Wall, Oliver J. Harmon and Albert Bryner.

SALT LAKE CITY, UTAH.—A telephone and electric light franchise have been granted by the county commissioners to R. W. Crockett and associates. The company proposes to build a telephone line connecting several towns of the county and extend its system through eastern Utah and connect with other lines.

ALEXANDRIA, VA.—The Mount Vernon Telephone Company has been incorporated to establish a telephone system in Fairfax County. The capital stock is $5,000. The officers of the company are as follows: J. N. Gibbs, president; F. H. Wilkins, secretary and treasurer, and Messrs. E. O. Thompson, C. Lukens, and S. B. Moore, directors. All of the officers are of Fairfax County.

BUCKHANNON, W. VA.—The Upshur County Telephone Company, of Buckhannon, has been incorporated with a capital stock of $25,000. The names of the incorporators are J. W. Downs, C. E. Downs, G. V. Downs, Buckhannon, W. Va., Dr. H. S. Yost, Amos, W. Va., W. H. Veach, Framington, W. Va.

GLENWOOD, WIS.—The West Wisconsin Telephone Company has been incorporated with a capital stock of $5,000. The names of the incorporators are Thomas Brockley, C. J. August and D. H. Syme.

ELECTRIC LIGHT AND POWER.

DE QUEEN, ARK.—The De Queen Light, Ice & Cold Storage Company has been incorporated with a capital of $50,000. J. S. Lake is president, I. O. Bunyon, secretary.

CORONA, CAL.—It is proposed to construct a municipal electric light plant, at a cost of $60,000. H. A. Wood is city clerk.

STERLING, ILL.—It is reported that the Sterling Gas & Electric Light Company will expend about $25,000 in improvements.

EDWARDSVILLE, ILL.—The directors of the electric light company agree to furnish the city sixty of the latest improved arc street lamps for a consideration of $500 per month for a ten-year franchise, the city to have the entire receipts from the commercial lights, the company to pay running expenses and turn the plant over to the city at the end of ten years for a nominal consideration. The proposition and the further consideration of the franchise granted at the last meeting of the council, which was vetoed by the mayor will be brought before the next meeting.

EAST ST. LOUIS, ILL.—An ordinance has been introduced in the East St. Louis City Council which is unique. It acknowledges that the city is entitled to compensation for a valuable franchise, and provides for payment on a scale hitherto unheard of. The ordinance grants to the Interstate Transit Company the right to erect poles and string wires, and supply electric lights and power to East Side consumers. A clause provides that 2 per cent. of the company's gross earnings shall be paid into the city treasury. The Interstate Company, which operates the Eads Bridge automobiles and is now installing a new automobile service to be inaugurated some time in April, will become a competitor of the [illegible] syndicate in the lighting field as well as in the bridge passenger business. Owing to the fact that there has heretofore been no competition in lighting in East St. Louis complaint has been made of high rates. The Interstate Company announces that it will be ready upon the passage of the ordinance to begin the construction of its new plant.

HARTFORD CITY, IND.—Geo. Mayer and others, of Chicago, Ill., are reported to have purchased the plant of the Hartford City Light Company and will make improvements thereto.

LOGANSPORT, IND.—It is stated that an investigation by the mayor into the affairs of the municipal lighting plant revealed the fact that 127 consumers have never paid a cent for their light. It is stated that there has been great dissatisfaction with the service and some action will now have to be taken.

TAHLEQUAH, IND. TER.—C. W. Turner, owner of the electric light plant at Muskogee, is stated to have made a proposition to Tahlequah to establish an electric light plant. If it is accepted he will probably move the plant at Muskogee to Tahlequah and construct a larger plant at Muskogee.

COVINGTON, KY.—A contract has been awarded to the Union Heat, Light & Power Company to illuminate the city at $75 per light per year.

HOLYOKE, MASS.—The General Electric Company is stated to have secured a contract from this city for 400 series enclosed arc lamps and 150 multiple enclosed arc lamps for about $13,500.

NEGAUNEE, MICH.—It is stated that improvements are to be made to the electric light plant, at a cost of about $10,000.

STANDISH, MICH.—The legislature has been asked for permission for the issue of bonds by the municipality for a water works and electric lighting plant.

MONROE, MICH.—The Monroe Heating & Lighting Company is about to be organized with Chas. Flowers, of Detroit, and Fred C. Nadeou, of Monroe, as incorporators.

VERNDALE, MINN.—Bids will be received March 14 by the village council for $7,000 bonds to be used for constructing an electric lighting plant.

MANKATO, MINN.—It is stated that the city council has voted to construct a municipal electric light plant and will receive bids for $40,000 electric light bonds on March 19.

LINCOLN, NEB.—C. C. Wright, of Omaha, has petitioned the State Board of Irrigation for the right to use the waters of the Platte and Elkhorn Rivers for power purposes. It is estimated that the plant to be constructed will cost $1,500,000.

BUTLER, NEV.—The scheme for the establishing of an electric power plant on the Owens River is receiving the attention of a number of Eastern capitalists, who are heavily interested in the mines of the Tonapah district.

PITMAN GROVE, N. J.—The New Jersey Southern Gas & Electric Company, of Pitman Grove, has been incorporated, with a capital of $500,000, by J. H. McNeal, R. M. Anderson and A. M. Worstall.

DANSVILLE, N. Y.—The Mill Creek Electric Light & Power Company, of Dansville, has been incorporated with a capital of $200,000 by F. A. Owen, Walter A. Beecher and others, all of Dansville.

MECHANICVILLE, N. Y.—New water wheels are being installed at the water power plant of the Hudson River Power Transmission Company at this place. The old wheels were rated at about 500 hp each, while the new ones will generate about 1,000 to 1,100 hp each. New draft tubes, 7 feet in diameter, are also being installed, and other extensive changes and improvements are being made to the plant. Seven new wheels will be installed, aggregating 7,500 hp. The original plant was of only 3,500 hp capacity. The plant will be modernized throughout.

WALDO, OHIO.—Michel Brothers have obtained a franchise for an electric lighting system.

TIFFIN, OHIO.—Kerlin Bros., of Toledo, proprietors of the plant of the Consolidated Gas & Light Company, have decided to expend about $30,000 in improvements.

NORWALK, OHIO.—The Norwalk Electric Light & Gas Company has been absorbed by the Cleveland & Southwestern Traction Company which it supplies with current.

STRUTHERS, OHIO.—The local lighting company has submitted a proposition to the village, offering to furnish arc lights at $66 per lamp per year on a moonlight schedule.

HUBBARD, OHIO.—The citizens of Hubbard will vote on the proposition to issue $10,000 for the purpose of erecting a lighting plant in place of the one destroyed by fire some months ago.

LEESBURG, OHIO.—The Leesburg Manufacturing, Light, Power & Water Company has been incorporated, with $25,000 capital stock, by M. Reake, J. Worthington, H. A. Beeson, W. E. Dibble and R. P. Barrett.

ATTICA, OHIO.—The village council has authorized the sale of $6,000 worth of bonds for the purpose of erecting a municipal lighting plant. Contracts for the equipment will be placed in the near future.

WAUSEON, OHIO.—The Consolidated Heat & Light Company has been incorporated, with $100,000 capital stock, to install a lighting and heating plant in Wauseon. Incorporators: F. J. Bolinger, F. J. Spencer, C. P. Campbell, J. C. King and H. G. Struble.

OBERLIN, OHIO.—The Oberlin Electric & Heating Company has been incorporated, with $50,000 capital stock, to build an electric lighting and steam heating plant in Oberlin. Incorporators: A. M. Loveland, A. G. Comings, Y. D. Yocum, C. K. Whitney, L. B. Fauver and L. E. Burgner.

PIQUA, OHIO.—The Miami Light, Heat & Power Company has been incorporated, with $150,000 capital, to construct an electric light and heating plant in Piqua. Incorporators: S. B. Hartman, W. V. Baker and F. W. Bailey, Columbus, and H. T. Bailey, J. W. Brown and A. E. Clark, of Piqua.

COLUMBUS, OHIO.—The board of public works, of Columbus, has closed a contract with the Western Electric Company, of Chicago, for arc lamps and other apparatus, the price being $3[illegible], which was the lowest of five bids. The contract also calls for switchboards at a cost of $4,400. Director Immel is visiting cities where there are municipal lighting plants.

OTTAWA, OHIO.—The Ottawa Electric Light Company has submitted a proposition to the village whereby the company desires to lease its plant for a period of ten years for a monthly rental of $200, the city to maintain the plant and pay taxes. At the end of ten years the city may purchase the plant for $15,000 or may release it for another ten years on the same terms and conditions and at the end of the twenty years the plant is to become the property of the city.

TOLEDO, OHIO.—George W. Tonsen, civil engineer for Toledo, has submitted to the council an estimate on the cost of a municipal lighting plant to supply 1,500 arc lamps. The estimates are: for building and foundations, $50,000; steam and electrical machinery, $102,000; conduits, $85,000; lines and poles, $75,000; arc lamps and fixtures, $35,000, engineering and other expenses, $15,000. Total, $383,500. The present contract with the Toledo Railways & Light Company expires in two years.

DONORA, PA.—The Donora Light, Heat & Power Company has been incorporated with a capital stock of $5,000.

CHAMBERSBURG, PA.—The citizens have voted to issue $25,000 bonds, of which $9,000 is to be used for improving the electric light plant.

SELLERSVILLE, PA.—The Sellersville Electric Light & Power Company has been incorporated, with a capital stock of $15,000, to be directed by Henry J. Wombold, of Telford; Morris H. Clymer, and Mamie E. Clymer.

CLINTON, S. C.—The Board of Aldermen is reported to have under consideration the construction of an electric light plant and water works.

SPARTANBURG, S. C.—The Electric Manufacturing & Power Company is about to be formed here with a capital of $100,000 by local capitalists, to develop the water power on French Broad River, 35 miles from this city and near Tyron, N. C. John B. Cleveland and J. N. Cudd are reported interested.

WALLA WALLA, WASH.—The Walla Walla Gas & Electric Company is preparing preliminary plans for the construction of a power plant on Walla Walla River.

WATERTOWN, WIS.—The Watertown Electric Company, Watertown, Wis., purchased recently a new street lighting equipment consisting of two 50-light series alternating circuits. The contract was awarded to the Western Electric Company of Chicago.

BERLIN, ONT.—The citizens are reported to have voted to purchase the electric light plant for $80,000.

WINNIPEG, MAN.—It is stated that the Canadian Pacific Railway Company will use electric lighting at all important stations in the mountains. Plants will be constructed at Banff, Field, Glacier, Lake Louise, Emerald Lake and at the hotel at Vancouver. The total cost of the work will be about $75,000. Edwin H. McHenry, Montreal, Que., is chief engineer.

THE ELECTRIC RAILWAY.

LITTLE ROCK, ARK.—A site has been selected for the new power house of the Little Rock Traction & Electric Company and the work of building the plant is to be begun soon. New machinery will be installed in the plant.

SANTA ANA, CAL.—Application has been made to the City Council by Collins & Scott for a franchise to build an electric railway from this city to Newport Beach.

ATLANTA, GA.—The Atlanta & Marinetta Electric Railway Company will apply for a charter. The capital will be $600,000. D. B. Gray, of New York, P. D. McCarley, of Fulton County, and others are among the incorporators.

ROCK ISLAND, ILL.—The Kewanee, Cambridge & Geneseo Railway Company will increase its capital stock from $100,000 to $850,000.

RUSHVILLE, IND.—The Indianapolis and Cincinnati Traction Company will locate its power house here. The equipment will cost $200,000.

LAPORTE, IND.—It is reported that Senator Mark Hanna is behind a movement to build an interurban line between South Bend and Chicago.

SHELBYVILLE, IND.—The stockholders of the Indianapolis, Shelbyville & Southeastern Traction Company have voted to extend the line to Greensburg and Batesville.

INDIANAPOLIS, IND.—The Knox, Chicago & Northern Traction Company has been incorporated. The capitalization is $150,000. J. C. Flecher, of Knox, is the president and financial head.

COLUMBUS, IND.—At the recent annual meeting of the Central Indiana Electric Railway Company the capital stock was increased to $200,000. A greater portion of the right of way has been secured.

INDIANAPOLIS, IND.—The Huntington, Columbia City & Northern Traction Company has filed articles of incorporation. Capital stock $50,000. John A. Knitz is president, W. A. Jones, vice-president, and B. E. Gates, secretary, all of Huntington.

KOKOMO, IND.—The Kokomo, Converse & Marion Traction Company has been incorporated with a capital of $10,000. O. V. Darby, G. E. Bruner and T. C. McReynolds, Kokomo, J. E. Kenney, Converse, and H. D. Thomas, of Marion, are the officials.

HUNTINGTON, IND.—Articles of incorporation are to be filed by the Huntington City, Columbia & Northern Traction Company. The capital is to be $50,000. The officers of the company are: J. A. W. Kintz, of Huntington, president; F. J. Heller, of Columbia City, vice-president; W. A. Jones, of Huntington, secretary; Benton E. Gates, of Columbia City, treasurer.

WINTERPORT, ME.—The Winterport, Frankfort & Prospect Electric Railway is seeking incorporation. Chas. A. McKenney, Frank C. Young, Charles R. Hill, of Winterport, and Albert Pierce, of Frankfort, are among the incorporators of the company.

CAMDEN, ME.—The Camden, Liberty & Belfast Railway Company has applied for a charter to build an electric railway through Camden, Liberty and Belfast, a distance of 20 miles. The power plant is to be located at Liberty. Capt. John J. Crowley, of Taunton, Mass., and Charles E. Littlefield, of Rockland, Me., are interested.

HAGERSTOWN, MD.—The Hagerstown Railway Company contemplates extending its lines into Berkely County and possibly as far as Martinsburg, W. Va.

HAVERHILL, MASS.—Permission has been granted to the Haverhill & Andover Street Railway Company to increase its capital stock to $190,000.

BEVERLY, MASS.—The Gloucester, Magnolia & Beverly Street Railway Company will apply for a franchise. Judge Edgar Tate, of Gloucester, is interested.

CHELSEA, MASS.—Application has been made to the Legislature for the incorporation of the Marginal Street Railway Company. The plan is to build a three-mile freight railway along the waterfront of the city. Jos. W. Stickney, of Chelsea, is interested.

DULUTH, MINN.—It is said that the Duluth-Superior Traction Company is planning to spend $200,000 in improvements.

ST. LOUIS, MO.—The large carsheds and 200 electric cars of the St. Louis and Suburban Railway Company were destroyed by fire on February 24. The loss is placed at $200,000.

LITTLETON, N. H.—The Littleton, Franconia & Bethlehem Electric Railway Company, to be capitalized at $100,000, is seeking incorporation. The plan is to develop Fifteen-Mile falls in the Connecticut River for power. A. S. Batchellor, of Littleton, is interested.

OLEAN, N. Y.—Interests identified with the Olean Street Railway Company are said to have in contemplation the construction of an electric railway from Bolivar to Little Valley.

GALION, OHIO.—The Ohio Central Traction Company has installed at its Galion power house a DeLaval steam turbine.

WEST UNION, OHIO.—Citizens of West Union and Portsmouth are forming a company to build a railway between West Union and Portsmouth.

COLUMBUS, OHIO.—The Central Market Street Railway Company is installing a storage battery plant in its West Mount Street power house.

CLEVELAND, OHIO.—C. H. Hubbell and A. E. Williams have applied to the County Commissioners for an electric railway franchise from South Brooklyn.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway Company will make important improvements to the city line of the New Castle Traction Company.

YOUNGSTOWN, OHIO.—John Stambaugh, Geo. Rose and other local capitalists are reported to be forming a company to build a new road to the plant of the National Steel Company.

CLEVELAND, OHIO.—The car barns of the Garrettsville division of the Eastern Ohio Traction Company, at Chagrin Falls, were destroyed by fire recently the loss aggregating $80,000.

ZANESVILLE, OHIO.—The Muskingum Valley Traction Company has been incorporated with $100,000 capital stock by S. A. Weller, W. B. Cosgrove, N. P. Shurtz, J. G. England and S. M. Winn.

MANSFIELD, OHIO.—The Citizens' Railway, Light & Power Company is reported to be planning to extend the Shelby-Mansfield line to Norwalk or Monroeville to connect with the Lake Shore Electric Railway.

SPRINGFIELD, OHIO.—The Springfield Southern & Cincinnati Railroad Company has been incorporated with $25,000 capital stock by George H. Frey, Jr., James Johnson, E. B. Hopkins, Charles R. Crain and J. D. DeWitt.

HAMILTON, OHIO.—Judge A. Caldwell, of Cincinnati, Herman Duhme, of Cincinnati, and James A. Mogaw, of Rising Sun, Ind., have in contemplation the construction of an electric railway from Hamilton to Richmond, Ind.

TOLEDO, OHIO.—The Interurban Construction Company is placing contracts for the building and equipping of the Toledo, Port Clinton & Lakeside Railway, for which it is contractor. The power house will be erected near Port Clinton.

CLEVELAND, OHIO.—The Lake Shore Electric Railway Company has contracted for about $150,000 worth of new equipment. Contract has been placed with the J. G. Brill Company, of Philadelphia, for ten new cars. The Kuhlman Car Company, of Cleveland, is building for this company two very fine interurban cars to replace two which were destroyed by fire some weeks ago.

FOSTORIA, OHIO.—The Toledo, Fostoria & Findlay Railway Company has placed $1,000,000 in bonds with Toler & Higgins, of New York, and a contract has been closed with J. G. White & Co., New York, for the immediate construction of the extension from Fostoria to Toledo. The line will be 32 miles in length and will be wholly on private right of way which has been secured.

WILDMAN, OKLA.—A company with a capital of $50,000 will construct an electric railway to connect Mountain Park and Wildman, a distance of about 15 miles.

HUMMELSTOWN, PA.—Application has been made for a charter for the Hummelstown & Campbellstown Street Railway Company.

LANCASTER, PA.—The Lancaster & Rocky Springs Railway Company has authorized appropriations for the erection of an extra 450-hp rotary converter station.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company, it is stated, will let the contract for the building of the section of subway in Market Street between Fifteenth St. and the Schuylkill River.

ALLENTOWN, PA.—The Siegfried & Danielsville Electric Railway Company has secured a charter to build a 16-mile line from the terminus of the Lehigh Valley Traction Company's line at Siegfried to Hazard. The company is capitalized at $250,000.

MT. HOLLY SPRINGS, PA.—It is said to be the purpose of the Carlisle & Mt. Holly Electric Railway Company to extend its lines from Mt. Holly to Hunter's Run, a distance of several miles. Col. Patricio Russ, president of the company, states that work will shortly be commenced on the new light, heat and power plant here

ALLENTOWN, PA.—At the recent annual meeting of the Allentown & Reading Traction Company a number of important improvements were decided on. A new engine and generator are to be added to the power plant at Kutztown, the storage battery station at Blandon is to be enlarged, and the line is to be double-tracked between Dorney's Park and Allentown.

WATERTOWN, S. D.—The City Council has granted a franchise to the Watertown & Lake Kampeska Railway & Transportation Company.

WACO, TEX.—Plans are being discussed for building an electric railway to traverse Hamilton, Comanche, Bosque, Hood, Somerwell, Johnson, Hill, Tarrant and Dallas counties. J. W. Riggins, of Waco, is interested.

SPRINGVILLE, UTAH.—The council has granted an electric railway franchise to Reed Smoot and Jesse Knight.

RICHMOND, VA.—It is said that the Richmond Passenger & Power Company has authorized the expenditure of $50,000 in increasing its power facilities.

RICHMOND, VA.—The Virginia Passenger and Power Company has decided to sell its old plant on Johnsons Island, which is valued at $100,000. The new additions to the company's plants elsewhere will fully compensate for the loss of the old plant. Pres. Sitterding has received a proposition from G. C. Jacobs, of Chesterfield County, Va., for power for two projected manufacturing plants. The company has let the contract for a new power plant in Richmond to W. B. Newell for $25,000.

RUTLAND, VT.—Leroy M. Baldwin, 88 Wall St., New York, N. Y., is reported interested in the construction of a combination electric and steam railroad from Rutland to Randolph.

VERGENNES, VT.—John J. Flynn, of Burlington, is reported to have purchased water rights here and contemplates constructing an electric railway to connect Vergennes and nearby towns.

WHEELING, W. VA.—The Wheeling, West Liberty & Belt Railway Company has been incorporated. Among the incorporators are C. L. Gill, Will Chambers, Will Gutman, James W. Ewing and E. Ball.

APPLETON, WIS.—Anchor ice recently clogged the water wheels of the power house of the Wisconsin Traction, Light, Heat & Power Company, cutting off electric light and power for several hours.

LA CROSSE, WIS.—Interests identified with the La Crosse Street Railway Company have just incorporated the Lacrosse & Northern Railway Company, which will build an electric railway from La Crosse to Winona.

DEPERE, WIS.—The Knox Engineering Company, of Chicago, Ill., is reported to have secured a franchise in Depere for an electric railway which it proposes constructing between Kaukauna and Green Bay. The Fox River Electric Railway and Power Company proposes to extend its line into Depere.

CHATHAM, ONT.—N. H. Stevens, president of the Canada Flour Mills, is reported interested in the construction of an electric railway through Kent County.

HAMILTON, ONT.—The Hamilton Cataract Power, Light & Traction Company has been incorporated to take over the Hamilton Light & Cataract Power Company. The capacity of the power plant at De Cews Falls will be increased at once.

NEW INDUSTRIAL COMPANIES.

THE CHATTANOOGA ELECTRIC COMPANY has been incorporated at Trenton, N. J., with a capital stock of $750,000.

THE ELECTRIC BULLETIN COMPANY, of Cincinnati, Ohio, has been incorporated, with $15,000 capital, to deal in electrical appliances.

THE HOLT ELECTRIC COMPANY, of Carthage, Mo., has been incorporated by Robert Holt, J. M. Long and others. The capital stock of the company is $10,000.

THE TELEPHONE TUBE COMPANY has been incorporated at Portland, Me., with a capital stock of $100,000. F. A. Newell, of Boston, is president and H. L. Cram, of Portland, is treasurer.

THE CHICKASHA WAREHOUSE & TERMINAL COMPANY has been incorporated at Chickasha, Ind. Terr., to build steam and electric railways, telephone lines, etc. M. M. Beavers and L. M. Stone, of Chickasha, are interested.

THE AUTOMATIC ELECTRIC PUMP COMPANY, of New York City, has been incorporated with a capital stock of $20,000. The directors are Horace G. Kimble and Edmund J. Fenn, of Brooklyn, and Fred White, of New York City.

THE MAINE ELECTRIC COMPANY has been incorporated at Portland, Me., to make and deal in electrical supplies. The president is J. B. Phillips and the treasurer A. J. York, both of Portland. The capital stock of the company is $10,000.

THE TROLLEY SUPPLY COMPANY, of Canton, Ohio, has been incorporated, with $1,200 capital stock, by J. E. McLain, W. S. Roath, A. W. Knutson, R. K. Fast, P. F. McDermit and P. L. McLain. They will manufacture electric railway line material.

THE J. G. WHITE COMPANY has filed a certificate of incorporation in Bridgeport, Conn., for the purpose of conducting an electrical and contracting business. The authorized capital stock of the company is $2,000,000, and the incorporators are Lewis B. Grant, of Brooklyn; Richard F. Emery and Ashley T. Cole, of New York.

THE MERCEDES COMPANY, of New York City, has been incorporated at Albany, with a capital stock of $2,700,000, to manufacture automobiles, launches, yachts and other self-propelling vehicles. The directors are Edward Bernhard, Philip Ahrens, C. B. Wynkoop, and James T. Arnold, of New York City; Philip Huetwohl, of Brooklyn, H. Smith, of Plainfield, N. J., and Theophilus Parsons, of Hempstead, L. I.

LEGAL.

GILMORE SOCKET SUIT.—The General Electric Company's suit against the Gilmore socket has been decided in favor of that company and an injunction has been asked. The suit was brought against Henry A. Truitt trading under the name of the Imperial Electric Company.

PREPAYMENT TELEPHONES.—The suit brought by William E. Berryman to test the right of the Kinloch Telephone Company to prohibit the nickel-in-the-slot devices to be used in connection with its telephones has been decided in favor of the company. Judgment for $1 damages was given against the company for tearing down a controller regulating a nickel-in-the-slot apparatus which was used with the instrument. Berryman took a non-suit on the claim for damages and filed an application for a new trial.

PERSONAL.

MR. W. J. LEE, of Washington, has been appointed telegraph manager for the new Department of Commerce and Labor.

MR. L. B. STILLWELL, consulting engineer of the Manhattan and other systems, is taking a well-earned holiday in Florida.

MR. B. A. BEHREND, chief engineer of the Bullock Electric Manufacturing Company, is making a visit to the Pacific slope.

MR. SEATON M. SCOTT is conducting the factory of the Storey Motor & Electric Company at Harrison, N. J., as superintendent.

MR. F. V. L. TURNER has become general manager of the Cuyahoga Telephone Company, of Cleveland. He was formerly in the independent exchange at Atlanta, Ga.

DR. LEE DE FOREST visited Cleveland recently and while there stated that a wireless telegraph plant will be erected at Euclid Beach Park, with two towers each 200 feet high.

MR. E. R. KNOWLES, C. E., has been retained as consulting engineer for the Carnegie Libraries for the Borough of Brooklyn; and also for the Massachusetts Portable Security Vault Company.

LORD KELVIN, Mr. Marconi, Lord Charles Beresford and U. S. Naval Attaché Capt. Clover, occupied a round table together at the recent banquet of the Pilgrim Club in London to Ambassador Choate.

MR. J. R. BEETEM, vice-president and general manager of the New York & Queens County Electric Railway, which is said to have passed under Belmont and Interborough control, has resigned his position.

MISS LEILA LIVINGSTONE MORSE, grand-daughter of Prof. S. F. B. Morse, and niece of Mrs. Franz Rummel, gave two song recitals with David Dexter in the Astor Gallery at the Waldorf-Astoria during the past week.

MR. E. H. DEAN, chief electrical engineer of the Primitiva Gas & Electric Light Company, Buenos Ayres, Argentine Republic, which operates the largest electric lighting plant in that part of the world, has resigned his position.

MR. E. A. DARLING, who was injured by the explosion at the Edison Cement Works, is improving rapidly and will show no scars on his face, but may have a few on the hands. Mr. R. H. Goodwilly, who was severely injured, is improving slowly.

MR. E. H. JOHNSON, who has been in England for some time past pushing the interests of the Johnson-Lundell electric railway patents, is again in this country and is at present in New York, renewing acquaintance with a very wide circle of friends.

MR. H. H. ROBINSON, heretofore assistant general manager of the United States Telephone Company, of Cleveland, has been appointed general manager succeeding Maxime Reber who will devote his time to developing the properties of the Federal Telephone Company.

MR. CARL KINSLEY, instructor in physics at the University of Chicago, has contributed a paper entitled "A Systematic Method of Calculating the Dimensions of Direct-Current Dynamo-Electric Machines" to Vol. IX of the "Decennial Publications" of the University.

MR. R. T. LOZIER, sales manager of the Bullock Electric Manufacturing Company, of Cincinnati, is recuperating from winter labors and has gone to Florida, down the west coast to Manible Island, hoping to bring back some big fish by April 1, or at least some big fish stories.

MR. S. FAIRFAX CUTHBERTSON, representing the Marconi system is in the United States preparing a wireless telegraphic code for publication to be used in transatlantic messages. The code will be complete in every respect and will be similar in purpose and extent to the Western Union and Postal Telegraph codes.

MR. W. J. HAMMER lectured before the Franklin Institute of Philadelphia recently, and has had the pleasure of receiving a letter from Dr. W. H. Wahl, the secretary, as to the unique amount of valuable and interesting data on electrical advances contained in the lecture, which was based on Mr. Hammer's recent observations abroad.

MR. LIVINGSTON EMERY, son of the late Chas. E. Emery, has associated himself with Henry D. Williams, Esq., and Herbert F. Gibbs, Esq., as counselor at law and solicitor of patents. Mr. Emery is entered in Great Britain as barrister at law, and has special connections in the other principal European countries for taking out patents.

MR. EDWARD P. BURCH, on Feb. 25, lectured before the senior class of the University of Minnesota on "Central Station Design." The lecture outlined the design of the electric light, railway and water plant at Everett, Wash., and brought out the relation between the excellent financial results in operation and the several features of the design.

MR. CHARLES P. STEINMETZ is the subject of a very interesting article in the March number of "Success," and a similar article appeared in the *New York Sun* on March 8. The personality and characteristics of the man are brought out in both very clearly, in a popular style. The details of Mr. Steinmetz's career in Germany as a revolutionist are quite amusing.

MR. ARTHUR B. LISLE, who for ten years past has been connected with the Narragansett Electric Lighting Company, of Providence, R. I., as sales and collecting agent, etc., has been appointed by President Perry as assistant general manager, and has assumed the duties of his office. For two years he had charge of the company's property known as the Bristol County Gas & Electric Company.

MR. T. A. EDISON, who has been in Florida for some time on a vacation, will remain South for another month. Mr. W. S. Mallory, vice-president of the Edison Portland Cement Company, at the works of which a fatal explosion recently occurred, has gone to Florida with the head draughtsman of the works to arrange for some new work. The loss by the explosion is stated not to exceed $15,000.

MR. W. J. CLARK, manager of the foreign department of the General Electric Company, sailed for Europe this week on Wednesday, after a brief visit to this country. During a recent trip to Connecticut where he once did interesting pioneer electric railway work in the Naugatuck Valley, a dinner was given in his honor attended by several old friends, leading officials in the State judiciary, legislature, etc.

MR. C. REVILL BELLAMY, general manager of the corporation tramways of Liverpool, England, was the guest of President J. C. Hutchins, of the Detroit United Railway last week. Mr. Bellamy is in America studying the operation of electric railways. Within a radius of a few miles of Liverpool there are fully thirty towns and cities without interconnection by electric roads. The American interurban service is one of the chief features about which Mr. Bellamy is seeking information. He sails this week.

MR. GEORGE W. MANSFIELD and Mr. J. M. Klingelsmith have formed the Eastern Electric Contract Company with headquarters at the Board of Trade Building, Boston. Mr. Mansfield is a well-known pioneer in the electric railway field, and was actively associated with the Daft and Thomson-Houston Companies. Mr. Klingelsmith is also an old electric railway man, and has been connected with Thomson-Houston, General Electric, Westinghouse and Stanley interests as well as with the banking business.

PROF. MORGAN BROOKS, of the electrical engineering department of the University of Illinois, informs us that important extensions of the engineering facilities are proposed in case the university should secure from the Legislature an appropriation of $300,000 or part of that amount. The university now stands sixth in the country in the number of its engineering students. The friends of the institution hope earnestly that it will be able to secure the funds needed for its work.

MR. EDWARD R. MASON, son of Mr. W. R. Mason, of electrical supply fame, has just been made vice-president of the electrical supply firm of Porter & Berg, of Chicago, recently incorporated. This concern makes a specialty of manufacturing and dealing in electric railway supplies. Mr. Mason was with his father in the same lines for a number of years, and has studied this branch of the industry thoroughly. He is a lieutenant in the naval militia of Illinois and a graduate of the nautical school.

NEW YORK ELECTRICAL SOCIETY.—The following new members were elected at the last meeting: Axel O. Bendichsen, Wm. C. Hall, Jr., Clarence R. Dean, Henry M. Bascom, Albert E. Blackman, Joseph Guttman, Wm. Hogan, Richard J. Riedl, William Mackay, Norman K. Althause, William W. Cully, Alfred W. Bourgeois, Alfred R. Tahl, Frank Gardner, Alfred J. Thompson, Emile C. Boerner, Jr., T. P. Teale, Jr., M. S. Clawson, G. W. Hallock, Alonzo C. Bell, Alfred W. Eckhoff, W. C. Minier, Bernard B. Neal, Chas. V. Walter, A. Th. Moberg, Harry J. Smith.

MR. MARCONI.—The birth of Marconi has been found registered in Bologna, as previously understood; Florence has discovered that the inventor went to school there between his sixth and tenth years. An aged lady, Signora Luisa Cavallero, who taught young Marconi how to read, was sure that she saw in the "inglesino," as she called him, the embryo man of genius. Nevertheless, she was obliged to punish him many times because he was very naughty, and since he has become a great man her conscience has severely reproached her. "Fancy, punishing a genius!" she exclaimed. "At the same time," she added in extenuation, "he was never able to learn anything by heart. That was impossible with him."

MR. S. E. MOFFETT, in a recent article in *McClure's Magazine*, says: Inch by inch the field is contested, and slowly, sullenly, the locomotive is giving way before the insistent trolley. A dozen years ago it was only the car horse and the cable in the towns that were threatened by electric traction. Then the trolley poked an inquiring tentacle over the city limits into the suburbs. The results were satisfactory, and swiftly the electric lines flung their spider filaments from town to town, until now great sections of the country are cobwebbed with them. The trolley map of eastern Massachusetts looks as complete as the steam railroad map. If you have a little time to spare you can go on an electric car to almost any part of southern New England that you could reach by a locomotive, and to a good many parts that you could not.

Trade Notes.

OIL FILTERS.—The American Locomotive Company has just sent to the Burt Mfg. Co., of Akron, Ohio, its fifth order for oil filters to be used at its works in Schenectady, N. Y.

THE ELECTRIC FURNACE for metal work in iron and steel is to be the subject of the first of four special monographs issued by the *Mois Scientifique et Industriel* now published at 8 Rue Nouvelle, Paris. The second monograph will be devoted to the industrial applications of cold.

CENTRAL ELECTRIC CO.—A complete line of Faries shades are carried in Chicago stock by the Central Electric Company which is, therefore, in a position to make prompt shipments. The above company has also a large stock of Duplex lamp guards for which it is quoting attractive prices.

WIRELESS TELEGRAPHY ON TRAINS. It is stated that the New York Central & Hudson River Railroad Company has given permission to the De Forest Wireless Telegraph Company to equip the "Twentieth Century Limited" with wireless apparatus. Experiments will be continued for two months, beginning April 1.

THE ELECTRIC APPLIANCE COMPANY, Chicago, general sales agent for the Gutmann alternating current wattmeter, is enthusiastic over letters and reports of tests which it has just received from Europe. The Gutmann meters sent for comparative tests with all other makes of wattmeters, both domestic and foreign, easily carried off the honors.

KILBURN, CLARK & COMPANY, of Seattle, Wash., have been made the Pacific Coast sales and distributing agents of the Nernst Lamp Company, of Pittsburg, and have established branch offices in San Francisco and Los Angeles, Cal. The increasing volume of business from that section of the country has made necessary special attention to its demands.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., has just issued a booklet on the subject of its direct-current generators of both the engine and belt types. The general features of construction are pointed out and some illustrations show some of the special features of design. A copy of the booklet will be sent free on request.

THE BANNER ELECTRIC COMPANY, of Youngstown, Ohio, is preparing to erect a three-story building, 68x110 feet. At present the company manufactures about 4,000 incandescent lamps per week, but this output will be increased when the new building is completed. The company recently secured several large contracts for lamps which rendered the extensions necessary.

THE NATIONAL STAMPING WORKS, Chicago, Ill., repairs all standard makes of dynamos, motors, transformers, meters, arc lamps, etc. Its enclosing attachment is adapted for use on all makes of high-tension series open arc lamps, and it is stated, prolongs the life of the carbons 15 to 20 times. The company manufactures a full line of gas, electric and combination fixtures. Its catalogue gives illustrations and information.

EBONITE.—E. M. Ashmore & Co., 30 Miami Avenue, Detroit, Mich., have issued a booklet containing copies of a few letters from customers using Ebonite. This commutator compound is evidently giving satisfaction to all who are using it. It is claimed that it lubricates the commutator without gumming the brushes and prevents sparking and cutting. The firm will be glad to send a copy of the booklet to all interested in the subject.

THE FOREST CITY PAINT & VARNISH COMPANY, of Cleveland, Ohio, is sending out a handsome catalogue and color sheet illustrating its line of paints particularly adapted for poles, bridges and depots as well as japans for finishing car bodies. The Cleveland concern is particularly strong on these lines and railway managers planning spring improvements requiring paint should not fail to secure a copy of this booklet.

PLUNGER ELEVATORS.—We have received the catalogue of the Plunger Elevator Company which has just come from the press. Although the principles of construction of the plunger elevator are generally known, it will probably be news to most of our readers that there are installations of these elevators where the car travel exceeds 200 feet, as for example, in the Ansonia apartment building in New York, illustrated on page ten of the brochure.

A MODERN SHAPER.—A few hints about a modern 16" shaper of the Garvin type are given in a booklet recently issued by the Garvin Machine Company, New York. This particular machine is illustrated and several detail views are shown. The features of the machine are pointed out progressively in accompaniment with the illustrations. The Garvin Company has also issued recently a folder illustrating and briefly describing its complete line of metal-working machine tools.

THE COLUMBIA ELECTRIC & MFG. CO. is now located in its new factory at High St. and Boyden Place, Newark, N. J. This is one of the most completely equipped manufacturing plants in the country and with new and special machinery the company is able to turn out more of its well-known Columbia arc lamps to meet the ever-increasing demand. All Columbia lamps are interchangeable from direct to multiple or alternating and are sent on trial. All lamps are guaranteed.

VEGETABLE BOILER COMPOSITION.—The Arlington Manufacturing Company, Canton, Ohio, has issued a pamphlet descriptive of its vegetable composition for use in marine, tubular and water tube boilers as a preventive of incrustation, scale, corrosion and pitting. These compositions are vegetable extracts which convert the lime and magnesia in the water, holding them in suspension in the form of a light precipitate which is blown or washed out of the boiler and thus preventing scale formation.

A SHORT CIRCUIT.—The Ohio Brass Company recently issued a circular containing an illustration of a straight line trolley hanger and a section of trolley ear which were subjected to a dead short circuit of 1500 amp. at 500 volts. A considerable portion of the ear was melted away, but the point of particular interest is the manner in which the "Dirigo" insulation withstood this great heat. This severe test occurred on the Millcreek Valley Street Railroad Company, St. Bernard, Ohio, and speaks well for the insulation of the Ohio Brass Company.

THE FRINK SYSTEM OF REFLECTORS are perfection for lighting pictures in galleries and private houses and are coming more and more into use. The Frink Company has recently completed the installation of its reflectors in the American Art Galleries, New York, also in the new galleries of the Drexel Institute in Philadelphia and has just finished putting them in the delivery room of the Boston Library for the purpose of lighting Mr. Abbey's "Holy Grail" decorations. Such commendation is sufficient to establish the merit of the Frink reflectors.

THE CRESCENT COMPANY, of Chicago, is manufacturing two new specialties. One of them is the Crescent soldering stick, which has, it is claimed, an entirely new combination of ingredients in its make-up. It is quick acting and economical, due to the small amount required. This stick is not brittle, but rather flexible without being soft, and as a result of this quality the entire stick may be used without waste due to crushing and crumbling. The other specialty is the Crescent paste, which is also an entirely new combination of soldering agents with a neutral mineral wax. The principal advantage of this paste, claimed by the manufacturer, is the small amount of heat required with consequent saving of time and the economical use of flux.

THE AMERICAN TOOL COMPANY.—Recent changes in the personnel of the American Tool Works Company, of Cincinnati, have placed the management of the business in the following hands: Mr. Franklin Alter, president; Mr. Henry Luers, secretary and treasurer; Mr. J. B. Doan, general manager; Mr. A. E. Robinson, general superintendent. The month of February resulted in next to the largest month's business in the history of the company. The plant is exceptionally busy in all departments, and the outlook is very bright. Extensive alterations and improvements are now being made, adapted to the company's increasing business. It has just brought out several new tools, and is much gratified at the success attending their introduction.

HOOPES CONDUCTIVITY BRIDGE.—To copper mining companies, manufacturers of insulated wires and cables, and to the users of such material it is important to measure conductivity accurately. A new device for this purpose is the Hoopes conductivity bridge, designed by Mr. William Hoopes, electrical engineer of the Pittsburgh Reduction Company. The apparatus proved so satisfactory that arrangements have been made to place it on the market, and it is now manufactured by Morris E. Leeds & Co., of Philadelphia. James G. Biddle (as sole agent for Leeds & Co.) has published a comprehensive illustrated descriptive pamphlet (No. 430), which should be secured by all engineers interested in the subject. Mr. Biddle's address is 1024 Stephen Girard Building, Philadelphia.

INCANDESCENT LAMPS.—Amongst the manufacturers of high-grade incandescent lamps that are rapidly coming to the front is the Germania Electric Lamp Company, of Harrison, N. J. This company has been in existence for about two years and its endeavors during that period have been mostly along experimental lines and the perfecting of a very high grade incandescent lamp, in a factory fully equipped with the latest improved machinery and scientific appliances in the hands of skilled operatives. Every process of manufacture is followed with the utmost care and each lamp is fully tested after each operation by competent and experienced inspectors. The present works of the Germania Electric Lamp Company are especially well situated for shipping facilities with both railway sidings and dock privileges and the company is now in a position to fill orders promptly.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., is now completely settled in its new eight-story building at 919 Liberty St., whither it has recently moved. This is one of the largest buildings in the United States devoted exclusively to the handling of and dealing in electrical supplies and specialties. The company has a much larger stock than it ever had. Practically everything in the electrical supply field is contained somewhere within the eight stories and basement. Of course a perfect system of receiving and handling orders is necessary in an establishment of this sort, and the Doubleday-Hill people feel that they have evolved one which is equal to all the requirements. This means that every order received is carefully followed through the various departments, a rigid system of checking up having been instituted which insures a correct packing of the supplies and specialties ordered, and which further extends to the shipping department, guaranteeing shipments of orders the same day as received. The company has been very successful in this business in Pittsburg and vicinity and is agent for several of the well known manufacturers.

WESTON INSTRUMENT COMPANY'S NEW YORK OFFICE.—For the greater convenience of its numerous customers and to better care for the continued increase of business in New York and vicinity, the Western Electrical Instrument Co., Waverly Park, Newark, N. J., has opened a New York office at 74 Cortlandt St., under the management of Mr. Caxton Brown, who has a theoretical as well as practical knowledge of the different instruments manufactured by the company and their particular adaptabilities. This will enable any purchaser or any person visiting or doing business in New York who may wish to make inquiries relative to electrical measuring instruments, to come in direct contact wth a man who is properly qualified to answer such inquiries. There will be a show room in connection with the New York office in which will be exhibited the different types of instruments and their special uses; also the individual parts which make up the instruments. Besides being a great convenience to customers the New York office will eliminate much correspondence in the nature of inquiries, thus reducing time of delivery of orders. A general impression has prevailed that the Weston Electrical Instrument Company only made voltmeters and ammeters. This is not the case. The company is particularly fitted to turn out work of any special character in which the highest excellence of mechanical and electrical work and design are the important features. It has in fact been turning out a large amount of special laboratory apparatus for several years past and is now prepared to make standard cells, standard resistances, galvanometers, and the highest grade of special bridge work, speed indicators, etc.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 3, 1903.

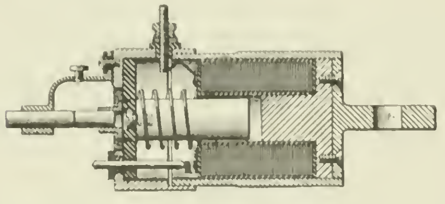
[Conducted by Wm. A. Rosenbaum, Patent Attorney, 145 Nassau St., N. Y.]

12,09[illegible]. TESTING SYSTEM FOR TELEPHONE LINES; W. W. Dean, Chicago, Ill. Original app. filed Jan. 6, 1903. (See page 445.)

721,669. ELECTRIC ENGINE; W. T. Clark, Schenectady, N. Y. App. filed Oct. 1, 1902. An arrangement of a magnet coil and movable core to act as a plunger, in a casing, and a switch for interrupting the current to obtain a reciprocation of the plunger.

721,670. ELECTRIC ENGINE; W. T. Clarke, Schenectady, N. Y. App. filed Oct. 1, 1902. An arrangement of two coils within a casing acting upon a common plunger together with suitable switching apparatus.

721,678. MAGNETIC CLUTCH; E. R. Douglas, East Orange, N. J. App. filed July 14, 1902. A part of the clutch body carrying one of the pole faces, slides, to compensate for frictional wear and insure uniform contact between the parts when the circuit is closed.



721,669.—Electric Engine.

721,679. MAGNETIC CLUTCH; E. R. Douglas, East Orange, N. J. App. filed July 28, 1902. A modification of the preceding patent, involving a clutch in which a single rotary member may be made to engage at will with any one or more of several co-acting rotary members.

721,682. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed November 28, 1902. (See page 444.)

721,689. MEANS FOR PROTECTING GAS OR VAPOR ELECTRIC LAMPS; S. E. Flichtner, Englewood, N. J. App. filed June 12, 1902. In order to protect the vapor tube from being fractured by the shock of mercury during transportation, a chamber connected with the lamp at one end by a neck is provided for containing the mercury in transit.

721,703. ELECTRIC FURNACE; P. L. T. Heroult, La Praz, France. App. filed October 11, 1900. (See page 444.)

721,708. TELEPHONE-TRANSMITTER; A. F. Lawson, Buffalo, N. Y. App. filed August 6, 1900. (See page 445.)

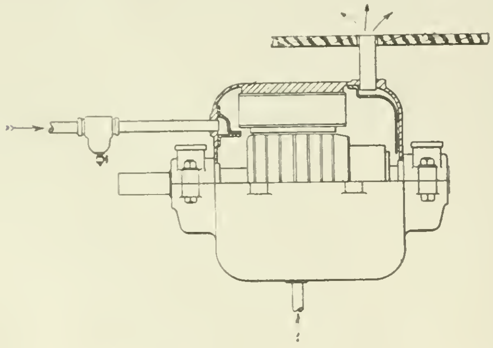
721,713. GRAPPLING DEVICE FOR MANDRELS FOR CONDUIT SECTIONS; R. W. Tyle, New York, N. Y. App. filed Oct. 17, 1902. The device is provided with a slotted funnel with which the head of the draw-rod engages.

721,734. WIRE HOLDER FOR TROLLEY WIRES OR ELECTRIC RAILWAYS; L. Von Orth, Berlin, Germany. App. filed Dec. 26, 1901. Details.

721,741. PROTECTING DEVICE FOR GAS OR VAPOR ELECTRIC LAMPS; M. Von Recklinghausen, New York, N. Y. App. filed March 28, 1902. To protect a vapor lamp, a specially constructed pocket is provided for containing the mercury during transportation.

721,742. TROUBLE-TEST FOR AUTOMATIC TELEPHONE SYSTEMS; F. N. Reeves, New York, N. Y. App. filed February 15, 1902. (See page 445.)

721,774. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed May 30, 1898. This patent and those which follow in the same name discloses a multiple lamp socket for a bunch of lights, the general arrangement being an external dome-like shell having integral sockets, all of which are connected with one side of the circuit, and a central internal plate or carrier against which all of the lamp necks strike and which is connected with the other side of the circuit.



[illegible] Railway Motor Ventilating System.

721,775. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Dec. 9, 1901. See Patent 721,774.

721,776. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed May 20, 1898. See Patent 721,774.

721,777. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Feb. 7, 1902. See Patent 721,774.

721,778. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1902. See Patent 721,774.

721,779. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1902. See Patent 721,774.

721,780. CLUSTER OF PLURAL LAMP SOCKETS; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1902. See Patent 721,774.

721,794. TROLLEY; W. H. Goodyear, Wilkinsburg, Pa. App. filed March 18, 1902. Details.

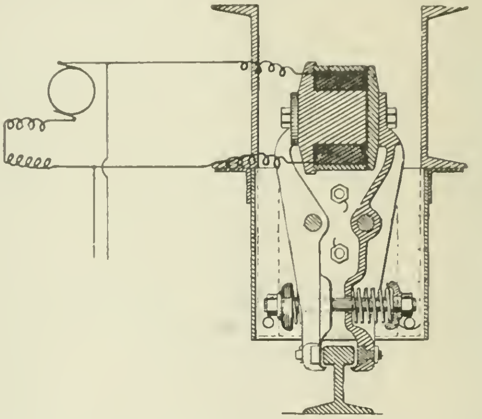
721,817. TELEPHONE-TRANSMITTER; L. Mellett, Somerville, Mass. App. filed June 6, 1902. (See page 445.)

721,877. RAILWAY MOTOR VENTILATING SYSTEM; J. H. Fedeler, Schenectady, N. Y. App. filed Dec. 6, 1902. Air is directed through the motor casing for cooling purposes and then led into the car for heating purposes.

721,882. TELEPHONE SYSTEM; S. B. Fowler, Morristown, N. J. App. filed November 5, 1900. (See page 445.)

721,939. LIGHTNING-ARRESTER; W. J. Chapman, Minneapolis, Minn. App. filed April 19, 1902. (See page 445.)

721,942. ELECTRIC SWITCH SYSTEM; A. L. De Leeuw, Hamilton, Ohio. App. filed Nov. 24, 1902. A switching system adapted especially for planing machines to feed the tool after each stroke of the table.



722,066.—Automatic Rail Gripping or Locking Device for Electric Cranes.

721,981. ELECTRICAL CASH REGISTER; J. C. Vahjen, New York, N. Y. App. filed May 9, 1902. The various functions of a cash register are performed electrically upon the pushing of a key and rotation of a crank as in the mechanically operated machine.

722,021. TELEPHONE-TRANSMITTER; C. Holmok, Cleveland, Ohio. App. filed February 21, 1902. (See page 445.)

722,024. SWITCH; J. N. Kelman, Colgate, Cal. App. filed Jan. 30, 1902. A high potential switch in which one terminal is placed in a vessel filled with thick layers of oil and water, the other terminal being passed through the liquid to make and break contact.

722,030. APPARATUS FOR MEASURING AND INDICATING ELECTRICITY SUPPLY; C. H. Merz, Westminster, Eng. App. filed Sept. 25, 1902. An integrating meter and an indicating device driven from the meter and adapted to indicate the greatest amount of current integrated by the meter during any one of a number of intervals of time.

722,036. TROLLEY STAND; W. B. Norton, Detroit, Mich. App. filed May 26, 1902. Details of construction.

722,042. ELECTROMAGNETIC MOTOR; A. P. Y. Aguirre, Havana, Cuba. App. filed Aug. 28, 1902. Details.

722,066. AUTOMATIC RAIL GRIPPING OR LOCKING DEVICE FOR ELECTRIC CRANES; S. T. Wellman, and J. E. A. Moore, Cleveland, Ohio. App. filed March 18, 1902. A magnet controlling the rail gripping device is in circuit with the motor of the train, so that when the motor is cut out, the rail is automatically gripped.

722,109. RAILWAY SIGNALING APPARATUS; H. J. Jefcoate, Crewe, Eng. App. filed Nov. 24, 1902. Automatic apparatus for displaying signals in the cab of a locomotive.

722,139. SELF-DECOHERING COHERER SYSTEM; A. Popoff, Cronstadt, Russia. App. filed March 8, 1900. (See Current News and Notes.)

722,189. TROLLEY WHEEL FOR ELECTRIC TRAM CARS; A. Selz, Flemingsburg, Ky. App. filed Nov. 14, 1902. The wheel has an elongated axle, along which it can slide against spring pressure when the car is passing a curve.

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CONTENTS.

Editorial 469
Tesla Split-Phase Patents 472
A. I. E. E. Philadelphia Local Meeting 472
Chicago Meeting of the A. I. E. E. on Car Lighting 472
Formal Opening of the Frontier Independent Telephone Exchange in Buffalo, N. Y. By Frank C. Perkins 473
The Testing of Recording Wattmeters on the Consumers' Premises by Means of a Specially Constructed Portable Test Meter. By W. J. Mowbray 475
System of Electric Control for New York Subway 477
The Heyland Induction Motor—*Concluded.* By Boy De la Tour 479
Electric Railways in Sweden. By Arvid Westerberg 481
Meeting of Independent Telephone Association of Maine 482
American Electrochemical Society 482
Reasons for Travel Congestion in New York 482
Recent Electrochemical Developments. By Clinton Paul Townsend 483
Dutch Cable Landing at Guam 483
New Telephone Patents 484
Proposed Municipal Lighting Plant for New York 485
Current News and Notes 485
Letters to the Editors:
  Tesla Split-Phase Decisions. By William Stanley 486
  The Mercury Arc. By Louis E. Walkins 486
  Fuel Consumption in Central Stations. By Jos. E. Lockwood 486
Digest of Current Electrical Literature 487
New Books 491
A Notable Invention in Rapid Telegraphy. By Romyn Hitchcock 492
"Sparklet" Fuses 493
Interruptions of the California Long Distance Power Service 493
The Felt Axle-Driven Train Lighting System 494
Monorail Railway 495
General Electric Motor for New York Subway 495
Electrical Contracts in the Philippines 497
New Electric Automobiles 497
Departments:
  Financial Intelligence 498
  Commercial Intelligence 499
  General News 501
  Trade Notes 505
  Record of Electrical Patents 506

A New York Municipal Plant.

We are not surprised that the idea of a New York municipal lighting plant should have been presented recently to the public of this city. The thing has been talked about before, especially under the Tammany régime, and it did look the other day as though the "municipal ownership convention," held under the nominal auspices of the Reform Club, might have a "joker up its sleeve" of some kind or other. Perhaps the convention and the attack on the lighting corporations have had nothing to do with each other; but it is a little curious that so much time and rhetoric should have been given to the iniquities of private gas and lighting plants. Looking back at the discussions of a week or two ago, it does seem as if whatever was left unsaid against the companies was now being voiced by Commissioner Monroe and other civic authorities in their eagerness to create a new municipal bureau.

Granting the good faith and public spirit of the city administration in the move now being made, we can but regret this effort to erect a new department to handle large sums of public money and employ large numbers of voters. If there be an evil that is aimed at, the remedy is worse than the disease. We do not see how the new plant could possibly be got into operation under two or three years, by which time, according to the normal ebb and flow of politics, it would fall into the hands of those who have, it is asserted, often looted the city treasury through the public departments. On Monday morning of this very week, while the papers were full of the new municipal lighting project, they also published extracts from the City Club's pamphlet on the rottenness in the Board of Health. We will make no comment, but just quote the following:

> Persons who made special investigation of the matter charged that the average blackmailing by officials of the Health Department amounted to fully $1,500,000 a year. If, for instance, a manufacturer could save $2,000 a year by burning soft coal, he could afford to have his violation of the smoke ordinance overlooked. It was well understood by property owners that they could regularly escape making repairs ordered by the payment of a bribe equal to 25 per cent. of the estimated cost of the work. If the case were such that the conditions demanding remedy could not be ignored, or if the owner decided that it was to his interest to do the work required, it was suggested to the owner to employ a certain firm recommended by the officials of the department. The charges of the firm were exorbitant, but experience convinced owners that it was cheaper in the long run to act on the "recommendation." The two presidents of the Board of Health during Mayor Van Wyck's administration, Michael C. Murphy and his successor, John B. Sexton, were typical specimens of the spoils politician. Neither knew anything of the real duties of such a position.

There is a lot more of the same kind in the report. Yet, in view of such allegations, another set of reformers actually proposes to saddle on the community a new department vested with all manner of opportunity for waste, blackmail, bribery and corruption.

In addition to the proposal that the new plant shall supply city lights, men of socialistic bent like Comptroller Grout, say that it should supply electricity to all the residents of New York. We believe that city lighting is about 5 per cent. of the New York Edison business, so that the ultimate investment of public money proposed by Mr. Grout is simply enormous; while the proposed profit or saving is as usual based apparently on erroneous figures like those of Detroit or the prices of little towns and villages where a square foot of land costs one dollar instead of six hundred. If the city does not go into the wholesale production of current, it is merely going to produce at retail a little five per cent, and before it does that, the part of wisdom and prudence demands that every possible step be taken to secure better terms from existing private plants. As against the socialistic municipal-ownership-of-everything craze, we cannot do better than quote the *New York Sun* when it says, in language echoed by other newspaper leaders of public opinion: "With the fullest precedents at hand for legislative regulation of the New York city gas companies, the movement, or rather the threat, to establish a municipal lighting plant is plainly not for the redress of grievances, but to get the city into the business of making light. The agitation started yesterday was started by the restless spirit of municipal ownership. There is more against that system than overburdening the government with responsibility for functions that are better served by private enterprise. The municipal ownership advocate is a load on industrial confidence and prosperity. His voice is a signal to every business company successful enough to be conspicuous that its business is in danger. The municipal ownership man is envious of it and wants to seize it. In his devotion to his hobby he longs to narrow the field wherein ordinary citizens may make a living. Trouble between the city and the gas companies will be much better adjusted by business men than by doctrinaires."

The Syndicate Idea.

This is the day of syndicates and consolidations, but it is only recently that the movement seems to have started actively among small electric light and power plants. It is rather strange, in view of the tendency of the times, that this idea has not been worked more extensively heretofore as regards small electric lighting properties. Probably the reason for this is that since the gross receipts from these small enterprises are small per company, there has not been the temptation for men of large affairs to attempt to bunch together a large group of them under one management, that there would have been if a similar gross income could be obtained from a smaller number. We have had in this country for several years a number of prosperous companies or syndicates controlling a number of electric lighting and railway properties under one general management. Most of these properties have been in moderate-sized cities of 30,000 to 125,000 population. They have usually been scattered from Maine to California, and with executive offices located in the East, as they usually are, the traveling expenses of administration are high. When we come to towns of 10,000 or less, while there is profit in well-managed electric light and power business, there is not sufficient money turned over in the course of a year to make the handling of such properties attractive to a company or syndicate located a thousand or several thousand miles away. However, it is beginning to be realized that even if such small plants cannot be handled to advantage by syndicates of national scope, there is a good opportunity for a consolidation of management of small plants located within a radius of 300 miles of a general office. By getting together a sufficient number of small plants within such a radius, the expenses of engineering and administration, and much of the expense of bookkeeping, can be reduced to an amount per plant consistent with the gross income per plant.

One of the greatest difficulties with which the smaller electric light and power company labors is lack of efficient engineering and management. This lack the syndicate idea makes good. It is not to be expected, of course, that the fact that a plant is operated by some central company will for a moment make up for the absence of a good man in local charge of each plant; but the central management is likely to insure such a competent man being placed in charge, for the reason that inefficient local management would probably not be borne with as long by a syndicate as by local interests owning a plant. Of course, there is the objection that there is likely to be less friendly feeling in a community for an outside corporation than for a company composed of local people. There is another side to this case. A company controlled by local parties is apt to show undue favoritism in the way of prices to some of the company's customers, because of local business and political reasons, much to the detriment of the revenue of the plant With outside local management this would probably be wiped out, and all customers would be put on a fair and equitable basis.

In effecting such a consolidation of such plants, it is not essential that local interests be purchased outright. It may even be possible in some cases to exchange stock in the local companies for stock in the consolidated company, leaving the local stockholders as stockholders in the consolidation, rather than stockholders in one individual plant. If the consolidation is controlled by men having the confidence of the various local capitalists, there would seem to be many excellent reasons why stock in such a consolidated company would be worth more and have a more stable value from an investor's standpoint than the stock in any one local enterprise. On such a basis as this many small plants could be established or extended, where now they either languish or do not exist.

The Heyland Motor.

We print in this issue the concluding part of the chapter on the Heyland motor from the excellent work on the "Induction Motor" by Boy De la Tour, which book has recently been translated into English by Mr. C. O. Mailloux. Much has been written about this interesting self-regulating and automagnetizing type of asynchronous induction motor, but thus far it appears to exist only on paper. It is apparently beyond dispute that the machine should be able to maintain a power-factor of unity over its ordinary working range of torque, but only through sacrificing that condition which made the induction motor pre-eminent—namely, the absence of a commutator. The induction motor, in spite of its small mechanical clearance, is a wonderfully reliable machine and can stand magnificent abuse. It has a pair of self-oiling bearings, and some primary terminals. When these terminals are connected to the mains through a suitable starting switch and transformer, the machine will start and go on running. There is nothing to be done save to see that the oil in the bearing is changed at long intervals. The machine takes, however, a fairly strong wattless component of magnetizing current, and is objectionable to the station manager from that standpoint. If, however, in order to eliminate the large magnetizing current, a commutator and brushes have to be added to the machine, the ideal simplicity of the motor is rudely dispelled and the question becomes one of choice between additional cost, complexity and inspection, with very little magnetizing current, or the original sin of much magnetizing current linked with a nature of guileless simplicity.

Testing of Recording Wattmeters on Consumers' Premises.

Mr. Mowbray's article, on page 475 of this number, deals with a subject of much importance to the central station manager. It is appalling to contemplate the total loss of income which a distributing system incurs, consequent upon a definite tendency of the consumer's meters to under-register at light loads. When adequate capital is available, it is wonderful how much first cost may logically be debited to a theoretically accurate meter, in order to avoid the loss of income which inaccuracy of friction at light loads may involve. It is almost a self-evident proposition that meters should be tested in place. Not only is serious objection raised to the frequent changes of meter that testing at the station involves, but also the transport and restoration of a meter may involve mechanical hardships to the instrument, in the hands of over-vigorous employees, sufficient to alter the rate. Mr. Mowbray's plan for testing is to use a peripatetic standard meter essentially similar to the meter tested, on the principle of "set a thief to catch a thief." This is certainly a better plan than the conjoint use of voltmeter, ammeter and slide-rule. It is perhaps the cheapest plan that could be devised, for it avoids numerical labor and employs a relatively inexpensive measuring instrument.

The method as described is, however, only applicable to meters in which the cover may be lifted for interior inspection. Permanently sealed meters require the slide-rule or equivalent arithmetical processes in testing. In such cases a portable indicating wattmeter, as distinguished from a watt-hour meter, is perhaps preferable. Some day we may see a standard form of house-service switch and fuse-block, for installation in the neighborhood of the meter, and in which a simple but effective attachment will be provided for the ready insertion of the testing watt-indicator. This, with a portable rheostat for adjusting an artificial load, would make it possible for an assistant to apply and maintain the full-load power, or any fraction thereof; while the inspector counts the revolutions per minute of the meter tested, with a stop-watch, and determines the rating. This would only differ from Mr. Mowbray's plan in the use of a more delicate and expensive form of testing instrument. The process might be worked out so as to avoid computations. By special design, one and the same wattmeter might be made to measure very varied ranges. This might be done with shunts. With any regularly organized testing system, the electric meter is capable of being tested in place more conveniently, swiftly and accurately than any other meter for house installation. Gas meters and water-meters are much more troublesome to test.

A Twentieth Century Project.

An important document comes to light in our current issue in the form of a project for the electric operation of all the railways of Sweden. That country has already been the scene of large activity in power transmission operation, and considering the lack of an adequate coal supply even for operating the railroads, there is good reason for working the water powers to their utmost. The present project contemplates the operation of the national railway system by electric traction, ultimately in its entirety. At first only sections would be transformed and then as locomotives needed replacement electric locomotives would take their place, so that without the burden of an immediate heavy investment, and without the scrapping of valuable material, the change will be made complete. It is proposed to press into service both water powers and the extensive peat beds that are here and there found and which lie scattered, so that by utilizing both sources the distances of transmission will not be excessive even from the standpoint of present practice. Mr. Dahlander, the engineer who has made the preliminary report, figures out a net annual saving of about two million dollars a year by the change, a sum approximately equal to the entire motive power expense on the electrical system; and in addition the importation of coal for railway purposes will become unnecessary, which from the governmental standpoint is very desirable.

The project as a whole strikes one as singularly sane and reasonable. It does not attempt the extraordinary, nor does it pass beyond the conservative limits of present practice. In fact it is conspicuous for the absence of sensational features of any kind. Even in the system of motive power proposed it does not indulge in radical novelties, but proposes tentatively at least, the Ward Leonard scheme recently developed by the Oerlikon Company. Now this plan, whatever may be said of its complication in apparatus, has at least the merits of involving no broadly experimental features, and of giving a most reliable and perfect speed control. Besides it lends itself very readily to installation in company with steam locomotives and involves no radical changes in methods of operation. The polyphase traction systems Mr. Dahlander turns down on the ground of complication, more especially in the overhead system. This of itself strikes us as a less serious objection than the matter of speed control, which assumes particular importance when a gradual conversion to electric traction is attempted. The Ward Leonard plan is remarkably well suited to meet this very case, although Mr. Dahlander does not seem to forget the Arnold and Lamme-Westinghouse devices, which we hope ere long to see tried out on a decisive scale in this country. If the latter plan succeeds it certainly will work a revolution in power transmission as well as in railway work, for if a big railway motor on the series single-phase system can be made to work as well as Mr. Lamme assumes, similar motors will *a fortiori* be important in ordinary distribution whatever system may be used for the transmission line. All this, however, remains to be proved, and Mr. Dahlander very sensibly bases his preliminary estimates on a system that certainly will do the work even if slightly less economical in its use of power than a system with alternating motors upon the cars. At all events, the low-tension working conductor must go if serious railway work over long distances is to be a success.

In this connection we cannot help running over the form this Swedish project would have taken if treated on our canonical and case-hardened American lines. Would it show a mighty trolley wire or the third rail? Of course there would be scores of sub-stations with rotaries—nice, steady-going, low-speed rotaries all thoroughly standardized and fed from giant transformers to match. There would be also a beautiful multiple unit control and as many motors per train as the Swedish treasury could pay for. There would be special provision for quick acceleration—no up-to-date engineer would tolerate less than enough to throw the passengers through the rear door in stopping. Jesting aside, it would not be very cheerful to have the first great application of electricity to general railroading made abroad by an American method which had been without honor in its own country, and which American engineers had lacked the initiative to apply. It is interesting to note in this connection that the Ward Leonard system has also met with favor in the land par excellence of electrical engineering—Switzerland—where it is being developed with a view to its application on all Swiss government roads to the entire exclusion of the steam locomotive. We have done marvels in this country in the development of electric traction for certain purposes and along certain canonical lines, but though the larger work has been discussed and proposed nothing has yet come of it. There is a great gap that yawns between the best and most extensive interurban road and the most modest of railway systems. Not long ago we had occasion to comment on a paper by Mr. Vanderbilt dealing with this larger problem of electric traction. From his standpoint the outlook was not encouraging, and it is safe to say that it will remain discouraging until we are ready to cut our coat according to the cloth and treat a trunk line as a distinct entity having characteristics of its own and not merely as a bigger street car line to be operated in the good old way or left to its fate. We trust that the Swedish project will be pushed to a final development and to construction, though it is a bit annoying to think of the first point being scored away from home.

Tesla Split-Phase Patents.

Judge Colt, of the United States Circuit, District of Massachusetts, on March 11 handed down a decision covering the Tesla split-phase patents, the parties to the suit being the Westinghouse Electric & Manufacturing Company and the Stanley Instrument Company The opinion, which is very brief, refers to the recent decision of Judge Townsend in a suit on appeal in which the same patents were involved, an account of which is given in our issue of March 7.

The opinion states that upon careful consideration of the evidence, the court has reached the conclusion that the complainant has failed to establish, by sufficient proofs, the conception by Tesla of the inventions in suit prior to April 22, 1888, the date of the Ferraris publication. In a complainant's supplemental brief no reasons were found stated or authorities cited which should lead the court to any different conclusion. Since the hearing in case at bar, the Circuit Court of Appeals for the Second Circuit, in a suit involving the same patents brought by the complainant against the Catskill Illuminating & Power Company, upon the same evidence which was before the present court, has held that the proofs were insufficient to establish invention by Tesla prior to April 22, 1888. Judge Colt considers that this decision, which was passed down February 26, 1903, renders unnecessary an extended opinion by him, since it would be only repetition of the views so clearly expressed by Judge Townsend in the opinion of the court in the Catskill case. A decree would be entered dismissing the bill, with costs.

A. I. E. E. Philadelphia Local Meeting.

The first regular meeting of the Philadelphia local meeting of the American Institute of Electrical Engineers was held at the Engineers' Club, 1122 Girard Street, Monday evening, March 9. There was a short business session during which Mr. Carl Hering was elected chairman, Mr. H. F. Sanville, secretary, and Messrs. Charles Hewitt, W. C. L. Eglin, J. F. Stevens, H. A. Foster and Theodore Spencer members of the Executive Committee.

Mr. W. L. Bliss then presented his paper on "Railroad Train Lighting," and Mr. W. C. L. Eglin presented abstracts of the papers of Messrs. Farnsworth and Sperry, on the same subject. A spirited discussion was opened by Dr. C. B. Dudley, of the Pennsylvania Railroad Company, and carried on by Messrs. W. L. Bliss, Hugh Lesley, C. J. Reed, H. C. Spalding, J. B. Klumpp and others. The remarks of the several railroad men added very largely to the interest and value of the discussion.

The next meeting of this branch will be held on Monday night, April 6.

Chicago Meeting of the A. I. E. E. on Car Lighting.

One of the most enjoyable and enthusiastic meetings of the American Institute of Electrical Engineers at Chicago was held Tuesday evening, March 10, at the rooms of the Western Society of Engineers. The main idea of this meeting was to increase acquaintance among members and prospective members of the Institute in Chicago and increase interest in the Institute meetings. An hour was given to the consideration of train lighting and a very profitable discussion resulted.

The discussion was started by Mr. C. Lock Etheridge, until recently electrical engineer of the Pullman Company. Mr. Etheridge has had considerable experience in equipping the cars of that company with various systems of lighting. He did not attempt to take up the merits and demerits of various systems described in the papers, but spoke rather from the operating standpoint in general. He criticized the lack of care given by the majority of railroads to their train lighting equipments. He cited one case in particular as an example, where a dining car running about three hundred miles a day had been out of the shops about three months when its axle-driven lighting system was reported to be in trouble. Upon investigation, Mr. Etheridge found that the belt driving the dynamo from the car axle was gone. Further investigation convinced him that absolutely no attention had been given to the electrical lighting apparatus in this dining car in the three months it had been out. This was shown by the fact that various adjustments of wires and the adjustment of the belt tension had not been disturbed. The belt had not been tightened in that time and when finally it was lost off and the storage battery was run down, of course there was trouble. He thought that a system that would run three months without any attention was not very bad. Considering the attention given to electrical equipments, he thought that the wonderful thing was not that there was so much trouble with them, but that there was so little. The car wiring done by many of the railway companies which do their own wiring was much of it very bad; in fact, no better than bell wiring. Wires were run fastened to woodwork by staples and a common return system used. It was nothing uncommon to be able to light all the lamps in a car by turning the switch which was supposed to control but one circuit. He regretted that the paper by Mr. Sperry had been presented to the Institute, as it gave absolutely no information as to what the new system spoken of really was, and might better have been omitted.

Mr. A. J. Farnsworth, author of the paper on the "Consolidated" axle lighting system, seconded Mr. Etheridge's criticism of ordinary train wiring, and said that in reality wiring of railway cars should be better than any other class of wiring, because of the constant vibration, which would in time break down anything but the most substantial construction. There was room for a great deal of work in standardizing junction boxes outlets and similar fittings. He favored a low voltage (thirty volts) because high-efficiency lamps taking 2½ watts per candle-power were possible by using the low-voltage lamps with thick, short filaments. High efficiency was desirable so as to get as much light as possible from a given weight of battery. He also favored standardizing train connectors.

Mr. Gillman, of the Chicago, Milwaukee & St. Paul Railway, said that there was some good train wiring, and in spite of the poor help employed by many railway companies, there was lots of good train lighting. He had taken great pains with the wiring of cars under his charge and had had but little trouble, even though much of the wiring was the molding work which had just been criticized. He favored wiring cars on the three-wire system, with 110 volts across the outer mains. When necessary, it could be switched over to operate on the two-wire system at half the voltage, and it would then work in parallel with the sixty-volt systems which are common. This would permit the use of sixty-volt lamps, which would be of higher efficiency than 110-volt lamps, and would stand the jarring of the train better, and it would permit storage batteries to be charged in cases of emergency from 110-volt circuits, which could be found at many places along the line of a railroad. Where a private car doing special service is taken from the regular equipment, this ability to charge at any important stations along the line. is desirable. This applies more particularly, of course, to systems using a dynamo in the baggage car. He favored the three-wire system also because of the drop in voltage on a long train where current is furnished from a generator in the baggage car.

Mr. D. Avery Kimbark, who has had extensive experience in the installation of car lighting systems for the Pullman Company, considered the use of thirty-volt lamps inadvisable, even with axle-driven systems, because of the drop in voltage on long 90-ft. cars, where, as is usually the case, the controlling panel must be placed at one end. A low voltage was sometimes favored because of the small number of storage cells it required, but the battery on the car must be large anyway to provide a sufficient reserve, and the number of cells required by a sixty-volt, as against the thirty-volt system, would not be as undesirable as it would if the battery were smaller. The Pennsylvania Company, after many years' experience, has adopted sixty volts. As to car wiring, he thought Mr. Gilman's cars wired in molding gave satisfaction, because of the close personal attention he gave to them. Much of the car wiring on railroads is undoubtedly very bad. Cars were frequently wired on a common return system. He had seen some cars wired with cotton-covered magnet wire, several circuits twisted together and fastened under one staple. Of course this was a common return system. He referred to a constant-speed axle system, devised by Mr. Charles E. Felt.

L. F. Mahler showed some lantern slides illustrating the application of a De Laval steam turbine to the driving of train-lighting generators. One of the Pennsylvania limited trains is lighted by a turbine-driven generator in the baggage car and orders have been placed for several more of these equipments.

Mr. R. H. Pierce, local secretary, tendered his resignation as he will move to Boston on May 1 to open an office in that city. The loss of his services is deeply regretted.

Formal Opening of the Frontier Independent Telephone Exchange, Buffalo, N. Y.

By Frank C. Perkins.

The Frontier Telephone Company, of Buffalo, had a formal opening of its new exchange on Ellicott Street, on Tuesday, March 10. In response to invitations sent out by the officials of the company the building was crowded from 2 P. M. to 10 P. M., and the day was set aside for public inspection, the visitors being received by Vice-President William A. Douglass, Assistant General Manager Willbur H. Johnston and others. The accompanying illustration, Fig. 1, shows the office building and exchange, the interior of which was profusely decorated with flowers, on this occasion, while numerous selections were rendered by an orchestra on the first floor and refreshments were served in the operators' parlors and dining-rooms on the third floor. A complete kitchen equipment has been provided by the company for the operators, as well as library and sitting-rooms, together with well-arranged lockers, wash rooms and an elaborately furnished hospital.

The president of the Frontier Telephone Company is E. C. Lufkin, the secretary and treasurer, Charles B. Hill, and the general manager, Samuel E. Wayland. The main switchboard and electrical equipment of the exchange is located on the second floor, the first floor being given up to offices and store rooms in the rear.

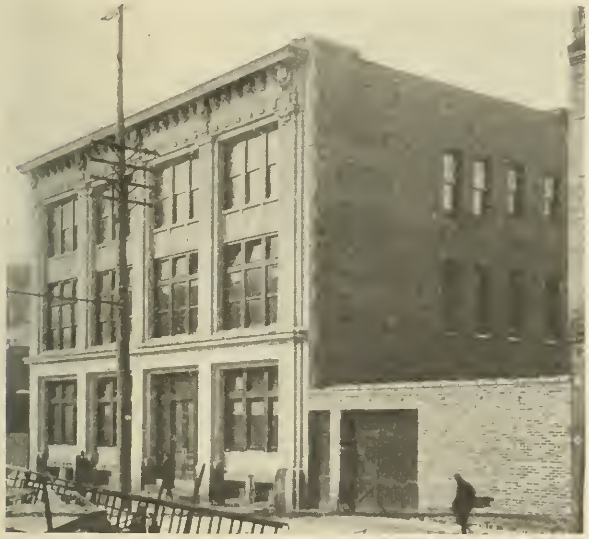


FIG. 1.—FRONTIER TELEPHONE EXCHANGE.

The current for operating the exchange is exclusively obtained from the Buffalo General Electric Company, but an independent gas engine plant has been provided for use in case of failure of the Niagara power. The electrical generators, Fig. 2, and motor generator sets were supplied by the Holtzer-Cabot Electric Company, the gas engine equipment by the Westinghouse Company, and the telephones and switchboards (Fig. 3) by the Kellogg Switchboard & Supply Company, of Chicago, while the storage battery plant was installed by the National Storage Battery Company, of Buffalo.

The storage battery room is equipped with two sets of accumulators consisting of 11 cells each, the present capacity of the 4 positive and 5 negative plates being 800 amp-hours, while the output can be doubled when desired by increasing the number of positives to 8 plates and adding 5 more negative plates. These cells are of the National type and are 33 in. long, 23 in. wide and 19¾ in. deep. The power switchboard seen in the accompanying illustration consists of three panels, the first of which is equipped with Weston instruments, the voltmeter reading from 0 to 3 volts for testing the individual storage cells. The second panel is equipped with the distribution switches and a Weston voltmeter reading from 0 to 50 volts. The third or charging panel is supplied with two circuit-breakers, one for each battery, together with a Weston ammeter reading up to 250 amp and the usual switches.

The batteries are charged by two motor-generator sets of 10-hp capacity each, one being held in reserve in case of emergency. These groups noted in the background of Fig. 2 operate at 1,000 r.p.m. The motor receives its current from the General Electric service at 220 volts, taking 10 amp, while the dynamo supplies a direct current of 175 amp and 30 volts, the latter being raised as the cells become charged. The motors and generators of these sets are of the Holtzer-Cabot four-pole type. In case it is necessary, the batteries may be charged from the gas engine plant located at the right in Fig. 4.

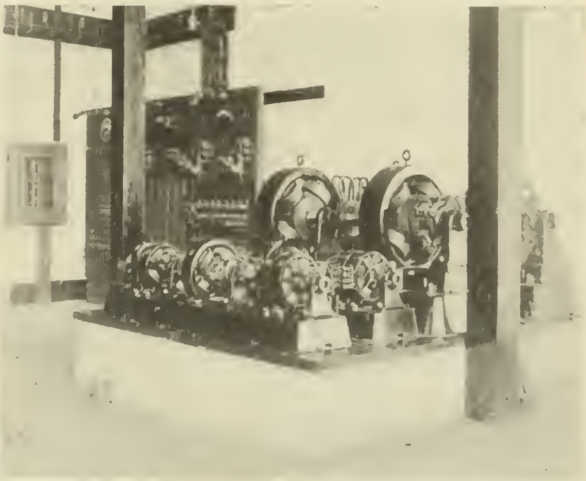


FIG. 2.—CHARGING MOTOR-GENERATORS, RINGING MOTOR-GENERATORS AND POWER SWITCHBOARD.

This installation includes a Westinghouse twin-cylinder vertical gas engine of 15-hp capacity, the cylinders being 6 x 8, and the speed 350 r.p.m. The engine is connected to a four-pole Holtzer-Cabot dynamo by a chain drive, the speed of the latter being 915 r.p.m. This direct-current auxiliary generator has a capacity of 5¼ kw supplying a current of 175 amp at a pressure of from 30 to 80 volts. This outfit may be utilized for charging the accumulators or operating lights as desired.

One of the most interesting apparatus in the exchange is the direct-alternating current ringing motor-generator sets seen in the foreground of the accompanying views (Figs. 2 and 4). These ringing machines are for the four-party lines and consist of two groups with five machines in each group connected by a common shaft. One set is held in reserve and may be operated from the storage battery, the motor in the center of the group being wound for 24 volts, while the other set is driven by Niagara current from the 220-volt power service of the Buffalo General Electric Company. These ringing machines and the wiring are arranged for supplying the current for the selective or individual ringing. The direct-current motor in

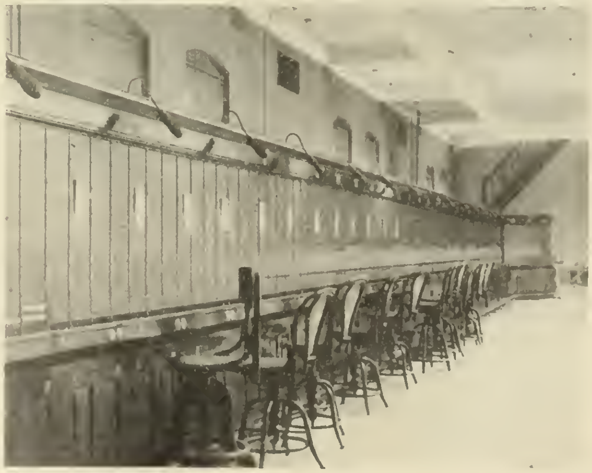


FIG. 3.—SWITCHBOARD.

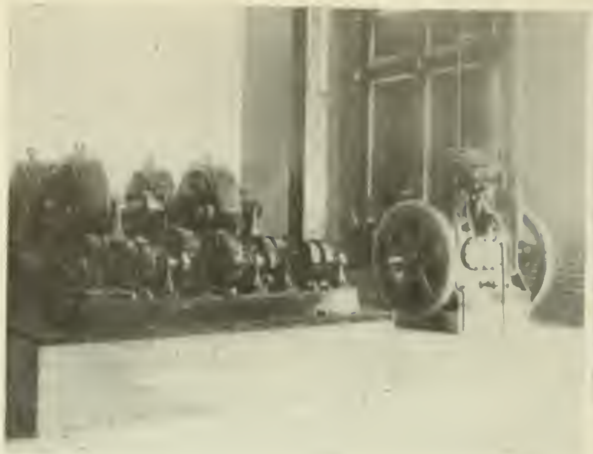


FIG. 4.—CHARGING AND RINGING MOTOR-GENERATORS.

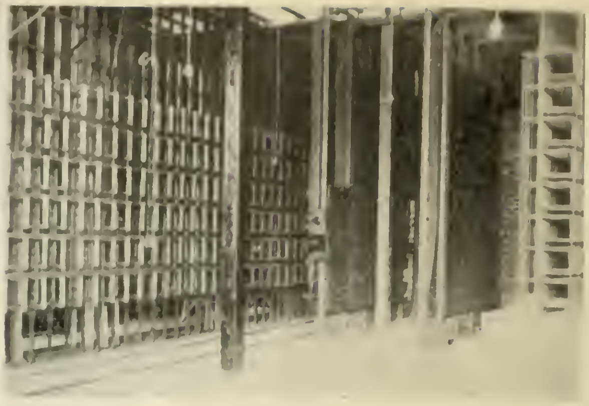


FIG. 5.—RELAYS AND REAR OF DISTRIBUTION RACK.

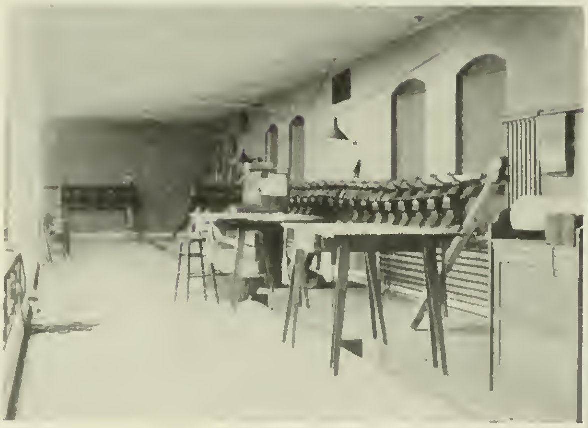


FIG. 6.—OPERATORS' PRACTICE ROOM.

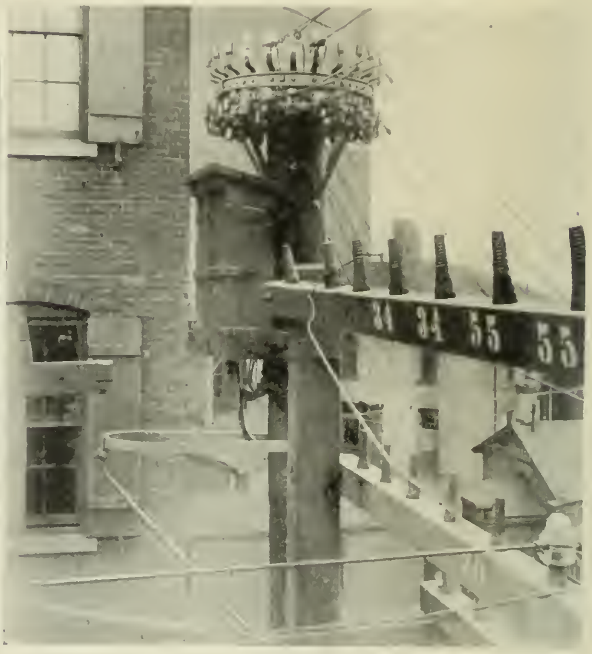


FIG. 7.—DISTRIBUTING POLE.

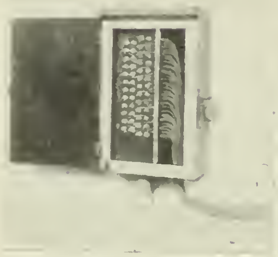


FIG. 10.—BASEMENT BOX WITH CABLE CONNECTIONS.

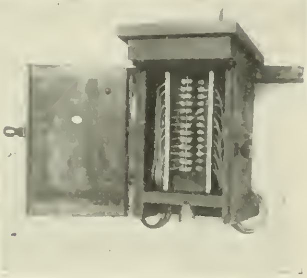


FIG. 8.—POLE BOX WITH LIGHTNING ARRESTERS.

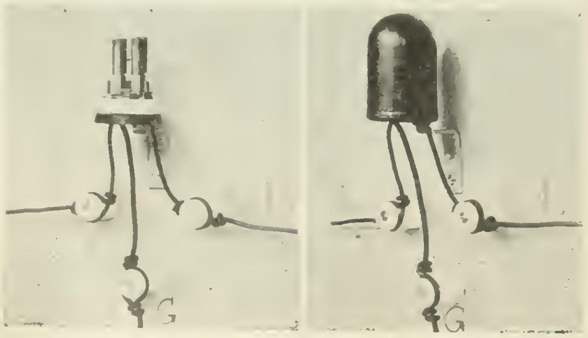


FIG. 11 AND 12.—INDIVIDUAL LIGHTNING ARRESTER. UNCOVERED AND COVERED.

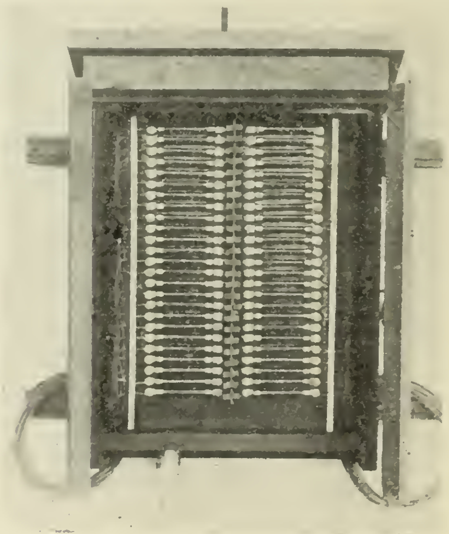


FIG. 9.—POLE BOX WITH LIGHTNING ARRESTERS AND FUSES.

FRONTIER INDEPENDENT TELEPHONE EXCHANGE, BUFFALO, N. Y.

the center of each group drives the alternating-current ringing generators at a speed of 1,050 r.p.m., and is a 1-hp, four-pole Holtzer-Cabot direct-current motor.

The ringing buttons for the four party lines are connected with each of the small ringing alternators. Party No. 1 bell receives current from alternator No. 1, which is a bipolar machine supplying a current of 1.5 amp at a pressure of 100 volts and a frequency of 17.5 cycles, while the bell of party No. 2 receives its current from ringing alternator No. 2, supplying a current of 1.5 amp at a pressure of 100 volts and a frequency of 35 cycles. In the same manner the party No. 3 bell is rung by alternator No. 3, having the same voltage and current, but supplied with six poles, while the former, No. 2, only had four poles, the periodicity being in this case 52.5 cycles instead of 35 cycles. Similarly alternator No. 4 rings the party No. 4 line bells, having the same voltage and current, but a current of 70 periods, the number of poles of this machine being eight. Each bell on the line is thus adjusted to ring only with the number of alternations which corresponds to the proper alternator and button of the operator. These buttons are colored red, green, black and blue, and the selective ringing is thus easily manipulated by the operators at the main telephone switchboard.

The telephone switchboard of the Frontier Telephone Company is of the latest improved type, as will be noted by the accompanying view, Fig. 3, which shows a large part of the 23 sections already installed. The complete switchboard on both floors will consist of 56 sections with three operators for each section. The board is finished in mahogany and each section is 5 ft. 7½ in. long and 7 ft. high. The total capacity of the board when completed will be 18,000 lines, which, including the four-party lines, will accommodate 36,000 subscribers. This board is very compact, and is already equipped for 8,000 lines, while it is stated that this exchange starts out with as large a list of patrons as that of any company installing a completely new plant.

The general working of this switchboard and exchange is similar to other modern common battery systems. A subscriber taking his receiver from the hook of his instrument operates a line relay in the terminal room seen in the accompanying Fig. 5 at the right. This line relay in turn lights a miniature lamp in front of the operator at the switchboard proper. She inserts an answering plug in the jack associated with this lamp plug, which in turn operates another relay called a cut-off relay, which extinguishes the line lamp. At the same time it cuts the operator's or switchboard line on to the subscriber's line. The room for practice work for the operators is seen in Fig. 6, and it is here that the necessary instruction is given new employees. After the lines are connected the operator asks the number, and, having received it from the subscriber, connects this subscriber by inserting another plug called the calling plug to the desired number. The switchboard cords are equipped with a double supervisory system whereby an operator by means of the supervisory lamps associated with each plug can tell whether a subscriber does not answer, or is talking over the line, or is through talking. The switchboard is also supplied with the usual busy test, whereby an operator before making a subscriber's connection first touches one side of the line wanted with the tip of her plug.

The accompanying illustration, Fig. 7, shows a distributing pole with ring top and pole box, while Figs. 8, 9 and 10 show 13-pair and 25-pair pole boxes with fuses and lightning arresters, as well as a 25-pair basement box with cable connections. The Figs., 11 and 12, show the latest type of individual lightning arresters, represented open and closed as installed outside of the subscriber's window or entrance.

The tariff rates of the Frontier Telephone Company, of Buffalo, are as follows, which are for unlimited service: For business telephones on direct lines the charge is $48 per year, while for private service on direct lines the charge is $36. On the party lines, the rates for the business purposes varied according to the number of subscribers upon the same line. The two party business telephones cost $40 per year, three party $32 and four party $24. In a similar manner the charges are arranged for residence service at $24, $20 and $15 per year for 2, 3 or 4 party lines respectively.

The total number of subscribers already under contract is said to be more than 10,000, and several thousand are already connected and are getting excellent service. As soon as the party-line instruments arrive several thousand more will be connected up. These instruments are expected at an early date.

The Testing of Recording Wattmeters on the Consumer's Premises by Means of a Specially Constructed Portable Test Meter.

By W. J. Mowbray.

When the various electric lighting companies of this country first considered the advisability of making the change from chemical to motor meters, the motor meter was generally considered to be an instrument which would continue to record accurately for a long period of time with very little attention. The contrary, however, proved to be the case, and those companies who rather suddenly made the above change found an amount of trouble on their hands, a large portion of which they never bargained for. It is true that these new motor meters gave good service for a short period, but they soon became slow, especially on light loads, to an extent which considerably decreased the company's revenue.

The problem, "How shall we keep our meters recording accurately?" then became a very important one, and different companies set about the solution in different ways. Some periodically replaced all consumer's meters with others which had just been calibrated in the station test room. However, the accuracy of these meters immediately after installation in the consumer's premises was often found to differ very materially from their calibrated accuracy in the station, due, no doubt, to the fact that they had *not* been calibrated under actual working conditions and that they were sometimes subjected to severe shocks and jars in transportation. Other companies took the stand that all meters should be tested under actual working conditions, that is, on the consumer's premises, and this, we think, is now generally conceded to be the better practice. None of the then existing methods of testing on the consumer's premises, however, possessed both the elements of quickness and accuracy, the ammeter and voltmeter method being accurate, but at the same time very slow, and, therefore, correspondingly expensive, while the system of testing the consumer's meter with another similar meter was inaccurate on light loads and was cumbersome in that it necessitated the daily checking and transportation of approximately as many testmeters as there were different capacities of consumer's meters to be tested.

Keeping in mind the four elements essential to the success of a system of this kind, namely, accuracy, quickness, low first cost and cheapness of maintenance, the writer, foreman of the Meter-Testing Department of the Brooklyn Edison Company, has developed the system herein described, a short outline of which was read before the 1902 convention of the Association of Edison Illuminating Companies.

This system uses as a portable test meter or so-called standard, a Thomson recording wattmeter with the recording mechanism omitted and having several special features, some of which are designed to secure quickness in connecting and manipulating, and others to eliminate the errors inherent to the ordinary meter of the above type when used as a test instrument. The principal causes of these errors are as follows:

(1) Changes in friction and vibration, especially when testmeter is running on light load. Changes in commutator friction may change the accuracy on one-tenth load as much as 10 per cent. in one day, and on a similar load any heavy vibration such as that caused by a passing truck or trolley car may change the accuracy for the time being to a very serious extent.

(2) Using the testmeter before the temperature and resistance of the potential circuit have become normal. The testmeter runs fast when the potential circuit is cold, due to having been disconnected for some time.

(3) Connecting the testmeter on the wrong polarity. This would make an error, especially on light loads, due to the projected field from the drag magnets.

(4) Heat radiated by the fields of the testmeter when carrying a heavy load for a considerable length of time. This heat increases the resistance of the armature and causes the testmeter to run slow to a slight extent.

Of the above errors, Nos. 1 and 2 are by far the most serious.

The principal features of the standard meter are as follows:

A double field winding is the principal and fundamental feature of the instrument, and is designed to render error No. 1, due to changes in friction and vibration, so small as to be negligible. This double winding gives three or four current scales. The advantage of a testmeter or standard having three current scales is comparable with that obtained by using a three scale millivoltmeter and shunt instead of a single scale ammeter. However, the multiplicity of scales is more important in the case of the standard meter, due to the fact that while the accuracy of the Thomson meter on full load is good, its acuracy on light load is much more erratic than that of an ammeter. By never using the standard on light load, that is, by always putting the load to be measured on a suitable scale (or field), the test instrument is always run at a sufficiently high torque to minimize the errors due to changes in friction and vibration.

In a 10-amp standard, which is initially a regular 10-amp, 115-volt, 2-wire Thomson meter, an additional field coil of 1 amp carrying capacity is wound around each of the regular 10-amp fields. The number of turns in each of these new windings is such that when 1 amp flows in it the moving parts of the standard will rotate at exactly the same speed as when a current of 10 amp flows in one of the regular 10-amp fields. In order to convey a clear mental picture of this arrangement, we will remind the reader that in the ordinary Thomson meter the armature revolves between a right and a left-hand field coil. This portion of the standard looks exactly similar, the only difference being that both the right and left hand fields of the standard are composite, each consisting of a 10-amp inside, and a 1 amp outside winding.

The wire used for this 1 amp winding is No. 20 B. & S., single cotton-covered, and the number of turns wound around the outside of each 10-amp field may vary between the limits of 325 and 330, disposed in 13 layers of approximately 25 turns each. An exact total number of turns is not necessary, for the reason that widening or narrowing the space between the right and left-hand composite fields changes the effective flux of the 10-amp winding to a much greater extent than that of the 1-amp. Such being the case, the right and left-hand fields are brought slightly closer together if the standard runs slower on 10 than on 1 amp, and vice-versa. The two halves of the 1-amp winding are connected to a small specially constructed switch by means of which they can be thrown either in series or in multiple. When in multiple, their capacity is, of course, increased to 2 amp. This construction gives three current scales which are rated as follows:

1 ampere scale = 1 ampere fields in series.
2 ampere scale = 1 ampere fields in multiple.
10 ampere scale = 10 ampere fields in series.

It is a generally known fact that the accuracy of the Thomson meter is practically independent of ordinary changes in friction and vibration on loads exceeding one-half its rated capacity, and that it will carry 25 per cent. overload for a considerable time without introducing serious heat errors. In other words, that portion of its accuracy curve from 50 to 125 per cent. of its rated capacity, is very nearly a straight line. In view of this fact, it can be seen that the ranges through which the above-mentioned current scales can be used with accuracy are as follows:

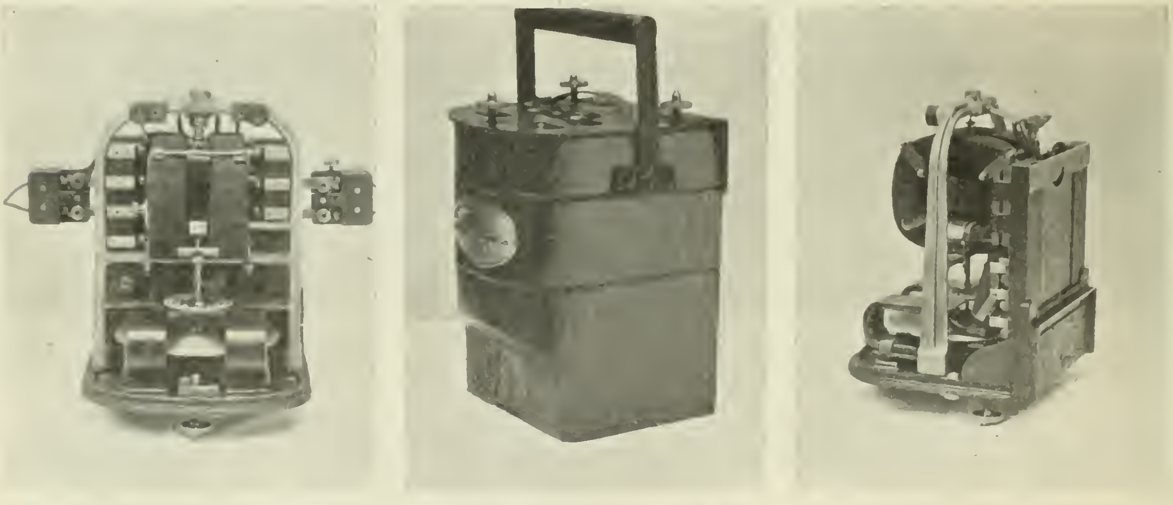
1 ampere scale is accurate from .5 to 1.25 amperes.
2 ampere scale is accurate from 1.0 to 2.5 amperes.
10 ampere scale is accurate from 5.0 to 12.5 amperes.

The 10-amp standard, the various scales and ranges of which have just been enumerated, is used to test all consumer's meters from 3 to 25 amp capacity. The full load of the meter to be tested is taken at from 50 to 100 per cent., and the light load at approximately 10 per cent. of its rated capacity. The current scales of the 10-amp standard are used as follows:

1 amp. scale is used for light load of 3 to 15 amp. meters.
2 amp. scale is used for light load of 15 to 25 amp. meters.
2 amp. scale is used for full load of 3 to 5 amp. meters.
10 amp. scale is used for full load of 5 to 25 amp. meters.

Larger meters, up to 300-amp capacity, are tested with a 75-amp standard, which is similar in its general principles to the 10-amp, with the addition that both its 7½ and 75-amp windings can each be connected either in series or multiple, thus giving the instrument 4 scales, namely, 7½, 15, 75 and 150-amp.

Error No. 2, caused by using the standard before the temperature, and consequently the resistance, of the potential circuit has become normal, would ordinarily be avoided by connecting the potential circuit on its normal voltage and allowing it to remain thus for at least 15 minutes. This would occupy too much time, especially when it is remembered that the object of the system is to get through with the test as quickly as is compatible with accuracy. This heating is best accomplished by connecting the potential circuit of the standard to a voltage double that for which it is rated for a time of 1½ minutes. Where this double voltage is not to be had, the normal voltage is applied to the two halves of the potential circuit in multiple, for a time of 1½ minutes as before. After heating by either of these methods, the standard is given its normal voltage and connections and is then ready for use.



FIGS. 1, 2 AND 3.—PORTABLE TEST METER.

In addition to the three current scales previously described, there are two potential scales, namely, 115 and 230 volts. The 115-volt potential circuit consists of the armature in series with an ordinary adjustable shunt, the armature being the standard article for a 10-115-2-meter, and the shunt having 1,200 turns and approximately 450 ohms resistance. The 230-volt potential circuit consists of the armature, shunt and a resistance card of resistance at normal working temperature equal to that of the armature plus the shunt in the same condition. This card is wound with tinned iron and German silver wire in the proportion of 76½ per cent. of the former to 23½ per cent. of the latter. This is the proportion used regularly by meter manufacturers, the object being to get a potential circuit having a temperature coefficient equal to that of the metal of which the disc is composed.

The standard is intended to be used principally on direct-current, but can also be used with very slight error on non-inductive, alternating current, that is, with a lamp bank or water resistance load. It must not, however, be used on inductive alternating-current circuits, except it is properly compensated therefor, as the above-described potential circuits are rather inductive.

With the exception of the double-field winding, the sight method of determining the percentage accuracy of the consumer's meter is the most important feature of the instrument. Without the double fields the standard would be so inaccurate on light loads as to prohibit its use, and without the sight method of determining the percentage accuracy it would be very little quicker than the ammeter and voltmeter. The principal saving of time when using the standard is due to the fact that the speed of the consumer's meter is compared directly with that of the standard, the per cent. fast or slow being determined immediately within ⅕ of 1 per cent., without having recourse to either slide-rule or stop watch.

With the ammeter and voltmeter system, the comparison is between the speed of the consumer's meter and the volt-amp, necessitating the laborious slide-rule process of multiplying the *volts* by the *amperes* to obtain *watts* (on direct current), reducing the *speed* of the consumer's meter to *meter watts,* and dividing the latter by the former to get the per cent. accuracy. The sight method, therefore, by rendering unnecessary the use of the slide-rule and stop-watch, effects a great saving in time. We will here state that the standard meter system requires a team of two men—a tester and a helper—and that, in our opinion, all important work such as determining the per cent. accuracy, repairing and adjusting the consumer's meter, etc., should be the duty of the more experienced and responsible man, namely the tester. The tester is, therefore, stationed at the consumer's meter and the helper at the standard. The per cent. accuracy of the consumer's meter is determined as follows:

The tester uses a circular scale, consisting of a piece of sheet brass on which is stuck a circular blue print of approximately two and one-half inches in diameter. The circumference of this blue print is divided by heavy lines into ten large divisions numbered from 1 to 10, and each of these large divisions is subdivided by fine lines into ten small divisions, thus making a total of 100 small divisions around the entire circumference of the circle. This scale is temporarily attached to the consumer's meter, just above the magnets, in a horizontal position, and adjusts itself so that the shaft of the meter passes exactly through its center and makes a right angle with its surface. A light-weight pointer is attached to the shaft of the meter rather close to th surface of the circular scale, over the entire 100 divisions of which this pointer passes in one complete revolution of the meter armature.

The meter is first tested on light load, and should, if accurate, make one complete revolution in exactly the same time in which the standard makes a certain definite number found by reference to a table of revolutions. The *helper* observes a white mark on the disc of the standard, and in a short and sharp tone of voice gives the word "On" at the beginning, and the word "Off" at the end of this allotted number of revolutions of the standard. At the words "On" and "Off" the *tester* notes carefully the position of the pointer on the circular scale which is attached to the consumer's meter, the per cent. accuracy being the number of small divisions passed over by the pointer between these two words.

For example, if the pointer is observed, from the word on to the word off, to pass over .85 of a revolution or 85 small divisions, the accuracy of the meter is 85 per cent. The same thing may be expressed in a different manner by saying that the number of small divisions which the pointer needs to complete one revolution, is the per cent. slow, and the number by which it exceeds one revolution is the per cent. fast.

The same method is used on full load with the exception that in the period of time between the words "On" and "Off" the consumer's meter, if accurate, makes ten complete revolutions instead of one. It will be remembered that besides being divided into 100 small divisions, the circular scale is also divided into ten large divisions numbered from 1 to 10. It is evident, then, that in ten complete revolutions the pointer passes over 100 of these large divisions, each of which have, therefore, a value of 1 per cent., and the per cent. accuracy is read directly same as on light load. For example, if from the word on to the word off the pointer is observed to make 9.5 revolutions, it has passed over 95 large scale divisions and the accuracy is 95 per cent. The number of large divisions which the pointer needs to complete ten revolutions is the per cent. slow, and the number by which it exceeds ten revolutions the per cent. fast.

When the number of revolutions which the consumer's meter should make between the words "On" and "Off" is other than 10, the formula for determining the accuracy is as follows: Accuracy equals the actual revolutions and fractions thereof made by the consumer's meter, divided by the allotted revolutions of the consumer's meter. For example, if the actual number of meter revolutions is observed to be 4.8, and the allotted number is 5, the accuracy equals 4.8 divided by 5, or 95 per cent. It will be seen that a slide rule is not necessary for an operation of this kind, as the divisor is never a fractional number.

Another circular scale and pointer similar to that described is permanently attached in a similar location to the standard. This makes it possible to station the tester at the standard and the helper at the consumer's meter, if this disposition of the men is considered desirable. It is principally useful, however, in cases where the meter to be tested is not of the regular pattern, thereby making it difficult to attach the circular scale. The formula in this case is: Accuracy of consumer's meter equals allotted revolutions of standard, divided by the actual revolutions and fractions thereof of the standard. The words "On" and "Off" are in this case given by the helper from observation of a white mark on the disc of the consumer's meter. This method requires the use of a slide-rule, as the fractional number of revolutions is the divisor. It also has the disadvantage of allowing the less experienced man to make the adjustments on the consumer's meter. We would, therefore, recommend the method first described, namely, that of attaching the scale and pointer to the consumer's meter, except in special cases where it is found impossible to do so.

It will be remembered that the essential elements of a successful meter-testing system were stated to be four in number, namely, accuracy, quickness, low first cost and cheapness of maintenance. In the foregoing portion of the description of the standard it is shown how accuracy and quickness are secured—the first principally by the double-field, 3-scale, scheme, and the second principally by the sight method of determining the percentage. The third and fourth essential elements, namely, low first cost, and cheapness of maintenance, will now be taken up.

The cost of the standard, buying the regular meter parts from the manufacturer, and making the special parts in the company's machine or meter shop, does not exceed $40, as against $170 for a first-class shunt ammeter and voltmeter.

The parts of the standard are mostly regular meter repair parts, such as are kept in stock by all central stations. The company's meter repair man can make all necessary repairs, while each tester can calibrate his own instrument. This is a very decided advantage when the expense and delay of having indicating instruments repaired and calibrated by the manufacturer is taken into consideration.

This system has been in use by the Brooklyn Edison Company from January 1, 1902, up to the present date, with the following results:

Volt-ammeter checks have shown the system to possess a high degree of commercial accuracy. It has increased the number of meters tested in service per team per week 65 per cent., as compared with our former records with the ammeter and voltmter. Our average, using the standard, for the last eight months of 1902, and January and February of 1903, was 45.1 per team per week, or 7.52 per day, and the maximum number tested by one team in one day was 14. The above average of 7.52 per team per day was obtained notwithstanding the fact that it includes large meters up to 300 amp capacity, special tests for investigation of consumer's complaints (19.5 per cent. of the total number tested), and that our territory is very extended.

The cost of maintenance has been very slight, and in one case where a standard was allowed to fall and was very seriously damaged, we succeeded in repairing it in one day.

System of Electric Control for New York Subway.

THE system of electric control which has been adopted for use on the New York Subway trains is similar to that employed on the Manhattan Elevated trains, and will be supplied by the General Electric Company, which also furnished the Manhattan electric control equipment. Some changes, however, have been introduced, the most notable of which is an attachment to the master controller which enables automatic acceleration to be secured without interference with the manual operation of the controller.

The master controller has twelve notches instead of ten, as with the Manhattan controller. The operating cylinder instead of being directly attached to the control handle is moved by the handle through the medium of a spring. To secure automatic accelaration the motorman moves the operating handle notch by notch, the operating cylinder following, or he can throw the handle to either full series or full parallel position. In either case the spring causes the operating cylinder to follow the movement of the handle until it reaches a position corresponding to that of the operating handle. To prevent the operating cylinder from moving too rapidly its speed is regulated by a limiting device, and the rate of current input is regulated by a current relay in series with the motor circuit The

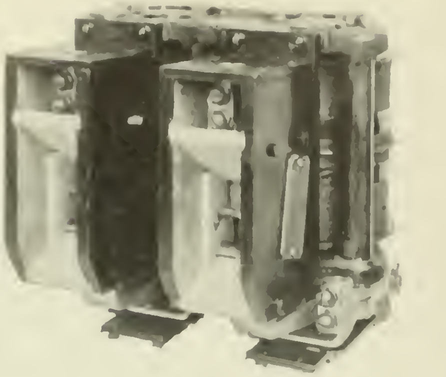


FIG. 1.—NEW FORM OF CONTACTOR.

closes a local circuit, locking the master controller cylinder against movement until the acceleration current has fallen sufficiently to release the master control cylinder for the next notch. In other words, the motorman in notching up slowly controls the train in exaactly the same manner as the ordinary manually-operated master controller. The automatic feature comes into operation only when the rate at which the operating handle is turned on would allow more than the desired amount of current to pass through the motors if it was limited. In ordinary practice, however, the motorman throws the handle to the full parallel position, and the controller cylinder follows up, notch by notch, as fast as the motor current will permit.

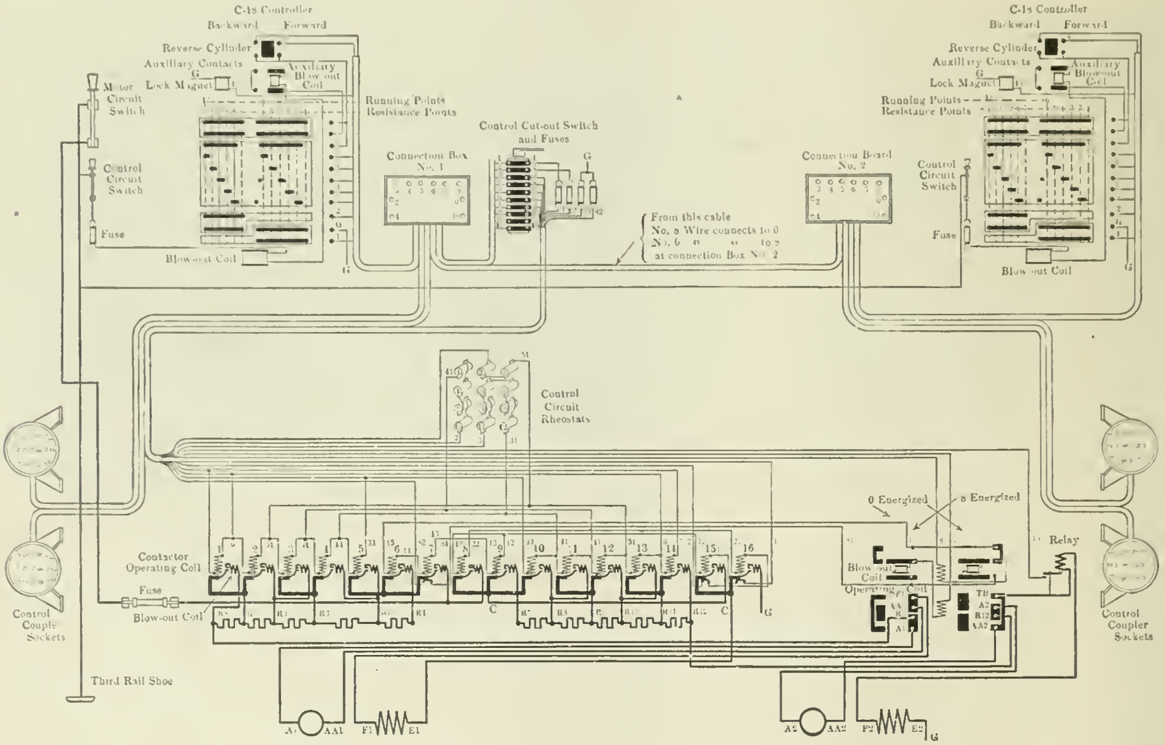


FIG. 2.—DIAGRAM OF CONNECTIONS OF CONTROL SYSTEM FOR NEW YORK SUBWAY TRAINS.

An improvement has also been made in the form of contactor. A view of a pair of the contactors to be used on the subway cars is shown in one of the accompanying cuts. As will be noticed, two contactors are mounted on the same base, instead of having them entirely separate, as in the Manhattan equipment. This plan of grouping contactors has been followed where two or more are of the same potential, and in the subway equipment there will be several groups of two and three contactors each This saves room and also avoids the necessity of much of the interconnection of the contactors by heavy wires.

An improved form of contactor blow out has also been adopted. It is considered by the manufacturers more efficient than that used on the Manhattan equipment, and by it a considerable reduction in weight has been secured with a greater current carrying capacity.

A diagram of the connections which will be used in the control system adopted is shown in Fig. 2. By following out the control circuits on first notch, it will be seen that the coils of contactors 6, 7, 9 and 15 are energized in the order given. This allows the main current from the motors to flow first through contactor No. 7, then through contactor No. 6, resistances *R*-1 to *R*-8, motor No. 1 and contactor No. 15; then through contactor No. 9 and resistances *R*-7 to *R*-12, and then through motor No. 2 to ground. On the second series notch, contactors No. 5 and No. 10 are picked up, each cutting out a portion of the resistance. The remaining resistance contactors pick up until all of the resistance is cut out, and the full series position is reached. The connections on the first parallel notch are such that the current for No. 1 motor passes through contactor No. 7 and No. 6, and through resistance *R*-1 to 8. The current for No. 2 motor in parallel working passes through contactors No. 8 and No. 9 and resistances *R*-7 to *R*-12.

It will be seen from this statement that the connections differ from those of the former type M control in two important particulars. First, the resistances are divided into two groups, and each group is always used with the same motor and only for that motor. The other point of difference lies in the fact that each resistance contactor short-circuits one section of the resistance only instead of controlling in some cases more than one. It follows from this that each contactor carries the current of only one motor. This arrangement allows the resistance grids to be made of larger cross-section. At the same time the number of contactors required is not materially increased, owing to the fact that with the former method, in some cases, two contactors had to be used in parallel when working with heavy current. By the arrangement described the actual number of contactors is increased only by two, viz., from 14 to 16.

The controller system adopted is made under the Sprague and General Electric patents.

The Heyland Induction Motor.

(Concluded.)

By Boy De la Tour.

We must now ascertain by what means it will be possible to preserve both the magnitude and direction of the magnetic flux, *A C*, while, at the same time, utilizing an e.m.f., E_2, which will always be in phase with that of the source supplying current to the motor.

We will show that the desired result may be obtained by simply displacing all three sets of brushes on the commutator in a direction opposite to that of the revolving magnetic field.

This displacement of the brushes, which involves that of the different branches of the winding, having taken place in a direction opposed to that of the rotation of the magnetic field, the e.m.f., e_2, induced by this revolving magnetic field in each of the branches will, therefore, advance by an angle corresponding to that which might have been produced before the brushes were moved (Fig. 3).

This e.m.f., e_2, retains the same magnitude as in Fig. 2.

Let us suppose the displacement of the brushes to have been such that the e.m.f., *A F*, which should be applied to the brushes in order to preserve the current i_2'' at its preceding value, falls along the line *O A;* that is to say, in phase with the e.m.f. of the source of current supply.

It is easy to understand that this displacement of the brushes has in no way modified the magnitude and phase of the fictitious magnetic flux of the second winding.

In fact, when the brushes were moved backward in the revolving magnetic field, thereby making the phase of the e.m.f. applied to these brushes lead forward by an angle equal to the displacement of the brushes, a forward lead of the same amount with respect to the brushes was also, at the same time, given to the induced e.m.f. e_2, to the current i_2'', and, consequently, to the fictitious magnetic flux produced by that current.

It follows that the displacement of the brushes has not changed the instantaneous position of this fictitious magnetic flux with respect to the others.

This fictitious magnetic flux, therefore, remains in the direction *A C,* although the current is in the direction *A G* (Fig. 3).

The diagram shows that the potential difference, *A F,* at the brushes has a lead-in phase with respect to the current i_2'' produced by the external source of rotor current.

We must not conclude, however, that this displacement of the brushes is capable of materially lowering the power factor of the magnetic field which, in all the diagrams given, has been assumed equal to unity.

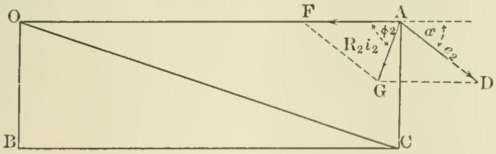


FIG. 3.—EFFECT OF DISPLACING THE BRUSHES.

It is apparent that the current i_2'' must always be smaller than the current i_2' when the motor is carrying a load.

On the other hand, the power e_2i_2' wasted by resistance heating (Joulean effect) in the ordinary winding itself amounts to only two or three per cent. of the power which is applied to the stator.

We may conclude, therefore, that the power e_2i_2'' taken from the external source of current, and sent through the brushes into each of the branches of the stator, is very small, since it itself remains much below e_2i_2, and, as a general rule, does not attain one per cent. of the watted power supplied to the primary winding.

It follows that the definite value of *cos* ϕ for any machine will differ only by a negligible quantity from the value of the power factor for the stator circuits alone. This is all the more exact inasmuch as a considerable amount of the current sent into the rotor through the brushes is not wattless.

Let us note again that the resultant effect of the currents $i_2'i_2''$ is given, both in magnitude and in phase, by the vector *O C*.

The potential difference, *A E,* which must be applied at the brushes, is generally very low compared to that applied at the motor terminals. This potential difference may be obtained either by means of a small auxiliary transformer connected in parallel across the motor terminals, or by means of a winding of a few turns placed on the stator core.

When the torque diminishes, the slip decreases. The area of the triangle *O A C* diminishes in the same proportion as the torque. The resultant magnetic flux *O B,* on the contrary, does not vary, since it must induce a constant e.m.f. in the stator.

If, for this new load, we wish to preserve a power factor equal to unity, the right line, *A C,* will have to retain its magnitude and direction. Since i_2'' cannot change, and since e_2 depends on the slip, the potential difference which must be now applied at the brushes will not only be smaller than in Fig. 2, but will also have a greater inclination with respect to the right line, *O A.*

It will be necessary, therefore, in order to neutralize the phase difference in the primary, to again displace the brushes and to diminish the amount of the potential difference applied to the brushes. The latter adjustment may be obtained by means of variable resistances interposed in the leads conveying current to the brush connections.

If, on the other hand, the load were increased, these operations would naturally be reversed.

When the power factor is equal to unity, the stator current has, very nearly, a ratio which is substantially proportional to the torque.

It might perhaps be possible, therefore, in certain cases to avoid the necessity of adjusting the potential difference applied at the brushes by making use of a transformer whose primary is connected in series with the stator winding.

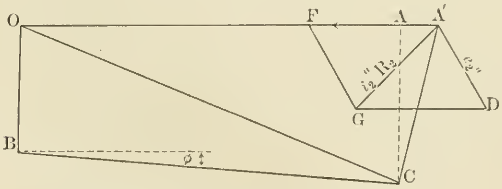


FIG. 4.—EFFECT OF DISPLACING THE BRUSHES.

It is interesting to ascertain what would happen, if, without changing the potential difference applied to them, the brushes are displaced more than would be necessary to give *cos* $\phi = 1$, in the primary winding.

The right line, *O B* (Fig. 4) remains the same as it would be in Fig. 3.

The distance *O A* will not vary; and, since the torque remains constant, the point *C* will be on a straight line passing through *A* and parallel to *O B.*

Since, by hypothesis, the brushes have been displaced more than was necessary, the vector *A′D, A′G,* and *A′C* will have a greater inclination with respect to their right line *O A* than they have for the case illustrated in Fig. 3.

In order to change *O A* to *O A′*, the slip must increase. This circumstance will increase the e.m.f. e_2, as well as the current i_2''.

But since the fictitious magnetic flux *A′C* is produced by this current i_2'', its value will, therefore, be greater than was the case in Fig. 3.

The inclination of the vector *B C* resulting from the length of *A′C* shows that the power factor will become negative in the stator winding; that is to say, that the primary current through the stator will now lead the e.m.f. applied at the motor terminals

We might expect this result, which could also be attained by retaining the same position of the brushes as in Fig. 3, and simply increasing the value *A F* of the potential difference applied to these brushes.

These points having been established, we will now show how easily the diagram may be corrected for magnetic leakage and for the resistance of the stator winding.

In designing an induction motor, we generally assume, at the beginning, the resultant magnetic density in the air-gap and the peripheral velocity of the rotor.

The latter seldom exceeds 25 metres (82 ft.) per second; the resultant magnetic density varies according to the size and character of motor, between 2,500 and 3,500 gausses.

Knowing the output and speed, the electromagnetic (tangential) effort (magnetic pull) at the periphery of the stator may be determined. We then calculate the reaction of the secondary winding, or, in other words, the value of the fictitious magnetic flux above mentioned, without paying attention, for the moment, to the Heyland principle.

It will then be possible to indicate, in Fig. 5, the value OB of the resultant flux, as well as the value OA of the fictitious magnetic flux, $V_2 \Phi_2$, of the rotor, and to also determine the vector AB, which represents that portion, Φ_1, of the fictitious magnetic flux of the stator which penetrates the secondary core.

If the torque is not to be varied when the brushes are applied to the commutator, the point C must fall on a right line, AC, parallel to OB.

Owing to magnetic leakage, this point C will fall beyond the point C', obtained by the intersection of the right line, AC, with the right line, BC', parallel to OA.

Let us select the position of this point C. The vector AC will represent the fictitious magnetic flux produced by the current sent from an external source into the secondary or stator winding by means of the brushes.

The resultant fictitious magnetic flux of the rotor will be represented in magnitude and direction by OC.

In order to obtain equilibrium, BC must be equal to that portion of the primary fictitious magnetic flux which passes through the air-gap.

If now we plot, along BC prolonged, the distance BH, equal to the primary leakage—that is to say, equal to $\Phi_1 (V_1 - 1)$—and if we plot, along OC, the distance HK, representing the secondary $\Phi_2 (V_2 - 1)$, then the vector, OK, will indicate, both in magnitude and in direction, the resultant magnetic flux in the stator.

This resultant flux induces an e.m.f., OM, which lags 90° behind OK, and which differs but slightly from the potential difference, E_1, at the motor terminals. If it be required that the power factor shall be equal to unity, this induced e.m.f., OM, must be parallel to BC, which represents the stator current.

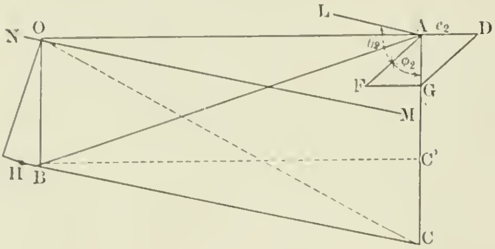


FIG. 5.—FLUX VALUES.

If this were not the case, it would be necessary to reconstruct the diagram, starting from a point C, situated at some other point along the line AC.

When once this condition is fulfilled, the ohmic drop, $R_1 i_1$, is to be plotted on ON prolonged, being indicated by the distance OM.

The difference of potential at the terminals will then be represented by the length NM.

If we also draw AD equal to e_2, and $HG = R_2 i_2''$, the difference of potential which must be applied to the motor brushes will be represented by the distance AF. The right line, AL, being drawn parallel to NM, the angle, LAF, will indicate the extent to which the brushes must be displaced.

Before closing this study, we may observe that, if the stators were constructed as indicated hereinabove, serious sparking would inevitably result at the brushes.

These sparks are due to the high self-induction of the portions of the stator-winding which are short-circuited at the brushes.

As the number of conductors per pole is always somewhat limited, a variation of the magnetic flux will occur when one of these conductors is cut out of circuit by the short-circuiting action of the brushes.

The effect of this variation is to retard the reversal of current in the portions of the winding which are at the commutation point, and to occasion an excessive potential difference between the collector and the trailing end of the brush.

It is this excessive difference of potential which is the direct cause of the sparking. To avoid this undesirable sparking, the commutator segments are shunted, i. e., partly circuited, by means of resistances.

It is evident that the shunting resistances not only complicate the construction of the motor, but also absorb some energy.

It would probably be difficult to predetermine by calculation the proper amount of resistance to be interposed between any two consecutive commutator segments. The resistance should be determined by experiment after the machine has been finished. It would seem that by increasing the number of active conductors per pole, as well as the number of commutator segments, the importance of these resistances, and of the currents which pass through them, might be materially reduced. These resistances, thus arranged, form a circuit which has much resemblance to the short-circuiting ring of the squirrel-cage winding, and practically the commutator segments and shunting resistances would doubtless take the form of such a ring, having a definite resistance.

Looking at the matter closely, we observe that the currents in these resistances modify the currents which would otherwise pass through the rotor winding.

We can, in the diagram, retain the action of these first currents, and superpose the magnetic effect of those which circulate through the winding and the commutator shunting resistances.

These currents must be in phase with the e.m.f. which produces them, and, consequently, they must lag 90° with the resultant field OB in the air-gap. They will, therefore, produce a fictitious magnetic flux, having the direction OA, and they will tend at the same time to increase the torque.

It will, therefore, be possible, thanks to their presence, to diminish slightly the secondary current, i_2', in order that, finally, the length of the vector, OA, may retain its original value. It is seen, therefore, that the currents passing through the shunting resistance of the commutator are not useless. The ohmic drop which they produce in the conductors is compensated by a reduction in the amount of the current i_2'.

Let us note further that since the slip at the instant of starting is easily thirty times greater than when running at full load, the currents in the commutator shunting resistances will increase in the same ratio.

It will, therefore, be necessary to make these resistances of large current-carrying capacity, in order to prevent their burning out when starting the motor.

To sum up, the arrangement devised by Mr. Heyland enables a power factor equal to unity to be obtained at all loads. This property of the Heyland motor type, which is already an advantage in itself, would seem to be further enhanced by the possibility of its enabling motors to be designed with larger air-gaps than those of present motors.

But the constancy of the power factor under changes of load can only be obtained by regulating, in some way, the potential difference applied to the brushes, or by the simultaneous use of both means of regulation.

The ordinary induction motors, as a substitute for which the Heyland system is proposed, give at full load, when well designed, a power factor equal to 0.9, which decreases slightly with the load, and is still as high as about 0.87 when the torque falls down to about ¾ of its normal value.

In order to raise the power factor from 0.9 to 1.0, it is necessary, in the Heyland motor, to provide the rotor with the commutator and an outfit of brushes; it is also necessary that all the segments of this commutator be shunted by resistances mounted on the rotor. It is also necessary, except in a few particular cases, to transform the primary e.m.f., in order to obtain the necessary potential difference to be applied to the brushes; and this potential difference must be regulated by hand within rather wide limits.

The principal merit of induction motors consists, without doubt, in their great simplicity of construction, which enables them to operate without requiring, so to speak, any attention or repairs.

In order to slightly improve the power factor, and to raise it from 0.9 to 1.0, a motor even more complicated than a direct-current motor has been devised, which, owing to the losses in the commutator shunting resistances, has an efficiency materially lower than that of the present induction motors; and, besides, it is by no means certain that in practice, when once sold and put in operation, the new machines will remain constantly regulated for a power factor equal to unity.

Under such conditions, what are the prospects of success for this invention? The future will tell.

The author prefers to abstain from answering this question, first, in order to avoid the appearance of being too pessimistic, and, second, because he has a firm belief that others will not fail to discover new improvements, perhaps new inventions even, which will eventually make the induction motor the ideal machine.

Electric Railways in Sweden.

By Arvid Westerberg.

In a communication to your columns (January 24, 1903) the writer referred to a report submitted by Mr. R. Dahlander to the Royal Swedish Railroad Administration on the practicability of substituting electric for steam power in the operation of the government railroads. Below a short abstract of this report is given:

Since the traffic on the Swedish railroads is relatively small, a system with low tension would be too expensive, and consequently the use of direct current is impossible. A three-phase system would be too complicated, because of the necessary two or three-contact lines, which would cause trouble, especially in tunnels and at the stations. Therefore, a high-tension, single-phase system is the only feasible one.

Three of the existing systems of this kind, none of which is in practical use yet, were then taken into consideration, viz.: the Ward Leonard system adopted by the Oerlikon Company, Zürich; the Arnold system and the Lamme-Westinghouse system.

The natural power sources of Sweden are very abundant. Based on the report of Mr. J. Gustaf Richert on the waterfalls and of Mr. E. Wallgren on the peat pits, the accompanying map has been drawn, showing the location of the most convenient power sources. The water power sources are indicated by a circle containing a dot, and the peat stations by a black circle. The following table gives the most important data of these stations:

No.	Length of road to be fed, miles.	H.P. at generator shaft required, maximum.	H.P. at generator shaft obtainable, minimum.	Distance from railroad, miles.	No.	Length of road to be fed, miles.	H.P. at generator shaft required, maximum.	H.P. at generator shaft. obtainable, minimum.	Distance from railroad, miles.
1	96	3,100	5,000	6	12	83	4,000	......	..
2	107	4,050	66,000	12	13	61	3,450	1,550	4
3	151	4,150	8,000	1	14	119	4,400	6,000	1
4	128	2,950	14,000	12	15	115	5,600	6,000	1
5	115	3,550	12,000	5	16	118	3,550	1,460	1
6	165	3,450	110,000	1	17	226	9,800	75,000	10
7	145	4,600	22,000	1	18	135	4,050	......	..
8	208	7,400	90,000	1	19	89	4,750	......	..
9	72	2,750	2,500	1	20	132	6,050	6,500	5
10	226	9,300	19,000	25	21	65	4,000	......	..
11	62	2,500	1,800	6	22	73	4,800	......	..
					T't'l,	2,691	102,000		

Nos. 12, 18, 19, 21 and 22 are peat stations. The horse-power needed are calculated according to the present railroad time tables.

The greatest distance from any one power station to the most remote point of its district is 100 miles. This makes possible that in case of emergency neighboring stations can help each other.

The estimate of cost is made for the Ward Leonard system and for a feeder tension of 40,000 volts and a contact line tension of 7,500 volts, although the voltages probably could be taken considerably higher—60,000 and 15,000 volts respectively. The frequency is supposed to be 25 periods per second. The most important figures of the estimate are the following:

Cost of water power: 1-H.P. at generator shaft per year..........	$10.00
Cost of peat power: 1-H.P. at generator shaft per year	19.50

These figures include interest, amortization and repairs of the complete power house. If the electric system is adopted by degrees, so that when new motive power is needed electric locomotives will be added, no extra cost will arise for the rolling stock. The estimated outlay for feeders, transformers, contact lines and everything connected therewith is $13,500,000.

The operating expenses per year will thus be:

3½% interest on $13,500,000	$473,000
Sinking fund and repairs	473,000
80,400-H.P. water power	804,000
21,600-H.P. peat power	420,000
Additional cost of administration and extra costs	181,000
Total	$2,351,000

The saving by introducing the electric system depends chiefly on the price of coal, which some years ago reached $6.75 per ton, but now has gone down to $4.05. Supposing the latter price to prevail, the saving would be $1,950,000 per year; or with coal at $5.40 per ton, the saving would be $2,400,000.

An approximate estimate of the operating expenses per year with the Lamme system shows the sum of $2,030,000.

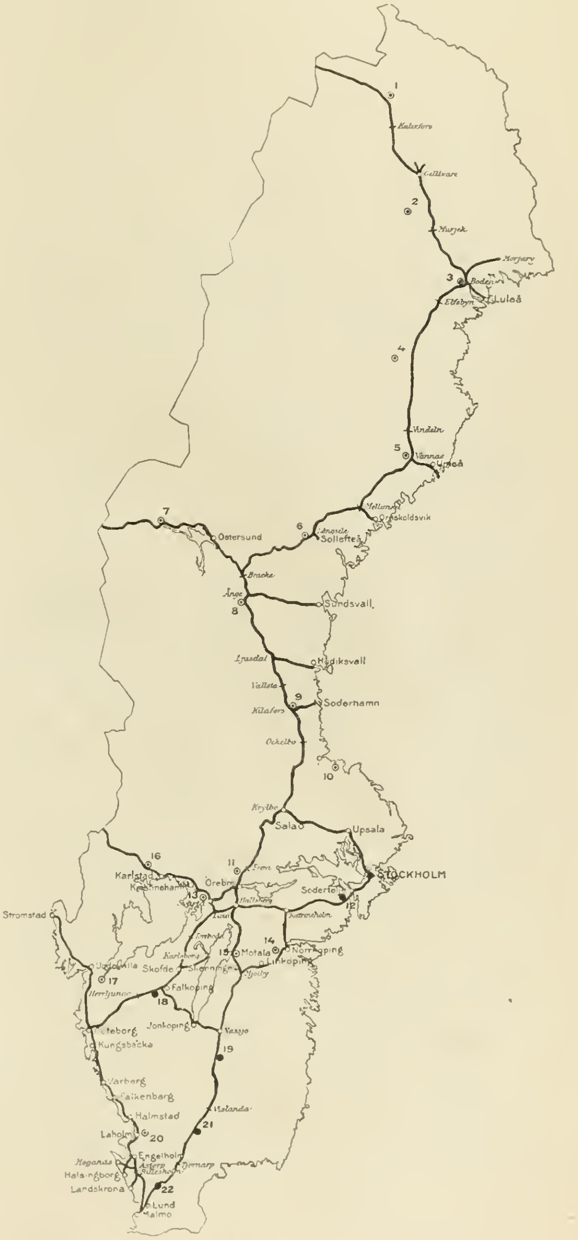
These figures are for the entire railroad system, while for some sections of it the conditions are much more favorable for electric traction. It is unquestionable that the traffic of the railroads will increase considerably after the adoption of the electric system, and the operating cost will not increase in the same proportion.

Based on the calculations made, Mr. Dahlander expresses as his opinion that, by using a single-phase current system, it will soon be possible to operate the Swedish Government roads cheaper than at present. But even if this were not the case, the national economical gain resulting from the electric system—coal importation for railroads then being no longer necessary—would be reason enough to accept it.

The adoption of the new system must be made in the following way, in order to avoid throwing away useful material: When new locomotives are required, electric ones are to be provided for use on a section electrically equipped. Interest and amortization of the capital expended will then be paid by the saving in operating cost.

Finally, Mr. Dahlander suggests further investigations in the matter and arrangements for experiments on electric traction on a short section of the government roads.

Mr. Dahlander's report is published in extenso in the Swedish periodical, *Teknisk Tidskrift*, of January 10, 17 and 24. From this publication I have made this abstract.



Map of Swedish Railway System with Power Sources.

Meeting of Independent Telephone Association of Maine.

At a meeting of the above named association at West Paris, Me., March 9, the following officers were elected for the ensuing year: President, Lewis A. Goudy, Northeastern Telephone Company, Portland; first vice president, R. L. Cummings, Citizens' Telephone Company, South Paris; second vice president, P. C. Chandler, Pine Tree Telephone Company, New Gloucester; secretary, E. L. Durgan, Northeastern Telephone Company, Portland; treasurer, F. L. Wyman, West Paris and Curtis Hill Telephone Company, West Paris. Executive Committee B. G. McIntire, Waterford; John H. True, New Gloucester; Dr. F. H. Packard, West Paris; E. W. Gross, Auburn; E. L. Tibbetts, Lewiston; George H. Jones, Oxford; H. C. Cook, Casco

A unanimous vote of thanks was extended to President Goudy for his explanation of the independent telephone situation in Maine and New England, and he was authorized and requested to represent all independent telephone companies who are members of the association, none of which are in affiliation with or under contract to the New England (Bell) Company, or its allies or licensees, the Eastern Company and others, who have sold out to or become under branch line contract with the New England and are thereby controlled by it.

The independent companies, for whom Mr. Goudy is authorized to appear as advocating the "repeal of the un-American monopoly law" which was placed on the statutes of Maine in 1895, are the Northeastern Telephone Company, Pine Tree Telephone Company, Curtis Hill & West Paris Telephone Company, Bryant's Pond & Paris Telephone Company, Greenwood & Woodstock Telephone Company, Citizens' Telephone Company, South Paris, Norway Local Telephone Company, Paris & Sumner Telephone Company, East Milton Telephone Company, Greenwood Local Telephone Company.

With regard to the status of the association, Mr. Goudy writes us as follows:

This association was organized in October, 1901, with Mr. M. S. Bird, of the Eastern Telephone Company, of Rockland, Maine, as its president, intercommunicating contracts having been made by the Eastern Company with many of the rural and village exchange lines. A short time after these contracts were executed, the Eastern Company merged its interests with the New England Telephone & Telegraph Company, licensee of the Bell Company.

This action created a great deal of bitter feeling on the part of the rural companies, who had thus been led into an alliance with the Bell monopoly, which demanded the discontinuance by the independents, of their own transmitters, substituting therefor the Bell transmitters. The refusal to accept such conditions led to the Bell Company refusing to transmit messages. This in addition to increase of toll charges and advance in rates at certain points, has created a decided agitation against the New England (Bell) Company, and the Eastern, its latest acquisition. Mr. Bird did not resign the presidency of the association, but he was superseded, at their recent meeting, by L. A. Goudy, vice-president and general manager of the Northeastern Telephone Company, which is the only independent company, with broad state charters, in New England.

The Northeastern Company is building trunk lines and installing large exchanges in the principal cities in Maine, beginning with Portland, using the Strowger system for its large exchanges, and the manual and selective party line systems for its village exchanges and rural service. It will expend nearly half a million dollars on its new exchanges and installation of its system in Maine and New Hampshire during 1903. It is an aggressive representative of the rural, independent companies, which it is working in harmony with for the expansion of independent telephony.

The New England Company has been forced to join in the repeal of the so-called "monopoly law" of Maine, whereby any other company in the State is debarred from entering into competition with or paralleling the lines of the Bell system. This piece of un-American legislation has been wiped out through the aggressive action of the independents, supported by the Maine State Grange (which desires rural telephone connections). Immediately in connection with this action, however, the move was made by the Bell Company to engraft seriously hampering legislation, whereby this company, its allies or representatives, could force suspension of construction of lines by appeal from the decisions of municipal officers of towns and cities, granting rights to independent companies, to the Supreme Court, which would cause long delays and discouraging results. This action is being sharply opposed by the Northeastern Telephone Company and others in harmony with its policy for broader expansion of the telephone business.

American Electrochemical Society.

The third general meeting of the American Electrochemical Society will be held April 16-18, in the assembly hall of the Chemists' Club, 108 West One Hundred and Fifty-fifth Street, New York.

On Thursday evening, April 16, there will be a reception of members and guests in the parlors of the German Liederkranz, followed by a subscription banquet in the same building, at $5 per plate. On Friday evening the society will, by special invitation, be the guests of the American Institute of Electrical Engineers at their extra meeting, held in the assembly hall of the Chemists' Club, at which, after an introduction by President Scott, Mr. W. J. Hammer will read a paper entitled "Radium and Other Radioactive Substances, and Certain Phosphorescent and Fluorescent Substances; The Properties and Applications of Selenium; The Treatment of Disease by Ultra-Violet Rays." On Saturday evening Prof. Jos. W. Richards will deliver his presidential address, after which there will be a demonstration of the Cooper Hewitt mercury lamp by Dr. Max von Recklinghausen. Later in the evening there will be a German-American smoker (Kneipe) at the Chemists' Club. Following is a list of the papers thus far announced:

Constant Voltage and Constant Current Separations, by Wilder D. Bancroft. Experimental Study of Some Electrode Effects, by H. T. Barnes, Ph. D. The Electrolysis of Water, by J. W. Richards, Ph. D., and W. S. Landis. Experiments with Metallic Diaphragms, by Wilder D. Bancroft, Ph. D. The Protective Action of Zinc Chloride on Metallic Iron, by C. J. Reed. Insulating Materials; A Field for Chemists, by M. Von Recklinghausen, Ph. D. A Historical Review of the Storage Battery, with Illustrations, by H. B. Coho. The Use of Pyroxyline in Electric Storage Batteries, by Elmer A. Sperry. The Concentration Changes in the Electrolysis of Brine, by W. H. Walker, Ph. D. The Influence of Some Impurities in Salt Upon the Yield of Soda by the Amalgam Process, by J. W. Walker, Ph. D. The Corrosion of Metals by Electrolysis, by A. A. Knudson. Modern Electrolytic Copper Refining, by Titus Ulke, M. S. Note on the Composition of Electroplating Solutions, by N. S. Keith, Ph. D. The Formation of Nitric Acid Under Electric Influences, by C. W. Volney, Ph. D. Note on Electrical Endosmose, by Wilder D. Bancroft, Ph. D. Ions and Electrons, by Louis A. Parsons, Ph. D. Uniformity in Electrochemical Equivalents, by Carl Hering. Electromotive Force of Alloys, by W. D. Bancroft, Ph. D. Electrolytic Production of Metallic Compounds, by C. F. Burgess, E. E., and Carl Hambuechen, Ph. D. The Electrodeposition of Metals Upon a Rotating Cathode, by J. G. Zimmerman. Electrolytic Conduction Without Electrodes, by A. B. Marvin. A New Type of Electrolytic Cell, by P. G. Salom. Potentials of Zinc in Aqueous Solutions, by H. E. Patten and W. R. Mott. Notes on Electrolytic Deposition of Nickel, by Woolsey McA. Johnson. What is the Capacity of Molecules for Electric Charge in Electrolysis, by Alfred H. Cowles. Exhibit of Aluminum Corrosion, by J. A. Steinmetz. Exhibit of New Apparatus, by A. Eimer.

Reasons for Travel Congestion in New York.

An interesting address was delivered before the Men's Club at the Judson Memorial Church, last week, by President H. H. Vreeland, of the Metropolitan Railway Company, on "slow trolleys" in New York City, and the reasons for them.

"Street railroads were never built for rapid transit," said Mr. Vreeland. "They were never intended for it. In spite of the fact that the average headway in New York City is closer than in any other city, and with cars running at an average speed of eleven miles an hour, there is not an electric line in the city below Twenty-third street where the cars can be operated under present street conditions as fast as the horse cars of ten years ago."

He told of the increase of the traffic of the city from thirty-seven to one thousand millions a year. Illustrating the proportion, he said that on last Wednesday there had been eighty thousand more passengers carried by his company than for the same day in 1902.

"You will readily see," continued Mr. Vreeland, "that the opening of the subway is only a question of a day, for by the end of this decade one thousand millions of passengers will have to be moved a year in the boroughs of Manhattan and the Bronx alone. The total number of passengers a year on all the steam railroads in the country is only 620,000,000.

"Not only must provision be made for the traveling of the two millions of inhabitants of Manhattan and the Bronx, but for fifty per cent. of the population of the cities and towns within fifty miles of the metropolis. The people of those outlying cities come here for their shopping, their work and for their amusement.

"Newark, with a quarter of a million of inhabitants, has only one theatre; Brooklyn, with more than a million, has only four theatres, and Yonkers, a flourishing little city, has one music hall, where occasionally a traveling company gives a performance. To-night sixty thousand persons are sitting in theatres along the line of Broadway from Fourteenth to Forty-fifth Street. They will all wish to go home at once. No matter how many cars we run, they are all full."

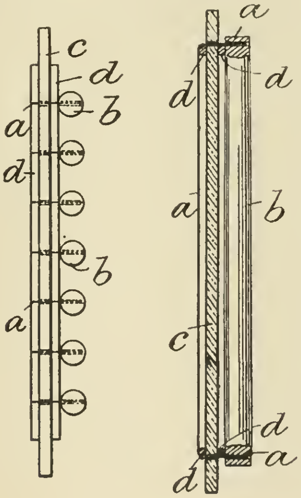
Recent Electrochemical Developments.

By Clinton Paul Townsend.

ELECTRIC FURNACE.

An electric furnace designed by Albert A. Shade, of Chicago, for fusing the raw materials of glass manufacture, is a modification, and in some respects a simplification, of the furnace of the same inventor, described in the issue of November 29, 1902. Essentially the new construction comprises an inclined tubular conduit through a fire-brick pier, the conduit being fitted with means for the introduction of the charge and the withdrawal of the melt, and several intermediate pairs of axially aligned electrodes for accomplishing the fusion.

Several gas burners are provided in the portion of the conduit above the electrodes for the preliminary heating of the charge, and a jacketed conveyor and hopper provide for the more complete utilization of the heated gases. Magnets placed within recesses in the fire-brick beneath the conduit direct the several arcs downwardly upon the moving charge, one magnet being provided for each arc, and its effect confined thereto by shields consisting of iron plates interposed between the magnets. Aside from details of construction, the furnace differs from that heretofore described mainly in the omission of any means for retarding or momentarily arresting the progress of the charge as it comes into proximity to the successive arcs.



IMHOFF BIPOLAR ELECTRODE.

BIPOLAR ELECTRODE.

Dr. Paul Imhoff, of Liverpool, whose work in relation to the electrolytic production of chlorates is well known, now offers a bipolar electrode intended particularly for this work, the construction being such as to economize platinum as much as possible. Platinum alone has been found suitable for use as the anode in the electrolysis of brine under any conditions capable of giving rise to oxygen or to oxygen compounds of chlorine, and its increasing cost lends importance to every effort made to reduce the quantity required. In this country, platinum in the form of foil of extreme thinness backed by sheet-copper is used, but abroad the tendency is toward the use of the metal in the form of wires, strips or gauze. Such open construction necessitates the interposition between the positive and negative sides of the double electrode of a non-conducting partition plate, faced on the one side by the platinum anode and on the other by the cathode of base metal or carbon, these two faces being in metallic connection through or around the plate in order that the electrode as a whole when placed in the electrolyte between the positive and negative leads may acquire opposite polarities on opposite sides.

In the construction shown in the accompanying figures the supporting plate, *c*, of glass or slate is fitted with ribs or distance strips, *d*. The anode wires, *a*, of platinum on the one side, and the cathode bars, *b*, of iron or carbon on the other, rest in contact with these distance strips, and are firmly bound in position by leading the platinum wires through or around the plate and firmly attaching them, by soldering or otherwise, to the bars. This construction not only gives a unitary structure capable of being removed bodily from the bath, but provides an effective electrical connection between the opposite sides of the electrode. The novelty of the invention is not broad, being substantially limited to the means by which the conductive faces are bound together by leading the platinum wires through or around the dielectric plate. In this art, however, the small advances merit consideration.

Dutch Cable Landing at Guam.

Formal application has been made by a Dutch cable company to the United States Government for permission to land a cable at the Island of Guam to connect with the transpacific cable now in course of construction. The other end of this cable will be at Marshall Island, in the South Seas, where it will connect with the Dutch and German systems of cables already laid.

The Department of Justice has decided to grant this landing right, but at the Navy Department there is a feeling that it is not altogether wise from a naval viewpoint to permit the Dutch company to establish a station at Guam. For this reason certain charts and soundings which the Dutch company desires to use in laying the cable have not yet been turned over to that concern. The Navy Department before doing so will consider the effect of the Dutch cable from a strategical point of view.

Germany and Holland are operating hand in hand in their policy of constructing cables, which will give them cable connection with their possessions in the East, independent of the English cables. Two-thirds of the total cable lines of the world are under English control. German companies, which in time of war would be forced to allow the German Government to control their lines, have already laid many lines in the South Seas, but even by using all the available Dutch cables they have yet no cable communication independent of English connections from the Orient to Berlin.

If a Dutch cable goes into Guam, Germany will have a line of direct communication from her South Sea possessions to Berlin without resorting to English controlled lines. The conditions under which the Commercial transpacific cable will be laid are so specific in regard to its control by the United States in time of war that the officers of the Navy Department who have been most concerned in the drawing of the contract under which the cable company will lay the cable are anxious to do nothing which will in the least interfere with the interests of the United States in time of war.

Apparatus for Johns Hopkins.

The department of physics at the Johns Hopkins University has received from the widow and daughter of the late Dr. William T. Barnard, some apparatus for the physical laboratory, consisting of several dynamos, motors, etc., which were originally designed to be used in connection with a system of multiplex telegraphy. The plans for establishing this system were abandoned shortly before the death of Dr. Barnard. Mrs. Rowland, widow of the late Prof. Henry A. Rowland, has given to the university the splendid collection of her husband's books on physics.

New Telephone Patents.

Of the four telephone patents of the issue of March 10, two by the same inventors, Messrs C. L. Goodrum and J. W. Lattig, are very closely allied, covering respectively a novel central energy telephone system and a party line lock out subscriber's station apparatus, primarily adapted to operate in connection with this system.

In almost all central energy systems the line signal is restored through the agency of a cut off relay or cut off joints in the spring jacks, which devices either cut the line signal apparatus entire from the circuit or open the circuit of the signal itself, independently of the actuating relay. In this system of Messrs. Goodrum and Lattig the retirement of the line signal is accomplished by an entirely different plan, viz.: by arranging the circuits so that the line relay winding is strapped by a shunt of very low resistance upon the insertion of a plug in the spring jack. The working of the supervisory or cord signals of this system is also novel. These features may, however, be best explained from a diagram of circuits such as shown in Fig. 1.

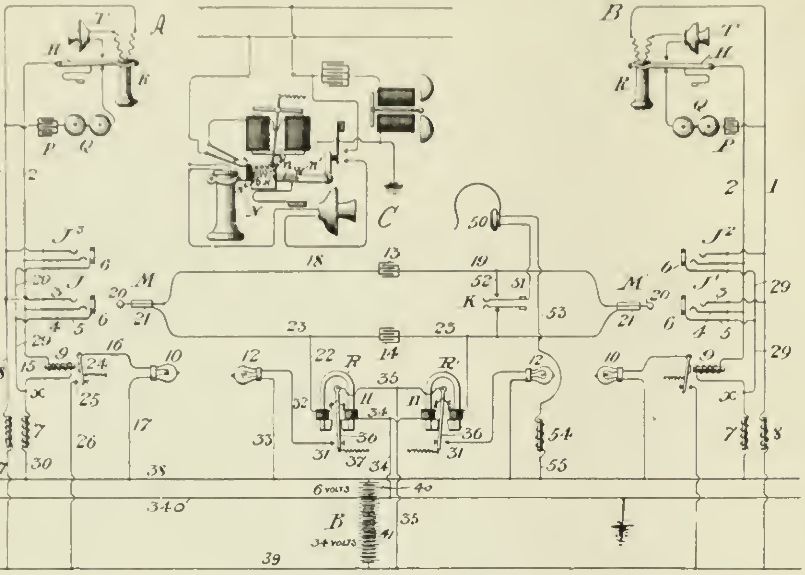


FIG. 1.—DIAGRAM OF CIRCUITS.

Considering first the shunted line signal feature, it is seen that a circuit is traceable from the exterior terminals of the two batteries, 40 and 41, in series, as follows: Wire 39, coil 8, wire 1, subscriber's set *A*, wire 2, relay 9, wire *X*, coil 7, and wire 38. This circuit is normally open in the subscriber's set, but upon the removal of the telephone from the hook switch, current flows, operating relay 9 and displaying the line signal, 10. Now it is noticeable that the spring jack consists of three elements or contacts, while the corresponding connecting plugs contain but two. The insertion of a plug in a jack results, therefore, in a short-circuiting of the jack spring, 4, with the jack thimble, 6. An examination of the wiring shows that this short circuit is a shunt upon the line relay. The insertion of a plug in the jack thus deprives the line relay of all but a most insignificant current and the relay armature falls back, extinguishing the light.

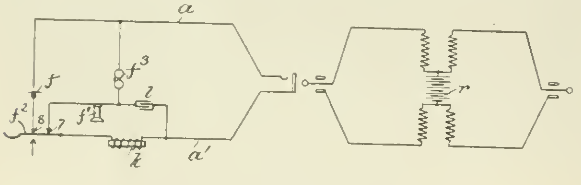


FIG. 2.—DEAN SUBSCRIBER CIRCUIT.

The operation of the supervisory signals is not quite so simple, depending upon a selection of resistances for the various pieces of apparatus, and upon a choice of potentials for the two batteries such that an oscillation of the subscriber's hook switch will cause reversals of the current in the polarized relay, *R*. First, consider the condition when the line circuit is open at the station, *A*, and a plug is in the jack. At this time there is a closed circuit existing as follows: From the six volt battery, through bus bar 38, coil 7, jack *J*, plug *M*, wires 23, 22, and relay *R*, back to the battery. The current which flows in this circuit is designed to operate the relay, *R*, and light the lamp, 12. Now, when the line circuit is closed at *A*, however, the six-volt battery does not operate independently, but operates in series with the thirty-four-volt battery. Under this condition, therefore, there is forty volts effective upon the coil, 7, and thirty four volts upon the relay, *R*, both sending their currents jointly through a path consisting of the subscriber's line and the coil, 8. Of course, with this reversed current the polarized relay fails.

This reversal of currents is accompanied by fluctuations of potential at the subscriber's station, and the inventors have based the operation of their lock-out device upon this fluctuation. The lock-out device itself, also shown diagrammatically in Fig. 1, is a polarized, hook-switch lock, the winding of which is momentarily connected to ground during each movement of the hook-switch. If, when the line is in use, and this contact be closed, a current will flow when the switch has closed its first contact, which current will help retain the bolt in the locked position. If the line is free, the current will be in the opposite direction, will withdraw the bolt, and allow the hook to complete its motion and close the talking contacts. If it becomes necessary to allow a second party upon the line to come into the connection, by an arrangement of keys at the central station, the operator may restore the potential temporarily to the normal direction, until this second station has responded, when upon the release of the key the potential becomes again reversed.

Fig. 2 shows a subscriber's circuit which is the subject of a patent issued to W. W. Dean and assigned to the Kellogg Company. In this circuit the receiver in series with a condenser is placed in shunt about a low-resistance, high-retardation coil, *K*. By this means the rapidly-fluctuating voice currents coming upon the inductance of the coil are caused to flow through the receiver circuit, while the steady portion of the direct transmitter current passes without obstruction through the coil, being withheld from the receiver by the condenser. With this circuit the receiver coil and cords are relieved of the effects of the relatively large magnitude direct currents.

The fourth patent of this issue shows a new departure in receiver supports for telephone sets, as the design is apparently based upon the supposition that the mouth of the receiver and that of the transmitter should occupy substantially parallel planes when in use. Now, while doubtless many telephone users place themselves in a position such that this condition is fulfilled, every telephone man knows that it is an improper position; for with the considerable mass of material comprising the buttons of modern transmitters it is quite essential for best results to project one's speech directly into the transmitter, that sufficient energy may be impressed upon the diaphragm to move the parts appreciably. This consideration alone would count heavily against the new device.

Extensive "Postal" Plans.

Announcement is made by the Postal Telegraph Company that construction work will soon begin on its main trunk line from Omaha to San Francisco, which is to be a connecting link of a cable and telegraph system that will span the globe. It will connect at Omaha with heavy through lines from Chicago to New York and on the West with the Pacific cable now being laid between San Francisco and the Philippines and China. The wires will parallel the Union Pacific right of way. Poles have already been unloaded from Omaha to Julesburg, Colo.

A Proposed Municipal Lighting Plant for New York.

At a meeting of the Board of Estimate and Apportionment, of New York City, last week, Mr. R. G. Monroe, Commissioner of Water Supply, Gas and Electricity, made a report on the subject of electric lighting, in which he urged the establishment of a municipal plant. The report, which is not yet in print, was accompanied by copious data from Chief Engineer Lacomb. In the course of it Mr. Monroe said: "Within the last five years the lighting interests in this city have all practically united, and even in those boroughs where there has been no formal consolidation the territory has been apportioned. In Manhattan both illuminants have been absorbed by a single corporation, and there is no rivalry even between producers of gas and producers of electricity. The Consolidated Gas Company of New York controls all the gas and electric light facilities in Manhattan, as well as all gas and electric light facilities in the more important sections of the Bronx. As far as gas light is concerned, not only does the price remain fixed, but all improvement in the utilization of gas is retarded."

After treating of the prices charged the city for gas, the Commissioner says that electricity is the illuminant of the greatest importance for public lighting, and adds that $2,000,000, or 60 per cent. of the entire appropriation for the year, will be expended for electric lighting.

"In Manhattan the price bid for a 2,000-cp lamp is $146," said Mr. Monroe. "The price in Brooklyn for a 1,200-cp lamp is $124.50. I have obtained from sixty-eight cities the prices paid to the various electric light companies for supplying these cities with 2,000-cp lamps, and the average price is $88.60. In twenty-three other cities using 1,200-cp lamps the average price is $81.08.

"The combination which now imposes exorbitant prices upon New York is formidable, but, to my mind, its strength is more apparent than real. The capitalization of the electric light companies in our city may be best exemplified by the New York Edison Company. It is now capitalized at $45,200,000 in stock, subject to $40,138,000 bonds, making the total $85,338,000."

On the question of municipal ownership the Commissioner said:

"If the City of New York would undertake to supply itself with electric light its interest charges would be limited to the amount actually expended on its plant, and it would not be burdened with the necessity of declaring dividends on watered stock. In Manhattan the electrical conductors would be carried through the existing subways without incurring any expense by way of rental for the space occupied.

"These subways are divided in ownership between two subway companies, but each of them is bound by its franchise to, without charge, supply to the City of New York all space in said subways necessary for its electrical conductors and the electrical conductors of each separate department of said city which may now or hereafter be required.

"I am informed by officers of the Edison Company that the subway rentals for electrical conductors which are now used for city lights amount to $100,000 a year. If the city had an electric light plant the cost of distribution would be reduced by that amount."

In conclusion, he remarked:

"I believe New York with its own plant could provide electric lighting for public uses at a cost much below what is now charged to the city. Whether reasonable prices can be obtained from private companies, or whether the city can with better results maintain and operate its own plant, is for you to determine. I do, however, urge that legislation be immediately asked and that you be given the power to establish and maintain an electric plant for street lighting, in case later you decide that it is in the interest of the public so to do."

Acting on this report, which has, it is said, the approval of Mayor Low, Comptroller Grout and some other city officials, surveys have been made for a plant on Blackwell's Island in the East River, of a capacity rumored to be not less than 15,000 kw, and distributing current to both sides of the river by submarine cable.

At Albany on March 17, Commissioner Monroe said that he expected to bring his bill for a municipal electric lighting plant to Albany on Thursday. Assemblyman Hornidge told the Commissioner that he was opposed to using Blackwell's Island as a site for the lighting plant. He said he thought that Blackwell's Island was ultimately destined to become the great playground of New York City and Brooklyn. Mr. Monroe said the naming of Blackwell's Island as the site for the lighting plant was only tentative. It was done merely that there might be some basis upon which to make computations of the cost of the service. It had seemed to him, he said, that Manhattan, Brooklyn and Queens could be more readily served from a plant on Blackwell's Island, but he did not propose to become involved in any controversy over the site. There were many sites which were available and any one of them would be acceptable to him.

CURRENT NEWS AND NOTES.

TRAIN TELEGRAPHY.—An enterprising stock broker is said to have made application to furnish stock quotations to the "Twentieth Century Limited" on the New York Central as soon as a wireless telegraph system now in course of preparation for this train shall be completed, and it is said that a news ticker service is contemplating similar action.

ST. LOUIS EXPOSITION.—The installation of the first exhibit of the Exposition began on March 10. A force of workmen in the employ of the Electrical and Mechanical Department, under Mr. Henry Rustin, unloaded and conveyed to the temporary boiler house the big marine boiler sent to St. Louis by the Duesseldorf-Ratinger Rohrenkessel Fabrik, of Germany. The boiler will be placed at once on the concrete bed which it is to occupy to the end of the Exposition. It will do service in lighting the Liberal Arts Building and the grounds for the dedication ceremonies.

STATE AND COUNTY CIVIL SERVICE EXAMINATIONS.—The next general examination for New York State and County service will be held on April 4, 1903. The following positions are included: Architectural draughtsman, assistant electrical engineer, assistant steam engineer. Persons desiring to enter these examinations must file applications in the office of the State Civil Service Commission in Albany before noon of March 30th. Application blanks and information regarding salaries and requirements of examinations may be obtained by addressing the chief examiner of the commission at Albany.

WIRELESS TELEGRAPHY IN NEW YORK CITY.—The Marconi Wireless Telegraph Company has made a practical test of the wireless system by sending messages from the steamship Umbria, lying at her dock in the North river near Christopher street, to the 20th floor of the Broad Exchange Building, an air line of probably one mile, with numerous tall steel buildings in between. On the roof of the building was stationed a receiver and an operator, and the messages were taken from the top of the flagstaff. The demonstration was a success, a number of mesages being received without interruption and with no delay.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The following candidates were elected members of the American Electro-Chemical Society at the March meeting of the council: A. S. Garfield, Paris, France; Louis S. Cates, Parral, Chih., Mexico; Lee Shepherd, Midland, Mich.; John L. Clayson, Philadelphia, Pa.; F. J. Davis, Lockport, N. Y.; John J. Riker, New York; W. R. Mott, Madison, Wis.; C. F. Carrier, Jr., Bethlehem, Pa.; H. M. Backus, Bayonne, N. J.; J. W. Aylsworth, East Orange, N. J.; E. N. Dickerson, Stovall, N. C.; Wm. Battle Phillips, Austin, Tex.; C. R. Walker, Cambridge, Mass.; Walter G. Graves, Cleveland, Ohio; Albert Finck, Cleveland, Ohio; D. R. Warmington, Cleveland, Ohio; Prof. C. F. Mabery, Cleveland, Ohio.

REQUEST FOR MOLYBDENUM.—Consul E. N. Gunsaulus sends from Toronto, February 24, 1903, a letter from Mr. W. B. Bentley, 72 Queen Street W., Toronto, as follows: I am interested in molybdenite and actinolite properties, of good quality, in Ontario. Molybdenum, as you know, was formerly used in the dyeing of silks and cottons, but its recent application to the production of a peculiar high-grade steel, rendered possible by recent advances in electrometallurgy, has resulted in molybdenite emerging from its position of comparative obscurity as a rare mineralogical specimen to an article of great commercial value. I desire to get into communication with the various dealers (chemical companies, I presume) in the United States who handle this mineral, and would be greatly obliged if you would forward my inquiry to the proper parties.

ACCESSIBILITY IN NEW YORK STATE.—The State of New York contains 50,000 square miles of area, and this area is made accessible to its people for transportation purposes by 522 miles of canals, 1,718 miles of street railways, 8,114 miles of steam roads and 73,857 miles of dirt roads. The relative cost of transportation to-day is alleged to be as follows: $1.25 will carry a ton of produce 5 miles by horse power; 25 miles by electric power; 250 miles by steam railroads, and 1,000 miles by steamship. It is proposed to bond the State for $5,000,000 a year for ten years and spend the money on the highways.

WIRELESS TELEGRAPHY IN ENGLAND.—In regard to the refusal of the General Post Office to give the Marconi Wireless Telegraph Co. the same facilities as are accorded to the cable companies, it is stated by the authorities that the former company did not ask for the same privileges as the cable companies enjoy. It demanded an "exclusive license," such as no cable company enjoys. If this were granted, it would prevent the Government from making similar concessions to any competitors of the wireless company, and the General Post Office declined to support a commercial monopoly. This seems to be the same tack as was taken in regard to the Bell telephone.

LETTERS TO THE EDITORS.

Tesla Split-Phase Decisions.

To the Editors of Electrical World and Engineer:

SIRS: The news statements in respect to the recently decided Tesla litigation seem to have been inspired and do not state the facts, inasmuch as they allege that the United States Court "in one circuit upholds his (Tesla's) patents, and in another does not." Thursday's decision by Judge Colt, in Boston, corroborates a prior decision by the United States Court of Appeals. Judges Townsend, Wallace and Cox, after a most exhaustive and thorough trial lasting four years, decides that Mr. Tesla failed to prove invention prior to the published description of the same invention made by Prof. Ferraris, of Turin, Italy. Prof. Ferraris held the chair of physics in the Academy of Sciences in Turin for many years. In Europe he is universally acknowledged to be the original inventor of the induction motor and power transmission system so largely used in this country, and which is described by the news statements referred to as 'one of the greatest inventions of any age." All foreign scientific publications speak of the Ferraris motor, the Ferraris principle and the Ferraris system, for he invented, constructed and described his work several years before Mr. Tesla claims to have devised it. So fully and completely is this fact accepted by scientific men that a public subscription has been taken up in Europe (now completed) for the erection of a suitable statue to Ferraris in Turin. I myself have seen the original motors, models and drawings made by Ferraris in 1885, have personally talked with the men who saw these models in operation, and heard Ferraris explain them at that date. Furthermore, I know that when the Tesla people learned that Ferraris's discoveries antedated Tesla's claims, they purchased from Prof. Ferraris the right to patent his inventions in the United States. Instead of exercising this right to patent, they concealed his inventions and thus left Mr. Tesla free to claim the honor and public credit resulting from his alleged discoveries. I have the necessary proof to substantiate my statements, including an acknowledgment of payment received by Ferraris from the Tesla people "in consideration of the cessation of my (Ferraris) rights in the United States to my discovery of the transmission of power by rotary-field motors."

As for the Tesla meter mentioned, as far as I am aware Mr. Tesla does not claim to have invented a meter, nor has he any patents for a meter; but poses in a general way as the inventor of a system of power transmission. If this were true he should have been able to prove it in court. The courts have decided, however, in the patents at issue, that he failed to prove invention prior to the Ferraris publications published several years after Ferraris's original discovery. WILLIAM STANLEY.

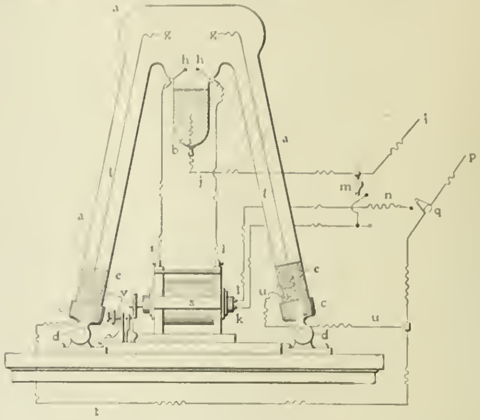
GREAT BARRINGTON, MASS.

The Mercury Arc.

To the Editors of Electrical World and Engineer:

SIRS: I have read with much interest the several articles on this subject, published recently in your columns, particularly that of Mr. Charles P. Steinmetz in your issue of February 21, for the reason that I have carried on a series of experiments during the past four years in the same line. The accompanying sketch shows a mercury arc lamp I made some three years ago, and exhibited to friends at my laboratory in this city. The lamp is on somewhat similar lines to the lamp illustrated by Mr. Steinmetz and attributed to Dr. Weintraub, of the General Electric Company.

In the series of tests that I have made, I believe I have demonstrated that the mercury vapor works more satisfactorily in the construction of lamp shown in the sketch. The partial vacuum obtained in the construction of a mercury arc lamp creates a condition such that the vapor settles more satisfactorily downward to the terminals of the positive terminals, *e* and *e*, than if they were at the top of the lamp. For a starting device I used an induction coil, *s*, with spark terminals, *h* and *h*, within the vacuum tube connecting chamber, these terminals being just above the mercury cup, *b*. A condenser, *n*, was with the induction coil in circuit when desired through switches *m* and *q* with the positive and negative wire feed, *e*, return *y* and *p*. Instead of using a carbon filament as in the Weintraub lamp, I used a fine platinum wire. The starting terminals and induction coil need only be of small size, and instead of using a condenser and any connection with the circuit for lamp, a battery may be employed. Only a small spark arc is required to start the lamp; at least under the construction here shown that has been my experience.



MERCURY ARC LAMP.

You will note by the enclosed sketch that I employ two tubes joined to an egg-shaped central chamber in which the mercury is held in a cup-shaped member. I use graphite at the positive terminals of each tube. The lamp gives a beautiful light. I have some vital improvements which I do not care to divulge at the present time, but the lamp that I have briefly described and sketched was demonstrated over three years ago and has worked successfully ever since. It was 12 in. high. LOUIS E. WALKINS.

SPRINGFIELD, MASS.

Fuel Consumption in Central Stations.

To the Editors of Electrical World and Engineer:

SIRS: It is extremely desirable that all central station data as to fuel consumption, kilowatt-hour output, etc., should be in terms of the pounds of water evaporated per hour, together with a statement of the pressure (or temperature) to which the water is raised; and if it is desired to be very exact, also a statement of the temperature of the water before it enters the heater or boiler.

In considering recently the results obtained in various stations and power houses, I found it extremely difficult to compare them with each other with a view to ascertaining the economy of operation, owing to differences existing in the quality and price of coal, and in some instances, in the types of boilers and heaters, firing, etc. All of these variable items are eliminated by using as a basis the pounds of water evaporated from a given temperature to another given temperature. The station showing is thus divided into two parts, one the economy and cost of evaporation, the other the economy and cost of generation.

On this basis the pounds of water evaporated per kilowatt-hour output of the station is a factor permitting the direct comparison of stations using the cheapest and best fuel obtainable, with stations using the poorest and dearest fuel. By taking into consideration the load curve and class of machinery equipment, it can then be quickly determined whether or not a station is operating economically, and the relative economy of systems employing different methods of distribution, alternating and direct current, rotary converters and motor-generators, with and without storage batteries, can be determined.

Jos. E. Lockwood.

Detroit, Mich.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Heating of Machinery.—Schneppel.—An article on the different causes which influence the heating of dynamo-electric machinery. The surface exposed to the air, the temperature of the surrounding air, and the motion of the air through the parts of the machine are well known to be of great importance. He first gives the results of an elaborate investigation of the question whether the chemical material and the color of a paint is important. The result is that paint increases only slightly the capability of cooling of machines; the differences of the different colors are too small to have any important bearing; but it is important to use such paints as can stand a rise of temperature by about 80° C.; the paints used at present in practice fulfill this requirement. Of much greater importance is the motion of air, which varies with the speed of the machine, so that the degree of cooling is a function of the speed. This function of the speed is given by various authors in the following formula; the temperature, T, equals C divided by h $(1 + cv)$, when h is the surface in square centimeters per watt and v the velocity of the armature wires in meters per second. C and c are two constants, for which following numerical values are given by different authors: Arnold $C = 300$, $c = 0.1$; Kapp $C = 550$, $c = 0.1$; Esson $C = 354$, $c = 0.0006$; Wilson $C = 640$. $C = 0.18$. The present author concludes from his experiments that 0.1 is the most probable value for c; he did not continue his experiments in this direction.—*Zeit. f. Elek.*, February 8.

References.

Parallel Running of Alternators.—Fernandez.—An illustrated article on the parallel running of alternators. The author gives a simple illustration of the relation of alternators in parallel, showing why it is necessary to alter the relative positions of the field poles of parallel generators to vary the load on one of the pair. The article embodies much practical advice, and also shows a synchronizing arrangement usually installed for three-phase work, consisting of a lamp in series with a second lamp on the engine at the throttle, a synchronizer, and a voltmeter. The three devices are connected to the secondary of two transformers, the primaries of which are connected across the generator switch.—*Am. Elec.*, March.

Alternators.—Loppe.—An article illustrated by a series of diagrams, in which he shows that if the no-load and the short-circuit characteristic curves are given, and if the existing current is known for a given load, it is possible to determine by a series of successive approximations, the exciting current for any load.—*L'Eclairage Elec.*, February 21.

Magneto-Electric Machines for Electro-Metallurgical Purposes.—An article giving some historical notes which show that engine-driven magneto-electric machines were used in the electro-metallurgical industry as early as 1844.—Lond. *Elec. Rev.*, February 20.

Commutator.—Vickers.—An illustrated article on the casting of commutator segments.—*Am. Mach.*, March 5.

Lights and Lighting.

Arc Lamps with Impregnated Carbons.—Ziegler.—A long and profusely illustrated paper, read before the Berlin Electrical Society, on arc lamps with impregnated carbons, made by the General Electric Company, of Berlin. From the former publications on the Bremer arc lamp it is well known that the addition of materials like calcium increases considerably the efficiency of the lamps. The impregnated carbons used by his company differ from the patented Bremer carbons because the former carbons "contain additions only in the core and in such quantities and of such quality that they become entirely gaseous in the arc" so that no insulating deposits are left at the pointed ends of the carbon. Nothing is said concerning the chemical composition of these additions. For lighting the lamps it is sufficient to touch the two carbons and then separate them to a certain distance. There are two types of these lamps in use; in the one the two carbons are vertical one above the other as usual; they are called "flame arc lamps" (Flammenbogenlampen); in the other type the two carbons are placed inclined like the letter V, with the arc at the bottom; they are called "intensive flame arc lamps" (Intensivflammenbogenlampen). These lamps are made for direct current as well as for alternating current. Their construction is described and illustrated in detail; it does not differ very materially from the ordinary arc lamps of the same company; the differences which exist appear to be caused by the fact that in order to obtain a quiet, steady light, it is necessary that the ends of the carbons should have a comparatively small surface; for this reason the carbons used are thin, the same diameter being used for the positive as for the negative. On the other hand, the impregnated carbons are consumed more quickly than in the ordinary arc lamp. To get a life, convenient for the practice, it is, therefore, necessary to use long carbons; they are used in lengths of 325 mm or more, up to 500 mm (13 to 20 in.); to get a still longer life, lamps are made with two pairs of carbons; when one pair is consumed, the other one is automatically lighted. The construction of an "intensive flame arc lamp" with two pairs of carbons is shown in the adjoining diagram. The lamp contains two mechanically independent, differential mechanisms; electrically they are connected, the two main-current windings in series with the one or the other pair of carbons; the shunt windings are in parallel with the arc; all the coils are, therefore, always supplied with current, although only one arc is lighted; this necessitates a small waste of energy, but gives greater surety of working. In a 110-volt network there are 2 direct-current or 3 alternating-current lamps in series; in a 220-volt direct-current network, 4 or 5 in series; in a 220-volt alternating-current network, 6 flame arc lamps, or 4 or 5 intensive flame arc lamps in series. On the basis of these practical arrangements, he gives comparative tables of the hemispherical intensities of various lamps at 220 volts and 9 amp for direct-current intensive flame arc lamps, about two or three times the hemispherical intensity of ordinary direct-current arc lamps; for alternating current it is about 4 times as much. The adjoining diagram gives the results of measurements of the illumination of a surface by different lamps; the zero point of the axis of abscissas represents

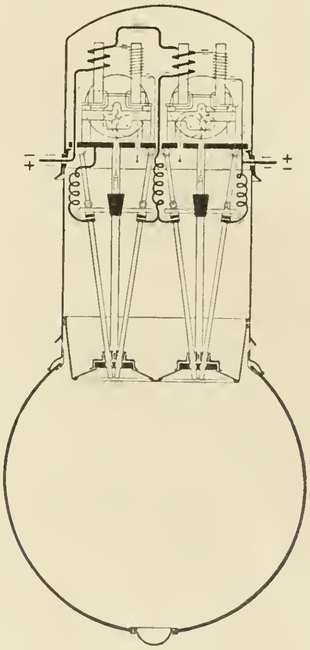


Fig. 1.—Arc Lamp with Impregnated Carbons.

the point of the surface perpendicularly below the lamp, while the abscissas represent the distances in meters from this point; the ordinates give the illumination in luxes; *A* is for a 45-volt, 10-amp, direct current intensive flame arc lamp; *B* for a 45-volt, 10-amp, alternating current intensive flame arc lamp; *C* for a 40 volt, 10 amp, direct current flame arc lamp; *D* for a 30-volt, 10-amp, alternating current flame arc lamp; *E* for a 40-volt, 10-amp arc lamp with non-impregnated carbons, and *F* for a 30 volt, 10 amp arc lamp with non-impregnated carbons. The intensive flame arc lamps are said to be especially suitable for advertisements and show window illumination.—*Elek. Zeit.*, February 26.

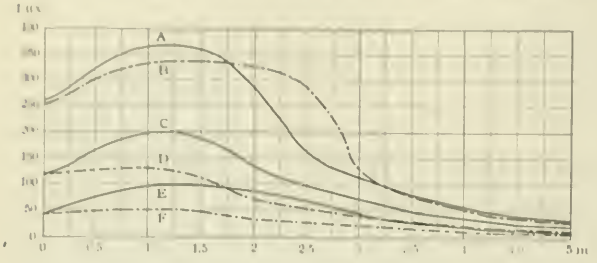


FIG. 2.—ILLUMINATION CURVES

REFERENCES.

Alternating-Current Arc.—GUY AND MONARCH.—The first part of an account of an extended investigation of the alternating-current arc of very small intensity, between metallic electrodes. The results are given in diagrams and tables.—*L'Eclairage Elec.*, February 28.

Arc Lamp Regulating Mechanisms.—An illustrated article describing minutely the shunt and series arc light regulating mechanisms.—*Am. Elec.*, March.

POWER

Combined Water Power and Gas Engine Plant.—An illustrated description of the water-power station at Goldach and the auxiliary plant at St. Gall, Switzerland. The hydraulic plant is located on the left bank of the Goldach at a place called Lochmühle, in the village of Untereggen. Two polyphase alternators direct-connected to turbines operating under a head of 417 feet, supply the current, which is transmitted from the Goldach station to St. Gall, three miles distant. On account of the variable supply of the water power, an auxiliary plant was installed at St. Gall, in which gas engines are used for supplying additional power required during heavy loading periods. This plant is so arranged that the engines are available for driving direct-current generators, either simultaneously with the three-phase motors or independently. The station at St. Gall is also equipped with a storage-battery plant, which acts as a regulator. A sub-station is also provided which contains motor-generator sets composed of polyphase motors and direct-current generators. The main station at St. Gall contains four gas engines having an aggregate capacity of 370 hp. One of the smaller combined generating and converting sets consists of two direct-current dynamos each of 40 kw capacity, either or both of which may be coupled to a 60-hp, three-phase motor. A 60-hp, single-cylinder gas engine is also arranged so that it can be used to drive one of this pair of dynamos by means of a clutch pulley, leaving the three-phase motor to drive the other one. A second group consists of two single-cylinder gas engines of 30 hp each, belted to motor-generator sets consisting of two three-phase motors of 30 hp each and two direct-current dynamos of 20 kw each. In this case the motors are capable of driving the dynamos at full capacity, whereas in the case of the set previously mentioned, the three-phase motor has only one-half the total ability of the dynamo part of the group. The third unit consists of a 66-kw dynamo, which may be belt-driven by a 100-hp, three-phase motor, or by a gas engine of similar capacity. The fourth unit consists of a double-cylinder, 150-hp gas engine, belt-connected to a 100-kw, direct-current generator, which may also be driven by means of a 150-hp, three-phase motor. For starting up the engines, a hand pump is provided by means of which a charge is compressed in the cylinder so that the engine may be started up by an explosion. A check prevents the engine from starting under the influence of the compressed charge until the charge is fired, at which instant the engine is automatically released. The fifth and sixth motor-generator units are not arranged for driving by gas engines. One of these consists of a 200 hp, three phase motor direct-connected to two 65 kw direct-current generators, and the other a 250-hp, three-phase motor driving two 80-kw, direct-current generators. Both of the three-phase motors of these groups are of the squirrel-cage type and operate at 3,300 volts. The storage battery equipment consists of 300 cells arranged in four groups of 75 cells each for use on the lighting system, and 300 other cells, which are floated on the railway system in order to steady the demands on the generators and the voltage of the system. The sub-station contains three motor-generator sets, each comprising a 250-hp, three-phase motor, direct-connected to a six-pole, double-commutator, direct-current dynamo. There are also step-down transformers which reduce the three-phase line current from 10,000 to 3,400 volts, at which e.m.f. the three-phase motors in this station, as well as those in the main station, are supplied. The motors in the sub-station have wound rotors with slip rings. The high-tension line between the Goldach and St. Gall stations consists of three bare copper wires carried on a line of wooden poles located 105 feet apart. The municipal high-tension line is carried on single wooden poles; the conductors are carried on an overhead line to the St. Gall-Roschach Railway and then under the railroad track in a high-potential, triple-conductor cable, which is laid two feet beneath the surface.—*Am. Elec.*, March.

REFERENCE.

Electric Pumping.—An illustrated description of the electric pumping plant at the Bridgeport station in Chicago for the Illinois and Michigan Canal.—*Eng. News.*, February 19.

TRACTION.

Interurban Roads.—GONZENBACH.—The first part of an article on the Engineering and Preliminaries for an Interurban Electric Railway. The writer points out the necessity for making an accurate and conservative estimate of the income which can be derived from all possible sources of revenue. In the present case the estimate was based upon the actual results obtained in parallel cases, and the population of towns along the road was taken from the census returns supplemented by actual investigation. Another important point to be investigated is what will be required by the new enterprise in order to secure its share of patronage from competing railways as well as the development of new business. In the case under consideration, a train schedule was arranged providing for half-hour headway and a speed of thirty-five to forty miles an hour, with stops averaging every three miles. The equipment necessary for providing this service has been carefully figured out. Another important point considered in this paper is whether the third rail or overhead trolley should be adopted, and it is pointed out that in the matter of first cost, which often decides in favor of the trolley, there is an unconscious discrimination due to the fact that the conductivity of the circuit is lost sight of. For purposes of comparison, curves have been presented showing the difference in first cost between trolley and third rail, and it is interesting to note that the third rail is lower, even down to the smaller sizes. The chief advantage of the third-rail system is its low maintenance cost, and it is stated that when this fact is fully understood many roads now using trolleys in high-speed service will be warranted to change to the third rail.—*St. R'y Jour.*, March 7.

Present Practice in Interurban Electric Railroading.—BRIGDEN.—An article in which the writer refers to early steam railroad engineering when many roads were built with a gauge of 3 ft. to 3 ft. 6 in. Most of these roads had to change later to the standard gauge. He hopes that this experience will not be lost on electric railway companies who, while not building narrow-gauge roads, often put in a cheap initial construction. The grades, curves, etc., should be selected for a speed of 30 miles per hour, which trains on these roads will ultimately be required to make.—*St. R'y Jour.*, February 23.

Chicago.—An illustrated article on the modern shops and methods of the Chicago City Railway Company. The new plant is described, which has been erected in the suburbs, occupying about two and a half city blocks. It is easily accessible, however, and is surrounded on all sides by street railway tracks built for the purpose of admitting cars to the shops and car houses. A large portion is set aside for car houses, one of which has already been completed. The building is divided into independent departments, and a similar plan will be followed in the second building, which will really be a duplicate of the first and separated from it only by an alley. The repair shops comprise several buildings which have been located and arranged with a view of facilitating the handling of the work.

Tracks have been laid through the machine shop, blacksmith and frog shops for distributing and collecting the material, and another track runs the length of the mill. The tracks upon which the cars pass through the machine shops and other departments for repairs are all provided with pits. Overhead electric traveling cranes are also provided for carrying heavy machinery and material. A number of separate departments are taken care of in the machine shop building, including the truck repair department, motor repair department, and repairs pertaining to other electrical parts. An extensive brass foundry has been installed and several new smelting furnaces using oil for fuel. Babbitt metal is also melted in the brass foundry. An interesting feature in the machine shop is the pit construction. The equipment of the shops is the most complete of any in the country for street railway work. Provision was made for protecting the shops as thoroughly as possible from fire. Power is supplied for the operation of these shops from a special electrical plant consisting of two units of 300-hp each. A voltage of 500 has been adopted because of the possibility of using the regular railway current for the operation of the shops in case of a shut-down in the shop power house, and also for utilizing this power plant in case of emergency in supplying current to the lines for operating cars.—*St. R'y Jour.*, March 7.

Electrolysis of Water Pipes.—HAWLEY.—An article explaining in a popular way the corrosion of gas and water pipes by electrolysis due to strong currents from the return current of tramway systems. The only sure and efficient method of avoiding this is the double trolley system. With a single trolley system electrolysis may be reduced by perfecting the bonding of the return circuit and increasing the resistance of the pipe lines and by careful inspection. The responsibility for the damage by electrolysis has not yet been finally determined by the courts.—*The Polytechnic,* February 28.

REFERENCES.

Locomotives.—An illustrated article on electric locomotives for yard and shop work.—*Sc. Am.*, March 7.

An Electric Troin Indicator.—PARHAM.—An illustrated article describing a device whereby passengers waiting on the platform or in the waiting-room of a station used in common by several lines of trains passing that station but for different destinations, may without danger or inconvenience to themselves or other passengers tell the destination of an approaching train, independently of colored lights, colored signs or any other destination marks carried by the train itself.—*Am. Elec.*, March.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging High-Tension Cables.—GARRARD.—A communication calling attention to the necessity of installing cable-charging gear. He says the only safe way to charge a high-tension cable is by means of non-inductive resistance connected directly in the high-tension circuit. As such only water rheostats need to be considered. The design of such a water rheostat is, however, a matter of no small difficulty. The best way is to choose such a value for the resistance as will charge each separate cable proceeding from the power house, so that one charging gear will do for all feeders; the resistance is such that the maximum pressure thrown suddenly on to the feeder, by the plunger of the rheostat coming below the surface of the water, is not more than say one-third of the working pressure. With these precautions no danger is to be feared. With the ordinary underground cables, however, the resistance required for this purpose is considerable and as ordinary water has to be used the column necessarily becomes very long and the insulating sleeves which direct the current flow are rather costly.—Lond. *Elec.*, February 20.

REFERENCE.

Isolated Plant.—An illustrated description of the power plant of the Wells Building in Milwaukee. There are one 100-kw, one 200-kw and one 250-kw direct-current generator, all operating at 250 volts. The three-wire system is used for distribution.—*The Eng.*, March 2.

ELECTRO-PHYSICS AND MAGNETISM.

Radio-Activity and Gravitational Energy.—GEIGEL.—An account of some experiments made with the object of determining whether the energy of radio-activity is derived from gravitational energy. He suspended a small bob of lead weighing 6.5 grammes over a watch-glass containing 1 gramme of radio-active substance and noticed a temporary diminution of weight amounting to 0.035 mgms. He supposes that "rays" of gravitational energy proceed from the whole earth towards the lead, and are partly intercepted by the radio-active substance. On this assumption he calculates the intercepting or absorbing power of the radio-active substance, varying the distance and dimensions of the substance for the purpose. The thickness of the radio-active layer varied from 3 mm to 21 mm and its width from 7 mm to 19 mm. He found that immediately after stirring the substance the loss of weight was greater, and also that some loss of weight remained after removing it. The writer of the abstract from which this is taken adds that the whole reasoning appears to be somewhat loose; if energy is absorbed, there should be a permanent loss of weight, unless its restitution is accounted for; if force only is intercepted, there is no loss of energy and no explanation of the radio-active energy; in any case a reduction of the radio-active surface does not bring about a smaller loss of weight.—*Ann. d. Phys.*, No. 2; abstracted in Lond. *Elec.*, February 20.

Electrodeless Discharge.—DAVIS.—An account of some experiments on the electrical conductivity and absorption of energy in the electrodeless discharge. As an illustration of the great absorption of energy and the heating of the gas, he mentions the following experiment: A vessel was constructed having a thin platinum wire passing downward through the center; the passage of the electrodeless discharge heated the wire to incandescence in a few seconds.—*Am. Jour. Sc.*, March.

Changes of Temperature of Permanent Magnets.—LOOMIS.—An account of an experimental investigation of the effect of change of temperature on the magnetic moment of magnets of different lengths but of the same cross-section, and on the distribution of the magnetism. The proportional change in magnetic moment due to change in temperature is greater for short than for long magnets; and the magnet having the greater intensity of magnetization suffers the less proportional change. The proportional change in distribution of magnetism due to change of temperature is greatest at the ends and least in the middle of the magnet.—*Am. Jour. Sc.*, March.

Energy of Magnetization.—LARMOR.—Some notes on a recent Royal Society paper in which he points out that there still appears to be some uncertainty as to the principles on which the energy of magnetized iron is to be estimated, and the extent to which that energy is electrodynamically effective. He takes as the simplest example a current flowing in a coil wound on a narrow iron ring-core. The energy in this case is made up of two parts, an electrodynamic part and a magnetic part; the former is mechanically available. The question has been raised by Lord Rayleigh as to whether the latter part has any considerable mechanical effectiveness. This question can only arise when it belongs in part to permanent magnetism whose ultimate annulment can induce a current. The conclusion reached by Rayleigh is that it cannot be annulled quickly enough when the ring carries a coil, to develop any considerable available electric energy by induction. Larmor uses a mechanical analogy to consider this matter in detail and reaches the same conclusion that the retained energy will not be available to any considerable extent unless the iron is not very receptive of magnetization. After an elaborate mathematical investigation, he arrives at the following conclusion: In an electrodynamic field there exists the usual "specification" of electrokinetic energy, but also in addition the energy of magnetization of the magnetic material. This energy of magnetization appears as made up of a part given by the ordinary formula, which, when paramagnetic, is derived from thermal sources, and so in the absence of hysteresis has the limited mechanical availability of thermal energy; together with a local part, which is to some extent thus available, but is also in part permanent intrinsic energy of the molecules, regarded temporarily as magnetic energy. The extent of the direct (non-thermal) availability of retained magnetism can be inferred only by empirical procedure, for example in general features by inspection of the hysteresis cycle.—Lond. *Elec. Rev.*, February 27.

REFERENCE.

Radium in the Periodic System.—RUNGE AND PRECHT.—An account of a spectroscopic investigation of radium.—*Phys. Zeit.*, February 15; abstracted in Lond. *Elec.*, February 27.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Nickel-Iron Battery.—An abstract from an article in *Nya Daylight Allehanda*, a Stockholm newspaper, claiming that the Edison battery was first described by the Swedish chemist, W. Jungner. As early as 1899 Jungner obtained a patent for a battery in which potassium hydroxide is the electrolyte and the plates consist of powdered metallic oxides, which are insoluble in the electrolyte and give a sufficient e. m. f. A few months after May, 1900, trials were made with automobiles, which are said to have given very satisfactory results. "Without exhausting the accumulators below normal voltage, the carriage with load is said to have run nearly 150 km., the weight of the carriage was 528 kg, that of the battery was 200 kg; at the end of the run the carriage had still a speed of 20.5 km per hour."* The nickel silver peroxide accumulators are, however, too expensive; for this reason Jungner afterwards used nickel oxide and iron, for which combination he obtained a patent on January 21, 1901, while Edison's patent is dated February 5, 1901.—*Zeit. f. Electrochemie,* February 5.

Plates Made of Slabs of Active Material.—LEIMER.—The conclusion of his article, the first part of which was noticed recently in the Digest. 1.5 amp are used for formation of positive plates of 140 × 100 × 6 mm; thick plates are best formed with a nearly constant voltage, which may be 3 to 3.2 volts at the start and about 2.8 volts at the end, and the core of the mass then gets a crystalline and therefore more solid structure. The ampere hours required for formation are about 35 to 45 per cent. higher than the capacity of the positive plate. For the negative plates the best composition is about 3 parts of minium and 1 part of litharge; they require about twice the time to form. After the formation the negative plates should be kept in pure water and not in air nor in sulphuric acid.—*Centralblatt f. Accum.,* January 15.

Reduction of Potassium Chlorate.—BROCHET.—A brief article on "a so-called electrolytic reduction of potassium chlorate." He agrees with Bancroft and Burrows that in electrolyzing potassium chlorate with a copper anode, potassium chloride is obtained, the quantity of which is greater than should be theoretically expected, but he believes that the theory is entirely different from what might at first be supposed. The products first formed react with one another, and there is an "abnormal" reaction. The reduction of the potassium chlorate is the result of an intermediate action of the metallic copper upon the chlorate.—*Zeit. f. Electrochemie,* February 19.

Static Electricity Applied to Ore Dressing.—SWART.—An illustrated description of a method of Blake and Morscher for a process of ore separation, consisting in bringing a mass of ore particles into contact with a statically charged metallic surface. Particles which have a relatively high conductivity are not repelled, while those of low conductivity are; a machine based on this principle has been working successfully in Denver for some time. A voltage of 10,000 to 20,000 is now used; the static generator is made almost wholly of metal, using no glass whatever, and it is self-exciting and able to run continuously in the open air without regard to atmospheric conditions and with no more attention than an ordinary dynamo receives. The standard machine is a double one, 24 ft. long, 41 in. wide and 81 in. high, using about 1 hp. which includes that for the static charge. The machine is not confined to ores of zinc; all metallic substances, most sulphides and arsenides, and some carbonates and oxides are thrown out of a siliceous or limy gangue, in many instances the extraction being very high; this is particularly true of the sulphides of copper. The advantages of the machine are summed up as follows: Low first cost of the machine and nominal operating expense; it separates materials without regard to their specific gravity, it works well at any mesh between 8 and 200, no roasting of sulphides is necessary, no water is required, no piece of the machine weighs 100 pounds, and any intelligent mill man or mechanic can build a machine and keep it in repair.—*Eng. & Min. Jour.,* January 24.

Electric Manufacture of Steel.—WALSH.—An illustrated article describing the method of manufacturing steel electrically at Kerrouse, France. At these furnaces all kinds of iron ore have been fused and treated successfully by electricity. According to the tests made, it was estimated that to manufacture one ton of steel from ordinary iron ores required the expenditure of 2,800 kw per hour, or about 3,800 electrical horse-power. At the factory in France the cost of electrical energy was estimated at $10 per kilowatt-year of 8,400 hours. Including the cost of electrodes, coke, ore, refining materials, and general expenses, the cost of manufacturing a metric ton of 2,204 English pounds ran from $18 to $20. The coke used, however, cost $8 a ton, and the iron ore likewise cost considerably more than it might be obtained for in this country. On the other hand, the labor item is considerably lower. The working quality of the steel produced has been found to be equal to that produced in the ordinary mills operated by the open hearth and Bessemer processes. The furnace now building at Kerrouse will consist of one refining furnace, which will do the work of a series of electric blast furnaces. The refining furnace will be portable, running on a heavy truck in front of the series of electric blast furnaces, and will be large enough to accommodate the whole battery of blast furnaces. It is built in the form of a huge ladle, which is inserted in the hole of the refining furnace and the electrodes lowered to begin the refining process. As the ladle is easily and quickly adjustable to any of the furnaces, the process is carried on continuously before the different blast furnaces. —*Am. Elec.,* March.

REFERENCES.

Duesseldorf Exposition.—DANNEEL.—Continuations of his long serial on electrochemical and metallurgical exhibits at the Duesseldorf exposition. He reviews the zinc, lead, copper, silver, nickel and cobalt mines of Germany; exhibits of copper tubes of the Elmore Copper Company are described; also storage batteries and the Goldschmidt thermic process. Heraeus solders aluminum so perfectly that the soldered pieces may be worked with the hammer and may even be rolled into sheets. Exhibits of manganese and manganese alloys (manganin) and platinum are also briefly described.—*Zeit. f. Electrochemie,* January 15, 29; February 5, 12.

Antimony.—IZART.—An article giving a summary of investigations on the electrolytic preparation of antimony.—*L'Ind. Elec.,* January 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

American Meter Practice.—REED.—An article treating of torque and friction in relation to recording wattmeters. The author states that the continued accuracy of any meter depends primarily on preserving permanently the ratio between the torque and the frictional counter-torque. The variable quantity of this ratio is the frictional counter-torque, hence the torque should be so large in proportion that a doubling or trebling of the friction will have no appreciable effect on the accuracy of the meter. In order to get a meter which for all commercial considerations would be correct through all ranges of load, it would be necessary to either increase the torque or reduce the friction; the most economic course is to eliminate the friction, since this cuts down the power consumption of the meter. When the friction equivalent is reduced to its minimum for a given form of construction, the ratio of the friction to the torque at full load for any meter should not be less than the ratio of 1 to 400. This ratio with no friction compensator gives a 2½ per cent. error on 10 per cent. of full load, or 1.2 watts with one light burning on a 5-amp meter. There is an economic limit to the increase of the torque of a meter with a view to obtaining greater accuracy, since when this increase in torque is directly proportional to the current necessary to produce it, the amount of power consumed in obtaining this extreme accuracy is greater than the amount of power lost through inaccuracy.—*Am. Elec.,* March.

Vibration Magnetometer.—SEARLE.—A description of a new form of vibration magnetometer which obviates the difficulty of the ordinary forms when used in a non-uniform field. The magnet is a cylinder 1.50 cm in length and 0.14 cm in diameter, of the "silver steel" used for making small tools, the steel being rendered "glass-hard" by quenching at a bright red heat. The magnet is magnetized between the pole-pieces of a small electromagnet and its magnetic moment is about 3 c.g.s. units. In order to make a great increase in the time of vibration, the magnet is attached to a brass plumb bob. The main part of the bob is 1.6 cm in length and 0.8 cm. in diameter, the total mass of the system being about 8.5 grammes. The lower part of the bob is turned down to a smaller diameter, and into this part are fitted the magnet and a pointer of aluminum wire 5 cm in length; the lower end terminates in a sharp point. The upper end of the bob is fitted with a small eye, made by soldering a loop of fine wire into a small hole drilled along the axis of the bob; to this eye the suspending fibre is attached. The change of magnetic moment due to the earth's horizontal magnetic force is only 0.2 per cent. The author also proposes to revive the ball-ended magnets described by Robinson in 1801. They can be made by mounting bicycle balls at the ends of knitting needles and magnetizing them between steel plugs, fitting the balls at the ends. Such magnets behave very nearly like ideal magnets having their poles in the centers of the balls. Cavendish's law of inverse squares may be demonstrated with some accuracy by the aid of such magnets.—*Proc. Cambridge Phil. Soc.,* V. XII, pt. I, 1902; abstracted in Lond. *Elec.,* February 27.

REFERENCE.

Integrating Wattmeter Connections.—WEEKS.—An illustrated article showing how to connect a wattmeter in circuit while the motor is in operation, and also explaining the calculations necessary to obtain the work done from the meter readings.—*Am. Elec.*, March.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Recording Telegraph.—HOPKINS.—An illustrated article on recording telegraph apparatus for amateurs.—*Sc. Am.*, February 21.

Telephone Engineering.—DOMMERQUE.—An illustrated article on the treatment of poles. The author describes several processes of treating poles with preservatives. The method followed by the German Post Office Bureau is given as a typical example of the sulphate of copper process. A description is also given of a similar process used in France, and of the creosoting process used in this country.—*Am. Elec.*, March.

A Modern Private Branch Telephone Exchange.—O'BRIEN.—An illustrated article describing the methods of operation and wiring, and to some extent the construction, of one of the most common types of private branch switchboards, and giving detailed instructions for the installation and maintenance of such systems.—*Am. Elec.*, March.

New Books.

TECNOLOGIA DEL CALORE. By Rinaldo Ferrini. Milan: Ulrico Hoepli. 268 pages, 58 illustrations. Price, 6.5 lire.

A literal translation of the title of this book would be "Technology of Heat." The volume is divided in five chapters or parts, respectively entitled Combustion, The Apparatus for Combustion, The Transmission of Heat, The Effect upon the Surrounding Medium, and Ventilation.

Chapter I, on Combustion, deals entirely with the theoretical chemical reactions of the various combustibles, and particularly describes the various forms of calorimeters and the methods employed in determining specific heats. Chapter II is occupied with the practical apparatus for burning combustibles, such as boilers, furnaces, etc. In Chapter III the absorption of the heat produced by the tubes of boilers, and by other things with which heating apparatus is surrounded, is described. Chapter IV deals with the methods used in the artificial heating of buildings. Chapter V exhibits the principles of ventilating both for public and private buildings. The work is somewhat mathematical in character and abounds in very complete tabular data of various kinds.

ASYNCHRONE GENERATOREN. Fur ein und Mehrphasige Wechselströme. By Clarence Feldmann. Berlin: Julius Springer. 134 pages, 50 illustrations. Price, 3 marks.

This is a treatise on asynchronous dynamo machinery, and though the title page claims a description of alternating-current generators, both in theory and practice, there is little to be found in the work excepting an exhibition of the mathematical theory. There are three chapters. The first chapter deals with the analytical methods which are applied to the calculations of multifarious generators and motors. The second chapter takes up the subject from the graphical standpoint, and gives diagrams, whereby the problems which in the previous chapter were solved analytically, are treated graphically. In the last chapter single-phase machines are discussed and are treated in a similar manner, both analytically and graphically. For those enjoying mathematical analysis as applied to dynamo machine construction, the work will be of interest and value, but its mathematics will doubtless be found formidable by the average engineer.

THE ELEMENTS OF ELECTRICAL ENGINEERING. A First Year's Course for Students. By Thomas Sewell, A.I.E.E. New York: D. Van Nostrand. 332 pages, 204 illustrations. Price, $3.00.

This volume embodies a series of lectures delivered to classes of students in electrical engineering, whose course was of the grade and character of those usually taught to evening classes at manual training schools. But little mathematical knowledge is demanded for its reading; and the text, which is largely descriptive, puts all numerical relations in the simplest possible manner. The class of readers to which the book will appeal are those who pursue a correspondence course, or attend an evening school; and the general reader who desires information on electrical subjects of a semi-technical descriptive character. There is evidently a demand for books of this nature, judging from the number published; and when they are intelligibly written they are of service to the general reader and of assistance to the professional engineer. The author who designs such a work needs not only a knowledge of the subject, but discrimination and judgment in presenting facts and principles, which come only from maturity and wide experience. The contents of the present book do not indicate that the author possesses these qualifications.

The author devotes the early chapters in this book to the conception of electrical resistance and the principles of the electrical circuit. In doing this he has resorted to an elaborate hydraulic analogy of the usual kind. This being well enough in its way for mere illustration, becomes poor pedagogy when strong emphasis is placed upon it. The reader's attention in such a case is more apt to be taken up with the illustrations than the electrical facts presented. In short, when an illustration requires more attention to follow it than the primary fact, it becomes inefficient and cumbersome. Judging from the insistence upon the hydraulic analogy, one would suppose the author was lecturing to a class of plumbers. The chances are that the general reader knows little of plumbing, and has in this book to master two dissimilar facts instead of one. The principles of Ohm's law, electrical resistance and circuits, and such subjects are intellectually so simple and easy of comprehension when intelligibly presented, that there is no need of illustration and analogy. These chapters in contrast with the method pursued by Prof. Atkinson in Chapter III of "Electrical and Magnetic Calculations," present the contrast of an obscure and cumbersome method with a direct, clear and intelligent one.

The style of the book is that of the oral lecture and makes its contents easy and pleasant reading. This feature is commendable and an agreeable change from the abrupt topical condensation of facts that characterizes the usual text-book. One cheerfully puts up with the increased bulk and cost of a book when it is written in a natural and pleasing style.

The chapter on the magnetization of iron is clearly and adequately written for a work of this scope. It is illustrated with frequent numerical calculations and accompanied with excellent diagrams. One is rather surprised, however, at the conservatism which avoids all reference to the names of the magnetic units. The caption of a following chapter is "Indicating Instruments—Ammeters, etc." The author here is confused as to the distinction between an indicating and a measuring instrument, for in the opening sentence he speaks of the ammeter as an instrument for measuring current. The Weston instrument comes in for a long discussion, and as a matter of course the Kelvin electrostatic switchboard voltmeter is described and illustrated, with its plumb bob and other accessories. In the following chapter, galvanometer and the resistance box are considered.

The arc lamp is well discussed from the point of English practice, though perhaps too little attention is given to the enclosed arc. As in other parts of the book, the author here avoids a reference to the alternating current, and so contracts his subject within too narrow limits. Unless this work is to be followed by a second one in which alternating current practice is discussed, the exclusion of all such reference from the present volume reduces its importance to the older lines of electrical engineering, and puts it out of touch with the advancement of the last ten years. The manufacture of the incandescent lamp is fairly well described, and its photometry in a meagre way. However, when describing the exhaustion of the lamp, no reference is made to other than the Sprengel pump. This is singular, for the Geryx mechanical pump is made in England and should be known to the author, and as well its employment in connection with chemical exhaustion.

The book concludes with the chapters on the continuous-current dynamo and the direct-current motor. The first is discussed in a conventional and elementary manner, and the second inadequately. As a book purporting to cover the elements of electrical engineering, one would expect to find in it some mention of separate driving, and many such applications to electrical practice.

This book is commendable from the manner in which the author confines himself to the presentation of the elements and principles of electrical engineering, and avoids purely descriptive and catalogue matter. The author, however, is again at fault when he makes but few references to formal and periodical literature; and the book from this defect will lack stimulation and suggestion for the reader.

Directory of Electrical Societies, Etc.

American Electrochemical Society, Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: March 27th, "High Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

American Street Railway Association, Secretary, T. C. Pennington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Iowa Telephone Association, Secretary, C. C. Deering, Des Moines, Iowa.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 26, 27 and 28, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

A Notable Invention in Rapid Telegraphy.

By Romyn Hitchcock.

Mr. Patrick B. Delany, who is so well known for his many inventions in telegraphy, particularly for the Delany multiplex and for improvements in automatic methods, has recently been granted a patent (No 72,004, issued February 10, 1903), for a method of utilizing the so-called static charge of a telegraph line in telegraphy, whereby signals may be transmitted and sharply recorded in Morse characters at the highest possible speed. Hitherto the retardation of the line has interfered with rapid operation, and even in ordinary hand working of duplex and quadruplex apparatus special devices are necessary to overcome static effects. In the more rapid operation of machine telegraphy, when signals must be recorded on chemical tape at speeds in practice of 250 or 300 marking impulses per second, with experimental speeds achieved of 2,000 or more, the static charge has always been troublesome.

It is obvious that if this disturbing charge is a noticeable impediment to fast working with the chemical recorder, where the line current passes directly to the chemical tape without intervening mechanism, it must impose much greater restrictions upon any system which requires the current to actuate armatures or mechanism, however light or delicate it may be. Moreover, when the successive impulses are of different duration, as when dots and dashes are sent for Morse characters, the static charge is not the same for all signals, being larger for the longer impulses. Under such conditions if we attempt to cut off the trailing of the dashes, which is caused by the discharge of the line, with a current of reverse polarity, that current may give rise to a discharge which will also weaken or obliterate a succeeding signal.

The only way to maintain the line conditions constant, or to exercise effective control of them, is to make the signals all of uniform duration. Having accomplished this, the best theoretical conditions of transmission would then be attained by successive reversals of polarity. Both these results have been practically achieved by Mr. Delany, and the patent above referred to shows a most admirable adaptation of alternating impulses of equal duration, to the production of perfect dots and dashes at the receiving end of a line, of whatever length.

It will be recalled that some years ago Mr. Delany produced a perforated tape by means of which all impulses in Morse transmission were made of equal length. They were also recorded on the receiving tape in marks of uniform length. The signals representing dots in the Morse code were sent with the positive current to line, while the dash signals were sent with the positive to earth. By an arrangement of three parallel iron needles, set close together, their points in line across the tape at the receiver, the positive line current passed to the tape through the middle point and made its mark by electrolytic action. The positive current sent through the earth made a double mark through the two outer needles. The single marks represented dots, the double marks represented dashes. The records thus made were easy to read. There could never be uncertainty in distinguishing dots and dashes. Under unfavorable line conditions the static charge would cause the marks to tail out and perhaps run together, but even under the most extreme conditions of tailing, the length of the lines thus merged together would enable the reader to instantly know the number of single marks composing them. In this method the reversals of polarity were irregular, depending upon the succession of dots and dashes in the letters sent. This represented the most advanced condition of commercially practicable machine telegraphy until quite recently, and it was capable of making legible records at a speed of several thousand words a minute.

The next forward step was to introduce reversals of current for every impulse, and to use a single marking pen for the production of dots and dashes on the chemical tape. The problem was to cause impulses, all of the same duration, to be recorded in a single line as dots and dashes. This is accomplished by allowing the static charge to continue or prolong a mark started by a short impulse sent into the line. Dots or dashes are made by cutting off the mark at the proper instant by the reverse current. The time allowed between the primary impulse and the impulse of opposite polarity, determines whether the record shall be a dot or a dash.

Thus, what has hitherto ben the most serious obstacle to rapid telegraphy becomes a most important adjunct for successful operation at speeds approaching the theoretical limit. If the line has not sufficient capacity, a condenser at the transmitting station supplies the deficiency.

The method of operating is simple. Each signal, whether a dot or a dash, is made with two impulses of opposite polarity and of equal duration. These are sent to line by means of a perforated tape. The tape is prepared by operating a Morse key in the usual manner of line working. When the key is pressed down a hole is punched near the lower edge of the tape; when it comes up a hole is made near the upper edge. The tape is constantly running, and thus the holes, being made in succession, bear a slanting relation to each other on the tape. The time of holding down the key determines the angle of slant. For a dot they are nearly in a vertical line, only sufficiently inclined not to overlap; for a dash the angle of slant is larger.

As the tape runs through the transmitting apparatus, electrical contacts are made through the holes by means of metal conductors or "brushes." The two brushes beneath the tape are connected respectively with the positive and negative transmitting currents, and the opposing brushes above are connected to the line. Through the holes along the lower edge of the tape positive impulses are sent, and through the other row of holes negative impulses.

At the receiver the line currents pass to the chemical tape through an iron marking point and thence to ground. The positive current alone marks the tape by electrolytic action—the negative current having no such effect. If a positive current is sent and a negative follows immediately, the mark is cut short, making a dot; if a longer time intervenes the mark is extended by the static discharge beyond the duration of the current.

There are a number of claims in this interesting patent, but the broad scope of the invention may be indicated by the wording of the first claim, which is as follows:

"In a telegraph system in which each signal is composed of two impulses of opposite polarity sent into a circuit at a transmitting station, the method of transmission and recording which consists in adjusting the capacity or consequent retardation effect of the circuit so that the formation of a record character will be continued after its primary impulse is sent into the circuit, sending the primary impulse of a signal into the circuit to initiate the production of a record thereof, disconnecting the generator from the circuit and permitting the "capacity" effects of the circuit to continue the production of said character, and terminating the formation of the character by transmitting the secondary impulse of opposite polarity."

"Sparklet" Fuses.

Elliott Brothers, London, are introducing an ingenious fuse, the invention of Mr. G. W. Partridge, chief engineer of the London Electrical Supply Corporation, which employs sparklets in its operation. These sparklets, as our readers are doubtless aware, are small steel bottles, about as large as an olive, containing liquid carbonic acid gas; the necks are closed with thin steel stoppers, made gastight for a pressure of 600 lbs. per sq. in., with a thin rubber ring. Sparklets are commonly used for the purpose of aerating water in "siphons," a simple attachment to the latter enabling the user to pierce the stopper of the sparklet, so as to release the gas. They are readily obtained in boxes of 12 from chemists, etc., and are inexpensive. The sudden expansion of the carbon dioxide as it flashes into gas, produces a temperature in the neighborhood of 100° F. below zero; the gas itself, by its incombustible nature, tends to extinguish flame, and at the same time the violence with which it is ejected from the sparklet, as though the latter were a small cannon, acts as a blow-out device of the highest efficiency.

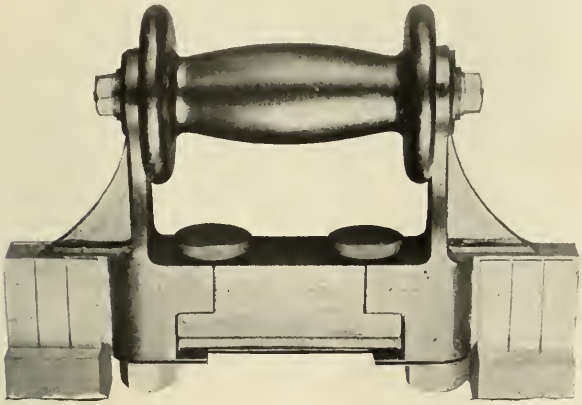


FIG. 1.—500-AMP SWITCHBOARD TYPE OF FUSE.

The construction of the actual fuses, which have now been in use by the L. E. S. Corporation for two years, is quite simple. The type of fuse illustrated is that which is intended for the high-pressure side of transformers; the body is a trough of earthenware, with a recess at each end, near the terminals. The fuse consists of a suitable number of fine copper wires, which are enclosed between strips of mica for the greater part of their length, but are exposed near the ends. The fuses are made up with metal terminal plates, ready for immediate insertion into the trough. Two marble blocks fit into the recesses in the earthenware referred to above; in each of these there is a hole shaped in such a way as to receive the body of a sparklet, while allowing its neck to project slightly beyond the surface at the side next to the fuse-gap. When these blocks are slipped into place, the sparklets are held in postilon by spring clamps projecting from the terminals of the fuse, so as to ensure their connection with the circuit—an essential feature.

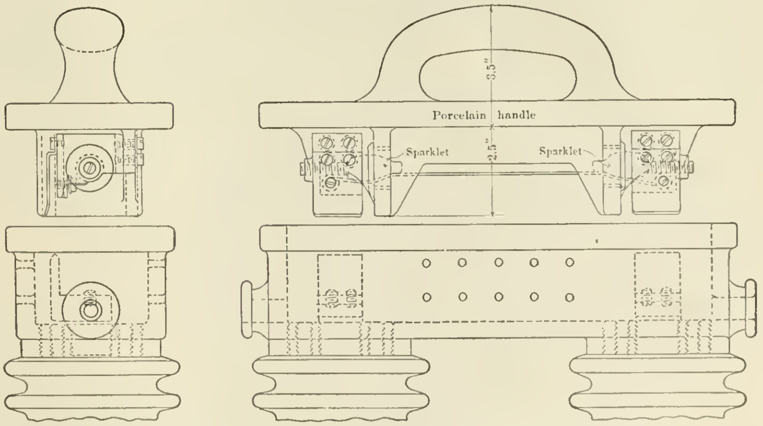


FIG. 3.—FUSE FOR SUB-STATIONS.

It will readily be understood that directly the fuse has blown, the arc which follows rises, passes on to the end of one or both of the sparklets, fuses the stopper and releases the gas, which extinguishes the arc. The fuse operates equally well whether blown by a short circuit or by a long-sustained excess of load; the latter condition is regarded by the inventor as an especially severe test, the arc formed under these conditions being peculiarly persistent. The length of gap required to deal with an arc at 10,000 volts is only 9 in., as compared with the 4 ft. 6 in. fuses which have been used; two sparklets are used, one at each end, but this is only for additional security, as one always suffices.

The sparklets may be applied to switches which have to operate under heavy loads, and are quite applicable to 500-volt circuits. Mr. Partridge has, in fact, employed them in this way, the sparklet being so placed that the arc formed on opening the switch opens the sparklet. When the system is applied to circuit-breakers, a magazine of the revolver type is employed, by means of which a fresh sparklet is brought into position every time the switch is closed. We understand that not one defective sparklet has yet been met with.

The fuses for low-tension work are made in several standard sizes for currents up to 1,000 amp, and pressures up to 500 volts continuous current.

Fig. 1 illustrates a 500-amp switchboard type of fuse, which consists of two gun metal castings separated by a block of insulating material and handle. The castings form the contact blades, sparklet holders and fuse contacts; the sparklets, held in position by the insulated screw caps, project through the insulating block so as to be in the path of the arc, which, by piercing the ends of same, liberates the compressed gas which extinguishes the arc.

Fig. 2 illustrates a type of high-tension fuse suitable for 500 amp at 2,000 volts. It consists of a substantial porcelain tube with metal caps cemented on the ends, each of which hold three sparklets projecting into the tube through bushed holes; the fuse wires are sweated to copper lugs and are bolted to the contacts in the usual manner. Fuses for pressures up to 10,000 volts are made similar to this, but with a group of sparklet held in a spider and fixed in the bottom of the tube, and so arranged that the liberated compressed gas blows along the path of the arc.

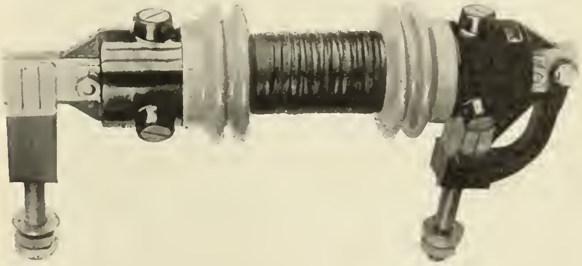


FIG. 2.—HIGH-TENSION FUSE.

Fig. 3 shows a sparklet fuse for use in sub-stations, etc. This is for currents up to 50 amp and pressures up to 5,000 volts. The sparklets, fuse wire, etc., are carried upon a porcelain handle which slips into a porcelain box supported on insulators fixed to a base. Several modifications of this type are made for house service fuses, instruments, etc. All sparklet fuses are made of the "Switch" or "Plug" type, and can safely be handled whilst alive, and removed for renewing fuses or for examination, without the use of insulated gloves or tongs.

Interruptions of the California Long Distance Power Service.

The Bay Counties Power Company's 140-mile transmission line, from Colgate to Oakland, Cal., was shut down for about 30 hours, following a switchboard fire, which occurred on March 4 in the Colgate Power Station. The Stanley generators were well adapted to withstand water, but they had to be carefully tested out after the wetting they received at the time of the fire. The company's engineers under Superintendent L. M. Hancock made a record for quick repairs and the system was in operation up to its full capacity of seven generators within four days. The California Gas & Electric Corporation has three other plants which combined have two-thirds of the capacity of the one at Colgate and so the valley and mountain power lines suffered no interruption of service

Within 90 days a large electric power plant at Nimshew will be in operation, and in case of any future trouble at Colgate the new station will be able to supply the bay lines. The 2,000-hp electric railway power house of the North Shore Railway Company, at Alto, Cal., which will be completed by May 1, will also be used as a steam reserve station in case of trouble on these lines.

The cause of the switchboard fire at Colgate is not fully understood, though there was a short circuit on the line at the Cordelia switching station just preceding the trouble. There are circumstances which would tend to support the theory that the plant was struck by lightning.

The Standard Electric Company's transmission system, extending from Electra to San Francisco, resumed operations on March 5 after a shut down of some days as a result of landslides on its hydraulic system in the Sierras. The company will greatly increase its water storage facilities this year. It was an unfortunate coincidence, which will probably never occur again, that the Standard Electric Company's plant was shut down at the time that the Bay Counties Power Company's service was interrupted, as the two plants are so connected as to be able to help each other out in case of trouble.

The Felt Axle-Driven Train Lighting System.

The system of axle train lighting, designed by Mr. Charles E. Felt, of Chicago, which was mentioned in the discussion on train lighting at the Chicago meeting of the American Institute of Electrical Engineers, is here illustrated. Fig. 1 shows the apparatus as applied to the truck, and Fig. 2 is a drawing of the details of the driving mechanism. The system is one in which the dynamo is driven at constant speed as long as the train exceeds a certain predetermined speed. The dynamo always revolves in the same direction. The driving mechanism consists of a disc either mounted directly on the car axle or geared thereto. Bearing against each side of this disc and driven by friction from it are two pulleys as seen in Fig. 2. These friction pulleys bear against the disc with sufficient pressure to transmit power to the generator. The pulleys are loose on their journals and are provided with ratchets and pawls, so that when the train is going in one direction, one of the pulleys revolves free without turning the journal on which it is placed, while the pawl on the other engages its ratchet and drives its axle. With the train going in the other direction, the condition of affairs is reversed; that is, the pulley on the opposite side of the disc does the driving and the other pulley revolves free. Power from the friction pulleys through the dynamo shaft is transmitted through spur gearing as seen. The regulation of the dynamo speed is accomplished by an ordinary ball governor. When the speed is slow, this governor allows the friction pulleys to remain near the periphery of the driving disc. As the train increases in speed, this governor moves the friction pulleys nearer the center of the disc. In this way the dynamo speed is kept nearly constant through a large range of train speed. The system is an exceedingly simple one electrically.

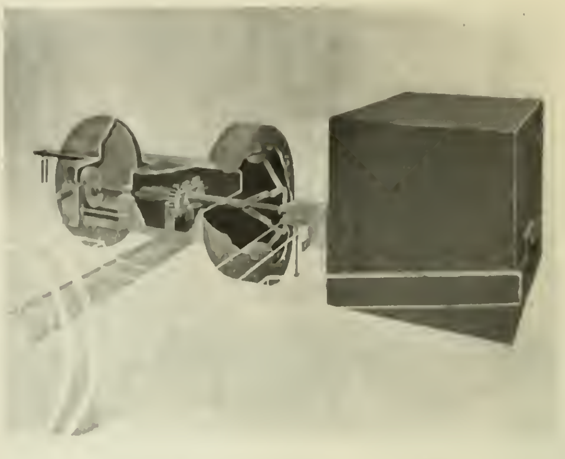


FIG. 1.—APPARATUS APPLIED TO TRUCK.

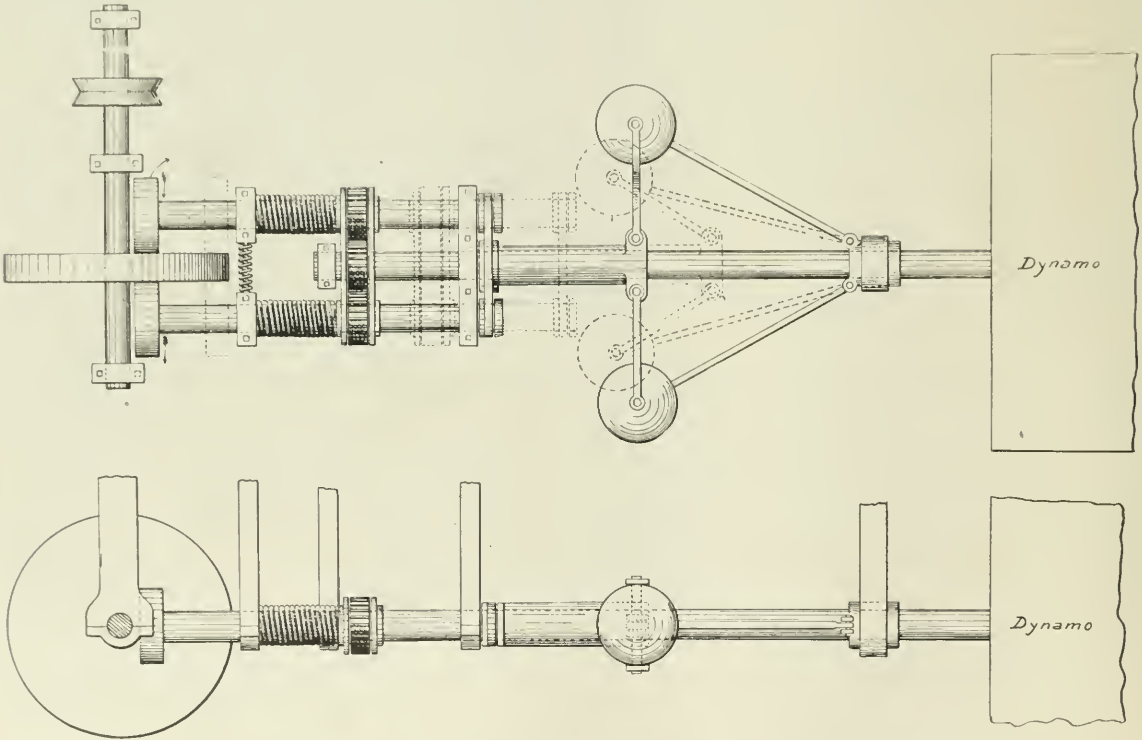
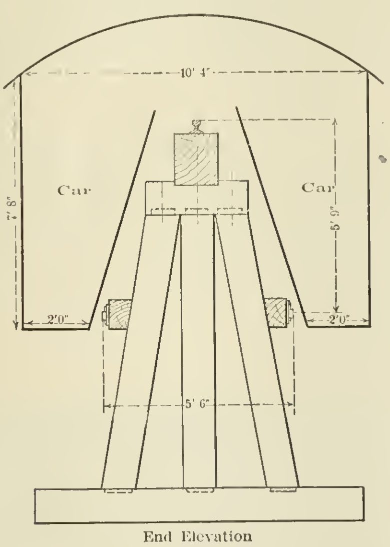


FIG. 2.—DRIVING MECHANISM TRAIN-LIGHTING SYSTEM.

As the dynamos are always revolving in one direction, no automatic reversing switches are required. All the switching necessary is to cut out the dynamo when the train is going at a sufficient speed to generate, and to cut the dynamo into circuit when the proper speed is reached. This is done mechanically by the action of the ball governor, so there is practically no automatic electric controlling apparatus. The driving is of course done entirely by the friction of the pulleys against the disc. This requires considerable pressure between the disc and pulleys, in order to transmit the power without slipping. However, this does not involve end thrust of any kind, because the pressure of the disc is equal on both sides, as the friction pulleys bear on both sides and tension is maintained simply by the spring drawing them together. All the bearing friction is, therefore, taken on ordinary journal bearings, which are not subject to the great friction losses of thrust bearings. Mr. Felt was formerly a mechanical engineer with the Pullman Company, and has had, therefore, much experience with various axle-driven train lighting systems. He has been impressed with the complication involved in many of them and believes that the present system on account of its simplicity will eliminate many of the common difficulties.

Monorail Railway.

The monorail railway system to which the accompanying cut refers has been devised by Frank Moberly, of Victoria, B. C., for the purpose of meeting conditions presented in the mining districts of British Columbia and similar districts elsewhere. In the province mentioned there are many large ore deposits unworked for want of cheap transportation, most of them being so situated that they cannot be reached by the ordinary railroad or tram. Mr. Moberly believes that a system of monorailroads operated by electricity would be a solution of the cheap transportation problem, and that proposed is a modification of what is known as the Lartique system. A road of this design has been in operation for some sixteen years between Ballybanion and Listowel, in Ireland, with satisfactory results, the operating power, however, being steam.



CROSS-SECTION MONORAIL RAILWAY.

The sketch will give a general idea of the mode of construction proposed. The cars to be used will vary with the requirements of each locality and can be utilized for the carriage of passengers, ore or general freight. The motive power will be electricity, which can be generated anywhere by water power, of which there is abundance waiting to be developed; and besides operating the railway, power can be supplied to mines or other industrial enterprises that may require it. In the majority of cases the power can be developed at or near the initial point of these railroads, thus greatly facilitating construction work.

The main features claimed for this system of railway is the cheapness of construction, maintenance and operation as compared with the ordinary railway, and also the possibility of avoiding obstruction by snow—a great feature in mountain work. All heavy grading and other costly work incidental to railway building in a mountainous country will be avoided.

General Electric Motor for New York Subway.

The accompanying cuts illustrate the type of motor which will be supplied by the General Electric Company for the equipment of the cars of the New York Subway. There will be 340 motors of this type used, and the same number of Westinghouse motors.

There will be two motors on each car of an aggregate capacity of 400 hp. The weight of each motor is 6,000 pounds, and it is adapted for mounting on a truck with 50 in. between wheel hubs. It is fitted with the nose suspension and its front side is supported by lugs cast on a frame. This lug is designed to rest on a bracket riveted to the truck transom with a forged strip bolted over the top of the lug to prevent the motor from rising. The motor is mounted on or removed from the truck from above, when the truck is out from under the car, no pit being required.

The magnet frame is unsplit, and is made of one piece of cast-steel, substantially in the form of a cube with well-rounded corners and large bored openings, one at each end, into which frame heads carrying the armature shaft bearings are bolted. Through these openings the armature is put in place or removed from the frame.

The pole pieces are laminated and are bolted to the interior, top, bottom and sides of the frame with through bolts with nuts on the outside of the frame.

The field coils are wound with flat copper ribbon in a common plane. The coils are insulated with mica and a specially prepared fabric which makes them semi-fireproof and practically impervious to moisture. The air-gap is a total of 7-16 in., 3-16 of an inch above and 4-16 of an inch below the armature.

The armature has a series drum barrel winding. Its conductors are copper bars, separately insulated and assembled in sets of five, the set as a whole having an outside protective insulation. The bars are soldered directly into ears, forming a part of the commutator segments, thus avoiding entirely the use of connecting leads. At the back of the armature the top and bottom bars are connected together with tinned clips riveted and soldered but easily removable in case it should be desired to replace top bars without disturbing the bottom bars. The conductors are held in slots by tinned steel wire bands imbedded in the core beneath the periphery, the wires being soldered together and held by tinned clips. The armature core is of the "iron-clad" type, and is made up of soft iron laminæ.

The commutator segments are made of hard-drawn copper insulated throughout with the very best grade of mica. The commutator shell and cap are made of cast-steel, the parts being especially strong; the segments are clamped very tight, the cap being pressed home in a hydraulic press previous to tightening the commutator bolts. The commutator ears, into which the armature conductors are soldered, are formed integral with the segments so that there is no joint between the ears and segments, thus making a thoroughly insulated, strong and compact construction.

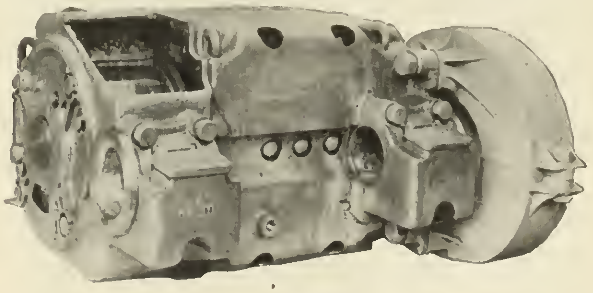


FIG. 1.—AXLE END OF MOTOR.

The brush holders are made of cast bronze, and are adjustable to allow for wear of the commutator. The heads carrying the armature shaft bearings are each made of malleable iron cast in one piece. In order to secure large and long bearings without sacrificing other desirable features of construction, the heads in a cone shape are extended well under the commutator shell and pinion and armature core load. This construction forms a support for the bearing lining, which is very strong and rigid.

The armature bearing of the motor bearing is open to lubrication only on the side opposite the shaft pressure. The babbitt lining is only 1/16 in. thick, preventing the armature dropping more than this distance even in case of hot bearings melting out the babbitt. The bearing is soldered into a shell of the best quality bearing bronze by first tinning the inside of the shell before pouring in the babbitt.

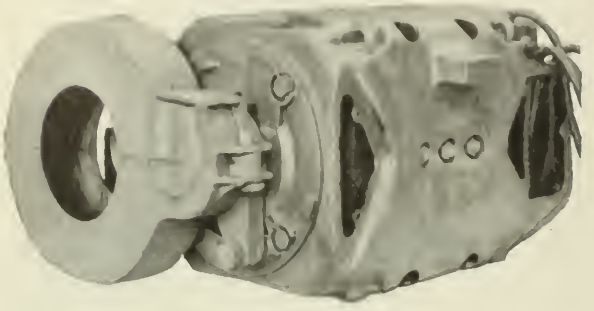


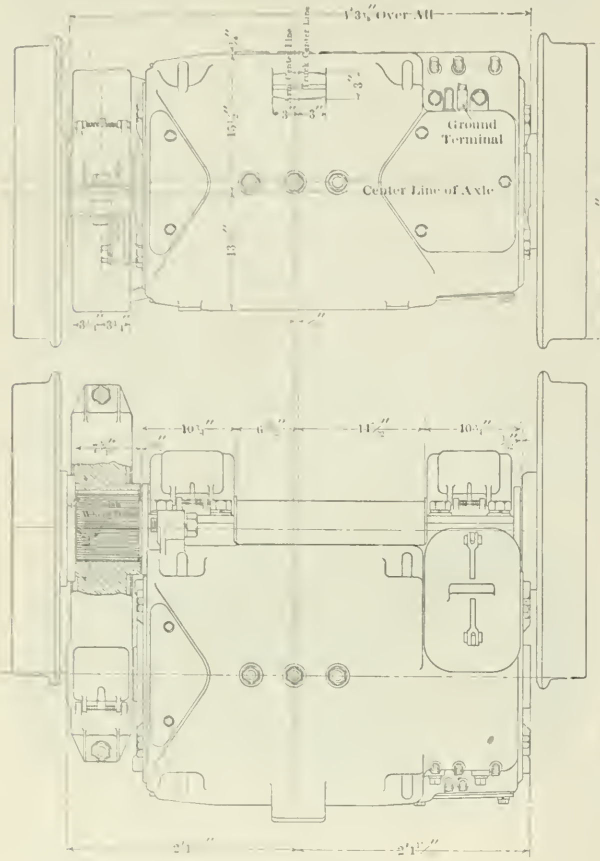
FIG. 2.—SIDE VIEW OF MOTOR.

The gears are made of a superior grade of cast steel and the pinions are forged steel, extra hammered to improve the quality of the metal. This material has an elastic limit of not less than 38,000 lbs., and a tensile strength of about twice that amount. The gears have a 5¼-in. face and are cut with 2½-in. diametrical pitch. The pinion has a taper fit on the armature shaft of ⅝ in. to the foot, measured radially.

The gear case is of substantial construction and is bolted directly to the frame of the motor without the use of lugs. This form of construction was introduced by the General Electric Company for the first time on the Manhattan Railway, and has given very good satisfaction, as it avoids all possibility of the breaking of lugs. The gear case is of malleable iron, and radiating from the three points at which it is attached to the motor frame are strengthening ribs to prevent the case from cracking when subjected to the excessive vibration received in service. Both top and bottom halves of the case are bolted to the motor frame and the two halves are bolted together.

Another very important feature of this motor is the method which has been adopted to overcome the trouble popularly known as "flashing over." It might be said that this is a subject to which the engineers of the General Electric Company have given a great deal of attention in the past, first to determine the cause of the "flashing over," and second to cure the trouble. A large number of tests have been made at the Schenectady shops, and those which have been carried out on this particular motor indicate that the correct solution for the problem of cause has been discovered as well as its proper remedy.

Properly to understand the improvement adopted it is necessary to understand the reasons for the flashing. This trouble occurs almost entirely when the motors are running at high speed, when the line voltage is high, or say above 575 volts, and immediately after there has been a momentary interruption of the power circuit with full current on. This interruption may be due to a variety of causes, as, for instance, a break in the third rail, a high joint, which causes the contact-shoe to jump, or in some cases from sleet or ice on the rail. Assuming that there has been a momentary interruption in the circuit, the magnetization of the field disappears. When, then, there is a restoration of the current on the completion of the circuit after contact is again secured, there is momentarily a large rush of current through the motor, due to the fact that for a very short interval of time, the self-induction of the motor being low, there is no field on which the armature can build up a counter e.m.f. This interval is measured in hundredths of a second, but it is long enough so that the excess current is liable to produce a disastrous effect on the motor.



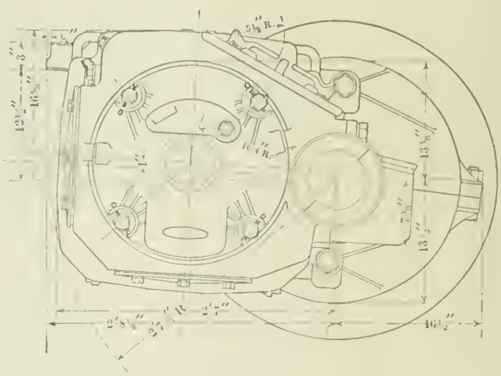


FIG. 3.—PLAN AND ELEVATIONS OF MOTOR.

The method of obviating the trouble, as applied on the subway motors, is comparatively simple. As is well known, it has been the practice of the principal manufacturers heretofore to place around the field poles of the motor short-circuited copper bands for the purpose of steadying the motor, and also, though not of the first importance, to reduce the arcing at the controller. With the type of control used, the contact resistances are of such a character as to possess ample margin to take care off any self-induction, however great. The use of these copper bands is, therefore, unnecessary so far as the controller is concerned. They have, therefore, been omitted, and where the field winding is supported by or surrounded by a metal

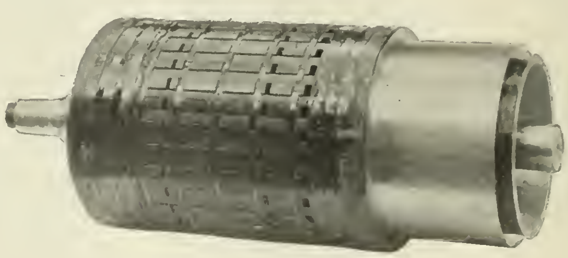


FIG. 4.—ARMATURE OF MOTOR.

shell for mechanical support, that metal shell is cut or open-circuited so as to prevent its acting as a short-circuiting conducting band around the poles. In other words, the effect has been to make the self-induction of the motor sufficiently great to prevent a sudden inrush of heavy current in case of the momentary interruption of the power circuit.

Electrical Contracts in the Philippines.

A cablegram has been received by the War Department at Washington, from Governor Taft, to the effect that the Municipal Board of Manila, the Advisory Board and the Philippine Commission, acting jointly, have accepted the bid of Charles M. Swift, of Detroit, for railway and electric light and power franchises in the city of Manila. First-class fares are to be 6 cents, 100 tickets for $5.50. Second-class fares 5 cents, six tickets for 24 cents. Mr. Swift represents a syndicate comprising himself, J. G. White & Co., engineers and contractors, of New York, Frank H. Buhl and P. H. Kimberly, of Sharon, Pa., and George C. Smith, of Pittsburg, representing the Westinghouse interests. The above syndicate will immediately form a company to take over this concession, which covers the building of 35 miles of electric railway in Manila and its suburbs, and the building and operation of electric light, heat and power plants.

The above syndicate has also contracted to purchase the old Manila tramways and will thereby have control of all the tramway business in the city of Manila which has a population of something over 300,000. J. G. White & Co. will have the entire construction of both the railway and lighting plants, as well as the track construction, overhead trolley system, etc., etc. The Westinghouse companies will furnish the apparatus.

It is stated that the Philippine Commission is very much gratified with the entire transaction, regarding it as the beginning of a new epoch in the Philippines in the investment of large American capital, and also feels convinced that the franchise granted by them to the syndicate will be both beneficial to the people in Manila and also to the investors. The engineering plans for the construction are now under way and engineers will start in the near future for Manila to begin their work, so that no delay will occur. It is probable that the greater part of the material used will be shipped from America at an early date.

New Electric Automobiles.

One of the notable exhibits at the recent Chicago auto show was the combination surrey and tonneau of the Kammann Manufacturing Company, designed by and built under the patents of William T. Kammann, engineer to the company. The machine comprises many interesting features, among which may be mentioned the steering heads at the center of the front hubs, first used by Mr. Kammann seven years ago, and the double-acting, self-tightening internal band-brake in the hubs of the rear wheels. The strain of braking comes on a stop integral with the axle and does not come at all on the operator.

The frame is of steel angle iron and T-iron, braced and rivetted like a bridge truss and is very light and strong. The four springs extending radially from the steel frame to the ends of the axles very close to the hubs of the wheels permit of the use of a very light and tubular axle, without trussing, and also give support to the body at such a distance from the center of gravity as to make the body very steady. The battery (88-95-amp-hour cells) rests in groups on T-iron channels rivetted to the main frame angle. The battery is open to the air at the bottom as well as at the sides and top. Pneumatic cushions on all the seats make riding luxurious without pneumatic tires.

The motor is the Kammann bipolar type, with a very short magnetic circuit of large cross-section, and is suspended from the body frame by means of two fore-and-aft trunniars. As the trunniars are longer than their bearings, and as the bearings are oblong horizontally, the motor can adjust itself to all conditions of chain length and body inclination.

As the body has a possible vertical range of motion of nearly five inches, and as the outboard motor bearings supporting the small sprockets are mounted integrally with the steel casting supporting the wheel bearings, provision is made for keeping these small sprocket bearings in line with the motor by making the arms on which the sprocket bearings are mounted of such a length that their vertical angular movement due to the varying angularity of the springs supporting the body just compensates for the vertical movement of the body. The trunnions take care of any fore-and-aft or oblique movement. The four motor bearings (two on the motor and two at the small sprockets) are, therefore, kept in line and free from binding without the aid of universal joints in the motor shaft.

The differential gear is bevel and is on a hollow motor shaft. The motor has roller bearings. The machine is all metal, not an ounce of wood being used in its construction. The body is aluminum with frosted finish, wheels and axles are steel tubular and frame is of structural steel. The wheels are ball bearing, 52 one-half-inch balls being used in each wheel, running in bearings absolutely frictionless. The wheels can be removed without disturbing the bearings.

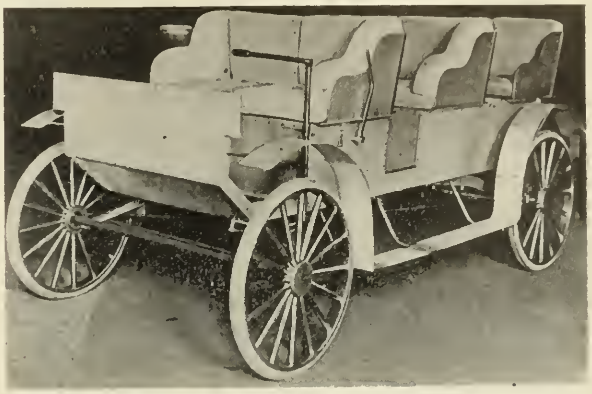


FIG. 1.—COMBINATION SURREY AND TONNEAU.

The other electrical novelty from the Chicago show noted in this article is the "long-distance" carriage of the National Vehicle Company, of Indianapolis. As will be observed, half the battery—or 36 cells—is carried under a polished brass hood in front of the vehicle, giving it a close resemblance to the ordinary gasoline automobile. The other half of the battery is carried in the body at the back, thus distributing the weight fairly and evenly over the two axles and the truck frame. The cells are those of the Western Storage Battery Company, and the vehicle is estimated to have a radius of 100 miles on one charge. Moreover, the motor can be reversed so as to generate current and operate as a brake. The motor is supported on the rear axle, at the center, and is placed with the reduction gears in an outer cylindrical case. Steering is effected by a hand wheel. The brakes are on drums on the drive wheels and set by a foot lever. The frame is angle iron, mounted on full elliptic springs at the rear and half elliptics in front. The vehicle is quite handsome in appearance and weighs 1,600 pounds. To all outward seeming it is a gasoline vehicle, as will be noted from the engraving.

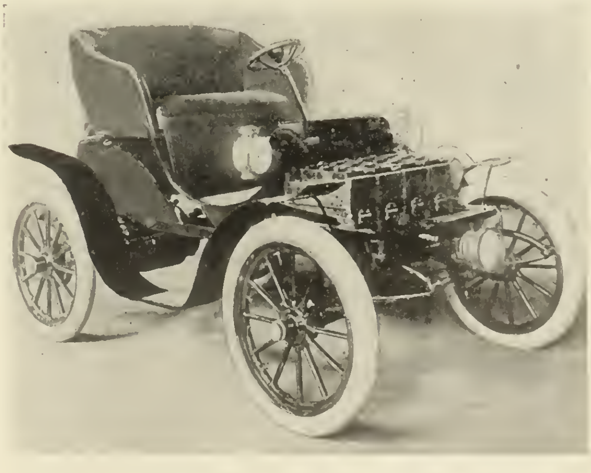


FIG. 2.—LONG-DISTANCE CARRIAGE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered freely as to amount, but prices held firm, there being a good demand for short periods. The closing rates were 6 per cent. for 60 to 90 days and 5¾ a 6 per cent. for four, five and six months. In the stock market there was a better feeling and the tendency was toward higher prices. Electrics on the whole were rather inactive and the market in this class of securities was not affected by any general cause. Each stock seemed to fluctuate independently, due probably to particular causes. Among the tractions, Brooklyn Rapid Transit showed a downward tendency, closing at 65¼, this being a net loss of ¼ point. Metropolitan Street Railway lost 1⅛, closing at 133¾ after dropping to 131⅝, the agregate sales being 65,250 shares. General Electric was the exception in the industrial list in point of activity and strength, closing at 193½, this being a net gain of 3 points. Westinghouse, on sales of 700 shares, closed at 202, being a net loss of 8 points. Other closing quotations were American Telegraph & Cable, 82¼, a net loss of 1½ points; Commercial Cable, 105, a net gain of 4 points, and Western Union, 89¾, a net loss of 1¼ points. Among the features in the trading on the curb during the week was the decline in United States Steel 5 per cent. bonds and rights. The general list was irregular but fairly steady at the close of the week after early heaviness. An interesting incident of the week was the offering of United Copper shares, the Heinze Company, at "seller 60" and "seller 15" at a considerable reduction in price by reason of the proposed extension of the syndicate, and suspicions that few shares have apparently been taken by the public. Other copper shares were pressed for sale by their respective pools, following the sharp rise in the metal. Following are the closing quotations of March 17:

NEW YORK.

	Mar. 10.	Mar. 17		Mar. 10.	Mar. 17
American Tel. & Cable	80	80	General Electric	190¼	192
American Tel. & Tel.	163	164¾	Hudson River Tel.	..	..
American Dist. Tel.	37	37	Metropolitan St. Ry.	132⅝	133¾
Brooklyn Rapid Transit	63¾	64⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel	..	..
Electric Boat	21	20	N. Y. E. V. T. Co.	9	8½
Electric Boat pfd	30	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	2⅝	2⅝	Western Union Tel.	88¼	89⅝
Electric Vehicle.	8	8½	Westinghouse com	195	205
Electric Vehicle pfd	13¾	14½	Westinghouse pfd	200	218*

BOSTON.

	Mar 10.	Mar. 17		Mar. 10.	Mar. 1
American Tel. & Tel	163¾	†165	Western Tel. & Tel. pfd.	99	99
Cumberland Telephone	.	..	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum.	...	..	New England Telephone	138	138
General Electric	192½	.	Westinghouse	100	100
Western Tel. & Tel	23	22	Westinghouse pfd.	102	106

PHILADELPHIA.

	Mar. 10.	Mar. 17		Mar. 10.	Mar. 1
American Railways	50	.	Phila. Traction	97	97¼
Elec. Storage Battery	..	76½	Phila. Electric	6⅞	7⅛
Elec. Storage Battery pfd.	.	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	8⅞	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Mar. 10.	Mar. 17		Mar. 10.	Mar. 17
Central Union Tel.	..	..	National Carbon pfd.	96	99
Chicago Edison	159	..	Northwest Elev. com	..	..
Chicago City Ry	210†	210	Union Traction	9½	9½
Chicago Tel. Co	..	..	Union Traction pfd.	42	42
National Carbon	24	24⅛			

* Asked. † Ex Dividend.

ALBANY & HUDSON REORGANIZATION.—The Albany & Hudson Railroad Co. was incorporated last week with a capital of $27,000,000. The company has acquired the property and franchises of the Albany & Hudson Railway and Power Company, which operates the third rail electric line from Albany to Hudson. The property and franchises were acquired after the latter company had gone into the hands of a receiver after the two serious collisions due to the carelessness of motormen, which impoverished it. The directors are H. G. Runkle, C. L. Rossiter, A. M. Young, Foster M. Voorhees, William F. Sheehan, R. A. C. Smith and H. L. Seibert, of New York; Horace Andrews, of Cleveland, Ohio, and Seth L. Keen, of Brooklyn. The directors of the new railroad are prominent in traction enterprises in this and other cities. A. M. Young, H. G. Runkle and R. A. C. Smith represent a syndicate which has been very active in traction matters in New England. Their offices are located at No. 100 Broadway. C. L. Rossiter, W. F. Sheehan and H. L. Seibert have been more or less identified with Brooklyn Rapid Transit. Mr. Rossiter was at one time president of that corporation and Mr. Sheehan is its general counsel. Mr. Seibert is at present a director of the Brooklyn company. The road is an excellent property, and is developing a large earning capacity.

DIVIDENDS.—The executive committee of the Western Union Telegraph Company has recommended the declaration of the regular quarterly dividend of 1¼%. Directors of the General Electric have declared the regular 2% quarterly dividend, payable April 18. The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 1¾% on the preferred stock, payable April 1. The directors of the Electric Storage Battery Company have declared the regular quarterly dividends of 1¼% on the common and 1¼% on the preferred, payable April 1. The directors of the Hall Signal Company have declared the regular quarterly dividend of 1½% on the common stock, payable April 1. An annual dividend of 6% was also declared on the preferred, payable April 1. Chicago Telephone directors have declared a regular quarterly dividend of 2½%, payable March 31. The directors of the Union Switch & Signal Company have declared dividends of 2¼% on the preferred and 1½% on the common. This makes the preferred a 9% stock and the common 6%. The Boston Suburban Electric Company has declared a regular quarterly dividend of $1 on the preferred stock, payable April 15.

WESTERN UNION EARNINGS.—The fiscal year of the company began July 1 last, and the returns now in show actual net earnings over all expenses, including interest on bonds, as follows:

Quarter ended September 30 last	$1,994,624
Quarter ended December 31 last	1,864,780
Total for the half year	$3,859,404
Add estimated net earnings for the current quarter	1,590,000
Makes total earnings for the three quarters (one quarter estimated)	$5,449,404

Or at the rate of 7.44% for the fiscal year. The first part of the statement reviews the figures for the preceding quarter, and shows that the net earnings of that quarter, ended December 31 last, after deducting interest on bonds, were $1,864,780, which is $17,330 more than the estimate made three months ago, and $250,000 more than the earnings of the corresponding quarter one year ago.

LAKE SUPERIOR COMPANY'S AFFAIRS.—The statement of Vice-President Search, of the Consolidated Lake Superior Company, to the stockholders, was made public this week by John W. Moffley, chairman of the stockholders' committee now investigating the affairs of the corporation. The statement in part is as follows: The Ferro-Nickel Reduction Works at Sault Ste. Marie, fully equipped and in operation, represent an investment of $499,700. In water power development and equipment the company has invested, on the Michigan side, $2,923,600, in addition to the proceeds of $3,500,000 of bonds issued by the Michigan Lake Superior Power Company. The Tagona water and light plant represents an investment of $161,000, in addition to the sum invested from the proceeds of the $160,000 of bonds of that company outstanding.

BELL TELEPHONE.—The stockholders of the American Telephone & Telegraph Company will hold a special meeting in this city on March 31 for the purpose of voting on a proposition to increase the capital stock of the company from $150,000,000 to $250,000,000. This increase of $100,000,000 is to be used as necessity demands, and is not all to be issued at once. The stockholders will also be asked to act on a proposition to limit the number of vice-presidents. A decrease of 2,073 instruments is reported on the net output of the American Telephone & Telegraph Company for the month ended February 20, as compared with same period last year, but a net increase of 31,862 instruments since December 21 last.

ELECTRIC GROWTH AT GENOA, ILL.—The Eureka Electric Company and the Advance Electric & Telephone Company, both of Chicago, have consolidated with a total capital of $150,000, and will remove to Genoa, Ill. Bids will be received for the erection of a two-story brick building, 96 x 225, of mill construction. About 40 new houses, required for employees, and other buildings will be erected. E. C. Shippee, John Hadsall, Thomas Sager, all of Genoa, can give information. The negotiations were conducted by Funk, Lawrence & Co., Security Building, Chicago.

STROMBERG-CARLSON INCREASE OF STOCK.—At a meeting of the stockholders of the Stromberg-Carlson Telephone Mfg. Co., held in Rochester, N. Y., on March 9, it was voted to increase the capital stock from $3,000,000 to $4,500,000. The total stock will consist of 15,000 shares of preferred and 30,000 shares of common stock, the par value being $100 each. The company has been doing a very large business.

OTIS ELEVATOR ANNUAL REPORT.—The annual report of Otis Elevator for the year ended December 31 shows as follows:

	1902.	1901.	Changes.
Net earnings	$978,410	$842,096	Inc. $136,314
Dividends	411,835	267,539	Inc. 144,296
Surplus	$566,575	$574,557	Dec. $7,982
Depreciation	266,575	274,557	Dec. 7,982
Surp. added to working capital	300,000	$300,000	....

President W. D. Baldwin says that during the past year the volume of the company's business has very materially increased, thereby justifying the action of the directors in making the large expenditures during the past three years for increasing and improving the company's plants, all of which expenditures, other than those made for the purchase of real estate and the erection of new buildings have been charged to operating expenses. The preferred stock has been increased from $4,500,000 to $6,500,000 and about $1,000,000 of this increase remains in the treasury, while 9,895 shares were issued and sold for cash. The proceeds were used in taking up all outstanding notes (except the 4 per cent. gold notes), and to pay current liabilities. Of the 4 per cent. gold notes, $150,000 maturing in December, 1902, practically all were anticipated and paid before they became due. The cash received from the sale of the preferred stock has enabled the company to declare the dividend of 2 per cent. on the common stock. The prospects for the current year are said to be very promising.

ERIE CANAL TOWAGE.—Mr. John Murray Mitchell, counsel for the International Towing & Power Company, has made estimates showing what the operating expenses on the Erie Canal would be under the Wood electric system. The plan, as laid before the canal committee at Albany, is for an electric motor car, which, traveling on a rail at the towpath's edge, should tow boats at a speed of four miles an hour. The entire system would be leased on a royalty basis to the State, which would rent the motors to the boat owners. The Wood electric system, Mr. Mitchell declares, would be superior to the 1,000-ton barge canal proposition. The interest on the cost of the barge canal, $100,000,000, at 5 per cent., would equip the Erie Canal with the Wood system, he says; and, further, it would take five years, according to the State Engineer, to deepen the canal sufficiently for 1,000-ton barges, and during those five years the canal would be idle, losing business amounting to $3,500,000 a year. Not only would this income be lost, but the $1,000,000 a year now paid for maintenance would also be a loss, he points out, as the expense of the "canal establishment" would go right on. The Wood system, on the contrary, Mr. Mitchell says, would solve all difficulties. The operation of the system would not interfere with the use of the present towpath; the power to operate the motors could be acquired from the power plants now along the canal, or the State could use water power. The cost of a 1,000-ton steam barge, $25,000, would debar individual investors and most of the present canal operators, Mr. Mitchell says.

WESTERN TELEPHONE ANNUAL.—The Western Telephone & Telegraph Company, which succeeds the old Erie Telephone & Telegraph Company, issues its report for the year ended January 31, 1903, as follows:

Gross earnings		$453,623
Dividends		850,586
Total net receipts		1,304,209
Interest and taxes	$519,343	
General expenses	24,537	
Depreciation (including $70,621 interest not now collectible)	86,478	
		630,360
Net reserve		673,849
Dividends		640,000
Surplus		33,849

President Fish says: "The earning property of your company consists chiefly in a controlling interest in the capital stock of the Northwestern Telephone Exchange Company, the Cleveland Telephone Company, the Wisconsin Telephone Company, the Southwestern Telephone & Telegraph Company, and the Michigan Telephone Company. These four companies have expended during the past year in improvements and development $2,203,193, of which $282,086 was for underground work, $629,044 for toll lines, $547,178 for switchboards and other equipment, $73,462 for real estate and buildings and $671,423 for exchange aerial construction. The money so expended was supplied by this company. At the end of the year the total number of subscribers' stations in the four companies now under consideration was 111,036, in addition to those under sub-license contract, which numbered 25,753, a gain of 19,732 in the exchanges of the four companies and 11,315 in the sub-license exchanges. The situation of the Michigan Telephone Company, of which company the Western Telegraph & Telephone Company is a creditor to the extent of more than $1,700,000, as well as principal stockholder, is far from satisfactory." The company is now in the hands of a receiver.

Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing the trade conditions of the past week, *Bradstreet's* sums up the situation in stating that the demand is active, with staple prices strong at close to record levels, despite drawbacks in the shape of bad roads, labor troubles East and West, heavy rains, overflowing rivers and backward farm preparations at the south. Labor troubles, present and prospective, especially harass the building trade consuming iron and steel in the metropolis. The traffic congestion, although improved, still affects the transportation of coke, lumber, flour and grain. Railroad earnings are excellent for this time of the year. The country's railroads in February showed gainings of 14 per cent. in gross receipts, and the early March returns are fully as favorable. Export trade showed a very notable gain in February in many lines, particularly in the shipment of corn and cotton. According to *Dun's Review*, the reports of foreign commerce are fully as satisfactory as those respecting domestic trade, exports from the port of New York exceeding those of the same week last year by $5,875,593, or over 60 per cent. The copper market was active, the price of the metal reaching the highest figure in several months. This result, however, it is stated, is due to the speculative element, since consumers show no tendency whatever to engage in the "boom." The upward movement of prices is slow but steady, and on Thursday it reached 15 cents nominally, for lake, electrolytic and casting stock. Despite the strength of the market, there are many people who regard the present prices as largely fictitious and not warranted by the trade conditions.

THE TEXAS FLAT MINING COMPANY, of Madeira County, Cal., has taken its place among modernly equipped mines by purchasing from the Westinghouse Electric & Manufacturing Company one 75-kw, 2,200-volt, 3-phase, 60-cycle, alternating-current generator, 720 r.p.m.; one 1.87-kw, 125-volt, direct-current exciter, 1,800 r.p.m.; one switchboard panel, one 40-hp, 3-phase, 400-volt induction motor, 850 r.p.m.; one 20-hp, 3-phase, 400-volt induction motor, 1,120 r.p.m.; one 10-hp, 3-phase, 400-volt induction motor, 1,120 r.p.m.; three 30-kw, oil-insulated, self-cooling, lowering transformers, converting from 2,100 volts to approximately 420 volts; one 3-kw transformer for lighting circuit, converting from 2,100 volts to approximately 105 volts, and the various accompanying details of electrical equipment. The generator will be installed about three miles from the mine, and will furnish the power necessary to operate a 20-stamp quartz mill, with rock-breaker, concentrators, etc.; and will, also, run two hoists.

EQUIPMENT FOR JAPANESE ROAD.—Francis A. Cundill, 90 Wall Street, New York City, who acts as American representative for the British electrical engineering and contracting firm of L. J. Healing & Co., of Yokohama, has placed a contract with the Albert & J. M. Anderson Manufacturing Company for the line material to be utilized in the double overhead construction of a system to be built by the Yokohama Tramways Company, from Yokohama to Kanagawa, a distance of about four miles. The road, which is to be constructed with Japanese capital, will be the first electric traction system to be operated in that Japanese city. The poles—331 in number, with brackets—will be supplied through the Healing concern by the Railway Supply & Equipment Company, of Cincinnati, Ohio. Although all the other contracts have not yet been fully determined on it can be said now that the major portion of the various equipments for the Yokohama road will be purchased in the United States.

ELECTRICAL MACHINERY EXPORTS.—The Treasury summary of exports for the month of January shows the amount of electrical machinery to have been $556,315, as compared with $409,476 in January, 1902. The export for the seven months reached $3,668,432, as compared with $2,963,696 in the corresponding seven months of 1901-2. The export of electrical instruments for January, 1903, was smaller than usual, being $239,234, as compared with $419,098 in January, 1902. But the total for the seven months was $2,496,368, as compared with $2,248,000 in the corresponding period of 1902. The falling off appears to have been chiefly in Australia and British South Africa.

ROYAL ELECTRIC CONTRACTS.—Improvements in the municipal lighting plant, Lebanon, O., have been completed and operations will be resumed this month. A 300-hp McEwen engine has been installed and a 180-kw Royal Electric Co. alternator. The trustees of the City of Newton, Ill., have also placed an order with the Royal Electric Company, of Peoria, Ill., for one 120-kw alternator and one 200-hp engine.

THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, has purchased the plant formerly occupied by the Alfree Engine Company in that city. The plant is well equipped with large machine tools and will greatly increase the company's manufacturing facilities. A large increase has been made in the capital stock of the company.

SOME C. & C. FOREIGN AND DOMESTIC ORDERS.—The C. & C. Electric Company, of Garwood, N. J., which is considerably enlarging its offices in the Liberty Building, has secured within the last few days a number of foreign and domestic contracts for generators, motors, etc. The export business included an order taken through C. R. Heap, 47 Victoria Street, London, for a 75-kw belted generator and four belted motors, varying from one hp to 10 hp for installation in the London printing press works of R. Hoe & Co. Another foreign order calls for the shipment of a 65-kw belted generator and switchboard for the plant of the Montezuma Lead Company, Mexico. The Metropolitan Printing Company, New York, has requisitioned for over 20 C. & C. motors, varying in capacity from 5 hp to 20 hp, which are to be used for driving printing presses. The majority of the motors are to be direct belted. The Buckingham Apartment Hotel, Pittsburg, Pa., is to be equipped with two 75-kw and one 25-kw generators for direct connection to engines to be built by the Watertown (N. Y.) Engine Company, of 115 hp and 40 hp respectively. The Standard Steel Company, Burnham, Pa., has ordered two more 50-hp motors, which will make the tenth order for motors of similar capacity received from the same source by the C. & C. Company within the last four months. A 125-hp belted generator—the third one—has been ordered for installation in the Chicago shops of the Allis-Chalmers Company. The Standard Electric Company, of New Orleans, has sent in an order for two 30-kw generators, direct-connected to Harrisburg engines. The Rogers Locomotive Works, Paterson, N. J., are to be equipped with an 80-hp motor, also a 30-hp machine for direct-connection to heavy machine tools. The Rogers plant will also be furnished with a 125-kw belted generator. The Edison Electric Illuminating Company, Brooklyn, has ordered a 125-kw booster. This will make the fourth order for similar apparatus. The C. & C. people also report recent receipt of several smaller domestic orders for dynamos and motors.

AMERICAN EQUIPMENT FOR CANADIAN LOCOMOTIVE PLANT.—The extensive locomotive plant now under construction at Montreal, Canada, by the Locomotive & Machine Company, Limited, is to be installed with American electrical equipment for light and power. The contract for the motors—80 in number and varying from 5 hp to 50 hp—has been awarded to the Westinghouse Electric & Manufacturing Company, Limited. These machines will be direct-connected on three-wires. About half the motors will be run at variable speed for direct application to machine tools. The Western Electric Company took the contract for a 400-kw generator. These contracts were secured, notwithstanding that American manufacturers had to combat an import tariff of 25 per cent., the Canadian manufacturer of electrical machinery having quoted higher prices. The contracts for the machine tools, aggregating about $300,000, have been about equally divided between Canadian and American builders. John Bertram's Sons, of Dundas, Ont., which is the largest machine tool building concern in Canada, and represents the interests in that part of the world of several United States firms, secured a contract which will represent an expenditure not far short of $130,000. About two-thirds of these tools will be made after American models at the Bertrams' plant. The remainder will be built in the United States. The principal contract allotted to American concerns was awarded to the Niles-Bement-Pond Company, 136 Liberty Street, New York, for heavy locomotive building tools. The value of the contract is about the same as the Canadian one. The principal orders for the other tools went to Manning, Maxwell & Moore, 85 Liberty Street, and the Prentiss Tool & Supply Company, 115 Liberty Street, New York.

FEBRUARY EXPORT TRADE.—The export trade of the United States is rapidly resuming its normal conditions. February figures of the Bureau of Statistics show the largest exports of any February in the history of our commerce, and also show that the exports of the three months ending with February were larger than those of the corresponding period of any earlier year. On the import side the figures also show a continuation of the growth which has characterized the last two years, and the figures of the eight months ending with February suggest that the imports of the United States in the fiscal year 1903 may exceed a billion dollars, while the export figures seem likely to exceed one billion, four hundred millions. In the short month of February alone the exports amounted to $125,502,105, which is 12 millions in excess of any preceding February, and more than double the figures of February, 1893, in which month the total exports were $59,931,984. Taking the three months ending with February, 1903, the total exports are $407,526,200, against $215,151,471 in the three months ending with February, 1893. Thus, considering either the month of February or the three months ending with February, 1903, the total exports are not only larger than in that period of any preceding year, but practically double those of a decade ago.

SOME BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, through its New York offices, Mr. Paul Bigelow, manager, has secured a contract for a 375-hp compound condensing engine for direct connection to a 250-kw Westinghouse engine. This equipment is intended for lighting and power purposes in the new Staten Island structural material plant of Milliken Brothers. Two 225-hp Buckeye simple engines for belting to 150-kw generators have been ordered by the New York Mutual Gas Light Company, foot of East Eleventh Street, New York. A 175-hp simple engine for direct connection to a Bullock generator of 115 kw capacity has been requisitioned for power use in the New Haven (Conn.) plant of the Seamless Rubber Company. The Naugatuck (Conn.) Malleable Iron Company has sent in an order for a 375-hp cross-compound condensing engine for installation in the Wilmington (Del.) Malleable Iron Company's plant at Wilmington, Del. This will make the twenty-third order received by the Buckeye people from the same source. The E. M. Brown Paper Company's plant at Ballston, N. Y., is to be equipped with a 110-hp Buckeye simple engine to be belted to a generator.

BALL ENGINE ORDERS.—The Hull House, Chicago, is installing a direct connected unit, the engine being furnished by the Ball Engine Company, Erie, Pa., and the generator by the Western Electric Company. The Duquesne Brewing Company, Pittsburg, has installed a direct-connected unit of 125 hp, the Ball Engine Company furnishing the engine and the Westinghouse Electric & Manufacturing Company the generator. The Union Trust Co. Building, Baltimore, has recently placed in operation an 80-hp, direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine and the General Electric Company the generator. The Fayhall Mine, of the Minnesota Iron Company, Eveleth, Minn., will have an electric lighting plant of 100 hp, the engine being furnished by the Ball Engine Company.

THE ATLANTIC CITY & SUBURBAN TRACTION COMPANY is constructing a suburban electric railway extending from the famous Board Walk at Atlantic City to Pleasantville, N. J., from which place the road will branch in two direction, one leading to Absecon and the other to Somer's Point, a total distance of approximately eighteen miles. This road will operate twelve cars, each being equipped with four Westinghouse motors and five trail cars. The following electrical apparatus is also to be installed in the power house at Pleasantville: Two 400-kw, direct-current, Westinghouse railway generators, running at 550 volts and 125 r.p.m., together with a switchboard which will be of the standard Westinghouse railway type and consist of two generator panels, one load panel and four double-feeder panels.

THE WESTINGHOUSE AIR BRAKE COMPANY will at once begin the erection of a new foundry to be 320 ft. long by 65 ft. wide, and constructed of brick with steel frame. This foundry will be located just west of the present air brake works at Wilmerding, Pa., and has been made necessary by the greatly increased demand for castings used in the apparatus manufactured by this company. Owing to the development of the traction brake business, the Air Brake Company's present foundry facilities have been overtaxed for some time past and in order to insure greater efficiency in production and prompt delivery of material it has become necessary to provide greater capacity. This addition to the plant will materially increase the brake company's working force, now numbering about 3,000 men.

ANDERSON LINE MATERIAL ORDER.—The Albert and J. M. Anderson Company, Boston, Mass., through its New York offices, 135 Broadway, has secured a contract for the line material to be utilized in the construction of the Sheffield-Tuscumbia (Ala.) electric traction system, of which L. H. McIntire, at one time manager of the Savannah (Ga.) street railway system, is the consulting engineer, and whose office is in the Morris Building, New York. The Anderson Company has taken the order for the large switchboard, etc., to be installed in the Wall Street Exchange Building.

ELECTRICAL EQUIPMENT FOR NEW BRUNSWICK (N. J.) PLANT.—The plant of the Janeway Button Company, of New Brunswick, N. J., is to be electrically equipped, the contract having just been secured by the A. D. Granger Company, White Building, 95 Liberty Street. The initial installation will have a capacity of 120 hp. The engine will be of Corliss type and will be built by the Watts-Campbell Company, of Newark, N. J. The orders for the generator, etc., have not yet been let by the Granger Company.

ELECTRIC STORAGE BATTERY.—A director of the Electric Storage Battery Company states that the annual report to be presented to stockholders will show a considerable increase in earnings over the previous year, and heavier gains for the months of January and February, 1903, against last year January and February.

MORE UNITED STATES EQUIPMENT FOR CANADA.—The Montreal (Can.) Terminal Railway Company has awarded a contract to the C. & C. Electric Company, 143 Liberty Street, New York, for the supply of two railway generators of 200 kw capacity each.

General News.

THE TELEPHONE.

DENVER, COL.—The Citizens' Automatic Telephone Company, capital $500,000, has been incorporated by J. C. Shields, F. F. Castello, A. T. Gunnell and others.

BARNESVILLE, GA.—The sale of the Barnesville telephone exchange to the Southern Bell Telephone Company has been confirmed before a referee.

GRAYMONT, ILL.—The Friendship Telephone Company has incorporated with a capital of $2,500.

MANLIUS, ILL.—The Bureau County Mutual Telephone Company, with a capital stock of $2,500, has been incorporated by J. J. Stauffer, Ben Monson and A. L. Martin.

CHICAGO, ILL.—The Central Illinois Telephone & Telegraph Company has been incorporated at Jersey City, N. J., with a capital stock of $500,000. The capital in Illinois is $50,000.

LINCOLN, ILL.—The stockholders of the Lincoln Mutual Telephone Company have decided to accept the offer of the Central Illinois Telephone & Telegraph Company to assume the bonded and floating indebtedness of the former concern, pay the stockholders $100 a share and guarantee existing rates for a period of five years, which are $12 for residences and $24 for offices and business places.

THORNTON, IND.—The Thornton Telephone Company has increased its capital stock from $2,500 to $6,000. Wm. Brenton is president and G. Lyster, secretary.

WINCHESTER, IND.—The Winchester Telephone Company has increased its capital stock from $2,750 to $25,000. The company will make improvements and extensions.

SWEETSER, IND.—The Sweetser Telephone Company has filed articles of incorporation. Capital stock $10,000. James E. Carry, F. H. Stephens, James Dooley are interested.

CLAY CITY, IND.—It is stated that the Bell Telephone Company, which put in its service in this city two years ago in opposition to the Home Telephone Company, has discontinued its service, having lost $4,000 in the venture.

ANDERSON, IND.—The Anderson and Fall Creek Telephone Company has filed articles of incorporation, with a capital stock of $14,000. Winfield Scott, of Anderson, and Harry Welz, of Pendleton, are president and secretary respectively.

WARSAW, IND.—The Home Mutual Telephone Company, of Stoney Point, Kosciusko County, has filed articles of incorporation. Capital $10,000. Joel Hall, of Warsaw, W. B. Anglin, Alonzo Bucket and Z. T. Byers, of Etna Green, are the directors.

LOGANSPORT, IND.—The county commissioners have granted a franchise to the Burrows Telephone Company to construct and operate an independent line in Cass County. The company recently incorporated with a capital stock of $8,000. It will do a farm and village business.

INDIANAPOLIS, IND.—The Bell Mutual Telephone Company has filed articles of incorporation with a capital stock of $400,000. H. S. Offenback, Robert E. Bell and Asa Hamilton are the incorporators. The company will construct lines and operate in Marion, Hancock and Hamilton Counties.

PATRIOT, IND.—The Posey Mutual Telephone Company has filed articles of incorporation with a capital stock of $25,000. The company will construct and operate telephone exchanges and telephone lines in the counties of Switzerland and Ohio. Edwin R. Mead, Elmer Palmer, and H. S. Humphrey are directors.

WAKARUSA, IND.—The St. Joseph Union Telephone Company has filed articles of incorporation, with a capital stock of $10,000. The company will establish exchanges at Claudville and Wakarusa, construct and operate lines in St. Joseph and contiguous counties. E. L. David Bizar, A. T. Gocker, Wakarusa, and C. B. Nettrow, Claudville, are the incorporators.

FISHER'S STATION, IND.—Articles of incorporation have been filed by the Fisher's Station and Oaklandon Telephone Company. The capital stock is $4,000. The company proposes to establish exchanges at Fisher's Station and Oaklandon, and will erect and operate lines extending into Marion and Hamilton counties. Jonathan Conkle, Bert Klepfer, of Oaklandon, and John R. Hoss, Abraham S. Neaver, of Fisher's Station, are the incorporators.

IRETON, IA.—The Ireton Local Mutual Telephone Company has secured a franchise in this place.

DES MOINES, IA.—The Manley Telephone Company has been incorporated with a capital stock of $10,000. Mr. Parker is president and P. A. Bryant, secretary.

AUBURN, KY.—Herschell Helm, of Morgantown, has bought the exchange at Auburn formerly owned by Blakely Helm. The system will be improved.

BILLINGS, MONT.—The stockholders of the Montana-Wyoming Telephone Company will meet here next month to increase the capitalization from $40,000 to $100,000 for the purpose of raising necessary capital to make needed improvements.

PENN YAN, N. Y.—The Torrey Telephone Company, capital $5,000, has been incorporated by F. E. Spencer, E. B. Thayer and E. C. Gilbert.

CANANDAIGUA, N. Y.—The Ontario & Steuben Telephone Company will build a trunk line from Naples to Bath with a branch to Wayland and will increase its capital to $25,000.

NEW YORK, N. Y.—The Astor House, the Fifth Avenue Hotel and the Hotel Grenoble are being equipped throughout with Bell Long Distance telephone service. Two hundred and seventy-five stations are being installed at the Astor House; 360 stations at the Fifth Avenue, and 100 stations at the Hotel Grenoble.

GASTONIA, N. C.—The Piedmont Telephone Company, Gastonia, now operates telephones in 23 towns. The recently purchased exchange at Shelby, N. C., will be rebuilt. A long distance line from Lincolnton to Asheville, N. C., will also be built.

CAREY, OHIO.—The Carey Electric Telephone Company has increased its capital stock from $6,000 to $25,000 and will make important extensions. H. I. Graves is president of the company.

APPLE CREEK, OHIO.—The Franklin Union Telephone Company has been incorporated, with $1,500 capital stock, by Frank E. Beazell, A. D. Eyman, J. E. Franks, J. W. Tate and others.

LOGAN, OHIO.—The Citizens Telephone Company, of Logan County, has been purchased by W. H. Fledderjohann and A. Van Gordon. The system will be extended and will be known as the Logan Home Telephone Company.

WARREN, OHIO.—The directors of the Madison Telephone Company have decided to expend $10,000 in extending its lines in Lake and Ashtabula counties. Important improvements will be made in the Geneva and Madison exchange.

POINT ROCK, OHIO.—The Point Rock & Wilkesville Independent Telephone Company has been incorporated, with a capital stock of $4,000, by J. L. Westfall, George Barnes, E. H. Fletcher, W. R. Trainer and Walter Cooper.

PHALANX, OHIO.—The Phalanx-Leavittsburg Telephone Company has been incorporated, with $5,000 capital stock, by W. O. Chaffee, C. F. Ivers, C. J. Rood, D. H. Leiby and others. It will build a line from Leavittsburg to Phalanx.

CLEVELAND, OHIO.—Members of the Everett-Moore syndicate deny that there is any truth in the report recently sent out from Pittsburg, to the effect that the Elkins-Widener syndicate had purchased the United States Telephone Company.

DEERFIELD, OHIO.—The North Benton-Deerfield Telephone Company, of Mahoning County, has been incorporated, with $1,000 capital stock, by A. R. Cobbs, G. B. Kinsey, C. W. Hartzell, E. E. Walker, L. F. Pearce and others.

HARPERSFIELD, OHIO.—Farmers in the vicinity of Harpersfield have decided to incorporate the Harpersfield Home Telephone Company. About fifty telephones have been connected to a central station at Cork. The system will be extended throughout the district.

SANDUSKY, OHIO.—The Sandusky Telephone Company now has 1,100 subscribers as compared with 670 for the established Bell Company. This year's business will show a surplus for stock of about 11 per cent. Rates are $18 for residences and $30 for business.

CINCINNATI, OHIO.—The independent telephone people have made a long step towards entrance into Cincinnati. The United States Telephone Company has perfected an arrangement with the Miami & Erie Canal Transportation Company whereby its lines will be extended into Cincinnati on the poles of the canal company.

LIMA, OHIO.—The Lima Telephone Company has issued $75,000 worth of preferred stock which has been taken up by present stockholders at 80. The money derived will be used to enlarge the switchboard and install 500 new telephones in Allen County. At present the company has 1,087 telephones in operation. E. J. Cable is president of the company.

TOLEDO, OHIO.—The Toledo Home Telephone Company at its annual meeting will vote to spend $30,000 on new cable and an extension to the switchboard. The company is now serving 6,000 subscribers and is growing rapidly. General Manager Hamlin denies the truth of the report that the company contemplates an immediate increase in rates.

ZANESVILLE, OHIO.—The Zanesville Telephone Company, one of the subsidiary companies controlled by the Federal Telephone Company, has elected these directors: F. S. Dickson, W. L. Carey, J. B. Hoge, Maxime Reber, H. A. Sharp, S. M. Granger, J. B. Rhodes and W. C. Handschy. The company will make extensive improvements, material for 1,000 additional telephones having been contracted for. Exchanges will be installed in the nearby towns.

HOOD RIVER, ORE.—The Rural Telephone Company, of Hood River, has been incorporated, with a capital stock of $10,000, by J. H. Shoemaker, James T. Shaw and W. B. Johnson.

MONTREAL, QUE.—At the annual general meeting of the shareholders of the Bell Telephone Company of Canada, held in Montreal, the report of the directors showed that 5,623 new subscribers were added during the year, the total number of sets of instruments now earning rental being 48,481. The company now owns and operates 377 exchanges and 553 agencies. Over 2,655 miles of wire have been added to the long distance system in 1902. The long distance lines now owned and operated by the company comprise 26,848 miles of wire on 6,991 miles of poles. There were $250,000 worth of 5 per cent bonds sold during the past year, the premium on which amounted to $22,809. All the retiring officers were re-elected.

EAGLEVILLE, TENN.—The Cumberland Telephone Company contemplates installing an exchange at Eagleville.

SPARTA, TENN.—The Gainesville Telephone Company, with headquarters at Sparta, will extend its lines to a number of towns connecting with the Cumberland Telephone Company at Stanford, Ky.

GREENVILLE, TENN.—A meeting of representatives of the independent telephone lines of Greenville was held to consider consolidating and unless suitable arrangements are concluded with the Cumberland Company it is proposed to unite and establish a central station in Greenville.

MONROE, WIS.—The Brodhead Telephone Company has increased its capital stock from $5,000 to $15,000 for the purpose of extending its system. A dividend of 5 per cent. was paid.

ELECTRIC LIGHT AND POWER.

HUNTSVILLE, ALA.—A bill has been passed by the State Legislature granting this city permission to issue $10,000 bonds for an electric light plant.

NEW DECATUR, ALA.—It is reported that the Decatur Light, Power & Fuel Company will soon make extensive improvements to its electric light and gas plants here.

BIRMINGHAM, ALA.—The Judiciary Committee of the City Council has recommended that T. H. Aldrich, representing the Birmingham District Coal, Light & Power Company, be granted a franchise for an electric light and gas plant.

DE QUEEN, ARK.—The De Queen Light, Ice and Cold Storage Company has been incorporated with a capital stock of $30,000. J. S. Lake is president, Frank Ogden, vice-president, I. O. Bunyon, secretary and treasurer.

QUEBEC, CAN.—There is at present every indication that the Quebec & Jacques Cartier Electric Power Company and the Quebec Railway, Light & Power Company will soon be amalgamated. The stock of the former company is controlled by American capitalists, while the latter is owned and managed by a number of Quebec citizens. The Quebec & Jacques Cartier Electric Power Company has made an offer to purchase the interests of the other company, but without success. Recently negotiations were entered into with a view to amalgamate the two companies, and are still in progress.

ATLANTA, GA.—The council committee on lights will immediately advertise for bids for furnishing the city with electric lights. It is believed that the proposal of J. Frank Lester to build a combined crematory and lighting plant will, however, be adopted.

QUINCY, ILL.—The Independent Light & Power Company has been incorporated with a capital of $200,000. Incorporators: J. W. Cassidy, C. E. Mead and L. P. Wheeler.

BLOOMINGTON, IND.—The legislature has appropriated $20,000 for a lighting and heating plant for the State University.

HARTFORD CITY, IND.—This city having tired of municipal ownership and its failures, has sold its electric light plant to Chicago capitalists, headed by George Mayer, who will improve and enlarge the plant.

INDIANAPOLIS, IND.—A bill has passed the legislature authorizing the city of Indianapolis to make long-term contracts for electric light. This will enable companies to bid on the new contract to be let in July.

LEWIS, IA.—Daniel Stevens has petitioned for an electric light franchise.

ODEBOLT, IA.—The Odebolt Lighting & Heating Company has been incorporated with a capital of $12,000. Jos. Mattes is president and E. W. Lester, secretary.

GUTHRIE CENTER, IA.—The Guthrie Center Electric Light Company has been incorporated, with a capital of $15,000, by W. F. Moore, C. G. Trent, Sr., Alex. H. Grisell and others.

CROWLEY, LA.—It was voted March 5 to issue $100,000 bonds for an electric light plant and water works.

MERRIMAC, MASS.—A committee has been appointed to investigate the cost, etc., of installing water works and an electric light plant. Probably only preliminary work will be done this year.

SCHOOLCRAFT, MICH.—The citizens voted on March 9 to issue bonds for the construction of an electric light plant. J. W. Budrow is the village clerk.

DEXTER, MICH.—It was voted March 9 to issue $8,000 bonds for an electric light plant. J. W. Barley is clerk.

MANKATO, MINN.—W. I. Gray, of Minneapolis, has been selected to prepare plans for a municipal electric light plant.

SOUTH STILLWATER, MINN.—The question of issuing $20,000 bonds for an electric light plant will probably be submitted at the next election.

NATCHEZ, MISS.—The Natchez Gaslight Company has been indirectly absorbed by the Electric Street Railway Company, $100,000 being involved.

COLLINS, MISS.—The Collins Light & Power Company, of Collins, has been incorporated with a capital of $10,000. Incorporators: W. E. Payne, H. Swinney and others.

LITTLETON, N. H.—The house has passed a bill authorizing the town to establish or acquire an electric light plant and water works.

BINGHAMTON, N. Y.—Aldermen Fetherolf, Stephenson and Hewett have been appointed a committee to investigate the question of municipal ownership of an electric light plant.

BUFFALO, N. Y.—The Lamp Committee of the Board of Aldermen recommends that the Commission of Public Works be authorized to enter into a 5-year contract with the Buffalo General Electric Company, which offers to furnish 4,000 lamps at $70 per lamp per year. If the city accepts this offer, electric light will be substituted for gas light throughout the city.

SCOTLAND NECK, N. C.—The town of Scotland Neck has voted bonds for electric lights. Dr. J. E. Shields is mayor.

CHARLOTTE, N. C.—The Highland Park Mfg. Co., of Charlotte, will erect a $100,000 electric plant to operate a new $500,000 cotton mill. Two thousand horse-power will be developed.

ELIZABETH CITY, N. C.—A charter has been granted to the Elizabeth City Light & Power Company, which has a capital of $100,000, and the Elizabeth City Water & Power Company, with a capital of $100,000. The incorporators of both companies are David B. Banks and M. W. Offut, of Baltimore, Md., and C. M. Ferebee, of Elizabeth City.

FOSTORIA, OHIO.—W. T. Mills, of Columbus, is said to be preparing plans for an electric light plant.

TOLEDO, OHIO.—The Toledo & Interurban Railway Company is to be incorporated under the laws of Ohio to build a line from Pioneer to Goshen, Ind.

MEDINA, OHIO.—The plant and business of the Medina Electric Light & Power Company has been sold to a Cleveland company. Improvements will be made.

BARBERTON, OHIO.—The Barberton Inn Company is securing estimates on a 1,000-light plant to furnish light for the hotel and neighboring business blocks in Barberton.

GALLIPOLIS, OHIO.—The Gallipolis Electric Light Company has increased its capital stock from $10,000 to $40,000 and will make improvements. J. H. Moxon is general manager.

LOUISVILLE, OHIO.—The Louisville council has made a contract with the Canton Light, Heat & Power Company, of Canton, for 25 arc lamps at the rate of $60, on a moonlight schedule.

COLUMBUS, OHIO.—The city clerk has been instructed to advertise for bids on wire, poles and fixtures for the municipal lighting plant, in accordance with specifications provided by the Director of Public Improvements.

LEESBURG, OHIO.—The Leesburg Manufacturing, Light & Power Company has been incorporated, with $25,000 capital stock, by R. P. Barrett, W. E. Dibble, H. A. Leeson and others. They will erect a lighting plant.

STRUTHERS, OHIO.—The town is negotiating with several lighting concerns for electric light. Prominent local people stand ready, if given a franchise, to construct an electric light plant which shall be owned by local capital.

COLUMBUS, OHIO.—The Indianola Heating & Lighting Company is preparing to erect its plant on King Avenue. The plant will have a capacity of about 1,000 hp and will furnish steam heat as well as light throughout a large portion of the residence district of Columbus.

STROUDSBURG, PA.—It is stated that the Monroe County Water Power & Supply Company, recently chartered, will begin at once the erection of a plant, to cost $75,000. Jos. H. Schull is president.

PERKASIE, PA.—It is proposed to purchase an engine and dynamo for the electric light plant. H. B. Scheetz is clerk of the council.

EASTON, PA.—Cramp, Mitchell & Serrill, bankers of Philadelphia, are stated to have purchased a controlling interest in the gas and electric properties of Easton and Phillipsburg, N. J., and intend to consolidate them.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company is reported to have acquired privileges held by M. P. Davis for water power from the Soulanges Canal. This will supply 40,000 horse-power.

SUMPTER, S. C.—The Sumpter Ice, Light and Power Company, capital $70,000, has been chartered by Chas. T. Mason and Perry Moses.

UNION, S. C.—It is stated that a large water power plant will be established on the Broad River at Neal's Shoal, twelve miles from this place, by Mr. T. C. Duncan, president of the Union Cotton Mills, and others. It is the purpose of this enterprise to supply electrical energy for the mills, and the surrounding towns with electric light. It is also likely that a trolley line will be constructed.

MEMPHIS, TENN.—It is stated that the Memphis Electric Light & Power Company will expend about $125,000 in improvements.

CHATTANOOGA, TENN.—The Chattanooga Light and Power Company has been reorganized with $750,000 capital. Improvements involving about $300,000, including a large new building, are being inaugurated.

AUSTIN, TEX.—It is reported to be the purpose of the Austin Light, Heat and Power Company, recently incorporated under the laws of Delaware with a capital of $2,500,000, to rebuild the great dam across Colorado River, at Austin, and to supply the city and private concerns with light, heat and power. The incorporators are Edw. C. Dowling and Harry U. Spence, of Brooklyn, N. Y., and Milard H. France, of New York City, N. Y.

SPRING CITY, UTAH.—An electric light plant is to be installed here in the spring by the Spring City Mill Company.

PARKERSBURG, W. VA.—V. B. Archer, one of the chief promoters of the Parkersburg & Ohio Valley Electric Railway, claims that his company has been financed to the extent of $1,500,000 and will build from Williamstown to Moundsville.

CHARLESTOWN, W. VA.—Stephen B. Elkins, Chas. Swisher and others are reported to have purchased the gas, water and electric light plants at Charlestown and will operate them from a single power station under the name of the Kanawha Water & Light Company. The capital stock of the new company is $600,000.

RICE LAKE, WIS.—The citizens have voted to issue $32,000 bonds to purchase the electric light plant and water works.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—It is said that the Huntsville Railway, Light & Power Company has decided to extend its lines.

SANTA ANA, CAL.—The Santa Ana & Newport Beach Electric Railroad has applied to the Council for a franchise.

WATSONVILLE, CAL.—The Watsonville Transportation Company has been incorporated, with a capital stock of $1,000,000. F. A. Kilburn, R. W. Eaton and H. H. Main are among the incorporators of the company.

HARTFORD, CONN.—The Senate has passed the bill granting a charter to the Naugatuck Valley Railway Company.

NORWICH, CONN.—It is reported that the Worcester & Connecticut Eastern Railway Company will this summer begin the construction of an electric railway between Norwich and Jewett City.

ST. ELMO, ILL.—The St. Louis & Eastern Electric Railway is seeking incorporation. Johnston Brothers, of St. Elmo, are interested.

DIXON, ILL.—The City Council has granted a franchise to G. H. T. Shaw to build an electric railway into the city from DeKalb and Lee Center.

QUINCY, ILL.—E. H. Arnold, chief engineer of the Quincy & Western Illinois Electric Railway Company, has opened offices in the Wells Building and the announcement is made that final arrangements are to be made at once for building the company's proposed lines. Bracey, Howard & Company have the contract for building.

INDIANAPOLIS, IND.—A bill has been introduced in the Senate to require interurban railway companies to employ train dispatchers.

SIOUX CITY, IA.—It is understood that the new owners of the Sioux City Traction Company plan to rebuild the entire system of the company.

LOUISVILLE, KY.—The Fiscal Court has adopted a resolution providing for the sale of a franchise for an electric railway to Valley Station and River View. The upset price is $500 per mile. It is said that a company is being organized to bid in the franchise.

LOUISVILLE, KY.—The stockholders of the Louisville Interurban Railway which will run between Louisville and Mt. Washington have organized. Mr. Charles Doherty was chosen president and John Russell, vice-president. The board authorized an increase of $100,000 in the capital stock, making it $500,000.

NEW ORLEANS, LA.—The Southern Light & Traction Company, of New Orleans, has been incorporated, with a capital stock of $500,000, to build electric railways and power plants in the interior towns of Louisiana and Mississippi. The officers are: Sol. Wesler, president; J. H. Ingwerson, vice-president; G. H. Hovey, secretary; R. J. Kennedy, treasurer.

CHERRYFIELD, ME.—Application has been made to the Legislature for the incorporation of the Cherryfield & Millbridge Street Railway Company, with a capital not exceeding $100,000. E. R. Wilson, of Cherryfield, and George A. Sawyer, of Millbridge, are interested.

WINNIPEG, MAN.—The Winnipeg Street Railway Company plans to build several extensions within the city during the summer.

CHESAPEAKE BEACH, MD.—Announcement is made of the sale of the Chesapeake Beach Railway to David H. Moffat, of Denver.

FREDERICK, MD.—It is announced that the Baltimore & Frederick Electric Railway Company has awarded the Westinghouse Company a $400,000 contract for equipment. The plan of the company is to build from Baltimore to Frederick, a distance of about 45 miles.

ATTLEBORO, MASS.—The selectmen have granted a franchise to the Attleboro & Mansfield Street Railway Company.

WORCESTER, MASS.—The Blackstone Valley Street Railway Company is considering the advisability of extending its line through Northbridge to South Sutton, Mauchaug and East Douglas.

FALL RIVER, MASS.—It is stated that a deal has been closed by the Old Colony Street Railway Company for the purchase of a large tract of land on which it is proposed to erect a new power plant.

MUSKEGON, MICH.—The Muskegon Traction & Lighting Company has increased its capital stock from $600,000 to $700,000.

LAPEER, MICH.—The Council has declared forfeited the franchise granted in 1900 to the Detroit, Lapeer & North Branch Electric Railway Company.

JEFFERSON CITY, MO.—The Senate has passed a bill declaring that electric railways in Missouri are common carriers, and placing them under the jurisdiction of the State Railway and Warehouse Commission.

TRENTON, N. J.—The Trenton, Lakewood and Atlantic Traction Company, with a capital of $1,000,000, has been chartered. The road will run from Trenton to Lakewood. The incorporators are George O. Vanderbilt and Albert D. Cook, of Princeton, Thomas P. Allen, Joseph H. Allen, Peter Schlichner, William Allfuther and Richard N. Page, of Trenton, William B. Wills, of Mount Holly, Abel B. Haring and William H. Martin, of Frenchtown, Jacob Wyckoff, of Princeton Junction, James C. Robbins, of Hamilton Square, and Albert T. Eckles, of Milford.

RIVERHEAD, L. I., N. Y.—The plan to build an electric railway to connect Riverhead, Quogue and other south side villages on the east end of the island has been revived. Wm. J. Martin and Joseph Martin are said to be interested.

ROCHESTER, N. Y.—It is understood that the Rochester & Eastern Rapid Railway Company, which now has under construction an electric railway from Rochester to Canandaigua, is negotiating for the purchase of the property and rights of the Ontario Light & Traction Company and the Canandaigua Gas Company.

NEW YORK, N. Y.—The United States Senate has passed the bill granting to the New York & Jersey Railroad Company the right to construct and operate an underground railway under and along Greenwich Street, New York, past the block bounded by Greenwich, Christopher, Washington and Barrows Streets, owned by the United States.

JAMAICA, L. I., N. Y.—The South Shore Traction Company has just been incorporated with a capital stock of $2,000,000 to build an electric railway sixty miles in length in Suffolk and Nassau Counties. The directors of the company are L. Lee Slingluff, of Baltimore, Md.; Arthur C. Hume, James A. Hawes, S. B. Thompson and C. G. Perot, of New York, F. D. Schaffer, of Hamilton, Ohio; Samuel Worthington, of Kearny, N. J.; Edward Phillips, of Brooklyn; and Chas. Hall Davis, of Petersburg, Va.

CLEARFIELD, PA.—The Centre & Clearfield Street Railway Company has organized as follows: J. G. Platt, president; O. L. Schoonover, vice-president; James Passmore, treasurer; H. B. Hartswick, secretary; James Passmore, Jacob Swires, A. J. Graham, George W. Hawtorp, C. E. Murray, J. H. Turnbach, John G. Platt, C. H. Rowland, H. M. Hughes and O. L. Schoonover, directors.

CELINA, OHIO.—Officials of the People's Rapid Transit Company which proposes to build from Toledo to Greenville, have agreed to locate the power plant at Celina.

CANTON, OHIO.—The directors of the Canton-Akron Railway Company have decided to increase the capital stock of the company for the purpose of making improvements.

URBANA, OHIO.—An ordinance is before the city council to grant permission for a street railway system to bring in a transmission circuit operating at 26,000 volts from a power station 25 miles away; the sub-station being in the center of the city.

CINCINNATI, OHIO.—Henry W. Huggins is the promoter of a new electric railway to extend from Maysville, Ky., through Georgetown and Ripley to Hillsboro, Ohio, where connection will be made with the Cincinnati & Columbus Traction Company for Columbus.

KENTON, OHIO.—The Kenton & Southern Traction Company has been organized, with J. S. Harshman, Springfield, president; R. Emery, Columbus, vice-president and secretary; S. D. McGomery, secretary. The capital stock is $600,000, with bonds for the same amount.

CLEVELAND, OHIO.—It is reported on very good authority that the Pomeroy-Mandelbaum syndicate will soon consummate a deal whereby it will obtain control of the Toledo, Fostoria & Findlay Railway, furnishing the desired Toledo connection for its Cincinnati to Toledo line.

CLEVELAND, OHIO.—The consolidation of the Ohio Central Traction Company with the property of the Mansfield, Crestline & Galion Railway pool has been effected. Officers have been elected as follows: F. T. Pomeroy, president; L. M. Coe, vice-president; M. J. Mandelbaum, second vice-president; L. M. Wolf, secretary-treasurer. The above, with F. D. Carpenter, F. L. Fuller and H. C. Lang, are directors.

SHAWNEE, OKLA.—Plans are being discussed for building an electric railway from Shawnee to Tecumseh. Wm. Edwards is said to be interested.

TORONTO, ONT.—H. B. Giveren, of Ottawa, is applying to the Dominion Parliament for a charter for another electric railway between Toronto and Hamilton.

OTTAWA, ONT.—The annual report of the Canadian department of railways and canals has been issued, and in respect to electric railways in the Dominion it shows that there were on June 30, 1902, 558 miles of electric railway completed. The paid-up capital amounted to $41,593,063, of which the municipal aid amounted to $173,000. The gross earnings aggregated $6,486,438, an increase of $718,155, and the working expenses $3,802,855, leaving net earnings of $2,683,583. The number of passengers carried was 137,681,402, an increase of 16,744,746, and the freight carried amounted to 266.182 tons, a decrease of 21,744 tons. Electric power was supplied in thirteen cases by water, and in twenty-seven cases by steam. Ontario has 334 miles of electric railway; Quebec, 140; New Brunswick, 12; Manitoba, 13, and British Columbia, 45 miles. One company has ceased operation.

PROVIDENCE, R. I.—The Pascoag & Providence Street Railway Company is seeking incorporation. Samuel Mellor, of Gloucester, and Nicolas S. Winsor, of Greenville, are interested.

PERSONAL.

DR. F. A. WOLFF, of the National Bureau of Standards, Washington, is to discuss "Modern Methods of Electrical Standardizing" before the Franklin Institute, on March 26.

MR. C. O. MAILLOUX is lecturing this spring before Harvard and Lehigh Universities on the subject of train resistance, of which, as is well known, he has made a special study.

MR. ROBERT WATSON, patent lawyer and solicitor in Washington, has removed his offices in that city to the McGill Building, 908 G Street, where he will be glad to see old electrical friends and acquaintances.

MR. R. J. HEWETT, of St. Louis, has taken service with the Hall Signal Company, New York. Mr. Hewett has for a number of years been connected with the telegraph department of the Missouri Pacific Railway Company.

MR. C. J. FIELD has returned to the conduit field and is again handling vitrified and glazed clay conduits, as the sole agent of two large factories "outside the combination," with headquarters at 29 Broadway, New York.

MR. CHARLES M. SCHWAB, president of the U. S. Steel Corporation, has given the Automobile Club of America sufficient steel plates to lay nearly a mile of track, to test the adaptability of a steel plate roadway for automobiling.

MAYOR SETH LOW, on March 14, drove the first spike in the rails of the New York Subway road. It was a silver spike which will be preserved and given to the mayor with an inscription. The scene was the Columbus Circle station at West Fifty-ninth Street.

MR. B. B. WHITE, formerly superintendent of the city of Thomaston lighting and power plant, is now superintendent of the city of Starke, Fla., electric light and water plant, where he hopes to enhance his record as an electrical and mechanical engineer.

MR. W. W. BRADFIELD, the engineer in charge of the Marconi wireless telegraph installations in the United States, sailed last Saturday on the *Umbria* for England, to complete arrangements for an extensive system of wireless telegraphy in this country.

MR. JAMES G. BIDDLE has removed his offices from the Stephen Girard Building to Rooms 60 and 62, 1114 Chestnut St., Philadelphia, where he will have better accommodations than heretofore for giving proper attention to his business in high grade electrical measuring instruments.

MR. GUY W. HINTON, who has been for some time connected with the New York office of the H. W. Johns-Manville Co., has been recently appointed auditor of that Company, the branches of which are located in Milwaukee, Chicago, St. Louis, Pittsburg, New Orleans, Cleveland, Boston and Philadelphia.

MR. CHAS. S. PROSSER has been appointed general sales agent of the Peerless Rubber Manufacturing Company, New York City. Mr. Prosser is fully qualified for such a position, having been five years in the factory, and five years as traveling salesman for the Peerless Rubber Manufacturing Company.

MR. HENRY NOYES, of the Australian electrical engineering and contracting firm of Noyes Brothers, Sydney and Melbourne, which represents the Westinghouse, Bell, Niles-Bement-Pond and other prominent American manufacturing concerns in that part of the world, sailed Saturday last for Europe after a short visit to the United States.

MESSRS. J. H. VAN DEN W. BAKE and W. C. Muhlhaus, Jr., of Amsterdam, Holland, are visiting this country with respect to export trade in electrical apparatus from the U. S. A. to the Low Countries. They expect to spend about six weeks in America, and are now staying at the Hoffman House. They will shortly make a Western trip.

MR. CHARLES A. BROWN, of Chicago, was the patent counsel in the recent split phase suits won by the Diamond Meter Company, and has received many congratulations upon his work and success in this difficult litigation, directed nominally against the Catskill Illuminating & Power Company, but aimed in reality at the Scheeter meter.

MR. A. F. BRANDT, who for some years past has been representing the Allgemeine Electric Company, of Germany, in Japan, China, etc., is now on his way home, passing through the United States. He is now in New York City looking up recent central station work, etc., and expects to sail for Germany about March 24, after a trip to Washington, etc.

MR. C. E. LEFEBVRE, at one time identified with electrical interests in the East, is now manager for the Engineering & Equipment Company, Bissell Block, Pittsburgh, Pa., conducting their business in supplies, construction and engineering in electrical and mechanical lines. Catalogues, printed matter, etc., for him are requested to be sent to the company endorsed "Department S."

MR. JOHN DAVIDSON, who has for some time been connected with the Germania Electrical Lamp Company, of New Jersey, has severed his connections with them and associated himself with the Sterling Electrical Mfg. Company, of Warren, Ohio, manufacturers of the Sterling incandescent lamps. Mr. Davidson operates from the New York office of this company, No. 26 Cortlandt Street, New York City.

DR. R. M. WALMSLEY, principal of the Northampton Institute, London, who is already well known in American electrical circles, is visiting the United States to study the development of technical education and of the electrical art since his last visit. Dr. Walmsley is accompanied by his sister, Miss Walmsley, who is also prominently identified with English educational work. They will probably go as far as Canada and Chicago.

MR. F. W. STILLWELL, of Scranton, Pa., is reported at Richmond, Va., dangerously ill from ptomaine poisoning. Mr. Stillwell is a brother of L. B. Stillwell, the consulting engineer, and went to Richmond to inspect the proposed improvements and additions to the Virginia Passenger and Power Plants for Frank J. Gould. After inspecting the properties, the party intended leaving for a Southern trip, but were prevented by the sudden development of illness.

MR. E. F. SCHURIG is well known as the city electrician of Omaha, Neb. The lack of appreciation felt for the services of such an important official in so large a city is shown by the fact that the Omaha charter bill introduced recently in the Nebraska legislature reduces the salary of the office from $1,800 to $1,500 a year. The higher salary was too low as it was, and it is hard to see how it is expected to secure and retain competent electrical engineers at such rates. No better way could be hit upon to impair the efficiency of incumbents of the position.

MR. CARL SNYDER.—Some time ago Mr. Snyder, a young American scientist, stirred up discussion by an article upon the inferiority of the American position in science. Since then he has been the exponent of vigorous and aggressive theories in scientific matters. This spring he will publish through Harper & Bros. "New Conceptions of Science," a volume designated to give the layman a chance to keep pace with scientific progress. Mr. Snyder is very deeply interested in electrical matters and proposes to make two or three leading inventions in new fields, if his ideas prove tenable.

MR. H. T. HARTMAN, of Philadelphia, has been asked by President Ferguson to take charge of the Question Box for the twenty-sixth convention of the National Electric Light Association, and has kindly consented to do so. It is hoped to make this a very prominent feature of the convention programme. The desirability of all members contributing both questions and answers at an early date need not be emphasized. The success and utility of the Question Box last year was remarkable, and it is believed that Mr. Hartman's intelligent efforts this year will elicit a great variety of valuable information.

MR. W. C. GOTSHALL, president of the New York & Portchester road, which has just received a decision confirming its charter granted by the railroad commission of New York, says: "This, of course, is only the beginning of a mass of legal work which has to be accomplished before we begin the actual construction work next June. Our present capitalization, which was only a temporary one, is $250,000. We intend shortly to make an application to increase this to $16,000,000, the actual value of our road when completed. Almost the entire right of way from New York to Portchester has been purchased, and we are only waiting till we are through with our preliminary legal work. Negotiations are now under way between us and the Subway people for a traffic understanding."

MR. JOHN I. SABIN, president of the Chicago Telephone Company and the Central Union Telephone Company, who went to Chicago two years ago from the Pacific States, announced at the directors' meeting, March 13, his unwillingness to serve as president of these companies any longer than is strictly necessary. He wishes to return to San Francisco. Mr. Sabin consented to serve until a successor could be selected and the affairs of the president's office are turned over to the new man. During Mr. Sabin's administration there has been an enormous expansion of the business of both companies of which he is president. In fact, the Bell interests in the Central States have been very much rejuvenated. The capital investment has been increased and the growth in revenue and subscriptions has been very large. In fact, the companies have been taxed to take care of the business offered.

MR. LLOYD MARSHALL has been appointented Superintendent of Electrical Machinery in the Department of Electricity of the Louisiana Purchase Exposition. The electrical and engineering training which Mr. Marshall has received has well fitted him for the work he has now undertaken. After graduating from the school of electrical engineering of Purdue University in 1895, he was retained as assistant in the electrical laboratory. Later he accepted the position of electrical editor of the *Street Railway Review*, of Chicago, and, during the period of this connection, from 1896 to 1898, he served as secretary of the Chicago Electrical Association. Mr. Marshall for two years held the position of designing and testing engineer for the Jenney Electric Manufacturing Company, and then took up experimental work for the Railway Materials Company, of Chicago. In 1901 he accepted the position of plant engineer, and, later, of engineer of the sales department of the C. W. Hunt Company, of New York. The latter position he has just resigned to accept the appointment of the World's Fair Directors.

NEW INDUSTRIAL COMPANIES.

THE OHIO TIE COMPANY has been incorporated at Lucasville, Ohio, with $12,000 capital stock, by C. A. Little and others. The company will manufacture railway ties and timber.

THE AMERICAN MINIATURE AND DECORATIVE LAMP COMPANY has been incorporated with a capital of $100,000. The directors are H. J. Jaeger, C. Hubert and Samuel Stern, of New York City.

THE UNITED ELECTRIC COMPANY has been organized in Detroit, Mich., to manufacture electrical appliances. The capital stock is $100,000. Among the names of those interested are A. H. Gaukler, Robert Kuhn.

THE SCHLICHT COAL SAVING COMPANY, of Greenport, L. I., N. Y., with a capital stock of $100,000, has been incorporated. Among the directors are L. L. Lewis, V. P. Donihee and R. H. Jaeger, of New York City.

THE AMPERE ELECTRO-CHEMICAL COMPANY, of Portchester, N. Y., has been incorporated, the capital stock being $200,000. Messrs. H. C. Mortimer, Jr., and C. W. Barnaby, of New York, and W. H. Miller, of East Orange, N. J., are the directors.

THE DE FOREST WIRELESS TELEGRAPH COMPANY OF CANADA has been incorporated with a capital stock of $2,500,000. The company's headquarters will be in Toronto and the provisional directors are Alexander McKenzie, E. G. Long, Charles V. Bennett and W. H. Templeton, all of Toronto.

THE W. J. BARR MANUFACTURING COMPANY, Cleveland, Ohio, capital stock $10,000, has been incorporated by W. J. Barr, T. E. Barr, W. F. Atterholt, J. W. Burrell and Wm. E. Patterson. The company succeeds the firm of W. J. Barr, which for a number of years has conducted an extensive business in the manufacture of telephone transmitter arms and other telephone specialties. With increased capital it is proposed to expand the business.

LEGAL.

TELEGRAPH POLES ON INDIANA HIGHWAYS.—The Indiana legislature has passed a bill allowing telephone companies to set their poles in all highways outside of cities and towns, without obtaining anybody's consent, provided that they are erected and maintained in such a manner as not to incommode the public in the use of the road or interfere with the ingress and egress from any premises. The bill was defeated a few days previous; but, on reconsideration, was passed. In the meantime Judge Hord, of the Bartholomew Circuit Court, decided a case in which he held that the poles of the company in question were an obstruction, and entered a fine of $100 against the company. Ninety-five per cent of telephone poles in Indiana are on public highways, and every one of these would have been involved as a result of Judge Hord's decision had the case gone to the Supreme Court and been there sustained. For the first time in the history of Indiana telephony the representatives of the Bell Company and the independent companies united in a common cause in asking for legislative relief, and worked in harmony for the passage of the bill, which was finally accomplished.

OBITUARY.

MR. WILLIAM DU BOIS, of Albany, chief electrician of the Delaware and Hudson Railroad, died in Plattsburg, N. Y., on Monday, March 16. The week before, he was thrown from a carriage, sustaining a compound fracture of the leg and internal injuries. He was about forty-two years of age, and leaves a widow and two children.

MR. J. H. HERRICK.—The death occurred in New York City last week of Mr. J. Hobart Herrick, due to a fall at the Union League Club, from sudden faintness. He was 69 years of age. He was a graduate of New York University and succeeded his father in the conduct of a large grain business. After his father's death Mr. Herrick formed the firm of J. H. Herrick & Co., grain and produce brokers, and continued in that business until 1889, when he entered the Edison General Electric Company as vice-president. When the General Electric Company was formed, in 1892, Mr. Herrick went with that corporation, also as vice-president, but left it the following year. He was for years one of the prominent members of the Produce Exchange. Prior to his election as president he had been chosen time and time again a manager of the Exchange, and he had served on its important committees. A director of the Mutual Life Insurance Company, he served also as one of the auditors.

MR. E. A. DARLING.—E. A. Darling, the general superintendent of the Edison Cement Company, whose works are at New Village, N. J., died there on Sunday last, aged 37 years, of the effects of burns received by the explosion of pulverized coal at the works on March 2. He is the ninth victim to lose his life by that accident. His father is F. H. Darling, of 126 West 123d Street, New York. A brother, Thomas Darling, also survives with his mother and two sisters. Mr. Darling was a widower. On the day of the accident he had just finished directing men in putting out a fire in the coal room. Seeing a bucket containing coal which was afire being carried into the blowing department and knowing that an explosion was sure to follow if the live coals reached the room, he tried to stop it, but failed. Then as an employee followed the bucket, he called to him to fly. Mr. Darling, however, did not heed his own warning and was terribly burned by the explosion, which occurred a second later. His body was brought to New York for burial. Mr. Darling was born in Jersey City in 1865. He received his education in Cooper Institute and Cornell University. He was a member of the Cornell Club, the American Society of Mechanical Engineers, and of the Society of Phi Delta Phi. He was at one time mechanical superintendent at Columbia University. He was a man of most engaging personality, and his death will be severely felt by a wide circle of friends.

E. B. ARNOLD.—We regret to report the death of Mr. Everton Burritt Arnold, which occurred March 9, at Loch Haven, Pa., from typhoid pneumonia, after an illness of ten days. For a number of years Mr. Arnold was associated with his brother, Mr. B. J. Arnold, and of recent years has had charge in a confidential capacity of the finances and work of the Arnold Electric Power Station Company. Mr. Arnold was born in Ashland, Neb., thirty-one years ago, and received his education in the public schools of that place and Hillsdale College, at Hillsdale, Mich. From 1893 to 1895 he had charge of the factory of the Pumpelly-Sorley Storage Battery Company in Chicago. Since 1895 he had been connected with the Arnold company in the capacity mentioned. His duties kept him out of town most of the time, and he supervised the business end of the construction of many important installations carried out by the Arnold company, such as the Chicago and Englewood storage-battery road, the Chicago and Milwaukee electric railway, the Baring Cross shops of the St. Louis, Iron Mountain and Southern Railroad, at Little Rock, Ark., the Lansing (Mich.), St. Johns and St. Louis electric railway and the Oak Grove shops of the New York Central Railroad at Oak Grove, Pa. He was just finishing up his work in Oak Grove when he was taken ill. Mr. Arnold was a young man of high principle and excellent capacity. He was noted for an extraordinary aptitude in mental numerical calculation, and his grasp of all business details was precise and accurate. He possessed the fullest confidence of his friends and associates and his services were of great value to his employer. He was unmarried.

Trade Notes.

THE WESTERN TUBE COMPANY, of Kewanee, Ill., which was one of the first users of Nernst lamps, is now displacing all arc and incandescent lights in favor of the new illuminant.

VALVES.—Jenkins Bros., 71 John Street, New York, in their 1903 pamphlet, describe and illustrate their very complete line of valves, disks, packing, etc. A complete telegraph code is given to facilitate ordering these goods.

PLAIN MILLING MACHINES constitute the subject of the Garvin Machine Company's catalogue No. 2, of recent issue. Machines of various sizes are illustrated, each illustration being accompanied by a few descriptive facts.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out an up-to-date transformer catalogue. It describes the new Packard vacuum process of transformer insulation. In sending for a copy ask for transformer catalogue "G."

ELECTRIC HOISTS.—The C. W. Hunt Company, of West New Brighton, Staten Island, N. Y., is sending out a pamphlet describing and illustrating its electric hoists. Those in this line of work will find information of interest in this pamphlet.

LINOTYPE MOTOR.—The linotype motor of the Jenney Electric Manufacturing Company, Indianapolis, Ind., is the subject of a neat booklet just issued by the company. The features of this machine are pointed out and practical applications are illustrated.

THE WARD LEONARD ELECTRIC COMPANY reports a large increase of orders for motor controlling panels for the Navy, fulfilling specifications of the Bureau of C. & R. Also large orders for its PU type circuit breaker which is being used largely for alternating current.

SPON & CHAMBERLAIN, the technical book publishers, who for the past 15 years have been at 12 Cortlandt Street, New York City, have moved nearer the heart of the mechanical and engineering district, and have taken offices in the Liberty Building, 123 Liberty Street.

THE YOST ELECTRIC MANUFACTURING COMPANY, of Toledo, Ohio, has purchased a building site and will erect a large factory for the manufacture of several specialties, among them electric lamp sockets. The factory at present occupied by the company has been found too small.

THE HANSEN CAR COMPANY has been incorporated at Cleveland, Ohio, with $25,000 capital stock, by R. Hansen, M. L. Thomson, F. H. Gould, G. A. Gaston and C. K. Fauver. The company will manufacture street car bodies and automobile bodies. It succeeds the business heretofore conducted by R. Hansen.

THE CENTRAL ELECTRIC CONSTRUCTION COMPANY, recently incorporated at Youngstown, Ohio, with $20,000 capital stock, to manufacture motors and electrical supplies, has secured a building site in Struthers and will commence work at once on two buildings. W. L. Goodhart, of Youngstown, is manager of the company.

BULLOCK APPARATUS.—The Bullock Electric Manufacturing Company, Cincinnati, Ohio, in a leaflet shows two fine illustrations of "Bullock" direct and alternating current machines, water-wheel driven. On the reverse side of the sheet are reprinted three letters from the managers of plants regarding the satisfactory operation of their Bullock apparatus.

MESSRS. BARDONS & OLIVER, manufacturers of turrett lathes and other machine tools, Cleveland, Ohio, whose plant burned down some months ago, have leased the factory at No. 1 Water Street. Machinery will be operated by electricity and a number of motors will be installed. The Cleveland Engineering Company is doing the electrical engineering work.

THE SCHOEMAN ELECTRIC MFG. CO., Alleghany, Pa., expects to move its works and office to the large and commodious building at Berlin St. and P. R. R., East End, Pittsburg, about April 1. This step has been rendered necessary by the demands of its rapidly increasing business. With the new facilities at its command, it will be prepared to manufacture promptly all kinds of switch and panel boards, knife switches, etc.

TRAVELING CRANES.—In a very completely illustrated catalogue, recently issued by the Northern Engineering Works, Detroit, Mich., their standard types of cranes in more frequent demand, are very artistically illustrated and their features and advantages briefly pointed out. Actual installations of these cranes are illustrated. These machines are made in standard capacities, ranging from 100 tons down to 1 ton, and spans and lifts are made to suit locations.

STATIONARY INDUCTION APPARATUS.—The Kuhlman Electric Co., Elkhart, Ind., makes a complete line of transformers, potential regulators, auto-transformers, reactive coils and spark coils. These transformers are fully described and illustrated in a pamphlet recently issued by the company, and various curves illustrate their performance. The company keeps stocks of transformers at Denver, Col., Kansas City, Mo., and Waco, Tex., as well as at headquarters.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., is erecting a new factory which will give it more than double its present manufacturing capacity and in a large measure better enable it to meet the demand for "Sumterfones" and switchboards. The company manufactures complete equipment for interior local exchanges and long distance service. A folder recently issued contains illustrations of apparatus of various designs manufactured by the company. Descriptive bulletins and prices can be obtained on application.

DROP FORGINGS.—J. H. Williams & Company, of Brooklyn, N. Y., in their catalogue for 1903, illustrate their complete line of drop forgings of iron, steel, copper, bronze and aluminum. The articles illustrated are briefly described and tables giving dimensions and prices of the articles accompany them. Apart from the descriptive matter, the pamphlet contains some very handsome illustrations, three etchings at the front giving an exterior view and two interior views of the work. At the back are several full-page illustrations, showing samples of the great variety of articles produced by this firm.

MECHANICAL BOILER CLEANER.—The problem of keeping steam boilers clean is one that confronts every steam user, and many have been the devices designed to accomplish this desirable result. The Garrigus mechanical boiler cleaner manufactured by the Mechanical Boiler Cleaner Company, Chicago, Ill., is claimed to be successful in keeping boilers clean and free from scale, mud and oil. The cleaner removes all impurities and foreign matter from the water before they settle. In a pamphlet issued by the company many interesting facts concerning the device are given, together with copies of letters from users of this cleaner testifying to the satisfactory results obtained.

STANDARD VITRIFIED CONDUIT COMPANY, 39-41 Cortlandt St., New York City, has just issued an admirable trade pamphlet in small quarto size, the cover of which resembles exactly in color, shape, etc., a couple of sections of conduit. It is a handsome piece of cover work. Inside, the contents are equally interesting and are displayed with corresponding taste. Very full details are given as to all parts of the work, and engravings are used freely, so that the book might well serve as an exposition of the conduit art as practiced in America. The company is to be heartily congratulated upon its literature as well as upon its success with the conduit to which the pamphlet is devoted.

"SOME TELEPHONES."—Under this title the Utica Fire Alarm Telegraph Company, Utica, N. Y., has just brought out a pamphlet which describes and illustrates the company's line of telephones and telephone accessories. The pamphlet is divided into two main parts, the first being devoted to telephones and the second to telephone specialties. In the first part are described and illustrated seven different styles of wall sets, a private line telephone and an intercommunicating set. Among the specialties shown are magneto boxes, linemen's testing sets, extension bells, ringers, lightning arresters, etc. The text is printed on heavily coated paper and the front cover contains a neat design of a telephone.

METAL-WORKERS' CRAYONS.—All workers in iron and metal goods will be interested to learn that the D. M. Steward Mfg. Co., Chattanooga, Tenn., manufactures a line of crayons and pencils, especially adapted for marking on iron. The marks, it is stated, do not disappear when used on iron and heated. These goods are made in various forms—round, square and flat, and it is stated that they meet the requirements of metal workers in a very satisfactory manner. Two grades of goods are made, the "genuine" and the "compo," the latter being a composition which is similar in appearance to the genuine. A booklet issued by the company gives illustrations and prices of the various styles of pencils and crayons.

PASS & SEYMOUR SPECIALTIES.—Mr. John W. Brooks, Western Sales Agent for Pass & Seymour, Inc., with headquarters at 130 West Jackson Boulevard, Chicago, has just returned from a Western trip extending over two months. He reports great success with the new brass socket Pass & Seymour are placing on the market, having booked orders for over 100,000 sockets. The socket seems to supply a long felt want as it is "double pole." Mr. Brooks also has recently made contracts with the Kuhlman Electric Co., Elkhart, Indiana; Maloney Electric Co., St. Louis, Mo.; Fort Wayne Electric Works, Fort Wayne, Ind.; Gregory Electric Co., Chicago, covering their year's requirements for the popular P. & S. transformer cut out.

BITUMENIZED FIBRE CONDUIT.—A very handsome pamphlet has been issued by the American Conduit Company, of Philadelphia, Chicago and Los Angeles, setting forth the merits of its bitumenized fibre conduit for electrical work. This make of conduit is stated to be electrolysis proof, non-abrasive, moisture-proof and non-corrosive, as well as possessing high insulating qualities, and it would seem from this that every essential requirement in a conduit is embodied in this one. The pamphlet furnishes some interesting reading on the subject of underground electrical work, giving a résumé of the development from the earliest methods of placing conductors underground out of harm's way, to the present highly developed conduit systems. The experience of years has indicated what essentials a conduit should possess, and it is claimed that the bitumenized fibre conduit as manufactured by this company meets every requirement that actual practice has demonstrated as necessary. Various illustrations throughout the pamphlet show views of underground installations in various cities and sections of the conduit. The cover is of handsome design and exceedingly effective.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 10, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

722,21 SUBSCRIBER'S TELEPHONE CIRCUIT; W. W. Dean, Chicago, Ill. App. filed March 22, 1902. (See page 484.)

722,249. HOLLOW TILE OR BRICK; O. C. Pixley, Chicago, Ill. App. filed Oct. 30, 1901. Terra cotta conduit sections having longitudinal grooves on the outside to receive keys for aligning the sections.

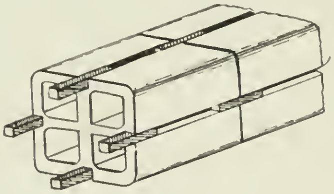
722,255. ELECTRICAL TRACTION DEVICE; B. M. Scott, Coalport, Pa. App. filed April 3, 1902. A mine locomotive having a take-up device for a flexible conductor permitting it to run into short side passages where the trolley wire does not extend.

722,301. CIRCUIT CONTROLLER; J. S. Hobson, Edgewood, Pa. App. filed July 30, 1902. Details.

722,302. AUTOMATIC GAS REGULATING VALVE; C. M. Holley and M. H. Rix, Ann Arbor, Mich. App. filed Feb. 3, 1902. A valve for gaseous fuel regulated by the action of heat on a thermostatic circuit closer.

722,334. ELECTRICAL ALARM SYSTEM; H. M. Sutton, W. L. Steele and M. Coerver, Dallas, Tex. App. filed May 25, 1901. The line wires throughout the protected structure contain independent resistances so arranged that the total resistance on each line is the same, while that at the same point on each line is different from that on the associated lines.

722,345. SYNCHRONISM INDICATOR; Jonathan E. Woodbridge, Schenectady, N. Y. App. filed July 30, 1900. One current is passed through one coil of an electro-dynamometer, and the other through the second coil.



722,249. Hollow Tile or Brick.

722,348. TELEPHONE-SUPPORT; J. S. Young, Brooklyn, N. Y. App. filed May 21, 1902. (See page 484.)

722,362. LOCK-OUT PARTY-LINE TELEPHONE SYSTEM; C. L. Goodrum and J. W. Lattig, Philadelphia, Pa. App. filed September 12, 1902. (See page 484.)

722,367. TELEPHONE SYSTEM; J. W. Lattig and C. L. Goodrum, Philadelphia, Pa. App. filed September 12, 1902. (See page 484.)

722,379. TROLLEY POLE; H. P. Oler, Camden, N. J. App. filed Aug. 9, 1902. The trolley head is rotatable on an axis in line with the pole, so that the wheel will tilt in passing a curve.

722,411. ELECTRIC FURNACE; Albert A. Shade, of Chicago, Ill. App. filed May 15, 1902. (See page 483.)

722,446. ELECTRICALLY OPERATING DOOR; J. Chambers, Jr., Dallas, Tex. App. filed Aug. 12, 1902. Locking devices for elevator doors are controlled automatically by the movement of the car and that of the controller.

722,453. ELECTRIC CURRENT CONTROLLER; J. J. Murphey, Jersey City, N. J. App. filed Aug. 25, 1902. A terminal head for a cable carrying a number of circuits in which the terminals of each circuit are arranged side by side in a passage of the head so that a conducting push rod can be moved into engagement with any number of them.

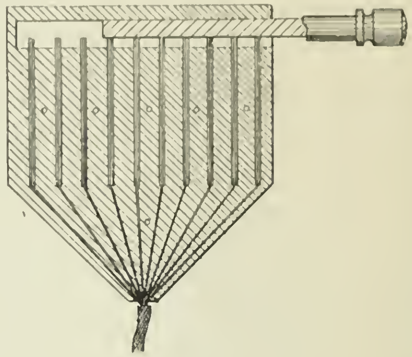
722,527. ELECTRIC CONTROLLER; F. A. Merrick, Johnstown, Pa. App. filed Oct. 14, 1902. Contacts and connections arranged to place a motor in parallel with the armature and a part of the field winding of another motor, the balance of said field winding being in series with the parallel circuit.

722,535. AUTOMATIC REGULATOR FOR CONSTANT CURRENT DYNAMOS; F. B. O'Hanlon, Portadown, Ireland. App. filed April 22, 1902. A relay adapted to reverse the action of a mechanical regulator and to weaken the field current when a flash across the brushes has occurred.

722,563. SYSTEM OF REGULATION FOR ELECTRIC MOTORS; P. J. Collins, Scranton, Pa. App. filed Dec. 18, 1899. Details.

722,583. SECONDARY ELECTRODE FOR ELECTROLYTIC APPARATUS; P. Imhoff, Liverpool, Eng. App. filed Dec. 17, 1902. An electrode built up of conducting strips placed upon the opposite sides of a non-conducting supporting plate.

722,594. ELECTRICAL INSTRUMENT FOR SURGICAL OR SIMILAR PURPOSES. M. D. Law, New York, N. Y. App. filed June 25, 1900. Details of construction of a speculum.



722,453. Electric Current Controller.

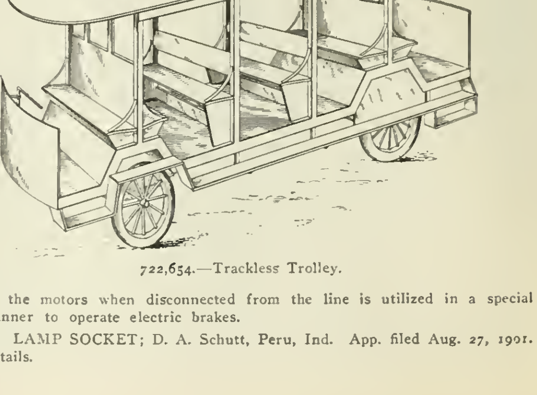
722,598. ELECTRICAL GENERATOR AND DISTRIBUTER FOR MEDICAL USE; E. L. Madden, Kanawha, Iowa. App. filed Feb. 3, 1902. Relates to the construction of a battery, belts and pads for application to the body.

722,606. ELECTRICAL CONTACT BRUSH AND METHOD OF PRODUCING SAME; H. N. Motsinger, Pendleton, Ind. App. filed Aug. 25, 1902. A carbon brush surrounded by a sleeve of copper gauze.

722,608. TROLLEY FOR ELECTRIC RAILWAYS; R. L. McCartney, Ottumwa, Iowa. App. filed Dec. 12, 1902. A device for retaining the trolley on the wire.

722,654. TRACKLESS TROLLEY; A. B. Upham, Boston, Mass. App. filed April 25, 1901. The trolley pole supports a horizontal "lazy-tongs" at each end of which is a trolley and with which the pole makes a pivotal connection, thus permitting the vehicle to wander freely considerable distances at either side of the conductors.

12,098. ELECTRIC BRAKE FOR VEHICLES; J. N. Mahoney, New York, N. Y. App. filed Jan. 8, 1901. A controller whereby current generated by the motors when disconnected from the line is utilized in a special manner to operate electric brakes.



722,654.—Trackless Trolley.

12,099. LAMP SOCKET; D. A. Schutt, Peru, Ind. App. filed Aug. 27, 1901. Details.

Electrical World and Engineer

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ELECTRICAL WORLD AND ENGINEER.

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CONTENTS.

Editorial 507
Bidwell Electric Railway Patent Litigation 510
Telephony Before the Chicago Electrical Association 510
An Example from the Pacific Coast in Running Telephone Cables and Wires 511
Electric Lighting at the Delhi Durbar 512
The Induction Coil. By James Edmund Ives, Ph.D. 513
Thurston on the Steam Turbine 516
To Discipline Dishonest Electric Companies 517
The Principles of a New Method of Electric Lighting. By Paul Hoho 517
The Coming Iowa Electrical Association Convention 519
The Inventor and the Trust. By William Stanley 519
The Construction of Aerial Telephone Lines—VII. By Arthur V. Abbott, C. E. 521
The Electric Club of Pittsburg, Pa. 522
A Plea for the Sky Scraper 522
A Switchboard Model. By Arthur B. Weeks 523
Trials of Commercial Automobiles in New York City 523
Autobiography of Mr. Charles Proteus Steinmetz 524
Recent Electrochemical Developments. By Clinton Paul Townsend 525
New Telephone Patents 525
Current News and Notes 526
Letters to the Editors:
  Meter Testing. By W. J. Mowbray 527
  Power Required to Drive Machine Tools. By Geo. H. Gibson 527
  Wireless Telegraphy in Alaska. By the Marconi Wireless Telegraph Company of America 527
Digest of Current Electrical Literature 528
New Books 531
Automobile Telephone Truck 532
Westinghouse Motors for the New York Subway 532
Bullock Apparatus 533
Annual Report of the Electric Storage Battery Co. 534
Incandescent Lamps for Street-car Headlights 535
Guy Anchors for Poles 535
Departments:
  Financial Intelligence 536
  Commercial Intelligence 537
  General News 539
  Trade Notes 543
  Record of Electrical Patents 544

Municipal Lighting in New York.

To what extent the public of New York is interested in the proposal to establish a municipal electric light plant, it is difficult to ascertain. We have watched the daily papers in vain for any evidence that it cares in the least, or attaches the slightest importance to the figures and statements put forward in favor of the scheme by its chief advocates, in one or two of the city departments. The daily newspapers themselves betray no enthusiasm on the subject, one or two of them being chiefly occupied with a gas campaign, and others opposing the idea more or less directly. We cannot ascertain that the Mayor is in favor of the scheme; in fact, it is believed he is not very anxious about it, although rather free use of his name appears to have been made by his official associates. We are forced to the conviction that outside two or three city officials, a few busybodies, and a coterie of speculators on the Stock Exchange, no one is discussing with any earnestness the idea that the city should invest large sums of money of its own in an electric lighting plant. It is true that Commissioner Monroe gets a hearty reception from the Order of Acorns when he says that the city should have an isolated plant, just as hotels and office buildings have; but the argument is not pertinent nor is the Order of Acorns particularly well informed on the subject of lighting or the history of American municipal enterprises. It is, on the other hand, unfortunate that this movement should be associated with deliberate and painstaking efforts to depress the value of lighting securities on the Stock Exchange, the market acting as though the city itself were selling short so as to pay for the plant out of the profits of its bear gamble "in the street." The *Wall Street Journal,* too, makes the theme occasion for a long article showing how easily and cheaply the system could be duplicated, and how much "water" there is in its stocks. We are not concerned to defend the Brady methods of financing, and are willing to admit that they are not to our way of liking as a usual thing; but when we remember that the city electric lighting is a bare 5 per cent. of the New York Edison business, it will be seen that ulterior motives might well inspire this irrelevant "drive" in financial circles and organs at the securities in question, quite regardless of the merits of the municipal plant problem.

Possibly the public sees this, too. Possibly the public is also not anxious to increase the number of city departments, city enterprises, city officials and the city pay-roll. Possibly the citizens do not overlook the fact that this same department asking for control of a lighting plant handles its water supply so badly that thousands of New Yorkers buy other drinking water in order to be safe, and are often unable to bathe, so laden with dirt and impurities is the city supply furnished them. This has gone on for years. Possibly the public wonders whether it would be likely to get better city light than it gets city water, or whether the one supply would be handled any more economically and efficiently than the other has been, lo, these many years. It might be better to get the water supply right before assuming these other serious obligations.

We have before us that report made to Commissioner Monroe by Mr. Lacombe, engineer of the department, as to what might and ought to be done with a city plant. As to how this was got together, Mr. Monroe said to the Acorns:

> But this year I sent to 175 cities in every part of the United States for the purpose of ascertaining what price they paid for their lighting. When about 100 replies had been received and the results

tabulated, I found that only in exceptional cases did any city come within 10 per cent of what we paid, that only few came within 30 per cent, and that a great many paid less than 50 per cent of what we were paying. While in most cities $80 was the price per annum for one light of 2,000 cp, which is the standard size used, we paid $140 a year. In looking about for a reason for this large difference, I came to the conclusion that where a corporation owned a city the price was high, and that where the governments were in a position to insist that the interests of the city should be safeguarded, the price was low.

We cannot say that such figure-collecting inspires us with any confidence, and an examination of the figures, to which we shall probably return later, reveals a mass of "data" of the most suspicious and untrustworthy character, including some of the old municipal lighting yarns which are simply and utterly false, or else offer no possible basis of comparison on even terms. If Mr. Monroe really wants figures on arc lighting they can be got, we think, right in this town. It is a matter of notoriety among electrical engineers that arc lighting, by itself, long since ceased to be an item of important profit to any large central station. Unless the old arc companies had taken up power and incandescent lighting, many would have had to go out of business long ago. It is also an open secret, we believe, that in New York City, since the introduction of the subways, the old Brush system and possibly the other arc networks, have never been able to make ends meet, or show any profit. In other words, they are carried by the business done in other branches. Yet the city is invited to go directly into an enterprise which presents the strictest analogy to that now operating at a loss, despite the fact that it has so many years of experience behind it and the services of trained men, who, if anybody could, ought to be able to make mere arc lighting pay. We do not know whether the figures are available, but we do know that we would rather depend on them than on any loose data, unchecked and unconfirmed, from 100 out of the 3,000 central station systems in this country.

We venture to suggest, at this juncture, to the Department of Gas, Water and Electricity, of New York, that if it wants to get a lower rate for arc lighting, that might be easily obtained by effecting with the company a long-term contract. Many of the lower rates it could quote were secured in that manner, and it stands to reason that any company would make reasonable concessions on such a basis where on a precarious renewal from year to year it has to protect itself against loss involved in purchase of dynamos, lamps, poles, cables, etc., which would only be required for a brief twelve months. This is so obvious it should not require statement, but it certainly does seem to have been lost sight of in the present "agitation."

We objected above to Commissioner Monroe's analogy between a municipal plant for the city and an ordinary isolated plant. It is, indeed, a most misleading analogy, quite aside from the fact that most or all central station men dispute the assumption that isolated plants need exist in central station areas. But an isolated plant, as Mr. Monroe speaks of it, is for one building or a restricted area. In this instance, however, we are dealing with an area of a great many square miles with circuits in every direction along which lights would be scattered very sparsely, only a few to each mile. We could understand the use of the analogy if the city were proposing, for example, to light the city hall alone; but if the city has one building to light, it must have scores and scores; and the use of the phrase "isolated plant" for the central station plan involved is most decidedly objectionable, and whatever idea of economy it is intended to convey thereby must be dismissed from the argument.

THE PRINCIPLE OF A NEW METHOD OF ELECTRIC LIGHTING.

We print in this number, on page 517, an article by M. Paul Hoho on a new type of electric lamp. M. Hoho distinguishes his lamp from an arc lamp, or a mercury vapor lamp, owing to the radically different physical conditions under which it is produced. He submerges his cathode in water, or in a weak aqueous solution of some salt, and forces a fairly powerful current through it. Under these circumstances the cathode becomes surrounded with a gaseous layer which is presumably of hydrogen, and the resistance of this layer of gas is so great that the energy expended in it by joulean effect raises the temperature to a very high degree. Consequently, it would seem that the Hoho lamp is a particular form of arc lamp. In the carbon arc lamp it is the resistance of a layer of carbon vapor which gives rises to the local expenditure of heat energy. In the mercury vapor arc lamp it is the resistance of a much longer column of mercury vapor that produces the energy. In the Hoho lamp it is the resistance of a layer of hydrogen, or other gas, which serves the same purpose.

It must be confessed that since we are accustomed to throw hot things, such as red-hot rivets, into a bucket of water in order to cool them, there is something paradoxical, to the ordinary mind, in submerging a rivet, with a pair of electrically-conducting tongs, into a bucket of cold salt water, in order to heat it in a few seconds to the temperature of vivid incandescence. Yet the experiment is very readily performed with 220-volt mains, and it has even been proposed to heat rivets electrically in this manner, in places where it was inconvenient to employ the ordinary riveter's forge. We are not aware, however, that the plan has come into commercial use, although it might do so at any time when the conditions for electric heating are more convenient than for forge-heating. M. Hoho states his reasons for believing that a higher temperature can be attained at the cathode in his bath than by any other existing artificial means, including even the electric carbon arc. If this is the case, the apparatus should have important use in that department of experimental physics where the highest temperatures are desired.

All of the difficulties related in the article seem to be connected with the very high temperature attainable in the bath, and the all-too-ready fusibility of even platinum or iridium. He even seems to think that he melts carbon. It has been supposed by various experimenters that carbon softens and melts at a temperature not far from that of its volatilization. The best material that he has been able to find is one on which he has to keep water dropping during the continuance of the current. If it were possible to find a sufficiently infusible substance that had conducting power, the highest temperature attainable would form a most interesting subject for measurement. The illustration in the article indicates that the lamp is really a hot cathode in a bucket of water, and the hot cathode appears to be semi-submerged. To most persons unfamiliar with the subject it would seem incredible that such an apparatus could produce an extraordinarily high temperature; yet the proposition is not at all unlikely.

THE INDUCTION COIL.

The induction coil, using the term in its most general sense, is one of the most important pieces of apparatus in the whole range of electrical engineering. In electric lighting and power transmission, we employ it under the title of the transformer, both to lower and to raise the pressure, as the case may require. In these conditions there is sought and secured a high efficiency combined with good regulation. In telephony the apparatus is used to raise the pressure and increase the range of telephonic transmission. In telegraphy it has a few special applications. In wireless telegraphy it is also used to raise the pressure in the sending circuit as well as to assist in tuning the local receiving circuit. In a great variety of minor utilities, such as gas-igniters, the induction coil is again applied. Moreover, whenever a very high electric pressure is desired, which does not need to be steadily maintained, as in the operation of Röntgen-ray tubes, Crookes tubes and Geissler tubes, the induction coil comes to the rescue.

In some of the applications above outlined, the induction coil has been with us for half a century. And yet, although we can make satisfactory coils for various needs, our theory of the induction coil is very meagre and incomplete. There are great gaps in it. Some of the conditions are so seemingly complex that we are unable to bring them within the reach of arithmetic; as, for example, the law of the resistance in the spark-gap of the interrupter, or the law of the distributed capacity in the windings. We can design transformers with a very fair degree of certainty; but in the design of a spark-coil for a given maximum voltage, or a given spark length, we are still very much at sea, and have to depend upon empirical rules, and on cutting and trying. Dr. Ives' article, on page 513 works in the direction of improving the theory of the induction coil, both from the mathematical and from the experimental side.

A very important generalization is that which expresses the maximum secondary voltage as the product of the primary current into a virtual resistance of an alternating circuit containing a distributed inductance equal to that of the secondary and a distributed lateral capacity equal to that of the condenser across the gap. According to this theory, assumed correct, the induction coil primary behaves like a transmission line having the inductance of the primary and the distributed capacity of the condenser, so that the virtual resistance is the square root of the ratio of these quantities. The drop in this virtual resistance with the actual strength of current at the instant of breaking is the magnitude of the primary prssure, and which is transferred to secondary terminal in the ratio of transformation. No theory of the induction coil can, however, hope to be reliable until the influence of distributed capacity in the windings can be estimated and taken into account. Some of the phenomena of the induction coil are, in fact, directly opposed to the ordinary elementary theory, by reason of the effects of this distributed capacity. It is earnestly to be hoped that such researches as these may be steadily advanced, owing to the great industrial importance of their application to the design of powerful induction coils.

The Tesla Split-Phase Patent Decisions.

The recent decisions against the validity of the Tesla split-phase patent bring food for thought. It is not our purpose here to go into the merits of the case, for these are in the domain of the court; nor do we have any immediate interest in the bearing of this particular decision or others involving similar issues. Those best informed on the state of the art have long considered the split-phase motor patent as the weakest link in the chain of Tesla patents, so that the present decision is not altogether surprising and perhaps not unexpected. We have always regretted that the fundamental polyphase patents have not been fought to a finish, for the issues are important, and in the interest of fair play to the inventor and the public, it would have been a desirable thing to have them finally settled. The claims of Ferraris, which proved effective abroad, were of course blocked here by statute. Our patent law wisely and properly relieves the American inventor from the serious burden of defending himself against attacks based on unpublished work in foreign countries. In this instance the rule may have worked some hardship to Ferraris, but without it the American inventor would have to fight his rights clear around the world against any litigant with money and pertinacity enough to keep the ball rolling. The telephone patent and to a certain extent the incandescent lamp patents, scored against foreign claimants in a similar fashion, but quite aside from the merits of individual cases, we believe that revocation of the rule would work greater injustice than its continuance.

There is, however, serious ground for dissatisfaction in the outrageous amount of time which generally elapses before an important patent reaches the court of last resort and is sustained or invalidated. In this Tesla case the patent is nearing its end before the adverse decision comes. If this decision is sound it ought in justice to the public to have been reached years ago; or if unsound it should have long ago been made impossible by the weight of favoring decisions. The fact is that in a case of any considerable importance the public does not know whether it is infringing or not until the patent is moribund or dead and buried. The telephone cases seemed interminable and the Berliner part of the matter, a quarter of a century old, could be yet revived by the United States Supreme Court ordering the case before it. Litigations clustered about the deathbed of the incandescent lamp patents and at the tomb came the notorious Goebel defence which, in justice to the public, ought to have prevailed fifteen years before or not at all. No sane man really believes that the facts were hidden from human view and forgotten through all those years of turmoil and recrimination. If an inventor has any rights to his monopoly he ought to have a quick and easy road to their final establishment, and if his rights are ill-founded, the public ought to have prompt benefit. This Tesla case serves to point the moral. Invalidation at this late date means that grievous wrong has been done either the public or the inventor. If a patent is sustained after years of legal strife, the owners of it have small chance to secure adequate damages from infringers who have had ample time to clear up their profits and get out; while if it is broken, the public has paid the piper and has no remedy for years of tribute.

It would take a very long legal head to devise an adequate remedy for such a state of affairs, but procedure in infringement cases is certainly one of the weakest points in our patent system, and it sorely needs improvement. In general, the remedy lies in rigorous rulings as to laches and the establishment of a definite procedure by which prosecutions for infringement need not, and could not, be bandied about from District to District and from lower court to upper court. As it now goes, the whole procedure is needlessly drawn out from tribunal to tribunal, and the litigants spar for wind month after month and year after year. Infringement cases are, it is true, sometimes complicated and often involve gathering large masses of evidence, but we do not overstate the facts in saying that of the time taken by any of the noted cases, two-thirds has been wilfully and intentionally frittered away by one party or the other in the effort to gain some advantage of position. For all this there is small excuse, and while it is now permitted or at least tolerated, there ought to be provision for throwing a case out of court at the first sign of deliberate negligence, and for compelling both litigants to push ahead vigorously toward a decision. It ought to be possible to force any case to a decision within two years, and that decision ought to carry far more protection than it does at present. In rare instances a very large volume of evidence might require more time than that named, but the whole procedure of taking evidence in patent causes is dilatory and the court ought to have authority to cut it short when abused. Examining a witness for two weeks before an examiner and cross examining him for two weeks more, perhaps on a single claim of a single patent, is little short of a farce, a travesty on the forms of justice, and properly should be interpreted as contempt of court. Patents have, of course, to be put in litigation, but it is little short of scandalous to permit the fight to last through Time into the borders of Eternity.

Bidwell Electric Railway Patent Litigation.

Judge Cochran, on February 20, 1903, dismissed a suit of Benson Bidwell, Clara L. Bidwell and Charles F. Bidwell against the Consolidated Street Railway Company, of Grand Rapids, brought in the United States Circuit Court for the Western District of Michigan and involving claims for damages and profits in connection with alleged infringement of an electric railway patent.

The basis for the suit was patent No. 318,594, dated May 26, 1885, which the Bidwells alleged broadly covered any and all practical means for propelling and lighting cars by electricity supplied from a central station, and lighting the way stations and track as well, the lamps and car motors being supplied with current by a single set of conductors connected with the generating station. The broadest in terms of the claims of this patent is the first, which reads as follows.

"In an electric railway, cars having an electromotor, a line circuit, movable circuit connection between the line circuit and said motors, a branch circuit in said movable circuit, and an electric lamp with switch mechanism in said branch circuit, substantially as shown and described."

The third claim specifies branches for lamps and switches "along the line of way." The patent expired last year.

The Bidwell Trolley & Car Telephone Syndicate, Limited was organized as a "partnership association" November 5, 1902, under "the provisions of Chapter 160 of the Compiled Laws of the State of Michigan of 1897," with an initial capital stock of $3,000,000, having a par value of $100. "The business to be conducted by this association is to collect damages for infringements" of the claims of 7 patents (of which 3 have expired) and 5 applications (of which 2 are stated by the articles of the association to have lapsed); also to collect and receive royalties, etc. The business office of this "Syndicate" is at Grand Rapids, Michigan, and the treasurer for the first year is Benson Bidwell. This suit is only one of a large number that Bidwell has brought under several patents relating to electric railways, which he claims broadly cover devices in universal use. One suit in particular against the Manistee, Filer City & East Lake Railway Company, of Manistee, Mich., relates to Bidwell patent No. 684,596, issued October 15, 1901. Bidwell claims that this patent covers the modern overhead trolley system. His application was in the Patent Office for seventeen years and the patent granted is maintained by the defendants to have claims of very limited scope which bear no relation whatsoever to the trolley system in common use.

The suits instituted by the Bidwells have principally been against the smaller electric railway companies, and though none has been successful, the defense has been vexatious and expensive. There is not the slightest probability at the present stage of electric railway development that paper patents of the Bidwell class will be adjudged by the courts to control the art.

Telephony Before the Chicago Electrical Association.

S. J. Larned, general superintendent of the Chicago Telephone Company, gave an entertaining paper before the Chicago Electrical Association Friday evening, March 20. The paper was somewhat popular in its nature, but gave the electrical engineers in other lines a good idea as to some of the inside workings of the telephone business in a large city. Mr. Larned began by showing the important place the telephone occupies in our modern civilization. The history of the progress of civilization is principally the history of transportation and communication. Various branches of telephone service were then briefly spoken of, including the growing importance of residence telephones. It is coming to be more and more the case that a man is considered isolated from the world if he cannot be reached by telephone. One of the chief values of the telephone in a residence is in the kitchen: and in San Francisco a very popular one-way party line service has been installed, called the kitchen service, by which a number of transmitters and receivers are put on a party line. The calling is one way, that is, the subscribers can call central, but central cannot call subscriber. This service is primarily for the giving of grocery orders. Residence service has many variable demands put upon it.

The growing importance of the operator in the private branch exchange was noted. The operator in the private branch exchange of a business house performs many of the functions of a private secretary to the leading members of the concern, and is more closely in touch with the whole company's business than is any other one person. In fact, the private branch operator becomes such an important cog in the business machine of any concern that when, after two years' service, when she has become thoroughly familiar with the business, she marries the bookkeeper, there is general grief until her successor can be broken in. The importance of the private branch exchange business is shown by the fact that in New York City there are twice as many private branch exchange operators as there are operators in the regular exchanges. In view of the growing importance of the private branch exchange operator, who gives personal attention to the telephone communication of the various persons connected to her exchange, Mr. Larned thought it unlikely that any mechanical or automatic system would displace the operator, as he thought the tendency was rather toward having an operator who would give personal attention to the telephone business of the concern, than toward an automatic exchange.

The average number of calls per line per day in Chicago is 17 to 18. An average of one call in every five is not given connection because of busy lines. The average length of time taken to complete a connection in Chicago is nine seconds.

A Lighting Swindle.

A new swindle, it is reported, is being worked on the rural population of northern Ohio. A man, bearing the card of an electric lighting company, supposed to be located in New York City, calls on the farmer. He has a small box bearing on the top a closed lamp with a frosted globe, of the exact appearance of a large size incandescent electric light. The turning of a button serves to light the lamp, which burns brilliantly. The solicitor goes on to tell the farmer that his company is the proprietor of a patent electric light plant, occupying a very small space, and which they will install at the small cost of $2 per light. The lighting of the average sized farm house will cost but little at this rating and the farmer is only too willing to make the purchase. A contract is produced and signed. This is sealed up in an envelope and left with the farmer until another representative shall come and install the plant. A few days later this man appears. The contract is produced and read. To the farmer's surprise and consternation it calls for $64 per light. Of course a refusal to have the plant installed follows, the agent threatens suit, and in order to avoid trouble the matter is compromised by the farmer giving his note for $200 which the agent takes to the nearest town and sells. The light exhibited is an acetylene one and a clever substitution of contracts completes the deception, at which so many are biting, it is said.

The New Battleships.

The last Congress appropriated the necessary funds with which to build five new battleships. In these electric motors, etc., will be used on an unprecedented scale. Most of the ammunition hoists will be controlled by electricity, while a moving platform passing by the doors of the ammunition rooms, will carry a continuous supply to the lifts, the men in the rooms having only to carry the boxes to the door and to place them on the traveling sidewalk, from which they will be removed as fast as needed at the various hoists for the gun stations. A safety feature of the ships will be the method by which all of the doors in the principal water-tight bulkheads can be controlled from a central emergency station. The doors will be closed automatically by power by the simple pressing of a button.

Power Rates in New York State.

A bill has been introduced in the New York Assembly to prevent discrimination of rates by electric power companies which derive their power from navigable streams or other bodies of water wholly or partly within this State. It requires a uniform scale of prices, which must be published annually in the newspapers, and forbids rebate, drawbacks or other forms of discrimination in rates. It allows an increase of 5 per cent. where the power is carried from ten to twenty-five miles and of 10 per cent. where it is carried more than twenty-five miles.

An Example From the Pacific Coast in Running Telephone Cable and Wires.

There is much in Horace Greeley's famous maxim, "Go West, young man." The East stands often for the conservatism which supports and sustains, the West for the radicalism which advances though it sometimes destroys. Even in minor affairs is this tendency clearly portrayed. Who has not often watched with mingled curiosity and contempt the process of installing telephone cables in New York or Chicago streets? At one manhole a huge wooden reel is clumsily jacked up upon a couple of wooden horses and supported on an iron bar thrust through a hole in its center. In the other manhole an old wooden capstan, seemingly a remnant of the equipment of the Ark, is tied to a couple of spikes, driven between the pavement stones. A hemp rope, badly frayed, passes over a pulley to the duct and is attached to the cable. When all is in readiness, some long wooden staves are thrust into the capstan head and a gang of patriarchs, almost as dilapidated in appearance as the apparatus, slowly man the winch, and with many a squeak and groan the cable slowly emerges at the rate of about 10 ft. per minute. Even the street urchin sarcastically whistles, "Tramp, tramp, tramp, the boys are marching," as the veterans toil about the windlass and stumble over the leading rope.

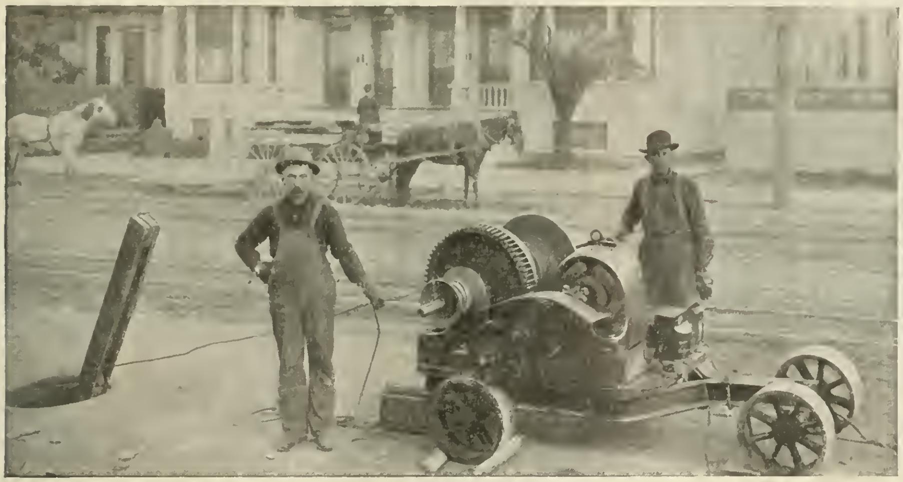

FIG. 1.—CABLE-DRAWING MACHINE.

On the Pacific coast the Home Telephone Company has set a notable example, for there some 10,000 ft. of cable are pulled per day with a gang of seven men, while here a gang of nine rarely make more than 3,000 ft. To begin with, the reel is mounted at the store yard or freight house upon a couple of broad-tired wheels and swiftly rolled or pulled by horse power to the man-hole, where installation is commenced, and instantly dropped into place, as is shown in Fig. 3. At the other end a really modern pulling engine is set. This consists of a substantial iron frame truck, upon which is placed a hoisting machine with differential gearing and two drums. This is driven by means of a 3-hp 500-volt electric motor, controlled by a variable rheostat. One side of the motor is grounded upon the truck, while the other side a heavily insulated flexible cable proceeds to a hook, mounted upon a long wooden handle, that can be instantly attached or detached to a neighboring trolley wire. The wattmeter is included in the cable circuit, so that the amount of energy demanded by the pulling engine is always recorded. This apparatus is shown in Fig. 1. The hemp rope is replaced by a quarter-inch flexible steel strand that is coiled three or four times about one of the drums of the engine, and passes to the hands of an attendant, who thus has the most sensitive conceivable control over the pulling of the cable and can stop its motion within the fraction of an inch. He can, in fact, feel it move and accelerate, retard or stop its motion as the case may demand. That such an electric drive for cable pulling would be severely handicapped by the absence of a trolley wire cannot be gainsaid; but in these days, when half the new bicycles are equipped with gasoline motors, there is little excuse for the capstan of our great-grandfathers.

New York is fortunate in having but few overhead lines, and those that remain are rapidly following the way of all flesh, and disappearing underground, so that Pacific practice in the stringing of open wire line is of minor interest to the Manhattanite, but in other suburban or rural districts, aerial lines will have a long lease of life and Pacific methods, as shown in Fig. 2, may, with profit, be copied. A special iron wagon consisting of a stout channel iron frame, placed upon four broad tired wheels, is provided. There are two longitudinal bars, each of which is equipped with five wrought iron pipe reels, so designed that a coil of hard-drawn copper wire may be dropped onto the reel and unwound without kinking. The cart is hauled to one end of the line, and a pulling rope, a couple of thousand feet in length extended over the cross-arms of the poles. One wire from each reel is mounted in its proper hole in a running board, to which the pulling rope is attached. A horse at the other end of the rope furnishes necessary power and strings ten wires simultaneously, so that some five miles of wire are erected at a single pull. When a coil is exhausted a MacIntire joint splices on a new coil, and the process continues until all the desired wire is in place. Where more than one cross-arm exists a spilt running board is used for the lower arms and wire strung with equal speed.

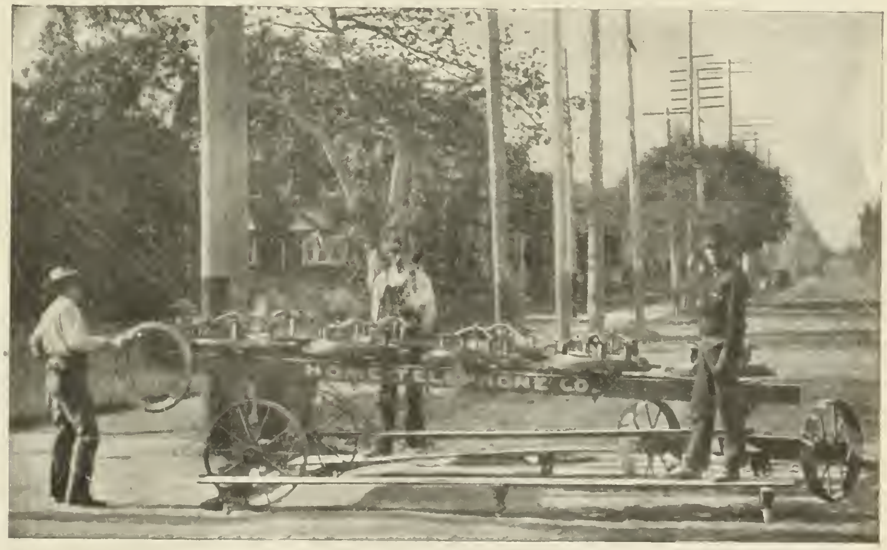

FIG. 2.—APPARATUS FOR STRINGING WIRES.

While the process of installing cable in conduits here described entails an expense for some special apparatus, this should in most cases be recouped many times by the saving in the labor bill.

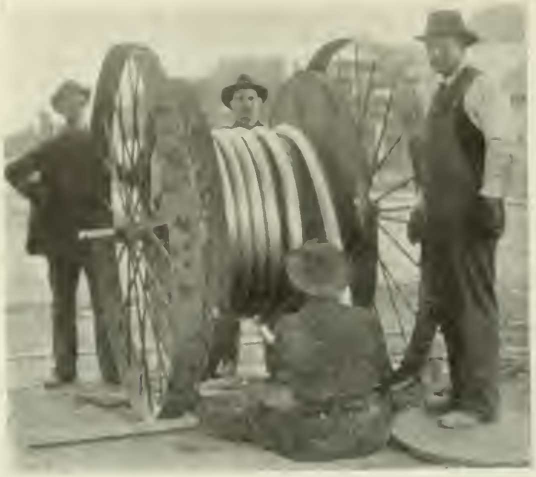

FIG. 3.—REEL MOUNTED ON WHEELS.

As stated before, where dependence cannot be placed on trolley circuits for a supply of power, a gasoline engine could be employed, or a steam engine of the standard portable type mounted on wheels, together with the necessary hauling-in gear.

Electric Lighting at the Delhi Durbar.

As if to distract attention from the abject poverty of the masses of India—or perhaps to distract temporarily the attention of these masses from their suffering—the government of that country recently indulged in a most gorgeous ceremonial costing, according to newspaper reports, some millions of pounds. To lend even more than Oriental magnificence to the Durbar, electricity was called into requisition, and a huge temporary generating plant erected, details of which are given below.

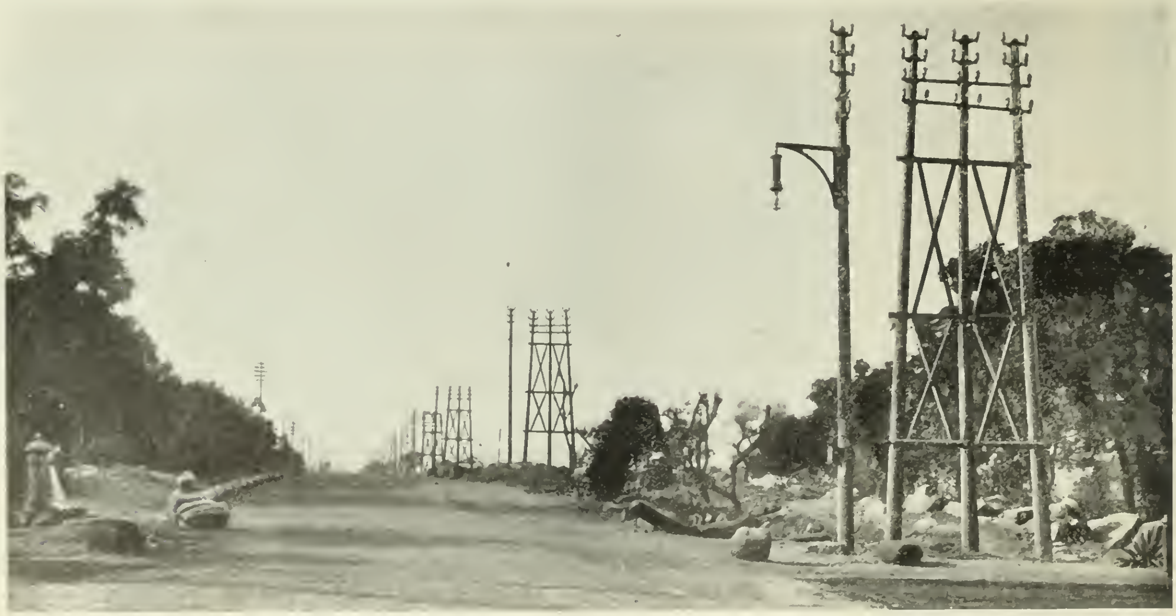

Fig 2.—View of Overhead Wire Construction, Delhi Durbar.

Work on the plant was commenced early last year, all material having to be sent to India from England. The site selected was in a rocky jungle, which was cleared for the erection of a boiler house 125 x 38 ft. and an engine house 125 x 28 ft., both being covered in with corrugated iron. Ten 50 hp boilers and two 80 kw and seven 40-kw direct connected generating sets were installed. Current was generated at 440-480 volts and two three-wire balancers employed. A switchboard 30 ft. in length was erected containing 10 dynamo, 13 feeder and two balancer panels.

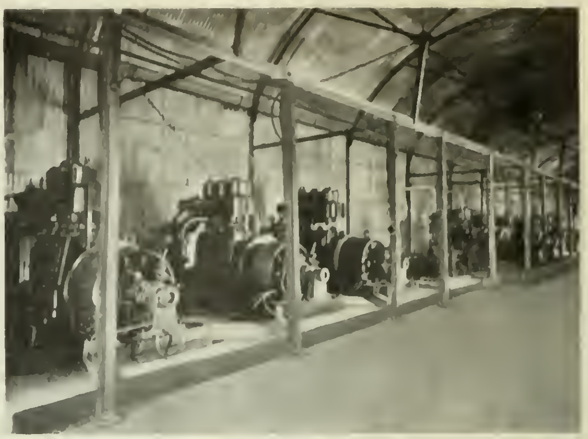

FIG. 1.—GENERATING PLANT.

The feeders were led from the switchboard to two special overhead constructions which carried the wires over the main road, from whence they were divided into the various overhead feeders, each of No. 0 bare copper wire. Over 600 poles of the tube type and 60 miles of No. 0 copper wire were used. The distribution to the tents was by lead-covered wire laid underground from the feeder points to the respective tents, this distribution having a total length of 35 miles. The wiring of the tents was carried out in braided vulcanized rubber cable, of which some 50 miles were used. Ordinary opal shade pendants were used for general illumination and decorative fittings in special tents.

The materials used in the tent wiring consisted of some 15 miles of flexible wire, 5,000 switches and cut-outs, 9,500 incandescent lamps and some 9,500 lampholders, carriers, etc. The street lighting consisted of 100 enclosed arc lamps and 380 incandescent lamps fitted upon the feeder and special poles. The light was switched on to the camps on December 7, 1902, and discontinued on January 22, 1903. The whole plant ran without a hitch throughout the Durbar, though the entire work was carried out by native labor. The staff engaged upon the works consisted of 38 Europeans and 1,000 natives, special camps having been built for their accommodation. The plant is now being dismantled and dispatched to the various military cantonments, where it will be re-erected and used for barrack lighting and punkah pulling.

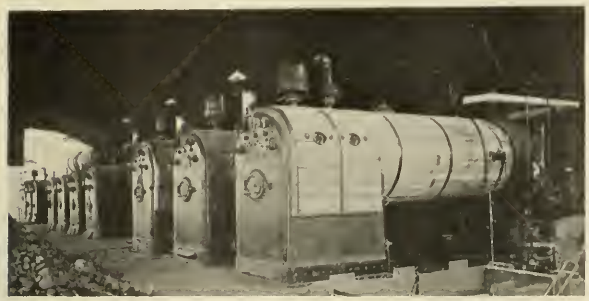

FIG. 3.—BOILER PLANT.

The Induction Coil.

By James Edmund Ives, Ph. D.

An induction coil consists of a primary, secondary, condenser and break. It may be represented graphically as in Fig. 1. In the figure, L_1 and L_2 are the inductances of the primary and secondary coils respectively; C_1 is the capacity of the condenser around the break, and E is the e.m.f. of the primary battery.

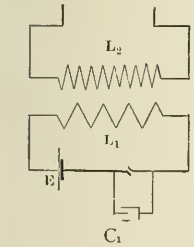

FIG. 1.—COIL CIRCUIT.

To get the greatest difference of potential in the secondary, the condenser must be adjusted so as to stop violent sparking at the break. Under these conditions when the primary circuit is broken, an oscillating current is set up in the primary, the period of which depends upon the inductance of the primary and the capacity of the condenser. This current is represented graphically in Fig. 2.

In the case shown in the figure, the primary current is supposed to be broken slowly, so that there are only a few breaks a second. The point *a* represents the point of time when the circuit is closed. The current then rises to its maximum value at *b*; is broken, and an oscillating current appears which vanishes at *c*. The period of this oscillation is given approximately by

$$(1) \qquad T_1 = 2\pi\sqrt{L_1C_1}.$$

It will be seen that the condenser around the break makes the primary current oscillatory. The changing current in the primary induces an e.m.f. in the secondary, and by Faraday's law the greater the rate of change, the greater will be the induced e.m.f. The greater the capacity of the condenser around the break, the flatter will be the curve shown in Fig. 2. Therefore, just as little capacity should be put in as possible, just enough to stop violent sparking. At present no law is known which determines this, but Walter and others have shown that if too much capacity is used, the length of the secondary spark is decreased rather than increased.

Lord Rayleigh (see *Philosophical Magazine*, Vol. II, pp. 581-594, 1901) has recently shown by experiment that when the primary circuit is broken very suddenly, as by a pistol shot, the condenser around the break can be dispensed with. In this case the primary circuit is broken so suddenly that there is no time for the potential of the condenser to rise to a sufficient value to cause sparking. This experiment shows that the function of the condenser is to produce as rapid a fall of the primary current, with as little sparking, as possible. Much sparking leads to conduction across the break, and the current cannot then fall rapidly.

The sparking in the primary is, of course, due to the *induced* e.m.f. in the primary, and not to the relatively small e.m.f. of the battery. That capacity of condenser which gives the longest spark in the secondary has been called by Johnson the *optimum capacity*. It depends upon the initial value of the primary current, and also upon the constants of the primary coil; that is, upon its inductance, its resistance and the resistances of the condenser connections. Every coil should, therefore, have a variable condenser. For different currents the condenser must be adjusted so as to give the longest spark in the secondary for that current.

The oscillating current in the primary produces an oscillating difference of potential between the terminals of the secondary, the value of which depends upon the relation between the primary inductance, the secondary inductance, the primary capacity and the secondary capacity. The capacity of the primary circuit is, of course, the capacity of the condenser around the break. The capacity of the secondary is the distributed capacity of the coil due to the fact that the turns of wire lie very close to each other.

Neglecting the damping due to the resistances of the coils, the general equation for this oscillating secondary potential is:

$$(2) \qquad V_2 = \frac{I_0 M}{L_2C_2 - L_1C_1}\left[\sqrt{L_2C_2}\,\sin\frac{t}{\sqrt{L_2C_2}} - \sqrt{L_1C_1}\,\sin\frac{t}{\sqrt{L_1C_1}}\right]$$

where

V_2 = secondary potential,
I_0 = initial primary current,
M = mutual inductance of primary and secondary,
C_2 = distributed capacity of the secondary;
L_1, L_2 and C_1 have the same significance as in Fig. 1.

It will be seen that it is made up of two component oscillations having the periods

$$(3) \qquad T_1 = 2\pi\sqrt{L_1C_1}, \qquad T_2 = 2\pi\sqrt{L_2C_2}.$$

It has been found by experiment that for all coils, even large ones, the secondary distributed capacity is very small, and consequently that the product, L_2C_2, can be neglected. Taking this fact into account (2) becomes

$$(4) \qquad V_2 = \frac{I_0 M}{\sqrt{L_1C_1}}\,\sin\frac{t}{\sqrt{L_1C_1}}$$

For a well-constructed coil, we may assume that there is no magnetic leakage; that is, that all the lines of induction through the primary cut the secondary when the primary current is broken. In this case $M = \sqrt{L_1L_2}$, and equation (4) becomes

$$(5) \qquad V_2 = I_0\sqrt{\frac{L_2}{C_1}}\,\sin\frac{t}{\sqrt{L_1C_1}}$$

The maximum difference of potential in the secondary, determining the length of the secondary spark, is, therefore, given by

$$(6) \qquad V_{2\,max} = I_0\sqrt{\frac{L_2}{C_1}}$$

The maximum difference of potential generated in the secondary, therefore, depends upon the value of the primary current before it is broken, the inductance of the secondary, and the capacity of the condenser. It varies directly as the initial primary current, as the square root of the secondary inductance, and as the square root of the reciprocal of the primary capacity. It is to be observed that it is independent of the primary inductance.

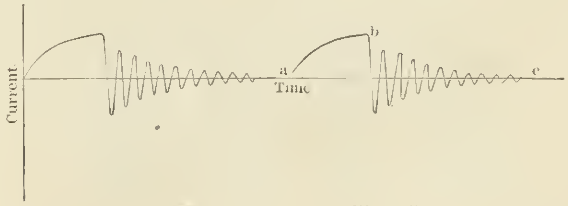

FIG. 2.—OSCILLATING CURRENT WAVES.

Equation (6) has recently been confirmed by the experiments of Klingelfuss (see *Annalen der Physik*, Bd. 5, pp. 837-871, 1901). His experiments show that for coils giving sparks of all lengths up to 100 cm:

1. The secondary spark length is directly proportional to the number of secondary windings.

2. The primary induced e.m.f. is proportional to the primary current.

3. The secondary induced e.m.f. is also proportional to the primary current.

The maximum difference of potential that can be obtained from any coil can, therefore, be calculated from (6) if I_0, L_1 and C_1 are known

It is to be noted that theoretically as large a difference of potential as desired can be obtained by decreasing C_1. Practically however, this is limited by the sparking. When the break begins to spark violently the secondary potential decreases instead of increasing.

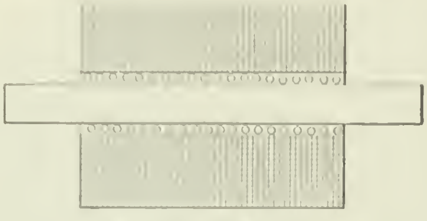

FIG. 3.—STRAIGHT COIL.

Klingelfuss has pointed out the important part which the primary induced e.m.f. plays in the theory of the coil. When the primary current is broken there is, of course, an e.m.f. induced in the primary circuit as well as in the secondary. The maximum value of this primary induced e.m.f. is given by

$$(7) \qquad V_{1\,\max} = I_0 \sqrt{\frac{L_1}{C_1}}$$

a formula similar to (6).

It is found that for induction coils the formula for the transformer holds approximately, viz.:

$$(8) \qquad \frac{V_2}{V_1} = \frac{n_2}{n_1}$$

Where n_2 and n_1 are the number of turns in the secondary and primary circuits respectively. Therefore, if the number of turns in the two coils, and the primary induced e.m.f. are known, the secondary e.m.f. can be calculated. V_1 can be calculated from (7) if I_0, L_1 and C_1 are known.

The determination of the inductance of a coil having an iron core offers some difficulty, since the primary current is oscillatory, and the permeability varies with the strength of the current. This difficulty may be met by determining the inductance for a small current, and then for the maximum current, and taking the mean.

THE CONSTANTS OF A COIL.

Walter (see *Annalen der Physik*, Bd. 62, pp. 300-322, 1897) found for a 30-cm coil, a mean value for L_2 of 620 henries. With $I_0 = 3.6$ amp and $C_1 = .22$ microfarads he obtained a spark 20 cm long, representing an e.m.f. of 130,000 volts. In the primary circuit he found $I_0 = 3.70$ amp, $L_1 = .122$ henries, and $C_1 = .22$ microfarads. Therefore, E_1 was equal to 2,750 volts. For a 60-cm coil he found a mean value for L_2 of 9,000 henries.

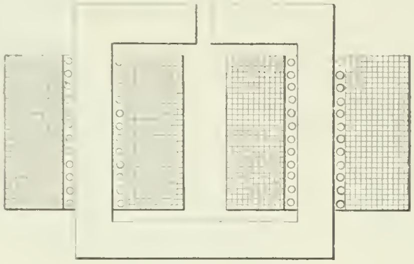

FIG. 4.—HORSESHOE COIL.

Klingelfuss experimented with two types of coils, one the ordinary type of a straight coil, shown diagrammatically in Fig. 3, the other the horseshoe type, shown in Fig. 4.

Varying the number of secondary turns, he obtained the results given in Fig. 5.

Curve I gives the results for the horseshoe type. II, for a straight coil with a core of large cross-section. III, for a straight coil in which the core had a square cross-section, being made of Swedish iron, 05 cm thick. The ratio of the length of a side of the cross-section to the length of the core was 1:20. He found that if a core was used in which the ratio of a side of the cross section to the length was 1:12, the spark length was increased about 25 per cent. IV gives the results for a Carpentier coil, having a maximum spark length of 45 cm. His experiments were made with a mercury break in which the breaking pole was an amalgamated copper wire, dipped in and out by hand. The mercury was covered with a layer of petroleum. My own experience has been that this break is the most efficient. The spark length in the secondary was measured between a blunt positive point and a negative plate. The curves in Fig. 5 show:

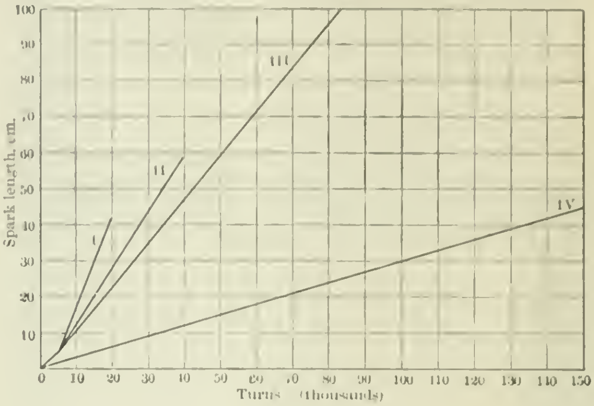

FIG. 5.—RESULTS OF VARYING SECONDARY TURNS.

1. That the horseshoe form is more efficient than the straight form. It cannot, however, be used for high differences of potential, as the sparks jump from the coils to the iron and thence across the air-gap.

2. That the greater the amount of iron in the core, the longer the secondary spark. My own experiments show that as the number of iron wires in the core is increased, the secondary potential rises very rapidly at first, and more slowly afterward (see *Physical Review*, Vol. XIV, Figs. 6-9, 1902). One of these curves is reproduced in Fig. 6. The iron wires were of soft iron 35 cm long and .0830 cm in diameter.

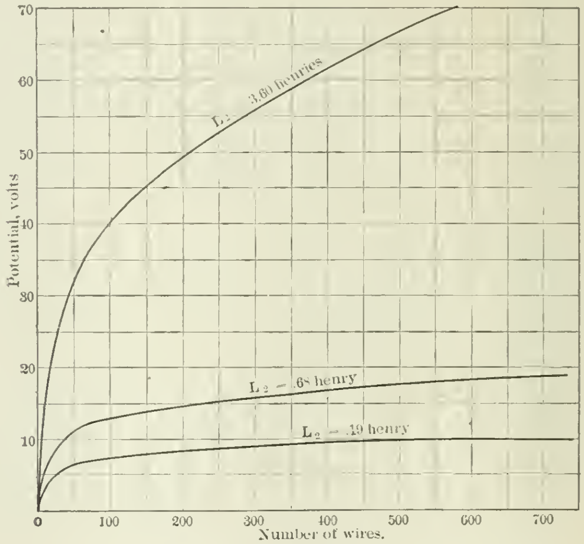

FIG. 6.—CURVES SHOWING EFFECT OF IRON IN CORE.

3. That a coil of a relatively small number of turns, when properly constructed, and used to the best advantage, can be made to give very long sparks. He obtained sparks 100 cm long with only about 85,000 turns. To achieve this, the secondary must be well insulated, the most efficient form of break must be used, and the condenser around the break must be variable so that the capacity can be adjusted to

that most suitable. The importance of this last condition is shown by the curves in Fig. 7, taken from a paper by Mizinro, in the *Philosophical Magazine,* Volume 45, 1898.

These curves show how the secondary spark length is increased up to a certain point by increasing the capacity of the condenser, and then is decreased. The peak of the curve gives the "optimum capacity" for a given primary current.

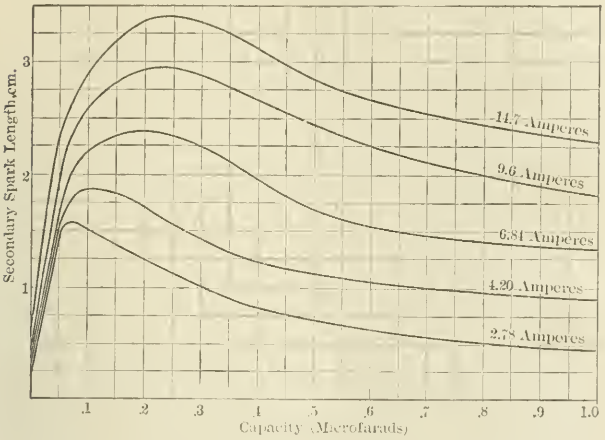

FIG. 7.—EFFECT OF VARYING CAPACITY AROUND THE BREAK.

In my paper in the *Physical Review* I have given the dimensions and corresponding inductances and resistances of a number of secondary coils. The inductances were determined with an air core. These tables are reproduced in Tables I and II below. The coils were wound with No. 34 B. & S. single silk-covered copper wire. Each layer was separated from the next by a strip of thin paper. In Table I each coil is given separately, while in Table II they are taken in groups placed side by side upon the primary. The primary was made of two layers of No. 12 wire and had the following dimensions:

Number of turns in outer layer	109½
Number of turns in inner layer	109
Total number of turns	218½
Mean length	25.63 cm.
Diameter of the outer coil	4.47 cm.
Diameter of the inner coil	4.11 cm.
Diameter of the wire	.230 cm.

Its self-inductance with an air core was .000281 of a henry.

THE CONSTRUCTION OF COILS.

The best form of induction coil appears to be the straight form with a long core projecting three or four inches beyond the secondary. The object of this arrangement is to economize the secondary wire, since the number of lines of force cutting a turn of the secondary is greater at the middle of the primary than it is at the ends. This is illustrated by the curve of Fig. 8, which is taken from my paper in the *Physical Review.* It shows the flux of force through a single turn of the primary coil at different points of its length. The primary used was that of which the dimensions have already been given. Curve 4 was calculated. Curves 1, 2 and 3 were found experimentally.

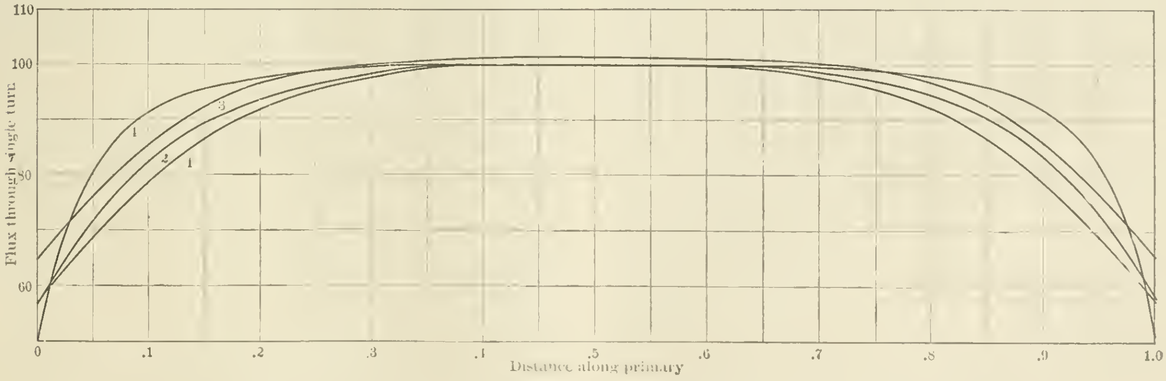

Fig. 8.—Curves Showing Flux at Various Distances Along the Primary Coil.

Various rules have been given for the length of wire needed to produce a spark of required length, such as "a mile of wire to every inch of spark"; but it is evident that such rules mean very little since the secondary difference of potential depends upon the diameter of the secondary wire, the character of the core, and the conditions prevailing at the break. The only way to have definite knowledge about a coil appears to be to measure the inductance of the secondary. Then if the value of the primary current and of the capacity of the condenser around the break is known, the secondary potential can be calculated from equation (6).

TABLE I.

Mark.	No. of Turns.	Inside diameter in centimeters.	Outside diameter in centimeters.	No. of turns in a layer.	No. of layers.	Self-inductance in Henries.	Mutal inductance with primary in Henries.	Resistance at 21° C in Ohms.
AI	5469	7.62	13.00	52-60	100	3.551		1527.0
AII	4600	7.62	13.00	50	92	2.594		1351.7
BI	5558	7.36	12.85	52-59	100	3.595	.00763	1516.0
BII	5000	7.36	12.49	50-57	95	2.913		1365.0
BIII	5000	7.37	12.82	50	100	2.951		1391.3
BIV	5000	7.34	12.25	51-60	90	2.934		1425.1
CI	1250	7.39	8.88	50	25	.1867		297.8
CII	1250	7.36	8.85	50	25	.1896		298.5
CIII	1250	7.37	8.87	50	25	.1880		297.5
CIV	1250	7.40	8.95	50	25	.1893		295.8
DI	2500	7.38	10.28	50	50	.684		612.2

TABLE II.

Coils used.	Self inductance in Henries.	Mutual inductance with primary in Henries.
BII+BIII	9.67	
BII+BIII+BIV	18.92	
BI+BIV	11.06	.0145
BI+BIV+BII	20.84	.0213
CI+CII	.5774	
CI+CII+CIII	1.076	
CI+CII+CIII+CIV	1.639	

Telephones for the Sick.

Telephones in the sick room, it appears, are not altogether a novelty. The latest instance reported is that of a Wall Street broker who was ill with scarlet fever in the late fall and was quarantined in a private ward of one of the city hospitals. He had a telephone placed at his bedside, and over it transacted all the details of his business during his convalescence, when the danger of contagion is greatest. In less than four weeks, while still a prisoner in his room, he executed deals that netted him more than $16,000, with which he hopes to pay his doctor's bill.

Thurston on the Steam Turbine.

At the March meeting of the New York Electrical Society, Prof. R. H. Thurston delivered a lecture entitled "Steam Turbines up to Date," of which we give below an abstract.

Though the beginnings of the steam turbine are found in the earliest historic times and in the earliest technical literature, its progress is wholly modern and mainly recent. Only after the evolution of the modern physical and mathematical sciences could its action be understood and the machine be properly designed, only after modern tools and methods of mechanical construction had become refined could it be built in safe and economical forms. The influence of the Alexandrian school upon modern engineering is shown to have been mainly through the philosophers who sowed the seeds of which we now see the germination and the fruit. They were necessarily dormant during the nearly two thousand years which elapsed between the days of Greek philosophy and modern, practically applied, science

The fundamental ideas of the theory of the steam turbine were considered as embodied in the modern steam turbine. The transformation of energy from its thermal into its dynamic form was traced and the principles controlling the thermodynamic change and the limitation of wastes were exemplified, both for the ideal case of the perfect machine and for the practical construction of the day. The method of development of thermal energy was exhibited and the mechanism of the process of change into dynamic form shown.

The turbine is not a thermodynamic machine, but belongs to the same class as the hydraulic turbine and its design, construction and operation are controlled by the same ultimate principles. The radical distinction between the types of the ancient Greek and of the engineer of the seventeenth century was pointed out and the influence of this difference in type upon the practical value of the invention brought out. The limitations controlling the engineer in his design and construction due to this difference in type were explained and their effect upon the economic value of the turbine shown. Notwithstanding these limitations it is found that the turbine is more nearly a "perfect steam engine" than any other known type, so far as its design and construction are concerned. It remains to be seen what the practical outcome is to be.

The economies and the wastes of the steam turbine were discussed and it was found that the machine, if its construction can be made perfect, will operate precisely as would its purely ideal representative. Its preliminary thermodynamic conversion of energy in the formation of its jet within the nozzle is exactly conformatory to the scientific theory of the case, and the action of the turbine itself, receiving the jet, is that which a scientific and perfect construction would illustrate, in so far as energy conversion is concerned, if the apparatus be correctly proportioned and constructed.

It is discovered, on investigation, that the wastes of the turbine, as now illustrating the best work of the time, are apparently not far different in amount from those of the best work on the older type of steam engine, the piston engine, but that these wastes are of a different sort and peculiarly distributed. The problem of their reduction is a radically different one from that of the older engine.

The present status of the turbine as respects design was shown and its relation to the ideal standard of the engineer was examined into. The Hero turbine as used in "centrifugals," the Branca type as employed in the same class of machines, the old Avery and Atwater types, and the recent forms of De Laval and Curtis, Parsons and Rateau, were shown to approach the theoretical ideal more completely than ever has or probably ever can any reciprocating engine. It does not necessarily follow that they will ultimately excel the common type of steam engine in every-day practice; it simply means that to this extent they possess certain fundamental advantages. The fundamental principles of the steam turbine being now entirely familiar to the engineer, its design has become one of the simple problems of construction and may be carried out with perfect comprehension of the requirements of the case as well as of the methods of successfully meeting those demands.

The now familiar types of simple and of compound turbine illustrate the familiarity of the engineer of to-day with this task. He recognized his limitations, as set by the weakness of his materials of construction and by the essential requirements for maximum thermal and mechanical efficiency which make demands upon him which are in precise opposition. He effects the best compromise possible in the one case and endeavors by a modified design to evade those limitations in the other case. Various expedients and various special devices, some of them amounting to real inventions, are found to be more or less successful in effecting this improvement and the differences among the steam turbines of the day are largely of this sort.

The fundamental principles of the compound turbine are simple and all forms of such machines are fundamentally the same in principle.

The performance of the steam turbine of the day, as observed by the lecturer and as shown by the work of many other investigators, was found to be excellent beyond the anticipations of the most sanguine among older practitioners. Figures presented show that the machine is about as economical as other engines of the same power, that its regulation may be made satisfactory and its adaptation to special purposes is remarkably perfect. It is found that while experience is not by any means as complete and judgment, therefore, not so well based as with the more familiar types of engine, the conclusion is probably well justified that this form of steam engine has come to stay and that it will find its field and a broad one in the engineering of the future.

Opportunities for improvement are found, on investigation of the theory and of the performance of the machine, comparing the predictions of a pure theory with the results obtained in a refined practice, to be very large. The direction which these improvements must take is shown clearly by experimental research and the way is clearly visible to all scientific designers and inventors. It is easily shown that there are two, and practically only two, ways of securing further gain in the efficiency of the turbine, the one involving the refinement of the construction of the machine, the other relating to the treatment of the working fluid. The method is simple in its requirements, but the practical meeting of these requirements may involve some difficulties. However that may be, the designers of to-day are competent, well-informed, and have the scientific training needed. They may be expected in due time to attain a high degree of success.

The characteristic advantages of the steam turbine in its now standard forms are, for certain purposes, peculiar and very important. The adaptations of the machine to driving high-speed machinery, to the turning of the armature or the field of the dynamo, to the purposes of the marine engineer, present promising problems. Their solution is already well advanced, in most cases, and we already know that the turbine may be made of use in the operation of machinery, as of alternating-current generators in multiple, where the difficulties with other motors are found to be singular and serious. These advantages are illustrated by the details of the engine trials and of scientifically conducted investigations lately effected.

The- trend of progress and the promise for the immediate future is in the direction of further gain in economy of the machine by suppression of leakage and of friction of fluid within its casing by improved workmanship and by securing a better working substance by freeing it from water and also by utilizing the process of superheating to increase the thermodynamic range. This means, however, improvement at the boiler rather than at the engine; which latter is fitted in all its forms to employ superheated steam of any temperature that can be practically furnished from the steam generator.

The trend of progress at the moment is also toward the application of specially designed and constructed turbines to special uses. It is probable that, gradually, forms will be adapted particularly to use in electric light and power "plants"; others will find employment as marine engines and still others in other varieties of work. The regulation and the adjustment of speeds constitutes a problem, already satisfactorily solved in some cases, but which requires some further consideration in adaptation of satisfactory regulating mechanism to some special forms of turbine and to some special uses.

The promise would seem at the moment to be the introduction very widely of a new type of prime mover which adapts itself in a peculiarly happy manner to purposes for which the common forms of steam engine are not likely to prove as perfectly satisfactory. The indications are that the supply of power by means of this motor will be made as low as with the best types of reciprocating engine and possibly lower; while its simplicity of plan and ease of construction would seem to insure freedom from liability to either accident or depreciation of value to any important extent for long periods of time. The theory and the practical modification of theory in the design, construction and use of the machine are so well understood and the real so closely approaches the ideal that the engineer may readily see his way toward the solution of any practical problem of design that may be presented, while he also may as readily see a remedy for any observed defect of efficiency or of mechanical action. It should, therefore, be expected that such approximation to the ideal perfect machine as is possible will soon be attained; particularly as, already, the study of the theory and the observation of the practice of the time with this machine is now being made the task of an immense number of learned men of science, of able practitioners and of skillful constructors. Probably never, in the history of engineering, was so simple a machine made the object of investigation of so large a number of able men, inventors, constructors, engineers and men of science, and the subject of such extensive experimental research.

It is very possible that, through the development of this ancient device we may yet see the nearest approximation to ideal thermodynamic and mechanical efficiency in the group of heat motors that man can attain.

To Discipline Dishonest Electric Companies.

A press dispatch from Albany, N. Y., of March 17, says: There was a hearing to-day before the Senate Finance Committee on Senator McEwan's bill to establish a State electrical laboratory. It provides that the Governor, the State Controller and State Engineer, together with Charles P. Steinmetz and Harold Winthrop Buck, shall be constituted a commission to construct a State electrical laboratory which shall provide for the standardizing and calibrating of electrical meters.

They said that at the present time there was no redress for the man who received less in electrical power than he paid for, outside the courts, and even when he went into court he stood little show of winning his case because of the fact that no impartial board existed in the State to pass upon the facts.

"The necessity for such a laboratory and such inspection in this State," said Mr. Steinmetz, "will be understood and appreciated when I tell you that there is $2,000,000,000 invested in electrical plants and apparatus in this State. The man who buys a pound of sugar knows whether he is being cheated, but such is the limited knowledge which the ordinary person has of electricity that the purchaser of that commodity has to trust to Providence for his due."

In response to many inquiries, we give the full text of the bill below:

The Governor, the State Comptroller, the State Engineer and Surveyor (Edward A. Bond), together with Charles P. Steinmetz and Harold Winthrop Buck, are hereby constituted and appointed a special commission to construct and equip a New York State electrical laboratory with such other duties as are hereinafter designated.

The commissioners shall select and acquire for the people of the State of New York upon such terms as they may approve a site for the location of a State Electrical Laboratory and proceed to construct suitable and proper buildings for the same, according to plans and specifications to be furnished by and under the supervision of the State Architect, and to equip, supply and furnish the same.

For acquiring the site and for the construction and equipment of such State Electrical Laboratory the sum of $275,000 is hereby appropriated, which sum shall be payable by the State Treasurer on the warrant of the Comptroller, out of moneys not otherwise appropriated, on bills audited by the said commissioners, or a majority of them. The said State Electrical Laboratory shall provide for the standardizing and calibrating of electrical meters and other electrical appliances and apparatus and for such independent investigations and experiments in electrical science as will furnish accurate and impartial data for the use and benefit of the people of the State of New York in the settlement of disputes arising from the development and use of electrical power; and for such further researches and experiments as will tend to increase knowledge of electrical power, and its application to serviceable ends.

The commissioners shall appoint a director of said Electrical Laboratory and fix his compensation and term of service. They shall further prepare a plan for management and control of said laboratory when completed, and shall have power to designate and appoint the members of a board of governors whose duty it shall be to direct and supervise the work of said laboratory, selecting and appointing all necessary employees, fixing their compensation and terms of service, prescribing their duties, formulating rules to govern work of the laboratory and determining fees of standardizing and calibrating, including the furnishing of certificates of conformation to the standard and compliance with the rules of the board, which certificate shall be prima facie evidence of the facts therein stated, and for such other work as may be properly subject to charge. All fees received by said laboratory shall be turned over to the State Treasurer to the credit of the general fund.

When completed and in operation, said State Electrical Laboratory shall receive and be open to and for the use of students in electrical science in any university, college or technical school which is or has been incorporated with the University of the State of New York under such rules and regulations as may from time to time be made by the board of governors of said laboratory, or by the director under their authority.

The Principles of a New Method of Electric Lighting.

By Paul Hoho.

The principal sources of electric light at present in practical use or in an experimental stage are as follows:

1. The voltaic arc.

2. The incandescence of solid bodies, due to the heat disengaged in accordance with Joule's law by the passage of an electric current. This class includes the carbon filament incandescent lamp, the more recent Nernst lamp with a glower having for a base an alkaline earth oxide, and finally, lamps with filaments of a metal or metal oxide impregnated with silicon or one of the rare earth metals.

3. The incandescence of rare gases, also due to the heat disengaged by the passage of an electric current. This method of obtaining light, the principle of which was long ago applied in the Geissler tube, has lately taken on a practical aspect.

The object of this article is to bring forward a new method of electric lighting which does not come in any of the above classes. I may at once say that this method has, at least for the present, no practical application, but it appears to be sufficiently interesting from a scientific point of view to be described, and I shall endeavor to point out what may be the future of the method, and in what manner it may be practically applied.

In the past I have had occasion at different times to refer to a heat and light phenomenon which occurs under certain conditions upon the passage of an electric current through the surface of contact of a solid and a liquid, and, in general, at the surface of contact between a good and a bad conductor. In a paper * which I presented before the Belgian Royal Academy (3rd Series, tome XXV, No. 2, 1893), it was shown that by means of this phenomenon temperatures may be attained higher than have yet been realized by any other method. The two final conclusions of this paper are as follows:

"1. By means of the phenomenon considered, temperatures may be attained incomparably higher than has heretofore been possible with any other method of producing heat; in principle the quantity of heat disengaged per second at a given surface is unlimited, and finally the only limit to the temperature that may be practically obtained is set by the output capacity of electrical generators.

"2. At the surface of contact between the electrode and the electrolyte there is an electrolytic action united with an extremely intense calorific action of such a nature as, under certain conditions, to effect powerfully chemical action."

In the production of heat, it should be borne in mind that the luminous rays are heat rays and that the proportion of light rays to the total number of heat rays—that is, the luminous efficiency—varies, first, with the nature of the body emitting the rays, and second, with the temperature of this body. Since the above-mentioned phenomenon gives rise to temperature higher than can otherwise be attained, it also involves the production of light with an efficiency higher than by any other method.

This is true in principle and there remain to be found a means of practical application. Metals can instantaneously be brought to the highest temperatures and fused, but the fusing temperature of

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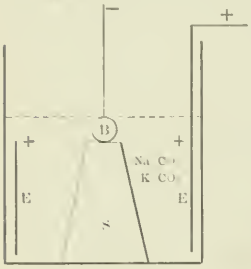
* M. Eug. Lagrange collaborated in the preparation of this paper.

the more refractory metals, such for example as platinum, is considerably less than the temperature of the incandescent lamp carbon filament and that of the voltaic arc. If carbon be submitted to the above mentioned action of electric current in a liquid, it is in a very short time brought to a white heat with an intense glare; and some of our experiments have appeared to indicate that carbon, though considered infusible, has actually been fused by this process.

It is evident that the temperature of the carbon filament of the incandescent lamp can be carried to a much higher temperature than the normal by simply raising the voltage of the lamp. The delicate thread cannot, however, stand any considerable increase above the normal, whereas there is nothing to prevent carrying to the highest point the temperature of a rod of carbon plunged in water. Unfortunately, the part thus heated is that which is in contact with the water, and a mechanical phenomenon occurs which I have never been able to prevent, no matter what kind of carbon was employed: namely, the tearing off of fine particles of carbon, which discolor the water. We cannot thus hope to produce light in this particular manner.

I next experimented with other materials of infusible character, and notably with the metallic oxides and salts, more especially with silicon. While most of these substances are very bad conductors, there are a few exceptions, for example, the bioxide of manganese. When this latter is employed as negative electrode, it is immediately fused, and at the same time a certain chemical action occurs. The bioxide is reduced to metallic manganese, which falls to the bottom of the receptacle in the form of drops, or being reduced to a less degree than the original oxide, Mn_2O_3 and Mn_3O_4 are formed. The same reactions are produced with other oxides and with sulphur compounds, such as the oxides of iron and the pyrites, and with certain salts; but the point of fusibility of these metals is too low. It is necessary to have an infusible body or one melting at a very high temperature and which is also a good conductor, in order to produce light by its incandescence in a solid state, or at least by its incandescence in a liquid state.

While I do not know of any oxide or salt which fulfills these conditions, and especially one refractory to heat, while at the same time a good conductor, I have tried to make artificially such a conductor. There are two methods by which this may be done. The first consists in mixing a refractory with a conducting substance, and wetting the resulting body by simply plunging it in the liquid of the bath. Should this substance be somewhat porous, it will absorb a certain quantity of the liquid, which is itself a conductor, and thereby increase its conductivity, which augments with the porosity of the body. If the substance is absolutely non-porous, a certain amount of the conducting liquid will remain on the surface to prime it.



HEAT CELL.

The second method is one which has been employed in connection with lamps of the earth-alkaline oxide type. While the conductivity of metals diminishes as the temperature increases, the opposite is true of these oxides and their salts. Their conductivity increases in a very large ratio with the temperature, and many of these substances which show no conductivity at an ordinary temperature, become conductive when the temperature is raised even slightly.

For example, ordinary glass, with a base of soda and lime, has at 20° a specific resistance of 91 mega-megohms, and this is reduced to 0.705 mega-megohms at 60°. Quartz shows no conductivity below 40°, while at 46° the specific resistance becomes 6,182 mega-megohms and at 105° falls to 11.6 mega-megohms. I may add that all fused substances are conductors of electricity.

By a rational and judicious combination of the means whereby a refractory body can be made more or less conductive, a practical result may be attained. The reactions that take place are, however, extremely complex and somewhat as follows:

To start with, there is a *double* calorific action of the electrical current. First there is the action in the gaseous envelope which separates the liquid from the solid: and as the solid has a high specific electrical resistance, an amount of heat is produced which can become very considerable.

To the calorific action must be added the chemical reactions of the elements which compose the body and of the conducting liquid. All these act together and the intensity of the chemical reactions are strongly aided by the simultaneous action of the phenomena of electrolysis. These reactions evidently vary indefinitely, according to the composition of the substances acted upon. To illustrate I shall describe an experiment with a small sphere composed of a mixture of silica and silicates, notably of aluminum, which gives a mixture more or less homogeneous. The conductive liquid consists of a five per cent. solution of carbonate of soda and bicarbonate of potassium. The exterior conductor to the sphere is an iron wire.

Following are the successive operations: The small sphere *B* composed of a mixture of silicon dioxide and of silicates rests on a support, *S*, so as to be submerged about three-quarters in the electrolyte, composed of bicarbonate of soda and bicarbonate of potassium. The negative side of the electric circuit is brought to the sphere by means of an iron wire. The positive side is connected with the electrode, *E*.

If the circuit is closed, the electrolyte entering the pores imparts a sufficient conductivity to give rise to a slight luminous phenomenon at the surface of the sphere. This, however, soon ceases on account of the water evaporating from the sphere, which must then be remoistened. This luminous phenomenon develops slowly. Simultaneously, two other reactions intervene. The luminosity is a manifestation of a calorific action which at first slight increases slowly and progressively the temperature of the sphere, which in turn increases its conductivity. There is also a chemical reaction. The potassium and the sodium freed by the electrolytic action coming in contact with the silica and the silicates, enter into chemical combination with these as soon as a definite temperature is reached. Small particles of silicate of potassium and sodium in a state of fusion are then formed. These bring about a greater calorification, which augments the conductivity and therefore increase all the preceding phenomena, especially the production of heat.

On the other hand, the iron also enters into combination with the oxide of silica and the silicates and forms a silicate of iron, also in a state of fusion. This can be easily recognized by its dark greenish color.

All of these phenomena take place simultaneously and assist each other, forming finally on the sphere a conductive layer, composed of various mixtures of silicate, especially alkaline silicates, silicates of iron and, of course, silicates of aluminum and silica dioxide. The current will then continue to pass with an even strength for several hours.

The current thus produces a *double calorification,* first at the contact with the water and through the conductive envelope, and secondly by the direct passage of the current in the fused matter.

As for the chemical reactions, I have indicated the theoretical ones, but aside from these others manifest themselves, and, among these there is one of considerable importance.

I consider it certain that the silicon is freed and that consequently a light is produced by the metallic silicon in an incandescent state. I have tried unsuccessfully to distinguish the rays of silicon in the spectrum of this light, but it must be remembered that the rays of silicon are extremely weak.

Under like conditions I have experimented with marble, which has given me similar results. While the chemical reactions are different, their effect is practically the same, but in this case it is possible to distinguish the calcium spectrum.

I shall now make two statements to which I attach great importance:

1. It is evident that the electrical current is in the necessary condition to bring about electrolytic action, that is to say, to decompose the salts and the oxides. Nevertheless, this must not be taken to mean that the entire current produces this action. It may be that part of the current passing produces merely a calorific action without an electrolytic action.

To illustrate, a small sphere weighing about four grammes was for almost five hours subjected to a nearly constant current of 6 amp. If the current had all gone to decompose the silicate of alumina, there would have been produced a quantity 5 × 6 multiplied by the weight of alumina deposited per amp-hour (.337 grammes), or $5 \times 6 \times 0.337 = 10$ grains of aluminum. In point of fact, in that time the sphere lost only one-half gramme of its weight. From this I conclude either that only a part of the current exerts an electrolytic action, or that the elements which are separated ultimately recombine, and a continuous cycle of dissociation and successive recombinations takes place.

2. After a certain time an equilibrium is established. The water

assumes a definite level and the current a definite strength, which depends on the diameter of the sphere, on the e.m.f. and on the rate at which the water is supplied. These elements, therefore, give us the means of regulating at will the strength of current and the intensity of light. I have succeeded in causing a small sphere of this kind to glow for six hours with a current nearly perfectly constant.

3. The homogeneousness of the sphere plays a very important part. The sphere may have strata of more or less conductivity. If the mass is not perfectly homogeneous the small luminous manifestations which precede the priming may appear on one or the other side of the sphere, which cannot happen when it is perfectly homogeneous. In this case the luminous manifestations spread all around the iron electrode.

Precisely the same thing takes place in the case of the carbon arc, according as the carbon rod is of perfectly homogeneous composition or not. For proper results it is necessary to have the small sphere as nearly homogeneous as possible. The material of the experimental sphere was far from being of pure quality, and in construction lacked the care that might be given.

I have said that for this method of lighting no practical claims can at present be put forward. The material used offers an inconvenience in that the evaporation of the water gives rise to alkaline vapors which form noxious fumes, and these condensing on the reflector required to thrown down the light, tarnish it, and thus render it useless for that purpose. It is not, however, absolutely necessary to use alkaline salts or even any salt at all. With appropriate substances nothing should prevent the use, as an electrolyte, of salts which do not evaporate, or even of acids. The problem set is, therefore, as follows:

The combination of a luminous substance with an electrolyte and negative electrode, such that a surface-conducting layer will be formed which will not melt or at least only melt at a very high temperature. The question thus becomes merely a chemical one. Moreover, there is nothing to prevent the utilization of the rays of the decomposed elements, such as silicon and calcium.

I have shown that it is possible to obtain experimentally with a constant current a light of constant intensity. There only remains to clear the theoretical process of the imperfections inherent in all new systems.

The Coming Iowa Electrical Association Convention.

The Iowa Electrical Association will hold its regular annual convention at Davenport, April 8 and 9. The following programme has been arranged for: Wednesday morning, April 8, will be given to routine business. Reports of secretary, treasurer, Executive Committee, etc. Wednesday afternoon at 2 o'clock, will be given the report of a committee on "Electric Street Lighting Data," by W. S. Porter, of Eldora. "Proposed Legislation Relating to the Development of Plans for the Inspection of Wiring," will be the subject of a committee report by J. S. Bellamy, of Knoxville. The report of the committee to establish "A Uniform Method for Arriving at the Cost of Furnishing Electric Current" and to collect forms in use by the different companies, will be given by Isaac B. Smith, chairman, Cedar Rapids. A paper on the "Maintenance and Operation of Central Stations Operated by Steam Power" will be given by H. T. Fiske, of Muscatine. A paper on the "Maintenance and Operation of Central Stations by Water Power" is to be presented by George S. Carson, of Iowa City.

At 4 P. M. a trip by special electric car will be made to the Rock Island arsenal, and from there the party will go to Rock Island and Moline, visiting the power plant at the latter place.

Wednesday evening at 8 o'clock there will be a lecture, either by W. D. Ryan, on "Modern Illumination," or by Mr. Hine, of Chicago, on "Arc Lighting in General." The papers and reports for Thursday, April 9, beginning at 9.30 A. M., are as follows: Report of committee on "Feed Water Heaters," J. A. Innis, of Cedar Grove. Report of committee on "Data for City Pumping by Central Stations," D. F. McGee, Red Oak. Report of committee on "Lamp Testing," J. S. Carson, Iowa City. Paper on "Commercial Rates, Including Fan and Power Rates," L. L. Kellog, Sioux City. Paper, "Analysis of the Cost of Street Lighting," Austin Burt, Cedar Rapids. Paper, the "Necessity for Grounding Secondary Circuits," W. J. Greene, Cedar Rapids.

After this will follow the executive session, election of officers and adjournment.

The Inventor and the Trust.*

By William Stanley.

THE relationship of the industrial trusts to the public is receiving the attention of many able men at the present time. The old question of safeguarding the weaker and unorganized side from the possible misuse of power, obtained by the trusts through the control of the producing capacity of the country, is a cause for grave anxiety to economists; and public and personal attention is justly concentrated upon the probable economic results that may follow the trust-born conditions.

The question finally assumes this form: Will the general production of trust-made products eventually give the public cheaper and better manufactures, or will this new system of operating industries result in unhealthy restrictions to general trade and in prejudicial monopolistic conditions? While this question is of paramount importance, far exceeding in its scope the minor field of which I write, yet I think that a statement of the methods adopted by some of these new organizations in dealing with one of the fundamental causes of their existence, may throw a side light upon their general trend and purpose, and may enable us to prophesy their future lines of action.

Next to the national wealth of this country, I believe our national growth, strength and prosperity is due to the American inventor. I by no means wish to sing his personal praises, nor do I desire to compare his individual importance with that of other highly-trained men devoted to other professions, or to the arts, but I believe that there is more national capital, more reserved strength and more potential good to come in this purely American type of man than in any other type that we have as yet developed. It is not necessary here to analyze his qualities, or to synthetically rebuild him, but it may be stated that he possesses in no common degree, foresight and the courage of his convictions, imagery and imagination, confidence and capacity, and an almost unique ability to discern the fitness of conditions to harmoniously operate together.

If to-day invention were stifled, there would remain, it is true, engineering and scientific industry, and progress would be made undoubtedly in the expansion and development of the arts; but one of the great potential forces of the twentieth century would be lost, and a nation not unsimilar in its general characteristics to the Japanese, would inevitably follow.

I believe the present methods adopted by the industrial trusts in dealing with the inventor, his work, his aims, and rewards, will, if uncontrolled in the future, annul his usefulness, discourage his endeavors, disgust him with surrounding conditions, and finally remove hm from the land. Inventors follow more or less definite lines of work. A man may be proficient and fertile in mechanical invention, and unfamiliar with the chemical arts; he may show great ability in solving electrical problems and know little of the possibilities of improvement in separating metals from their ores. He frequently is tied to a definite art by personal peculiarities, local conditions, education, etc. He is, therefore, dependent upon his art, his peculiar line of work, for his reward; and, if this art is in the hands of unscrupulous or narrow-minded men, who control it, he is in a sad way.

The industrial trusts now regularly employ, on salaries or by retainers, bureaus known as boards of patent control. To these boards is entrusted the problem of controlling the arts, by means of patents. They are expected to purchase such patents as they deem expedient, to manufacture any others they think necessary, to gather up "fresh lines of patents" wherewith to assail competitors, to bring suits against infringers, real or imaginary, and generally to operate an offensive patent campaign against competition.

No more pernicious system of controlling trade has ever been devised, and none that is in reality as fatal to the value of honest patents, whether they be owned by the trusts or their competitors. To speak plainly, these patent bureaus pursue an organized effort to obtain illegal support from the United States courts. They, too, often endeavor to restrict trade by means of dishonest patents, obtained in various ways from the patent office, for the specific purpose of controlling an art long disclosed to the public, and consequently free.

The trust patent bureaus are occupied in litigation directed against their competitors. They endeavor to weaken competition by exhausting the resources of their opponents in costly legal proceedings, prosecutions brought under questionable patents, and sustained by expert witnesses, who are simply the salaried testifiers of the trusts.

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* Reprinted from *Springfield Republican*, where the communication appeared as a letter to the editor.

I cannot too strongly state those matters, nor, in a brief article, can I clearly describe all of the complex legal methods that are brought to bear upon their opponents by the trusts, but I may give one or two typical examples of the methods employed first, to control an art, and second, to discourage an inventor.

A few years ago an important advance was made in a well known art. The invention employed new and specialized machinery, and the application of newly discovered data and facts. Shortly after the inventor had successfully completed his working system, he demonstrated it before a number of trust officials, plainly describing its operation and pointing out its far-reaching possibilities. "The trust" proceeded as follows: First their attorneys drew up a patent specification, cleverly disguised as a "blanket patent" to cover the art on broad lines, and then sent it by special messenger to Europe to find an inventor to sign it. After a little preliminary work the messenger returned with the document duly executed. The papers were then delivered to a second trusted attorney, who was instructed "to get it through the patent office." The patent office was presumably honest, but of course ignorant of the true condition, and in a very short time granted the patent.

Here then was a patent that cost the trust a few thousand dollars signed, sealed and delivered upon which the trust proceeded to issue new stock to the amount of several million dollars, a patent that on its face was genuine, but in reality was the grossest fraud.

To keep the real inventor from making trouble the trust allowed him a small pittance, kept spies about him, copied his private papers, bribed his servants, spoke of him as untrustworthy, irresponsible, and generally cast stones at him; but in this case justice to the public, at least, was done. The United States Circuit Court on the first hearing brought under the fraudulent patent disqualified it, although in entire ignorance of its real history.

We may well consider whether this was an attempt to restrain trade, and whether such attempts are likely to stimulate invention by holding out suitable rewards to inventors.

One more example will illustrate a less heroic and more common trust trick. The *United States Patent Gazette* suddenly discloses the issue of a patent covering an important invention in an art. The trust attorneys see it, obtain copies of the patent from Washington, and decide to have it. The inventor is looked up and an offer to purchase his invention is made, coupled with some statement to the effect that one of the trust's inventors had worked out the same result some years before. Now, unless the inventor sells the patent then and there, he may be subjected to the following coercion: First, notice is served on him by the United States Patent Office that (although this patent was issued to him) an interference had been declared between his patent and a new application. Testimony is then taken as to dates of invention claimed by both parties. In all probability the real inventor proves his priority, and the contending application is dismissed; but—and here the important part comes in—the trust lawyers are now in possession of the inventor's sworn dates of invention, back of which he cannot go. Another application signed by another applicant is put into interference with him. Again the dates of invention are given, and the inventor now realizes that he has a hard fight for his patent on his hands. Testimony is taken (the trust does not appear in the matter, of course) and the interference drags along, sometimes for years. Occasionally the inventor is visited by the trust representatives, and suggestions that he sell out are given him in a roundabout way. In 99 out of 100 cases he sells for a trifle and finds himself impoverished and unknown.

Thus I have endeavored to give one or two examples of the trust practices in respect to patents at the present time. What these practices trend to, where they will lead in the future, what their effect will be on the growth of the arts, it is difficult now to foresee. It would appear that the trusts must either have honest, conservative management, or that they must be controlled by the firm hand of the law.

Already a wholesome movement is on hand: The engineers look askance upon the salaried experts who pack the cards for the trust lawyers, and I think the courts view their testimony with suspicion. The lawyers who conduct these litigations for the trusts do not impress one as overscrupulous; they lack the sincerity, the freehandedness, the genuineness that goes with fair dealing, and a sense of justice in their cause; and as a matter of statistics, they far more frequently lose than win their cases. Generally speaking, right does prevail, but it is purchased often by great sacrifice and sometimes by financial ruin.

I am of the opinion that many of the present evils arising from the misuse of patent control may be avoided: First by limiting the number of patents granted to those who clearly disclose invention, and by refusing the great majority of applications for so-called tributary, or subsidiary improvements, for these applications rarely disclose any new idea and are usually based upon the particular application of well-known engineering or scientific data. That is to say they attempt to control the application of engineering methods to a particular subject. Great numbers of these "supporting" patents are taken out by corporations in the name of their engineers, for the reason that each patent obtained serves as a basis for expensive litigation against competitors. Thus in one branch of a particular industry I remember that not long ago 40 separate suits were brought against an alleged infringer who in reality was entitled to manufacture his apparatus by reason of the legal expiration of the master patents covering the fundamental discovery in the art. Therefore, I unhesitatingly state that the patent office should limit its patent rights to the applications that disclose invention, and refuse those based on engineering equivalents or engineering skill.

Second, I believe that our system of patent litigation is responsible for the troubled conditions that now perplex the courts. Under the existing system of litigation the court never or rarely sees or hears the expert witnesses, and, therefore, cannot judge of their truthfulness or character. All expert testimony is taken before a stenographer or typewriter who is nominally an officer of the court, but in reality has no power to enforce the ordinary rules governing the taking of testimony, has no power to limit the length and cost of examinations or to confine the witnesses to the subject matter at issue; consequently the strongest, that is, the richest party may completely exhaust its opponent by direct or cross-examinations of great length (a most expensive element in patent litigation), and thus, in fact, tire him out.

I believe that testimony should only be given by qualified experts satisfactory to the court, who instead of being the accomplices of the lawyers employing them, should, in fact, be court advisers; men capable of fairly advising the court as to the facts and fundamental data at issue. Such testimony should be given before the court, and not its deputy. It should be controlled by the court, and be limited to a terse and clear statement of the principal facts, and not be allowed to generally roam around on unimportant outlying subjects.

Third, I believe that the laws applicable to a conspiracy to injure an individual or a business by unnecessary litigation should be strictly enforced, and possibly modified so as to control the coercion measures now too commonly employed by trusts. These laws should plainly apply to those cases where the trust, relying on the absence of individual responsibility of its officers, used its power to coerce an individual. "Sell us your patents or we will clean you out of business by legal expenses," said the head of a patent bureau to one of my friends a few years ago. "No," said he, "I'll fight." "Well, then fight if you choose, but remember I warned you."

Individually this gentleman was an honest, conscientious, fair-minded man; as the mouthpiece of his trust he was a roaring lion, but as yet he has roared in vain.

In considering the broad question of trust control we must, however, remember that many of these enterprises are still in the hands of their original promoters; that this is a promoting generation which is absolutely certain to pass away when the clarifying effect of less prosperous times appears. We must remember that the men dictating trust policies are of a very temporary type in general uneducated in the true, broad sense. They are men who are primarily anxious to place their securities on a sufficiently remunerative basis to attract the public as purchasers. It is to be hoped that they will be replaced by better educated, broader-minded and cleaner men, who if they do not venture on as daring financial voyages, will discourage the tricky methods now in vogue for coercing competition and restraining trade.

Marconi's Transatlantic Work.

According to a London dispatch, Mr. Marconi has stated in an interview that he is not prepared to accept any newspaper challenge to demonstrate transatlantic wireless telegraphy, but is ready to demonstrate, before any proper tribunal, his claim that wireless messages can be sent across the Atlantic.

The Construction of Aerial Telephone Lines—VII.

By Arthur V. Abbott, C. E.

ROUTES AND RIGHTS OF WAY.

The selection of a pole line route is a difficult matter, because a wise choice of the best route depends far more upon the exercise of judgment, and the experience of a long education in pole line construction, than upon the application of any specific set of rules or formulæ. There are two general principles which must never be lost sight of. These are that the shortest line and the straightest line is the best line. The selection of routes for city lines is governed by the location of the subscribers that it is desired to reach, and by the streets, alleys, or other thoroughfares along which rights of way can be obtained. A city line is best located by plotting upon a good map, showing all available streets and alleys, the location of the subscribers, and then reaching the various groups by such routes as will give the straightest and shortest lines. A large number of Western cities have long blocks which are split centrally by alleys. These are hardly thoroughfares in the true sense of the word, as they are rarely wide enough to allow passage of two vehicles abreast, but they serve as means for the delivery of goods to both dwellings and stores, and afford an additional access for light and air. There is usually little objection to the erection of pole lines in alleys, so where such opportunities exist the designer has comparatively an easy task to select the most favorable wire route, compatible with urban topography. In older and Eastern cities, alleyways are less frequent, and, of necessity, lines must be located along the traveled thoroughfares. It is rare to find a city so hilly that any special designing is needed to accommodate pole lines to vertical changes in alignment, so that this question may be dismissed from the consideration of city pole lines.

The selection of a proper route for a cross country line is in some respects easier, and in others more difficult than the choice of a city route. While in general aerial lines follow the highways, there is always the chance of cutting across private property and thereby either saving distance or avoiding ugly and dangerous corners, and from this aspect the choice of the country line requires more consideration, and a more careful examination of a proposed route, than is necessary in a city. In the location of city lines the obstacles presented by forests or the crossing of wide streams are seldom encountered, but country lines frequently meet these, each one of which must be dealt with according to the circumstances presented. In rural districts the line must necessarily follow the contour of the country, and must be built "up hill and down dale," accommodating itself the best it may to surface configuration. For this reason it is customary to proportion the height of poles to meet, as far as possible, the requirements of hilly territory by using the shortest poles on the summits and the longest poles in the valleys.

Rights of Way.—In both city and country lines questions of rights of way play an important part in the selection of pole line routes. In many States the courts have held that the erection of a pole carrying telephone wire imposes an additional burden upon the highways, and that, therefore, telephone companies cannot condemn right of way under eminent domain laws, but must purchase, or otherwise obtain leave to erect poles, specifically from each abutter. Municipal franchises have been construed from a similar point of view. Further, most telephone companies have found it on the whole to their interest to resort entirely to pacific measures to obtain necessary consent for the erection of lines, rather than to appeal to the courts. Partially, this is due to a fear on the part of telephone companies, that if the right of eminent domain (where legal) is exercised, appraising jurors will establish such a measure of damages for the occupancy of either highway or private property, as to set a dangerous and undesirable precedent, which, if established, would incite all property owners to make an equal charge for every pole—thus, on the whole, raising the cost of construction above that which now obtains even when burdened by such damages as are occasionally demanded by miserly owners.

It is to the last degree desirable that questions of right of way should be fully and thoroughly settled prior to the commencement of work. If this is not done, the pole line gang, as it proceeds, is hindered and delayed, and the cost of erection enormously increased by objections which are sure to be interposed by property owners who feel that their just rights are being unwarrantably invaded. Again, it is relatively an easy matter to secure the right of pole erection, or tree trimming from an owner if approached by a polite and tactful right of way agent. If construction is commenced in the absence of a definite and well-understood agreement, the owner is likely to be raised to such a pitch of, what appears to him, warrantable indignation as to render it impractical to subsequently secure any consents whatsoever, and a resort to the courts, or a change in location, is the only remedy. Moreover, it is very greatly to the interest of the telephone company owning a pole line to secure the "good will," cordial friendship and assistance of all persons along the line of its routes. It must be remembered that the wire plant is an exceedingly exposed structure, that the poles or circuits may be injured, or even destroyed maliciously with the greatest facility in such a manner as absolutely safe against detection.

There is no pole line that is always exempt from accident, and when the day of disaster arrives, the hearty co-operation of all abutters is of the greatest value as an aid towards the repair of the wreck, remission of possible claims for damages due to falling poles and wires, and, if a subscriber, a greater tolerance of impaired service. To quarrel with an abutter, on anything short of overbearing injustice on his part, is in the end folly. So by throwing away a few sprats, the telephone company is likely to catch a great many herrings. Fair and square business dealings, the prompt and honorable fulfillment of all obligations on the part of the telephone company, with a manifest endeavor to be a little more than just to the property owners, are sure to win out in the long run.

In securing rights of way there is nothing more important than an explicit and definite contract with each property owner, stating exactly where and how poles and guy stubs shall be set, and to what extent tree trimming is permitted. For each location the right of way agent should secure a sketch, which may be conveniently made in a manifold copy book. This sketch should show the location of all poles and guy stubs with reference to the property lines of the owner. A brief contract should be drawn, specifying the number and location of poles and guy stubs, for which permission is given as shown upon the sketch; finally, the contract should contain a clause stating specifically the trees for which trimming permission is given, and how much trimming is to be allowed.

All such contracts should be made in duplicate on regular form (of which the following is a model), one copy to be retained by the company, and the other given to the owner. Occasionally property owners are met with who will grant right of way, but will not sign any contracts. In negotiating for right of way, therefore, it is always desirable to make a party of two men, so that there are at least two witnesses to every transaction.

In securing rights of way the right of way agent should plainly and honestly explain to each property owner exactly what the telephone company proposes to do, so that subsequently there may be no misunderstanding in the instructions given to the foreman for the erection of the line. When construction is actually undertaken, the foreman must be supplied with a copy of each contract, and instructed to be particularly careful that all poles and guy stubs planted are entirely within the specified height, diameter and location recorded in the contract with each owner; and ordered to take the utmost pains that tree trimming is done in such a manner as to injure in the least possible degree all trees or shrubberies; and that, under no circumstances, without additional special permission in writing, should tree trimming exceed that specified in the contract. It is only by means of dealings which are perfectly honorable and above board, and in which the telephone company is clearly within the rights that it has secured prior to commencement of work, that it is possible to establish any tolerable *modus vivendi* with property owners along the lines of open wire routes.

While all legal questions of importance should be referred to counsel, general managers and superintendents can gather valuable information, and inform themselves in a general way, as to right of way questions, by consulting Keasbey, on "Electric Wires"; Croswell, on "The Law Relating to Electric Wires," or Joyce, on "The Law of Electricity."

RIGHT OF WAY CONTRACT.

(Form ——.)

The......................Telephone Company.

In consideration of the building by the........................

Telephone Company, of a telephone line from... .....to
.. . . . . to be located. . .... .
... ...
....

And the further consideration of . . . . the receipt of which is hereby acknowledged well and truly paid to, and received by... ...., the undersigned, do hereby agree both for....... ...., jointly and singly, and for..... heirs, assigns, and legal representatives, jointly and singly, to permit the said Telephone Company, and its assigns, to erect and perpetually maintain the following specified poles, guys, guy stubs, and attachments; and also to cut, trim, or remove the following specified trees and shrubbery, as may be necessary to permit of the free and unobstructed passage of all the wires, cables and other attachments that said poles may now, or in the future, carry. And...................agree said trimming may be repeated from time to time in the future, whenever the growth of said trees or shrubbery may render it necessary.

If said telephone line is not completed within........years from the above date, or if in the future said company, or its assigns shall abandon its line, or shall discontinue the use thereof for a period of one year or more, then this contract shall be null and void, and all rights thereunder shall revert back to..............or.............. heirs, assigns, or legal representatives.

In witness whereof..............hand....... .....are affixed this........day of.......... .. ..

Witness . .. .

....
....
. ...

THE ADVISABLE CAPACITY OF POLE LINES.

Opinion as to the desirable capacity of open wire lines varies greatly. Formerly lines of twenty or even thirty cross arms have been constructed, but such lines are now only matters of history. In general, two-pin, four-pin, six-pin and ten-pin cross arms are recognized as standard sizes for arm design. Occasionally twelve-pin arms are used, but these are too rare to be standard, and when no more than four wires are needed, brackets are commonly employed. The two-pin cross arm is used where but a single circuit is needed, but is usually employed for lighting or power circuits. Four, six and ten-pin arms are used for a corresponding number of circuits. The tendency now seems to lie in the direction of the substitution first of aerial cable, and then of underground construction when any considerable number of circuits are needed. The best practice inclines to the design of a 35-foot line, carrying three or four cross arms. As soon as these are filled, a 50-pair aerial cable should be erected and the circuits transferred to the cable, thus releasing the open wire and permitting it to do duty over again. As soon as the 50-pair cable is full a 100-pair cable should be placed upon the other side of the poles. When this 100-pair cable is exhausted, the line is carrying 180 wires, and at this point, or even before, underground construction is to be recommended as more economical.

The Electric Club of Pittsburg, Pa.

The first annual report of the Electric Club of Pittsburg, Pa., is issued in the form of an attractive booklet under date of March 19, 1903, the anniversary of the club's organization. This pamphlet, of artistic design and illustration, gives the constitution and membership of the club, the scope, plans and personnel of the various committees, and an outline of the work accomplished and proposed. A feature of this work which has proven very valuable is the formation of classes for the study of technical subjects under the instruction of various engineers of the Westinghouse Electric & Manufacturing Company. These classes, or "sections," constitute "self-exciting" engineering societies within the parent body, each section pursuing a separate and definite line of study.

As a further aid, there is a well-equipped technical library, including the various electrical and mechanical magazines. The social side of life is directed by the committees in charge, of which not the least is that known as the "Ladies' Committee"—an ever-to-be-desired element in any club. The club has proved a decided success.

A Plea for the Skyscraper.

In addressing the Nineteenth Century Club recently on the subject of "Skyscrapers and their Consequences," Mr. Reginald Pelham Bolton, M. E., dealt with some of the æsthetical and general denunciations to which the tall buildings have been subjected, and presented the relatively superior importance of the mechanical engineering features of the tall office building and hotel, with some of the following considerations:

The tall building is no longer an experiment, but a fixed element in the existence of the metropolis, in which it has special source for existence and increase. The whole island of Manhattan comprises but 19.65 square miles, in which the old form of two-story building has so far disappeared that there are but 524 classed in that humble category.

It is an illustration of the actual need of height—merely as a means of increase of the area available for the populace, that if the present residents in tenements, flats, apartment and apartment hotels, who aggregate over 1,700,000, were to be afforded a separate home at an average of 6 to each small dwelling they would cover an area exceeding the entire area of the island by 12,576 acres, without allowance for parks, avenues, streets, docks, railways or business buildings of any sort.

The particular justification of the so-called "skyscraper" has been and is in the congested business district forming the extremity of the island, but also forming the center of the metropolis. This area comprises but 960 acres in all, including streets and the city park, and the erection of tall buildings has actually added a floor area of 179 acres, or nearly one-fifth to the total, this addition being placed in the positions where most required and making it possible to conduct various businesses by an increasingly large number of persons occupied therein, in a much more convenient and rapid manner than is the case in other cities where the members of a trade or profession are widely scattered. The result has been to bring more business firms to New York, and to promote the vast accumulation of its business and trade. These being the motive forces by which the tall building has been required, it is useless for æsthetical, artistical and architectural critics to waste their energies in denunciation and protest against the lofty structures when these are justified in their location. And incidentally it must be also said that those criticisms do not appear to be unanimous nor to be shared by the general public, since it is evident that the great offices have a special attraction to visitors and form one of the objects of sightseers of all tastes and nationalities. That they are in many cases crude, overbearing and lamentable failures in appearance is only repeating what architects generally admit, but the art of their outside design (their proportions being an element of circumstance and location and not influenced by the designer) has advanced with a better understanding by the professional designers, particularly in the direction of avoiding that superfluity of petty decoration which is so dear to the heart of that large proportion of architects who insist in regarding themselves as artists. In effect the nearer the designer has come to the realization of the fact that decorative treatment of such structures as chimney stacks, bridge towers, engine frames and business machines or skyscrapers, is out of place, and therefore, out of art, the more appropriate has the outside appearance of the building been.

It is too patent to need remark that the elements in which the tenants of such buildings are concerned are all interior and are mainly of a mechanical or engineering nature.

Given a sufficient access of air and light, in the possession of which the owners of these properties may be left to fight their own battles, the special questions in the exterior appearance and proportions of these vast buildings, in which the public has a vital interest, are the depreciation of the public streets of light and air, by the crowding together of such structures, the misuse of public property such as stoop areas and vault privileges under sidewalks, the disfigurement caused by lofty dead walls and their possible nuisance in future advertising, and the disproportionate demand created by the addition of the height of the buildings for the public convenience of water. On these subjects much may be written and said, and in them the public has rights which have been hitherto ignored. The tall buildings only exist by the use of some of these public conveniences, and should be made to bear their due proportion of the original cost and existing value.

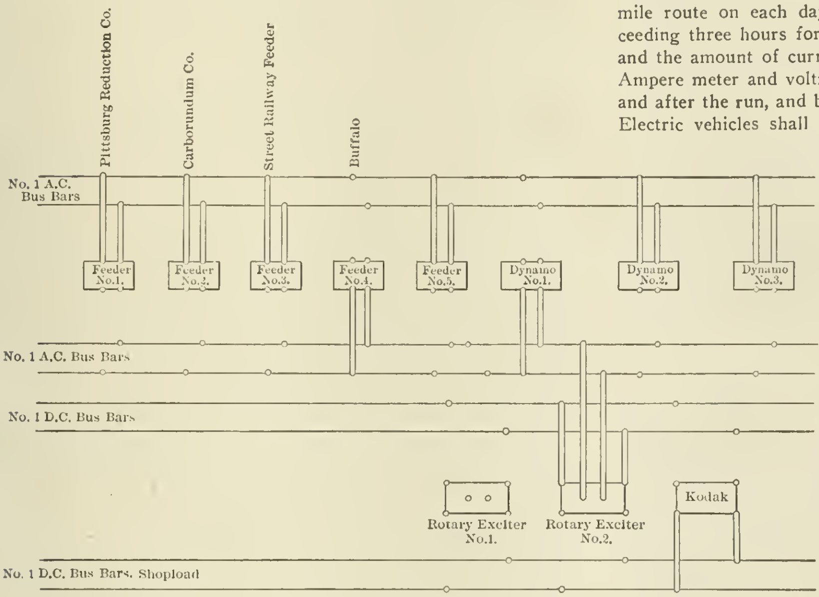
A Switchboard Model.

By Arthur B. Weeks.

Soon after the first three generators with their five-feeder switches were put in operation at the Niagara Falls power house it was early made manifest that any method which would reduce accidents due to switching to a minimum, would be of great value. The accompanying diagram is that of a model devised by one of the electricians for his use when in charge of the switchboard.

Whenever a generator, feeder or exciter was changed from one bus-bar to another, he changed the small wires on the model accordingly, so that he always had a working model before him. Since the several switches here mentioned are all beneath the slate floor of the switchboard, there is nothing but the position of the short levers on the panels on the platform to indicate what bus-bars they are on.

The rotary exciters shown have connections both on the alternating and direct-current bus-bars. This is due to the fact that they are driven by alternating current, and deliver direct current to bus-bars for field excitation.



SWITCHBOARD MODEL.

The "Kodak" is a direct-connected, direct-current unit, used to start up the plant after a shut down. As four turbine-driven exciters have been added to the plant since, the "Kodak" is now seldom used.

One who has watched the growth of the Niagara Falls power plant knows that all of the 5,000-hp feeders here shown are used to supply the long distance lines.

Trials of Commercial Automobiles in New York City.

The Automobile Club of America has issued the following prospectus for the commercial vehicle contest which the club will hold on May 20 and 21:

General Conditions.—The Automobile Club of America will hold on May 20 and 21 a contest for commercial vehicles which will be open to all types of self-propelled vehicles used for commercial purposes, made in the United States or abroad.

Observers.—There shall be an observer on every vehicle.

Stops.—The contest shall cover two days. On the first day vehicles in all classes shall cover the route without stops, except those that are involuntary. On the second day they shall cover the route, making various specified stops, according to their classes.

Route.—The route shall be twenty miles long consisting of a run from the club house at Fifth Avenue and Fifty-eighth Street to the Battery at the foot of Broadway; from the Battery up town and through the northern part of the city and back to the club house. Vehicles in all classes to go twice over this route (40 miles) on each day of the contest.

Load.—Each contestant shall furnish his own dead load, consisting of whatever material he may see fit to carry, which shall be weighed and checked by the Contest Committee. The committee will provide at the starting station a certain amount of ballast, in convenient form, to be available to supply any deficiencies in contestants' loads.

Tare.—Contestants will be required to report to the committee's representatives at the weighing station on the day before the contest with their vehicles empty, so that they may be weighed in that condition, and again (with their dead load on board) on the morning of each day of the contest, to be weighed and checked by the committee.

Cost of Operation.—The amount of gasoline, electricity, coal, etc., consumed (which shall be furnished by contestants) will be measured and the cost of operation per ton mile ascertained.

Electric Vehicles.—There shall be a class for electric vehicles. All electric vehicles shall be required to go twice over the twenty-mile route on each day. They shall be allowed one stop not exceeding three hours for re-charging batteries, the time of such stop and the amount of current taken to be recorded against the vehicle. Ampere meter and voltmeter readings will be taken each day before and after the run, and before and after all intermediate re-chargings. Electric vehicles shall be subdivided into four classes as follows: First Class—To carry a dead load of 750 pounds. (To make 100 specified stops on second day's run.) Second Class—To carry a dead load of 2,000 pounds. (To make 100 specified stops on second day's run.) Third Class—To carry a dead load of 3,500 pounds. (To make 20 specified stops on second day's run.) Fourth Class—To carry a dead load of 10,000 pounds. (To make 10 specified stops on second day's run.) Each vehicle must carry a dead load of at least 75 per cent. of its own weight in addition to the driver and observer.

AWARDS.

Medals will be awarded, based on economy in cost of operation and time consumed in covering the cost within the legal limit of eight miles per hour, as follows:

750-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

2,000-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

3,500-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

10,000-Pound Class (Electric, Steam and Gasoline).—A gold medal to the vehicle making the best performance, a silver medal to the vehicle making the second best performance, and a bronze medal to the vehicle making the third best performance.

Certificates will also be awarded, stating the performance of the vehicle.

Automobile Exposition at Brussels.

Consul Roosevelt reports from Brussels that an international exposition of automobiles and motor cycles was held February 7 to 16 in the Cinquantenaire Park, at Brussels. The hall was partly illuminated by electricity. There were 150 exhibits. One solidly constructed truck, which was immediately bought for the Congo Free State, had a carrying capacity of 6 tons and hauling capacity of 6 additional tons; average speed per hour, 12 kilometers (7.45 miles). The consumption, either alcohol or petroleum, was 1 liter (1.05 quarts) for 3 kilometers (1.86 miles), and its capacity permitted a run of over 90 miles without refilling.

Autobiography of Mr. Charles Proteus Steinmetz.

Mr Herbert Wallace contributes to the March number of *Success* a well-written and extremely interesting account of an interview with Mr. Charles Proteus Steinmetz. The first portion of the article contains expressions of opinion on the various electrical problems of the day which are admirable in their lucidity and in the firm grasp of the various subjects to which they refer. We reprint below the autobiographical section of the article:

"I was born April 9, 1865, in Breslau, Germany," he said; "I did not go to school until I was seven years old, when my father sent me to the best one available. He was always interested in scientific subjects, and I think it must have been from him that I acquired my interest along those lines. For twelve years I attended the gymnasium, as the school is called there. Then I went to the university, in the same city. As a boy at home, I had a small chemical laboratory, and used to spend a good deal of time in it, but I joined in all the sports and amusements of the time. In the gymnasium I was always interested in mathematics. It happened, during the last year there, that the professor gave additional lectures, which I attended. These lectures helped me a great deal, and, when I entered the university, I was in advance of the regular class. I want to say that absolutely all the success I have had has been due to my thorough study of mathematics.

"I went to the university to study mathematics and astronomy. It was somewhat before the time of electrical engineering. The arc and incandescent lamps did not exist, except, perhaps, as curiosities. Then I became interested in physical science, and studied physics, and, later on, natural history. It was some time before I began the study of electrical engineering, and then, strangely enough, it was chiefly because of my friendship for a fellow student who was pursuing that subject. When I commenced, I had no thought of making any practical application of it; I merely wanted to know something about the subject.

"My father had a fairly good government position, but he was not able to supply me with an unlimited amount of money. He had sufficient income so that I knew I could always live at home. The result was that I did not hurry through the university, but studied for five years there. I wanted to be independent, however, and so I undertook tutoring in mathematics. I had a practical monopoly of the business of preparing deficient gymnasium students for graduation, due to my knowledge of the needs of the university courses, and the peculiarities of the professors, and so I could pick the men I wanted to tutor. The work gave me a small income, enough to carry me along.

"I was twenty years old when I met my electrical engineer friend. It was through him, also, that I became connected with the Social Democratic party. We used to meet in different rooms and discuss Social Democracy. We talked of revolutionizing the world without any consideration of feasibility, just as young men are likely to do; but, for all that, it was very interesting. It really did me a great deal of good, though now, you see, I have somewhat reformed. I began to learn more about men, and studied workingmen, their ways of living, etc. I wanted to know how they look at things. Of course, all this socialistic business was secret. It happened that the editor of the Socialist paper there was suspected and imprisoned, and, without the knowledge of my father, I became editor of the paper. There was quite a band of us, and, to divert the police, we got a Polish fish vender to be recorded as the responsible editor. The fish-vender could not read or write, but we arranged to give him, as compensation, the left-over copies of the paper.

"For several months, while I was a student, I was the editor of three publications—the weekly Socialist paper, a weekly issue of *Popular Science Leaflets*, and the *Popular Science Fortnightly*. Part of the time, however, the latter two papers did not appear, because of difficulties with the printer and the paper dealer. None of the writers for any of the publications was paid for his work, and I never received a cent for mine. It was done for the good of the cause and for amusement.

"Finally, the police confiscated the Socialist paper. They arrested the supposed editor, the Polish herring man, and wrote out a statement for him to sign, but he could not write his own name. He and several others, among them my electrical engineer friend, were thrown into prison, and the government officials were sure they had all the leaders, and that the movement had been effectually broken up. Shortly afterwards we reorganized the paper and went on as before. Few of the real leaders had been discovered.

"We found a very ingenious way to communicate with the prisoners. A friend of mine, who was imprisoned with the rest, was, at the time, preparing his graduation thesis. He was allowed to send out to me for some literature on the subject. Among other things he asked for was matter about a certain electrical constant. Instead of the customary denotation of the constant (the Greek letter K), he wrote the chemical formula, NaCl. I at once noticed this, and guessed that he had written something on the paper in salt; so I dipped the paper in a silver solution, and was enabled to read his letter to me. We were then allowed to send him some solutions to use in cleaning his teeth. I also managed to send him in some blotting paper which had previously been dipped in some chemical. I would then write him a letter in this chemical and he would dip it in the tooth wash and develop it. In this manner we corresponded regularly, and by this means my friend was enabled to send and receive love letters to and from his *fiancée*. The correspondence was absolutely reliable, and was never detected. We were kpt informed of what was going on in the prison, and, when the police examined outside witnesses, we were enabled so to coach them that the same evidence was brought out as had been produced by examination within the prison.

"Then came an important turning-point in my career. We had grown bolder, and had sent a delegate to the Socialistic Congress in Switzerland. The police began to suspect and to watch my movements. They first tried to drive me out of the university by preferring charges against me to the president. They failed in this, and then I learned that they were about to arrest me. I decided to visit a theological friend who lived on the Austrian border, and wrote him a post card so that the police might see it. As soon as I arrived at my friend's home, I slipped across the Austrian border. I hurried to Vienna, and then made my way into Switzerland. The proceedings against me were continued on the court records for several years, but nothing was ever done, and the action was finally dropped for lack of evidence. The name of my friend is still seen frequently in foreign scientific publications.

"At the time of my flight from Germany, I was engaged in writing my thesis, a mathematical subject—very complex—afterwards published in Germany. I had saved some money for the publication of the thesis, but most of this went for traveling expenses. I did not have much when I arrived at Zurich, but I rented a room, paid the rent for a month in advance, and then gathered my friends there for a dinner to celebrate my escape. The next day I found I had just enough supplies to last me two days. I had previously written a book on 'Astronomy,' and had arranged to put it into the hands of a small but responsible publishing house. So I wrote to the publishers for money, and they agreed to give me thirty-seven francs (about seven dollars and thirty cents) a month. That was quite a lot of money for a student. Then I happened to meet one of the big lights in the Democratic party, a senator. He was one of the owners of a political paper, and, through him, I secured a commission to write a series of articles on popular astronomy for the paper. I received two dollars for each article, and one was used every two or three weeks.

"Before I left Germany I had intended to become a chemist. Because I was a Socialist, I could not bring myself to accept a government position, and I could not have earned a living at mathematics except in a government position. Electrical engineering really did not then amount to anything in Germany, and chemistry seemed the only field in which I could make a good living. When I reached Switzerland, however, I decided to take up mechanical engineering. I knew much about a good many things, but nothing by which I could make a living. Obviously, my political career was ended.

"I had arrived in Zurich in June, 1888. I studied privately during the summer, and in the fall entered the Polytechnic School with an elective course made up of mechanical engineering, turbine, steam engine, bridge construction, designing, etc. A friend and I lived together, and cooked our own meals. The following year my friend's guardian directed him to go to America, and I decided to go with him.

"We sailed in the steerage on a French liner, paying seventy-five francs from Zurich to New York. I have crossed the ocean since, in the first cabin, but I have not had so pleasant a voyage since as was that one in the steerage.

"I could read Latin and Greek readily, and started to learn English on the ship. I carried with me two letters of introduction from the editor of the *Electrotechnische Zeitschrift,* and a commission to write a series of letters from America for that paper. Through one of the letters I succeeded, finally, in getting a position.

"When we landed in this country my friend and I went to Brooklyn, N. Y., to live. Day after day we tramped about the great city, looking for work. One of my letters of introduction was addressed to Mr. Eickemeyer, who had a small electrical plant in Yonkers. I went to see him, and he promised to write to me later, about a place, but he probably forgot about me, and I did not hear from him. Then I went to see him again and he told me to report the following Monday, and begin as a draughtsman, at a salary of twelve dollars a week. My friend also succeeded in getting a place, and we took up our former housekeeping plan together, in a room in New York City. I had to get up very early, prepare breakfast and go to Yonkers.

"Our plan worked very well, with but one drawback. We could never agree as to who should wash the dishes. We were both good cooks and managed to live cheaply and well, but, after a year of this life, my friend had his *fiancée* come from Germany, and they were married. Then I moved to Yonkers, to be nearer my work."

From a draughtsman at twelve dollars a week, able to speak English very imperfectly, Mr. Steinmetz has become, as I have already stated, one of the greatest of electrical engineers, a consulting expert to whom other engineers are accustomed to go for solutions of difficult problems.

"How did I come to be graduated from draughting?" he asked, in reply to a question. "Well, it was a very simple thing. One day Mr. Eickemeyer happened to come into the room where we were working, and he was in a great rage because he had stained his fingers with aniline ink and could not get it off. I told him to use a certain acid, diluted, and the ink would come off at once. The result was as I said, and he was so pleased that afterwards he invited me into his office, and we gradually became acquainted. I was able to be of some assistance to him, so he raised my salary and kept me working more with him. He put me in charge of all new and experimental work, and I had to look after the men, make patent drawings, and see that everything was properly done at the factory. I studied every night until after midnight, and, during the first two or three years there I wrote a number of scientific papers."

It was not long before the leaders in electrical manufactures saw the advantages of combination, and scores of such factories as the Eickemeyer plant joined to make one of the greatest electrical companies in the world. Each one of these smaller plants had, of necessity, its expert man, and, naturally enough, the combined concern needed a chief of experts. The man was ready, a man who knew, and thus the hard-working, hard-studying engineer and inventor, Steinmetz, came into his own.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

SILOXICON.

"Siloxicon" is a term destined to become as familiar to the commercial world as "Carborundum." It is the name of a new compound, or class of compounds, discovered by Mr. Acheson, consisting of carbon, silicon and oxygen in chemical combination, and possessing physical and chemical properties of great importance to the metallurgical arts.

Siloxicon is described in Mr. Acheson's patents, assigned to the Acheson Company, of Niagara Falls, as amorphous grey-green when cold and light yellow when heated to 300° F., or above; very refractory to heat, insoluble in molten iron, neutral toward basic and acid slags; indifferent to all acids save hydrofluoric; unattacked by hot alkaline solutions; and self-binding to such degree that the use of a separate binding agent is not essential in forming it into crucibles, furnace linings, fire-bricks, and such other articles as may with advantage be made from it. The articles may be formed by merely moistening the pulverulent material with water, molding and firing, or a carbonaceous or other binding agent may be used if desired. As suggested uses for the new material the inventor names refractory linings for furnaces or converters; crucibles, fire-bricks, muffles, tuyeres, etc., and the properties of the body as above detailed sufficiently demonstrate its peculiar value for these purposes. A crucible composed of a material which is insoluble in molten iron, unattacked by its slag, and unaffected by furnace gases, possesses qualities which are scarcely to be found combined in any substance heretofore in the hands of metallurgists; add to these the self-binding character which permits the construction of the crucible without the introduction of any extraneous matter, and the material becomes unique.

Siloxicon is a product of the partial reduction of silica by carbon, and has been prepared by Mr. Acheson in an electric furnace of the resistance type, but under regulated temperature conditions. The charge used may vary in composition, but a mixture of two parts of silica with one part of carbon is given as suitable, sawdust being added if desired to increase the porosity of a fine mixture and its carbon content being considered in the preparation of the charge. The temperature of formation of siloxicon is less than that required for the production of carborundum, as at or about the temperature of formation of the latter compound, siloxicon is decomposed, and passes in part into carborundum, much in the same manner as carborundum, at a still higher temperature, passes into graphite.

A NEW REDUCING AGENT.

The lower chloride of titanium, titanous chloride, Ti Cl_3, is known in solution as a powerful reducing agent, and in crystalline form, with eight molecules of water, as an unstable salt of green color, dissolving to opalescent solutions. Mr. Howard Spence, of Manchester, England, now prepares the salt by electrolysis, by cathodic reduction of the corresponding titanic compound in a diaphragmed cell, and subsequent evaporation of the solution under reduced atmospheric pressure. The crystalline salt so obtained is described as of a fine lilac shade when dried, tending toward violet when damp, very stable, and readily soluble to a clear liquid. As a reducing agent it is stronger than stannous chloride, and should find a wide application in the arts.

SUBDIVIDING BLOCKS OF CARBIDE.

The rotating furnaces used by the Union Carbide Company, at Niagara Falls, for the production of calcium carbide yield their product in the form of great masses or ingots, which in practice are broken up while still in the furnace. The method whereby this is accomplished forms the subject of recent patents to Joseph Scales, assigned to the company, and consists essentially in aiding the drill by means of a re-agent capable of locally disintegrating the block; a cavity or a series of cavities is thus formed through which the block is broken. The invention is a broad one, limited neither to a specific material to be broken nor to a particular re-agent for disintegrating it. As applied to the carbide work, however, it consists in injecting into the cavity formed by a drill, preferably through the drill itself, air, steam or water, which oxidizes and disintegrates the heated block; through a series of cavities so formed the block may be broken as desired. The cavities may even be formed without the use of a drill by means of a jet or jets of the re-agent.

New Telephone Patents.

Since the advent of the central energy telephone system, contact relays have received an attention and development unprecedented. They have appeared in multitudinous types and varieties, impeding, non-inductive, polarized, locking, etc. It is only quite recently, however, that successful alternating-current types have appeared, and a relay of such a type is the subject of a patent to W. W. Dean, included in the issue of March 17.

Mr. Dean's relay is particularly designed for use at the stations of party line subscribers where the Bell company's four-party line selective ringing system is used. In this system the ringing currents consist of successive impulses of current all of the same sign, with corresponding and intervening periods of time, during which no current passes. The armatures of the bells used with this system are given a permanent set toward one pole piece by a spiral spring, so attached that after the armature has responded to an impulse of current the back stroke will be completed by the spring during the period of no current. In order to use this apparatus for four selective stations, generators of positive impulses and of negative impulses must be provided, and the bells must be poled to respond only to currents of proper sign. Then by using a ground return.

two independently signaled stations may be wired to each side of the line.

To all who are familiar with central energy working, it will be at once clear that such a system would be impracticable unless the bell circuits are kept normally open to direct currents. Further, a moment's consideration will show that a condenser will not suffice, as its presence will convert the single sign impulse currents into alternating currents consisting of impulses of both signs. Such currents would ring more than the one bell. The only alternative for opening this circuit is a relay at each station to connect the bells to the line at the moment of ringing. Such relays are provided and are permanently connected in series with a condenser and bridged across the line. The grounded bells are then connected to the contacts of their corresponding relays.

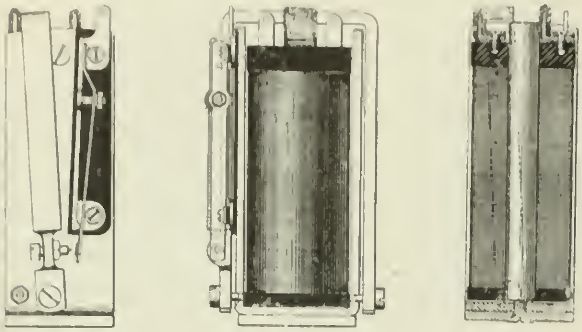


FIG. 1.—DEAN RELAY.

The controlling features of the required relay are as follows: It must not shunt out the bell; it must maintain its contact during the intervals of no current, and it must be almost noiseless, so as not to disturb stations not called.

All of these conditions have to be met by the present relay and how this has been done may best be explained by reference to Fig. 1, which shows a section and two elevations of it. Upon the central core, which is placed vertically, a winding of very many turns is provided, being contained between square heads of hard rubber. The completed spool is then secured within a U of iron which serves as a return pole piece. This forms the body of the relay.

The armature is also U-shaped, but is much narrower than the body U. It is inverted and pivoted to span the body U, as shown, the pivots being in line with the center line of the core. As will be noted, the body is shaped to conform to the line of motion of the armature. When the armature is in the unactuated position shown, the magnetic pull to move it forward is quite large. On the contrary, when it has once moved forward, the turning force becomes almost nil, the magnetic pull being almost all exerted against the pivots. Thus, as the armature proceeds, the turning or actuating moment falls off. This tends to make the relay strike its stop lightly, even though the starting force be quite great, and this, combined with the presence of a felt covering upon the stops, tends to make the relay noiseless in its operation.

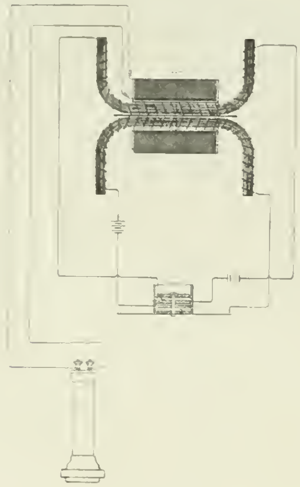


FIG. 2.—PARCELLE INDUCTION COIL.

The slow return of the armature and its consequent disregard for the period of no current is due to the reduction of the gavitational returning moment, as the center of gravity of the armature passes almost over the supporting pivot points. The patent for this relay has been assigned to the Western Electric Company.

A second telephone patent of the issue of March 17, describes a multiple magnetic circuit induction coil. This is the invention of A. L. Parcelle, of Boston, Mass., and is shown somewhat diagrammatically in Fig. 2. Within a secondary winding having a large aperture two distinct primaries are threaded. Each primary coil is wound upon its own iron-wire core, the ends of which are so bent that the poles of the two cores are non-interfering.

In using the coil a double transmitter is to be employed, the sections being so connected mechanically that the pressure vibrations within them will be 180° apart in phase. Each of these sections is wired to its own primary, and these latter are connected in opposition. There is, therefore, an active increasing wave of magnetization continuously effective in one of the cores, assisting the secondary current induced by the dispersal of the magnetic lines in the other core. Thus, the distortion of the wave induced by the dispersal of lines, which dispersal is always affected by magnetic lag, is reduced to a minimum. The inventor states that this arrangement of induction coil results in great clearness of transmission.

CURRENT NEWS AND NOTES.

RECTIFYING ALTERNATING CURRENTS.—Two patents issued March 17 to Prof. Elihu Thomson relate to means for rectifying alternating currents whereby the rectifying brushes are automatically shifted with change of phase relations, so that the commutation will always be effected at an instant favorable to the least sparking effect. This is accomplished in connection with the use of a constant-current transformer in the current rectification, the movement of the coils of which acts to move the brushes of the rectifier.

ELECTRIC HEATING PATENTS.—Three patents on electric heating were issued on March 17, two of them to H. V. Loss and the third to J. S. Peck and K. C. Randall, all three being assigned to the Westinghouse Company. The two patents issued to Mr. Loss relate to an apparatus for electrically heating rivets, which is adapted to receive rivets of widely different lengths and diameters, and by means of which the point of the rivet may be heated to a less degree than the other parts. The electrical contact is between the head of the rivet and a point in the body of the rivet more or less removed from the point. The third patent is also on an apparatus for heating rivets, and is so designed that the rivet may be readily and securely clamped between the electrical terminals and as readily released when the heating operation is completed. A single terminal engages the head of the rivet and means are provided for forcing this terminal forward so as to increase the clamping action of a two-part terminal, which engages the rivet near the point.

A TESLA WIRELESS TELEGRAPH PATENT.—The preamble of a patent issued March 17 to Nikola Tesla disputes the utility of selective wireless telegraph circuits tuned to but a single frequency, and the specifications describe a method in which there are two or more tuned circuits at each station. At the sending station there would be say two separate transmitting circuits, each with its antenna, and tuned to different frequencies, but both controlled by the same sending key. At the receiving circuit there would also be two separate antennæ and receiving circuits, but the latter would act conjointly on a third relay included in the local recording or sounding circuit. The latter will only operate when the two receiving circuits simultaneously respond to the definite frequencies of the two sending circuits. Thus, should the frequency of one of the receiving circuits happen to accord with that of a disturbing source of Hertzian waves, there would be no signal, since the third relay is only actuated when both receiving circuits respond simultaneously to the respective frequencies for which they are tuned.

University of Wisconsin Branch of the A. I. E. E.

A meeting of the Madison (Wis.) branch of the American Institute of Electrical Engineers was held in the Engineering Building of the University of Wisconsin on Thursday, March 12th. The papers on "Railway Car Lighting," read at the 173d meeting of the Institute in New York City, February 27, were abstracted by Mr. E. B. Mueller. This was followed by a general discussion of the subject by the members present.

This local chapter was organized in October, 1902, and meetings are held weekly throughout the college year. The papers read at the monthly meetings of the Institute are taken up at one meeting of each month, and the remaining sessions are devoted to other engineering subjects of interest. The chairman is Prof. B. V. Swenson and the secretary, Mr. C. Shaad.

LETTERS TO THE EDITORS.

Meter Testing.

To the Editors of Electrical World and Engineer:

Sirs:—Regarding the opinion in your editorial of March 21, that the portable test meter referred to is only applicable for the testing of wattmeters having removable covers, I may say that although the instrument is principally designed for testing removable-cover, direct-current motor meters, it is used almost daily for testing meters which are permanently sealed; and that while the slide-rule is sometimes found necessary, the entire calculation consists in dividing a whole number of revolutions by a fractional number, necessitating only one setting of the slide-rule.

The scheme which you suggest has been used for testing in the central station. In this method the tester uses a tabulation showing the exact load which each meter must be given in order that it should make a certain number of revolutions in a given time. One of the objections to using this method for testing meters in place is that it involves the use of a rheostat of such construction that any desired load may be exactly obtained and held constant in spite of varying voltage. Such a rheostat is apt to be bulky and complicated. Again, in case of any sudden change in voltage the needle of the indicating wattmeter may swing to an undesirable extent. Another objection is that a stop-watch is required, and it is generally known that none but very expensive stop-watches will stand the work imposed on them in continuous meter testing. Even granting that the load is held perfectly accurate and steady and that the stop-watch works perfectly, it is still necessary in order to determine the per cent. accuracy to divide the number of seconds in which the meter should run by the number indicated by the stop-watch or else to consult a table.

Using the special watt-hour test meter, the load applied, on the contrary, need not have any exact value, and the voltage may fluctuate to any extent without interfering with the accuracy of the test. The portable test meter system has also the advantage of using the slide-rule only in the case of permanently sealed meters, and the stop-watch not at all. W. J. Mowbray.

Brooklyn, N. Y.

Power Required to Drive Machine Tools.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of March 7 I find a criticism of my article on "Power Required to Drive Machine Tools in Locomotive Shops." The author shares the critic's regrets that more complete information regarding cutting speeds, depths of cuts and rates of feed could not have been obtained. However, the primary object of the tests was to find the average load on the motors in everyday working conditions and to determine whether or not the motors were adapted to their loads. There was only a limited time in which to make the tests and we were not permitted to interfere to any considerable extent with the regular operation of the shop. We realized that more complete information along the lines suggested by Mr. Sands would have been desirable, but did not think the circumstances favorable for obtaining it. Mr. H. M. Palmer, of the Westinghouse Electric & Manufacturing Company, who worked with me on these tests, is, however, engaged in compiling a very extensive collection of data on this interesting and important subject and has facilities for carrying on investigations on individual machines, with all conditions of feed, speed, nature of cutting tool, etc., under control, thus being able to obtain much better results than would have been possible in any case at Du Bois. If Mr. Sands has some particular installation in mind to which he would like to apply such information, he might be able to obtain it by taking the matter up with the Westinghouse engineers. Geo. H. Gibson.

Jamaica Plain, Mass.

Wireless Telegraphy in Alaska.

To the Editors of Electrical World and Engineer:

Sirs:—While it has not been the custom of this company to give serious attention to misstatements which occasionally appear in print regarding the progress of the Marconi system of wireless telegraphy toward a successful solution of the problem of the commercial value of the art, we should show an unexplainable lack of interest if we neglected to deny publicly certain ingenious misstatements appearing in your issue of March 14th. The fact that the news item containing the misstatement has appeared in Electrical World and Engineer, a publication circulating widely among the scientists and practical electricians of the world, gives more weight and substance to the inaccuracies than if presented in a general newspaper.

The article referred to is headed "Wireless Telegraphy in Alaska," and the impression evidently sought to be conveyed is that the Marconi installations in course of construction in Alaska under contract with the United States Signal Service, has, up to the present time, failed to operate properly and satisfactorily. There is also the intended intimation that the De Forest Wireless Telegraph Company has performed better service than the Marconi Company. The facts are these:

The United States Signal Service advertised for bids for the installation of wireless telegraph stations via four routes, designated as A, B, C and D respectively. A and B were practically the same routes, which is also the case with routes C and D. Route B was designated in the advertisement of the Signal Service "between Fort Davis (Nome City) and Fort St. Michaels," and route D "between Fort Gibbon and a point on the Tanana River, at or near the mouth of the Delta River." The former route was awarded to Queen & Company, of Philadelphia, presumably representing Prof. Fessenden, and the latter to the Marconi Company. The De Forest Company also filed a bid, which, for some reason, was not accepted by the government officials.

On June 9, 1902, a contract between the disbursing officer, Signal Corps, United States Army, and Marconi Wireless Telegraph Company of America was executed, and the construction of the stations provided for in the contract was proceeded with by the Marconi Company. The contract contained the provision that the station "at or near the mouth of Delta River and Bates Rapids, will be accessible to boats propelled by steam or other power." Unfortunately, this did not prove to be the case, and our engineers upon arriving at the head of navigation on the Tanana River, found it impossible to reach the site selected for the station, with their apparatus. A month of valuable time was lost in communication with officials of the Signal Corps in Washington, the local officer in charge being unwilling to assume the responsibility of allowing any change in the station site. Eventually, orders were issued from Washington allowing a more accessible site, but the time left of the short Alaskan summer was not sufficient to allow the completion of the stations. Our engineers, therefore, proceeded homeward, catching the last boat down the Tanana before the close of navigation.

Although the time specified in the contract for the completion of the stations expired October 1st, 1902, the chief signal officer has tendered proposals for completing the stations, and our engineers will proceed to Alaska for that purpose as soon as navigation opens.

The ingenious, but malevolent statement "notwithstanding the apparent success of the wireless system commercially, none of the companies offering to install a system between Cape Nome and St. Michaels, in Alaska, has succeeded in getting its system to work," while strictly true, we believe, since that route was awarded to Queen & Company, and has not been completed, when coupled with the statement following "that up to the present time Marconi has accomplished nothing so far as the Alaska wireless proposition is concerned," shows forth the animus of the whole article, viz.: to discredit the Marconi system to the advantage of another system which gives "some evidence of sincerity," according to the article. We believe, we are safe in asserting, that the only "evidences of sincerity," shown by the De Forest Company in connection with Alaskan installations for wireless telegraphy, consist in submitting a bid for installations which were rejected by the Signal Service. We have to submit for unprejudiced decision that we have given more "evidences of sincerity" up to the present time than any other company, in our efforts to develop wireless telegraphy in Alaska.

The Signal Service experiments referred to "between the army posts about San Francisco," must necessarily comprehend the exhaustive investigations of the possibilities of wireless telegraphy carried on between Fort Mason in San Francisco and Alcatraz Island, a distance of one mile. These are the only two posts equipped by the Signal Service in the vicinity of San Francisco.

Whatever the ultimate results of the present endeavor of the Marconi Companies to establish the commercial value of this new and wonderful art, they have sanctioned no sensational methods to awaken interest temporarily for speculative purposes. The present stage of commercial usefulness as exhibited in results already accomplished gives ample faith for better results. There is no other system than the Marconi which regularly accepts commercial business for ship to shore transmission. There is no other system than the Marconi which can communicate with the large fleet of steamers which enter and leave New York harbor. There is no other system than the Marconi that has evidenced its faith in wireless telegraphy by installing three expensive stations for transoceanic service, and no one but Mr. Marconi has transmitted messages through space over three thousand miles of ocean.

MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA.

NEW YORK CITY

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Design of Large Dynamos.—ESSON AND SCOTT.—The conclusion of the summary of the two papers of Esson and Scott, recently read before the (Brit.) Inst. Elec. Eng. The notes given in this issue refer to magnet steel, the forms of brush holders, the forms of poles, the armature hub, the armature core, the slots and the winding of armatures. The following notes are abstracted from Scott's papers. Designers appear to be practically agreed that to get sparkless commutation and a minimum zone of movement of the brushes, there must be a certain relationship between the ampere-turns for the air-gap at full load, and the cross ampere-turns of the armature. Some say that the best relationship is when the one divided by the other gives unity, or thereabouts. At the same time many machines, especially those made in America for traction purposes, show figures which, according to this rule, would indicate a precarious design. He gives as an example the figures for four large generators in which the ratio of gap ampere-turns to cross ampere-turns is 0.631, 0.61, 0.68, 0.65. If good commutation can be obtained with this ratio much lower than unity, then such a machine will be a cheap one, because a large number of cross ampere-turns means that a larger output is obtained from a given carcass. The following points tend to this result: the use of carbon brushes; the saturation of the pole-shoe, especially at the pole tips; the saturation of the teeth of the armature core; the use of high-resistance commutator lugs for the segments; the over-compounding of the fields. He considers the last a most important feature, because the increase of magnetization occurring with increase of load comes into action just at the critical moment when it is required. He suggests that it is a question whether it would not be as well to compound all dynamos, simply with this object in view: in a central station for lighting it would mean a little extra cable and switch apparatus, but this would be much more than covered by the greater output obtainable from a given machine and the improved commutation under varying loads. As the motor load grows in any particular area, the conditions which the dynamos have to meet approximate more and more to those of traction generators which are always compounded, and run well in parallel without trouble. On the other hand, the fact that practically all lighting networks are on the three-wire system and that batteries are generally used, are points in favor of keeping to shunt machines. —Lond. *Elec.*, February 6.

REFERENCE.

Design for a ½-HP Self-Starting Single-Phase Induction Motor. —An illustrated article with dimensional drawings giving all the essential features of a self-starting induction motor capable of giving one-half brake hp on a single-phase circuit of 100 volts and 125 to 133 cycles.—*Am. Elec.*, March.

LIGHTS AND LIGHTING.

Nernst Lamp.—STOETTNER.—An abstract of a paper read before the (Brit.) Inst. Elec. Eng. on the types of Nernst lamp, made by the General Electric Company of Berlin, which also holds the patents for England. Two types are now in use; the A type is made for 1 amp up to 250 volts and for ½ amp only from 200 up to 250 volts; the metal hood is furnished with metal combs of thin sheet copper in the inner cover, for the purpose of cooling the "bolstering" resistance, and between this inner tube and the outer mantle are a number of tubes for ventilation purposes and facilitating the radiation of heat; the latest B type is made for ¼ and ½ amp up to 150 volts and for ¼ amp up to 250 volts. In these lamps the compensating or "bolstering" resistance (called the ballast resistance in this country) is made of iron wire sealed in a glass globe which has been exhausted and afterwards filled with hydrogen. As to efficiency and life, he refers to tests of the Reichsanstalt, mentioned before in the Digest. He says that a great many errors are committed in the treatment of Nernst lamps, in consequence whereof numerous complaints of short life, etc., are lodged with the suppliers; but if instructions are carefully followed a life of about 300 to 400 hours may be expected. It is a mistake to "overrun the lamps, as the surplus current is taken up by the "bolstering" resistance, and practically the light is not the least increased." Another great mistake is to connect the lamp in the wrong way. In continental Europe the screw holder is in almost universal use, and the standard rule is to make the center contact minus; it is, therefore, immaterial how frequently the lamps are taken out of their holders, as they always come back to their proper position. With bayonet lamps it is different, the poles can be easily changed by inserting the lamps the wrong way, and to prevent this the makers have designed a tool to cut out a slot, and have provided the porcelain socket of the lamp with a third pin, so that it is impossible to get the lamps into the holders the wrong way. To determine the polarity on bayonet sockets, special pole finders are supplied, the negative pole being invariably indicated by the red appearance of the solution. In the discussion which followed Drake, Solomon and Swinburne gave an account of their work done with the Nernst lamp for the Nernst Electric Light, Limited, which holds the patents for certain British colonies; they give curves showing the results of tests of their lamps; they gave up the manufacture of the lamp on account of the chemical and mechanical difficulties in making the filaments. Hammond spoke about his use of 40 Nernst lamps for street lighting in Hackney, as an experiment on a mile of streets. From the results he concluded not to recommend at present the extension of the use of the Nernst lamp over all the streets of Hackney, on account of the non-uniformity of the life of the different lamps, as they "could not have street lighting with certain lamps out and certain lamps alight." The life of the different 40 lamps varied from "1,070 hours and still burning" down to 15 hours; the average life of the lamps which had burnt out was 305 hours. His report on these results is reprinted in full.—*Lond. Elec.*, March 6.

POWER.

REFERENCES.

Electric Cranes.—An illustrated description of the electric crane installation at the Manchester Ship Company's docks. There are 22 cranes in all, of which 12 are portable, being mounted on carriages. Direct-current motors are used.—Lond. *Elec. Rev.*, March 6.

Fan Motors for 1903.—A profusely illustrated article describing the various fan motors available this year. *Am. Elec.*, March.

Liquid Fuel.—SCHMIDT.—An article in which the author enumerates the advantages of liquid fuel, and also treats of the method of feeding.—*Am. Elec.*, March.

TRACTION.

Standardization in Electric Railway Working.—An editorial stating that an important conference at which all the leading railway companies of the United Kingdom are said to be represented, has recently taken place for three weeks in London, with a view to arriving at an arrangement which will insure the adoption of a uniform system of electrification on all their lines. This fact is said to be significant, as it shows that the irresistible march of progress has compelled them to take into very serious consideration the possibility or rather the prospect of the future conversion of their railway systems to electrical operation. It is pointed out, however, that decisions on standardization at the present moment would not only be ineffectual, but also directly harmful to the progress of the industry. The conditions of urban, suburban and interurban railways are entirely different from those of long-distance roads, and it is not probable that the same system will do for both cases. Reference is made to a recent trial of the huge steam locomotive, "Decapod," of the Great Eastern Railway, which was designed with a view to ascertaining whether it is possible to attain as good results with steam as with electric propulsion in suburban traffic; in 30 seconds this machine can attain a speed of 30 miles per hour, or 44 ft. per second, an improvement of 50 per cent. on the most powerful engines hitherto constructed in the shops of this railway; but this is said to represent the very last word of the steam engineer in his efforts.—Lond. *Elec. Rev.*, March 6.

Freight and Express on Electric Railways.—COOPER.—The conclusion of his article. Fifty per cent. of the interurban railways in the United States do a regular express and freight business, while over 25 per cent. of the remainder carry packages to a greater or less extent. As yet little has been done in standardizing the rates at which this business is done, as the rates have been based on local conditions. This the writer believes will cause confusion and trouble later. These rates vary from one cent to $3 per hundred pounds per mile. Instances are given of the practice of different companies in the transportation of different articles. Eleven roads haul regular freight cars over their lines; the rates of these are given.—*St. R'y Jour.*, February 14.

Car Dispatching by Telephone in Buffalo.—The Buffalo Railway Company has instituted a system of 250 telephones, as shown in a diagram. A dispatcher is located at the central exchange to instruct conductors and others as to what to do in cases of emergency, and if an accident occurs the conductor can be placed in immediate connection with the claim department, which thus gets the earliest information of the accident. The cars on the interurban lines are dispatched by telephone.—*St. R'y Jour.*, February 28.

REFERENCES.

Choice of Engines for Moderate Traction Stations.—E. K. SCOTT.—An article in which he draws attention to the great importance of simplicity of design and puts in a plea for the ordinary tandem-compound, single-crank engine and for the use of high superheating.—Lond. *Elec. Rev.*, February 27.

Plans for Extension of the New York Subway and "L" Systems.—A map showing by heavy lines the proposed extensions in New York and by light lines the existing roads, with the exception of the surface lines.—*St. R'y Jour.*, February 28.

Combination Sweeper and Sprinkler.—A description of a machine which has been built for Ilford, England, and is fitted with the usual tank and sprinkler for spraying the street and also with a rotating brush. The latter can be driven at any speed and can be raised and lowered from either platform. Although the car takes considerable current, it takes less than if two separate cars were used, and there is of course an economy of labor from the use of a single car to perform both functions.—*St. R'y Jour.*, March 7.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Determining the Distribution of the Current in Electric Networks.—HERZOG AND FELDMAN.—A long communication in which they reply to recent criticisms by Monath and Teichmueller, of the practicability of their and Kennelly's transfiguration method of determining the distribution of the current in networks.—*Elek. Zeit.*, February 26.

ELECTRO-PHYSICS AND MAGNETISM.

Polar Heating Produced by Sparks.—VILLARI.—An account of an experimental investigation, but the abstract from which this is taken is not clear. He found that sparks from a condenser passing from one pointed thermo-couple to another or to a sphere or disc, heat the thermo-couple in nearly the same proportion, no matter whether it is positive or negative, but the heating greatly depends upon the gas through which the sparks pass, being about 2½ times as great in nitrogen as it is in hydrogen. "When the sparks are supplied by an induction coil, the heating is much greater at a negative thermo-couple than at a positive one." This difference of heating is a peculiar phenomenon which is not due to any difference in current intensity produced by reversal. In rarefied nitrogen, which has a small resistance, both direct and reversed sparks pass and the discharges are much more energetic; therefore, the polar heating by these discharges is much greater than in nitrogen at atmospheric pressure. "By passing the same current through two bulbs in succession, one of which contains nitrogen at ordinary pressure and the other rarefied nitrogen, it is found that the cathode is always more strongly heated than the anode." The author recalls the analogy of the electric arc which experiences a higher resistance in hydrogen than in air.—*Phys. Zeit.*, February 1; abstracted in Lond. *Elec.*, February 20.

Radio-Activity near Waterfalls.—MACLENNAN.—An account of the investigation of the radio-activating process at the foot of waterfalls. Lenard showed that very anomalous electric conditions hold at the foot of Niagara Falls, where the impact of the water upon the rocks gives the water a positive and the spray a negative charge. The present author studied the radio-activity at the foot of the falls. The general result is that the radio-activity acquired under these abnormal conditions was very much smaller than that acquired under ordinary circumstances at Toronto. The measurements were made with a copper wire carried on ebonite insulators, and charged to 10,000 volts by means of a Toepler-Holtz machine. The radio-activity was compared with that produced by a standard radium preparation. The greatest radio-activity obtained at Niagara was 0.3 and the least at Toronto was 0.6; but, as a rule, the Toronto values were six or seven times as high as the Niagara values. The wire always got charged at once with the spray, sometimes to 7,500 volts.—*Phys. Zeit.*, February 27; abstracted in Lond. *Elec.*, February 27.

Thermo-Cells.—HEIL.—A description of a new thermo-cell designed by him. After giving a table of the thermo-electric forces of different materials, he says that the highest e.m.f. is produced by constantan (a Cu 60 Ni 40 alloy) against an antimony-zinc alloy (Sb 100 Zn 57), which is what he uses for his thermo-cell. A small percentage (3 per cent.) of iron to the antimony-zinc alloy strengthens it. The efficiency of his thermo-cell is 2.46 per cent. for the total energy, or 1.23 per cent. for the useful energy. The corresponding figures for the Guelcher thermo-cell are 0.864 and 0.432. He claims that the efficiency of his thermo-cell is superior to that of very small steam-driven dynamo sets.—*Zeit. f. Elektrochemie*, January 29.

Loud Speaking and Singing Transformer.—KRAETZER.—A brief communication on an observation made by him on experiments with the speaking arc. He found that when the speaking arc refused to speak the transformer would start to speak and sing under certain circumstances. The success of the experiments depends upon a distinct magnetic excitation of the core. *Elek. Zeit.*, February 26.

ELECTRO-CHEMISTRY AND BATTERIES.

Edison Battery.—A brief editorial note on a recent inspection of a sample of this cell and its component parts. "The cell is a model of excellence in mechanical construction; being composed mainly of steel, it afforded the designers a rare opportunity of which they have availed themselves to the full. * * * If all the claims advanced for this cell, or even a part of them, are fulfilled, we may look for more important results from its introduction."—Lond. *Elec. Rev.*, March 6.

HIBBERT.—A short article with discharge curves. He examined a cell which had never been used; it weighed 18 lbs. and had a 200-kw capacity; the striking feature is the small loss in the ampere-hour capacity when discharged rapidly, the cell is nominally rated at 25 amp, and then gives about 160 amp-hours at a potential difference of over 1 volt, for eight times this normal discharge current, the ampere hours, with a continuous discharge down to 1 volt, are practically 125. "During discharge the density of its liquid is not diminishing, but rather increasing. Hence the ability to call on a greater fraction of the available energy at a higher discharge rate." The manufacturers claim that there is no local action. The ampere-hour efficiency is only 2 or 3 per cent. less when 10 or 12 days intervene between charge and discharge than when discharge immediately follows charge. "The general result of an examination of the cell is to remove some antecedent skepticism, and one feels that there is a serious competition to the lead cell not far away. The final decision will appear when the cells are offered to the public and get tried by the infinitely varied rough usage and nescience of the general public. A preliminary to that stage will be reached when an adequate report has been made by outside authority. I understood Mr. Dick to say that this is being arranged for, and till then we must wait with such patience as we can command."—Lond. *Elec. Rev.*, March 6.

HIBBERT.—Another article giving some abstracts from American journals on this battery.—Lond. *Elec. Rev.*, February 27.

A New Synthesis of Hydrocyanic Acid.—GRUSZKIEWICZ.—A brief article on an electrochemical method of making hydrocyanic acid, which may develop into something of practical value. The electric furnace is not suitable, as the high temperature is apt to decompose the product; a method based on discharges must be used. Its production from acetylene and nitrogen by this method has been tried by Berthelot, but the acetylene is easily decomposed into carbon and hydrogen; this may be avoided by adding hydrogen, about ten times that of acetylene. The present author repeated these experiments and found that while the deposition of carbon does not take place to any such degree as in pure acetylene, nevertheless it occurred; but if the gas mixture did not contain more than about 5 per cent. of acetylene (and 5 per cent. nitrogen and 90 hydrogen), there was no longer any deposition of carbon. But as this is far too expensive and complicated to be of practical value, he experimented with a mixture which is cheap, containing carbon monoxide, nitrogen and hydrogen (water gas, Dowson gas, generator gas) and found that under proper conditions hydrocyanic acid may be obtained. The best conditions for the formation of hydrocyanic acid are a percentage of 49.79 to 52.44 per cent. of CO in the mixture; the electrodes must be very near together.—*Zeit. f. Elektrochemie*, January 22.

Commercial Cyanide of Potassium.—WHITBY.—An abstract of a paper read before the Chemical and Metallurgical Society of South Africa. He gives details of some tests made to show how the present system of purchasing cyanide for commercial use in the gold industry left the manufacturers a very wide margin for impurities. It is extremely easy for the manufacturer to comply with existing conditions, and yet supply the consumer with a lot of things he can do without. He then discusses the importance of these unnecessary impurities. The effectiveness of the mixed sodium and potassium cyanides being accepted, it would appear desirable to adopt the use of a sodium cyanide and not to call it potassium cyanide; also demanding an efficiency of at least 50 per cent. cyanogen. Or if potassium cyanide is to be used some limit should be stated for the sodium cyanide.—*Eng. & Min. Jour.*, February 28.

Electrolytic Preparation of Oxygen and Hydrogen.—An illustrated description of the Schoop method for the electrolysis of water. For soldering purposes the use of pure oxygen-hydrogen is superior to ordinary hydrogen, as the temperature is higher. In the application of a Schoop apparatus for a year, the following results were obtained: one electric hp-hour gives 97.5 liters of hydrogen and 48.75 oxygen (probably under atmospheric pressure); i. e., 6.8 hp-hours are required for one cubic meter of mixed gas; with warm acid (sulphuric acid of 1.23 specific gravity being always used), this value is reduced to 6.2 hp-hours; for 1 cent per hp-hour the cost of one cubic meter of mixed gases is 4.2 to 4.8 cents. The purity of the oxygen is 99 per cent.; that of the hydrogen, 97.5 to 98 per cent.—*Centralblatt f. Accum.*, February 15.

The Calcium Carbide Industry in France.—An article on a report issued by the German consul in Havre. The Bullier patents have finally been proclaimed good in France by the Court of Appeals. The company owning this master patent is practically the owner of 17 carbide factories scattered throughout the Alpine districts; its 50 agencies are compelled to sell at the uniform price of 363 francs per metric ton. The annual production is estimated at 18,000 tons. Forty villages are provided with central acetylene installations. The existence of the Bullier patent has prevented the importation of any carbide, but the export trade is growing. Most of the large steamship companies still dislike taking carbide on board, and leave the carrying trade to the "tramps."—Lond. *Elec. Rev.*, February 27.

A New Method for Heating Furnaces.—RASCH.—An article in which he expresses the opinion that the electric arc furnace and the use of high-tension electric discharges with carbon electrodes, are suitable only for special purposes; the following requirements must be fulfilled for pyrochemical reactions in general; the electrodes must be capable of withstanding a high energy density and a high temperature; they must not be oxidized and they must not produce a reducing action on the reaction to be obtained. Carbon does not answer and he suggests using for pyrochemical reactions conductors of the second class, which are chemically very persistent, and stand a high temperature. Among such conductors are rods or tubes of magnesia, aluminum oxide, etc.; but they must be preheated.—*Zeit. f. Elektrochemie*, February 19.

Electrodes Sensible to Light.—KOCHAN.—An account of an experimental investigation of a gold electrode, which was effected by light. Bose had found that a pair of gold electrodes in dilute sulphuric acid, which had been charged with 110 volts, had a different e.m.f. in the dark than when lighted, and that the oxygen electrode was the real seat of this sensibility to light. The present author made a long series of tests with this type of cell, in which he investigated the influence of light of different colors and the action of Röntgen rays.—*Zeit. f. Elektrochemie*, January 8, 15, 22.

REFERENCES.

Electric Analysis of Mercury.—GLASER.—An account of an experimental study on the electric analysis of mercury and the solubility of platinum in potassium cyanide. The difference observed in the electro-analysis of mercury from a potassium cyanide solution are due to an attack of the platinum disc serving as cathode and to the solubility of platinum in potassium cyanide.—*Zeit. f. Elektrochemie*, January 1.

Action of Iodine on Alkalies.—FOERSTER AND GYR.—In a continuation of their investigation of the action of halogens on alkalies they describe the action of iodine.—*Zeit. f. Elektrochemie*, January 1.

Catalytic Action.—BREDIG AND WATSON.—A preliminary account of an experimental investigation of the kinetic reasons underlying the fact that a solution of potassium iodide produces a catalytic action upon hydrogen peroxide, the latter being decomposed into water and oxygen.—*Zeit. f. Elektrochemie*, February 5.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCE.

Interrupter.—An illustrated description of a high-speed "trembler" of French manufacture for induction coils for producing the sparks in internal combustion engines of automobiles. It is claimed to permit practically unlimited speed of the motor, and yet give perfect sparking under every condition. With a 4-volt current it makes 436 interruptions per minute.—Lond. *Elec. Rev.*, March 6.

TELEGRAPHY, TELEPHONY AND SIGNALS.

The Core Ratio of Submarine Cables.—YOUNG.—The first part of an illustrated article on the ratio of resistance to capacity in long submarine cables, and some related quantities. Comparisons of signals on submarine cables having different ratios of resistance to capacity are liable to be misleading unless the e.m.f. and terminal resistances and capacities are adjusted to the ratio of R to S of the line. The quantities dependent on the design of the core are: the e.m.f. of the battery; curbing (sending or receiving end); the maximum and mean pressure on the cable; the best resistance of the battery for given maximum pressure; the best resistance and inductance of the receiver; and duplex adjustments. All these factors depend upon the ratio of R to S, or rather upon the square root of the ratio of R to Sp, where p is the coefficient involving the shape of the wave, or the time rate of change of the force; it is, in short, the quantity by which the instantaneous volts must be divided to find the instantaneous amperes. If telegraph signals were made by successive reversals, instead of by irregular combinations of impulses, these problems could be dealt with by the methods of alternating-current practice; but they are not, and if these methods are nevertheless applied, it is because it is the best approximation we have at present. His conclusions are arrived at on the understanding that the circuits whose R to S ratios are under comparison, either have equal $S\ R$ values or else are worked up to the maximum speed given by the $S\ R$ law. The usual figure for this is 600 divided by $S\ R$ letters per minute for what may be defined as "long" cables, whose $S\ R$ is not less than about 3.5 seconds, below which limit the disabilities of transmitting and receiving apparatus begin to come into prominence and lower the speed rapidly. He then discusses the amplitude of signals; for "direct sending," the lower the $C\ R$ per microfarad of the core, "C apparently signifying the current," the shorter the contacts required to produce signals of a given size, with a given battery; with direct-sending and constant-battery resistance the e.m.f. necessary to generate signals of a given size is directly proportional to the square root of the $C\ R$ per microfarad of the core. When sending or receiving through a condenser the curbing of the impulse is the primary adjustment. On a core of high $C\ R$ per microfarad the time constant of a given condenser is larger, and to preserve the sharpness of wave form, the condenser capacity must be reduced in the inverse ratio of the square root of the ratio of R to S in order that the signal may be correctly curbed. To get a given amplitude with constant curbing, the e.m.f. must be raised as the square root of $C\ R$ per microfarad after the above adjustment of the condensers. He then discusses the "curbing" of signals; for direct sending the lower the $C\ R$ per microfarad, the shorter is the correct duration of curbing contact, relatively to the main one, required to insure straightness of signals. A somewhat important matter in connection with the e.m.f. used on submarine cables is the maximum pressure produced on the dielectric at the sending end. The mean or effective pressure on the cable is kept constant when the capacity of the sending condenser is made inversely as the square root of $C\ R$ per microfarad. The maximum pressure on the cable is kept constant by making the capacity of the sending condenser vary inversely as the square root of the ratio of R to S of the core, with constant e.m.f. negligible battery resistance.—Lond. *Elec.*, March 6.

New Books.

DESIGN OF DYNAMOS. By Silvanus P. Thompson, D. Sc., F. R. S. New York: Spon & Chamberlain. 253 pages, 92 illustrations, 8 plates. Price, $3.50.

This is one of the most interesting books on its subject that has thus far appeared, and it is also remarkable for its unevenness of merit. Parts of it are invaluable to anyone directly interested in dynamo design; other parts are of merely academic value, while still other parts are open to adverse criticism.

The author begins with magnetic data and calculations, which are expounded in his well-known clear style; for when Prof. Thompson thoroughly knows a thing, no author can explain it better than he. This chapter contains some very useful charts and tables showing the specific losses due to hysteresis and eddy currents under various practical conditions, and includes a description of three methods of ascertaining the stray field coefficient of a machine, one of which is excellent, one tolerable and the other of doubtful value. A table of coefficients applying to various types of machines is also given, but it is problematical, for the reason that the types to which it refers (by numbers) are not identified anywhere in the book. It is gratifying to note that the author has dropped the method of calculating field excitation on the basis of reluctances, and works now in ampere-turns per inch length of path (which method, incidentally, was used by the reviewer twelve years ago). In considering the path in the air-gap, however, the author advocates the doubtful method of calling the air-gap area the mean of the pole-face area and the area of the tooth heads under a pole. With partly closed slots this might serve, but with straight slots the effective air-gap density is appreciably less than this method would make it. As a matter of fact, it is a waste of time to try to calculate air-gap areas; the average magnetic density taken over the pole-face is an adequate criterion of operative conditions, and this value is readily computed. Another dubious method suggested is to take the *average* width of an armature tooth in considering the path there. The density at the root of the tooth is invariably the prime criterion, the average width of the tooth being a misleading factor because of the wide differences in permeability at different points along the tooth. With reference to the length of air-gap, the author says on page 39 that it should not be much less than 1½ times the width of an armature slot; but by the time page 137 is reached, he appears to have changed his mind and recommends half the width of a slot.

Chapter III on copper calculations is excellent, barring a few typographical and slide-rule errors, and a superfluous discussion of "space factor." The conductors in a slot must be adequately insulated from the core, regardless of "space factor," and while everyone recognizes that as many conductors as possible should be put in one slot in order to economize insulation space, there are limitations to the allowable dimensions of a slot which "space factor" cannot alter. The errors in this chapter are as follows: On page 44, in the rules for copper wires at 30° C., "section in sq. mils" should read "circular mils" in the first two rules; on page 48, "coil" should read "wire" in the third line from the bottom; on pages 50 and 51, "1.045" should read "1.0045"; on page 53 the first formula has the sign of equality omitted between $\frac{V}{C}$ and M, and is, therefore, unintelligible as it stands.

Chapter IV is devoted to insulating materials, and contains much practical data compiled from various well-known sources. In Chapter V the author gives undue space to armature-winding schemes, and also makes several careless statements. Thus, on page 96, "if in any wave winding the number of circuits is made equal to the number of poles, ... the winding becomes identical to a simple lap winding." The fact is that multi-path wave windings are used in preference to lap windings because they are *not* "identical to" the latter in any respect except the number of paths. Again, on page 105, "For wave windings, whether series or series-parallel, ... there are required but two brush sets, whatever the number of poles." This is not correct with respect to series-parallel or simple multi-path wave windings, which invariably require more than two sets or rows of brushes. The discussion on page 108 of the choice of the number of armature circuits is highly general in character, and reads as though the author had tried to frame a general mode of procedure from consideration of a single actual machine. This unsatisfying characteristic crops out at intervals all through the book. For example, on page 147: "Assume a suitable value for the Steinmetz coefficient. . . . . Taking 3.13," etc. Why 3.13? And how is one to know what is a "suitable" value for a coefficient that ranges from 1.4 to 4.75, when calculating a single design with no precedent? Again, on page 153, after fixing on ½ inch as the proper air-gap (by some criterion not explained) the author says "unless there is some reason to the contrary, it would with advantage be larger so we will adopt 0.65 inch." Why need it be larger? And if so, why 0.65? Why not ⅝ or anything else? This sort of "designing" is academic to a high degree.

Taken all in all, the book is most commendable for the student and for designers who are sufficiently experienced to exercise discrimination. It contains many valuable charts and tables as well as complete details of a goodly number of representative dynamo designs, and after one has blue-penciled the inaccuracies and academic sections, the remainder is well worth many times the price of the book.

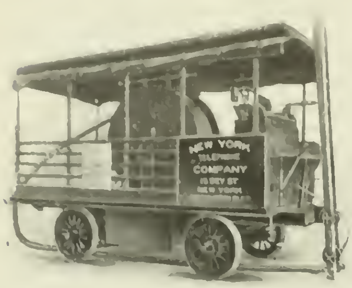
ELEKTRO-INGENIEUR KALENDER, 1903. By Arthur H. Hirsch and Franz Wilkins. Berlin: Oscar Coblentz. 287 pages, illustrated. Price, 2.50 marks.

This is the 1903 edition of a convenient little pocketbook—one that can really be carried in the pocket. The first section contains a calendar for the year, a table of squares, cubes, square and cube roots, logarithms, reciprocals, π and $\frac{\pi}{1} \times n^2$ values for whole numbers from 1 to 1,000; a comparative schedule of the metric, old Prussian, Austrian, English, Russian and Swedish systems of weights and measures; numerous tables of engineering data, such as specific gravities and weights of materials, specific heat values, etc. The remainder of the contents is divided into fifteen sections, the subjects of which include the various forms of prime movers, electric lighting and power circuits, mediums of illumination, dynamos, motors, transformers, generating and sub-stations, and comparative cost of installing and operating gas and electric motors. Each section abounds with tables which facilitate the reader's search for information. There are also two sets of blank pages for memoranda, wire-stitched, which may be held within the covers of the book by means of an elastic cord, secured to the binding for that purpose.

Automobile Telephone Truck.

At the recent automobile show in New York City an exhibit of special interest to electrical men was the traveling electric windlass for use in drawing telephone cables in and out of underground conduits. The New York Telephone Company is now utilizing this truck in regular daily service with the most satisfactory results. An illustration of the truck is shown herewith.

The vehicle measures 7 ft. x 16 ft. over all, the wheels being under the body of the truck. The total weight is four and one half tons, of which 2,800 pounds is battery. The truck is guaranteed to transport a load of five tons fifteen miles and supply power for the operation of the cable-hauling machinery for three continuous hours, all on one charge of the battery. The one charge will carry the maximum load twenty-five miles when the cable-hauling machinery is not used.



AUTOMOBILE TELEPHONE TRUCK.

The upright device shown in front of the vehicle is designed to be let down into man-holes. It is built up from two channel bars, and when it is dropped into a man-hole the lower end is firmly braced so as to afford a rigid support for the pulleys over which the hauling cable runs.

The cable drum is located under the driver's seat. It is driven by a 2½-hp motor through reduction gear and has six speeds varying between 10 and 40 ft. of cable per minute. The vehicle is propelled by two 3-hp General Electric motors of the automobile type connected to the rear wheels through reducing pinions. The control is of the standard type and gives four speeds ahead and two backward.

The battery equipment is carried in a box underneath the body of the truck, and consists of 44 "Exide" cells having a capacity of 200 amp-hours and weighing, as already stated, 2,800 pounds. The truck equipment includes portable electric lights for the lighting of man-holes, etc., while the men are at work.

The vehicle is kept in order, and the batteries are charged daily, by the Rainier Company, general sales agent for the Vehicle Equipment Company, which built the truck. It has proved to be very economical in actual service and does the work of two gangs of men operating under the old method. When it is not used on cable work, it becomes available for trucking. In this capacity it does the work of three ordinary 2-horse trucks and much more expeditiously. With the power windlass available at all times, reels of cable can be loaded on to the truck quickly and deliveries made in much shorter time than where the work is done entirely by manual labor. As to the economy it may be stated that in cable work it costs the telephone company $37 per day for the operation of the truck, whereas the same labor performed by man power, in the old way, cost $69 per day.

Westinghouse Motors for the New York Subway.

As has been previously announced, the Interborough Rapid Transit Company has divided the order for motors to be used on subway cars between the Westinghouse and General Electric Companies, each company to supply 340 motors. The subway company will operate two classes of train service. The first will consist of five-car local trains, composed of three motor cars and two trailers, making an average speed of approximately 16 miles per hour. The second will be eight-car express trains, comprising five motor cars and three trailers, and the requirements of the franchise include the maintenance of an average speed of 30 miles per hour. The same motors and gearing will be used for both classes of service. Each motor car will be equipped with two motors of 200 hp each. The present motors are said to be of smaller size for their output than any ever built heretofore.

These motors are of the heavy railway type, similar in general appearance to the well-known standard Westinghouse railway motor. They will be supported on the truck by nose suspension. The normal capacity of the motor is 300 amp. at 570 volts, or 200 hp for one hour. With this current and voltage a tractive effort of 4,150 lbs. is developed at the periphery of a 33-in. wheel, at a speed of 19 miles per hour. Although designed for an average voltage of 570, the motor will operate satisfactorily with voltages up to 625. It will carry loads up to 500 amp. without injurious sparking.

The motor has a field frame of cast steel, divided into halves on the line of the centers of armature and axle, and completely surrounding the axle. There are thus no separate axle-bearing caps, and the number of pieces is consequently reduced to the least number possible for an easily accessible motor. The two halves of the field are held together by eight bolts, and by removing these the top half of the field can be readily lifted off and access gained to the interior for inspection, repairs or the removal of the armature or field coils. When the top field is removed the lower half remains suspended from the axle by stirrups, which are permanently attached to the axle bearings.

The four pole pieces are made of laminated steel punchings, held between heavy end plates and secured by rivets. Each pole piece is bolted to the field frame by three bolts. These bolts do not pass through the pole pieces but terminate in a long nut inside, thus affording a smooth unbroken surface and absolutely rigid poles.

The field coils are made of copper strap wound on edge. All four coils are exactly alike in form and in number of turns. The insulation between turns consists of asbestos and mica, held in place by shellac and baked at a high temperature under heavy pressure, so that the coil and insulation make a solid mass. The completed coil is sealed in a curved metal case, from which it is insulated by molded mica made like the V-rings of a commutator. This construction gives a coil which is absolutely fire-proof, moisture-proof and practically indestructible. Each coil is held in place by the metal case or shell, which is securely bolted to the frame.

The armature is 20 in. in diameter and weighs 1,930 lbs. It is of the slotted-drum type, and is composed of sheet steel punchings assembled on a cast-iron spider. The commutator is also carried on the same spider and shaft and may thus be removed and replaced, should this ever become necessary, without disturbing the armature winding or its connection to the commutator. The winding is of the two-circuit type, and is of ventilated construction. There are 53 slots and 159 coils, i. e., three coils per slot. Each coil consists of a single turn of copper strap. The three coils which rest in each armature slot are formed and insulated before being put in place. They are placed in the slots without bending or hammering, and are carefully insulated from each other and from the core. Each conductor is continuous between commutator bars, thus giving minimum resistance and allowing the most effective insulation on all parts of the conductor.

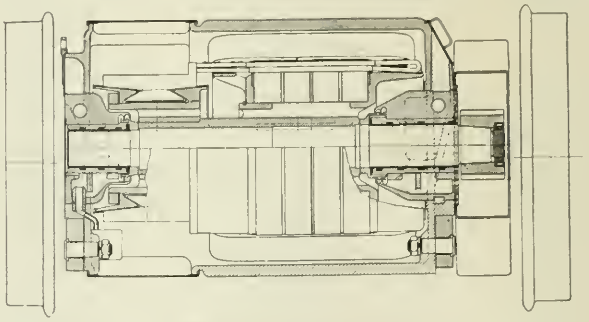


FIG. 1.—VERTICAL SECTION OF MOTOR.

The coils are held in the slots by wedges of special unshrinkable material, which will withstand a high degree of heat without injury. This greatly facilitates the removal and replacing of the armature coils. The armature insulation consists essentially of mica, which extends between turns at all points. The mica is protected by a sufficient amount of fibrous material to insure against deterioration.

The commutator is composed of 159 rolled and hard-drawn copper bars. These bars have solid necks raised above the surface of the commutator with milled slots, into which the armature bars are tightly soldered. The bars are mounted on a cast-iron spider and held in place by two steel V-shaped rings, one of which serves as an oil guard thoroughly to protect the mica from oil or grease. A low voltage between the commutator bars is secured, decreasing the liability of flashing from any cause. The bars are insulated from each other by sheets of mica of a hardness that insures its wearing at the same rate as copper. The mica separating the bars from the rings is 1-16 in. thick, and the mica ring also separates the bars from the commutator spider. The wearing surface of the commutator is 16⅞ in. in diameter and 9⅞ in. long. The bars are of a depth which allows a reduction in diameter of 2 in.

The brush holders consist of two cast-brass arms, each secured independently to the commutator end of the upper frame casting by a special vulcabeston-headed bolt. The arms and bolts are insulated from the frame by fuller-board and mica bushings.

Each arm carries three carbon brushes, ⅝ in. x 3 in. in sections. The brushes slide over finished surfaces and each is pressed on the commutator by a spring finger. The tension of these fingers is readily adjustable and the brush-holder arm is arranged for radial adjustment to allow for wear of the commutator. Copper clips are bolted to the carbon, and these clips are connected by flexible shunts, of ample capacity, to the body of the brush-holder, thus relieving the springs from carrying the current. By this arrangement each brush-holder can be easily removed through the opening above the commutator by loosening a single bolt.

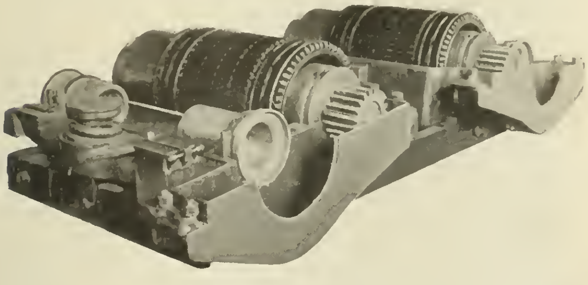


FIG. 2.—VIEW OF MOTORS WITH GEAR CASING REMOVED.

Field and armature leads extend 5 ft. outside the motors, and are furnished with detachable connectors. The bottom field lead is brought out to the end of the lower field frame and carried up through a leader on the end of the upper field frame, avoiding necessity of disconnecting it when opening the motor.

The completed motor will stand an insulation test between winding and motor frame of 4,500 volts, alternating momentarily, or a test of 3,000 volts for one minute.

The armature bearings are contained in housings, which are securely held between the halves of the field frame, being tongued and grooved to the frame and accurately boweled. At the pinion end the bearing is 4¼ in. x 10 in., and at the commutator end 4 in. x 7 in. These bearings are provided with drip grooves, into which oil is thrown by wiper rings on the shaft. The bearing boxes are of phosphor bronze, lined with babbitt metal well grooved for oil. The axle boxes are made to suit a 6½-in. axle and are 12 in. long.

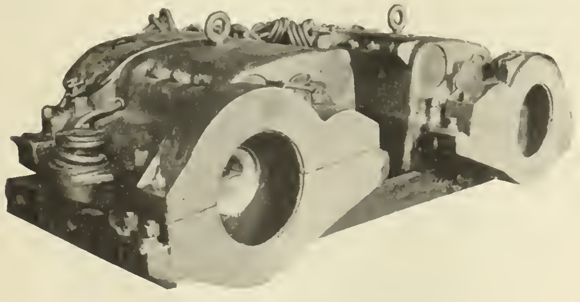


FIG. 3.—VIEW OF MOTORS COMPLETELY ENCLOSED.

Armature and axle bearings are lubricated by oil fed to the journals by waste, in accordance with standard railway practice. The oil boxes are formed so that the waste will pack itself against the journals. The oil box covers are lipped and hinged, and fitted with springs that keep the lids tightly closed or hold them open as desired. Drip boxes are provided to catch all waste oil so that no oil can get into the motor.

The gears are solid, of cast-steel, with cut teeth. The diametrical pitch is 2½ per inch, and the face is 5 in. The pinions are forged steel with cut teeth. They are taper bored to fit the shaft and are held in place by a nut and lock washer. The diameter of the shaft at the large end of the taper is 4⅜ in.

The gear case is made of malleable iron planed to a tight joint, with a suitable opening at top, having a hinged cover. It is supported at the ends by horns cast on the motor frame, and so shaped that they support the gear case without side strain, the weight being carried on its own plane. The whole motor can be dismantled with great ease and dispatch without the use of any special tools. The total weight of motor, gear, gear case, etc., is about 6,600 lbs.

Bullock Apparatus.

The accompanying illustrations show some of the more interesting type of alternating-current machines recently installed by the Bullock Electric Manufacturing Company. Fig. 1 represents the stationary armature of a 1,500-kw. three-phase generator operating at 100 r.p.m., and built for the Denver Gas & Electric Company. This machine is designed for 2,400 volts at 60 cycles. The generator is of a flywheel type, the poles being put directly on the rim of the flywheel. The inside diameter of the armature is 18 ft., the outside diameter being 23 ft. The armature is bar-wound, with two conductors per slot, each conductor consisting of three strips in order to prevent eddy currents in the bars.

The largest belted alternating-current generators built in recent years have also been installed by the Bullock Company in Denver. They are 600-kw. three-phase generators, having 18 poles and running at 400 r.p.m., generating 2,400 volts at 60 cycles. The inside diameter of these machines is 75½ inches. The peripheral speed is, therefore, approximately 8,000 ft. per minute. Owing to this high peripheral speed, and the very narrow armature, these machines can stand tremendous overloads without undue heating, the temperature rise at full normal load hardly exceeding 20 degs. C. in any part of the machine.

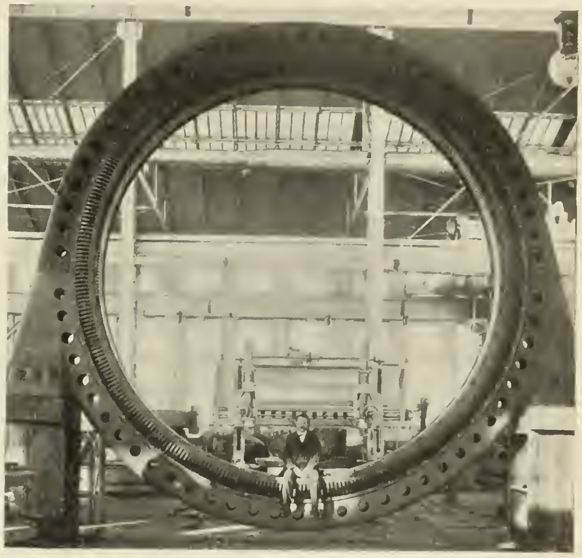


FIG. 1.—ARMATURE FRAME 1,500-KW GENERATOR, DENVER GAS & ELECTRIC COMPANY.

Fig. 2 shows an armature of 600-kw. three-phase synchronous motor operating on a 4,500-volt circuit at 60 cycles and 450 r.p.m. The peripheral speed of this machine is also very high, viz., 7,700 ft. per minute. The synchronous motors are direct connected to 300-volt direct-current generators to operate on an Edison three-wire system.

Fig. 3 shows a 1,000-kw., 30-cycle synchronous motor for 2,300 volts and 450 r.p.m. The photograph of this machine was taken in the testing room of the Bullock Company. The motor is one of four built for the Shawinigan Water & Power Company, and installed at Maisonneuve, Montreal. The motors receive current from the Shawinigan power house after two transformations. The Shawinigan Water & Power Company's station is at a distance of

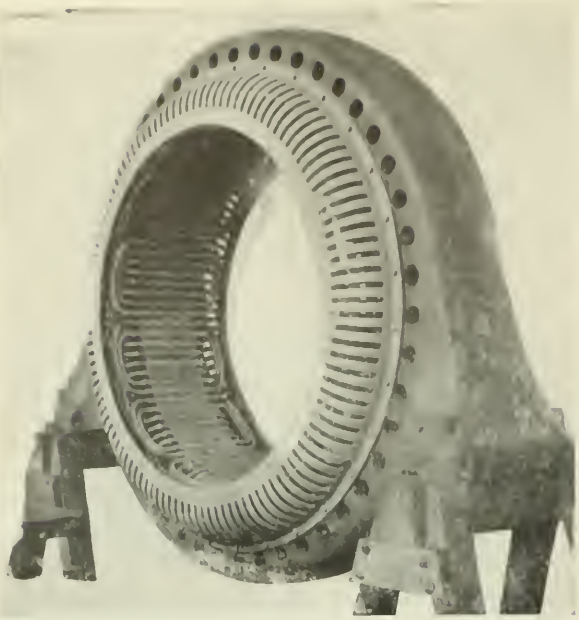


FIG. 2.—ARMATURE OF 600-KW, 3-PHASE MOTOR.

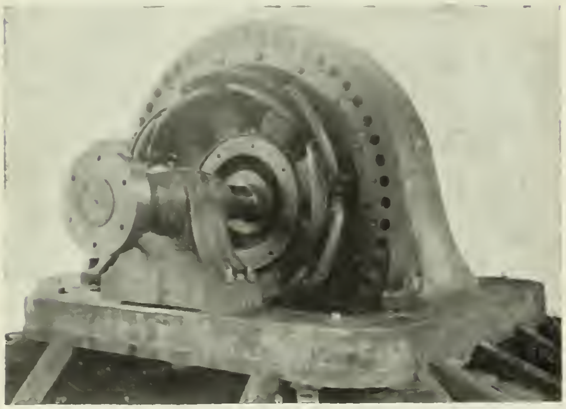


FIG. 3.—1,000-KW SYNCHRONOUS MOTOR FOR FREQUENCY CHANGERS, SHAWINIGAN COMPANY, MONTREAL.

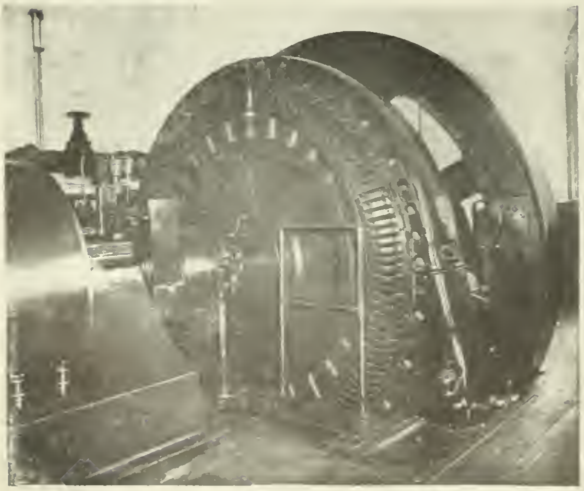


FIG. 4.—450-KW, 3-PHASE GENERATOR, SHELBYVILLE, IND.

85 miles from Montreal, the power being transmitted at 50,000 volts over three aluminum cables, being stepped down to 2,300 volts at Montreal. The current is then changed by the four 1,000-kw. frequency changers from 30 cycles to 60 cycles. The 60-cycle ends of these frequency changers are operating in parallel with the 60-cycle circuits of the Lachine Hydraulic Land & Water Power Company. The plant was put in operation in Fegruary, 1903. The field coils of these motors are made of copper strip on edge, 1 inch by 1-16 inch, and are perhaps the largest strip coils ever made, their outside dimensions being 21 inches by 15 inches.

Fig. 4 represents a 450 kw., 26 cycle, three-phase generator for 400 volts at 114 r. p. m. This machine is operating two 250-kw. Bullock rotaries for the Indianapolis, Shelbyville & Southeastern Railroad Company. The generator has nine slots per pole, there being two conductors per slot. The winding is a bar-winding provided with excellent ventilation. The generator is direct-connected to an Atlas engine. This plant has been in operation for almost a year, and in spite of the sudden variations in load, there have been no signs of hunting in the rotary converters, a fact which is doubtless due to the careful design of both the generator and rotaries.

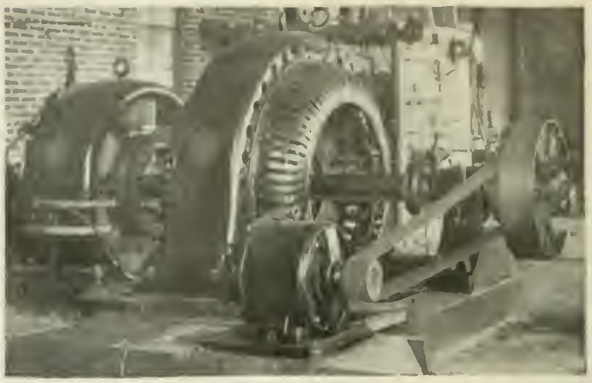


FIG. 5.—200-KW SYNCHRONOUS MOTOR, SAN BERNARDINO.

Two years ago the Bullock Company designed a 200-kw. motor-generator set, operating at 500 r. p. m. on the 11,000-volt, 50-cycle circuit of the Los Angeles Edison Company at San Bernardino, Cal. This machine, shown in Fig. 5, has 12 poles, and is perhaps one of the smallest units designed to operate directly on so high a potential as 11,000 volts. It is direct-connected to a direct-current railway generator.

Annual Report of Electric Storage Battery Company.

The annual meeting of the Electric Storage Battery Company, at which 138,539 shares of stock (out of about 160,000 outstanding) re-elected P. A. B. Widener, Wm. L. Elkins, Thomas Dolan, George D. Widener, Rudolph Ellis, Grant B. Schley, George Philler, Thomas J. Regan and Herbert Lloyd directors, and ratified the sale of the Derby Lead property and the purchase of Chloride Electrical Storage Battery Company, Limited, of England.

President Lloyd denied the newspaper reports of the last six months by stating that no agents of the General Electric Company had ever looked over the plant of the Electric Storage Battery Company and that the subject of the absorption of the Storage Company by General Electric had at no time been considered by the directors. He mentioned incidentally that the Storage Company during 1902 had done nearly 95 per cent. of the battery business of this country. It also transpired that the company owns about one-third of the stock and the same proportion of the bonds of the Pennsylvania Electric Vehicle Company.

The most important matter brought out at the meeting was the plans of the Storage Battery Company for the development of the Chloride Electrical Storage Battery Company, Limited, of England, which has been recently taken over. Control of the Chloride Storage Company, through the acquisition of 44,000 shares of stock, was purchased last October for about $298,000 cash. A new board of directors has since been elected, a majority of whom represent the

American Storage Battery Company. Last November several experts were sent over to Americanize the English works which are at Manchester, and this work is now under way. It is also proposed to reorganize the business department of the works. The Chloride Company is said to have paid 8 per cent. to the stockholders for a number of years. We are advised that the battery manufactured by the Chloride Company under an English patent is practically identical with that produced by the American Electric Storage Battery Company. The Chloride Company has already worked up a market in the British colonies, but it is the purpose of the American management to reach out on a large scale for new business in Mexico and South America, pushing the business side from Philadelphia, but shipping the Manchester product, which can go considerably cheaper to those points than the batteries manufactured in Philadelphia.

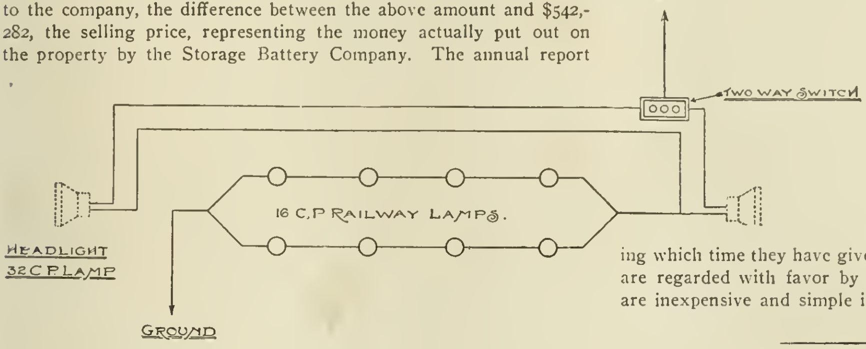


FIG. I.—WIRING CONNECTIONS FOR HEADLIGHT.

It is given out officially that the Derby Lead property, which was bought in 1900 for about $275,000, involved neither profit or loss to the company, the difference between the above amount and $542,282, the selling price, representing the money actually put out on the property by the Storage Battery Company. The annual report for the fiscal year ended December 31, 1902, compares as follows:

	1902	1901.	Changes.
Net earnings	$1,113,199	$900,242	Inc. $212,957
Less dividends	812,427	812,413	Inc. 14
Surplus	$300,772	$87,829	Inc. $212,943
Previous surplus	2,022,582	1,934,753	Inc. 87,829
Total surplus	$2,323,354	$2,022,582	Inc. $300,772

Incandescent Lamps for Street Car Headlights.

With the growth of urban trolley lines and the high speeds of modern street railway service, effective headlights are a necessity.

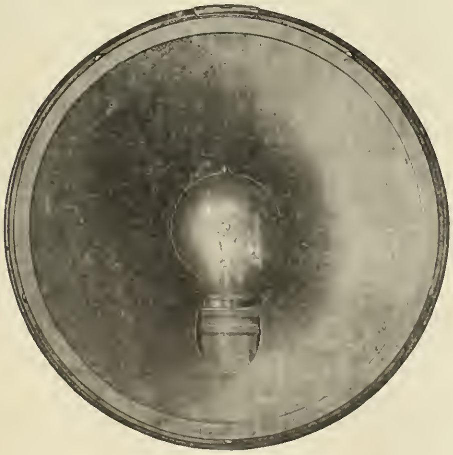


FIG. 2.—STREET CAR HEADLIGHT.

To be effective for such service a headlight must throw a brilliant path of light for a distance of at least one hundred feet ahead of the car. When using a parabolic reflector for projecting the light, the filament of the incandescent lamp should be compactly formed so as to concentrate the light as far as possible at the focus of the reflector.

The General Electric Company is producing a lamp with a special filament, wound in the form of a close conical spiral, which serves this purpose admirably. This filament is supplied in several types of bulbs made to fit the various types of headlights. The standard type of headlight lamp is the round bulb 32-cp size here illustrated. This requires the headlights to be wired in multiple series connection with two circuits each of four 16-cp lamps. The wiring connections are clearly illustrated in the accompanying diagram. For conditions which do not permit using a 32-cp lamp, a 16-cp lamp with a conical spiral filament is made. The larger lamp should, if possible, be used, as anything less does not give a sufficient volume of light for a good headlight service.

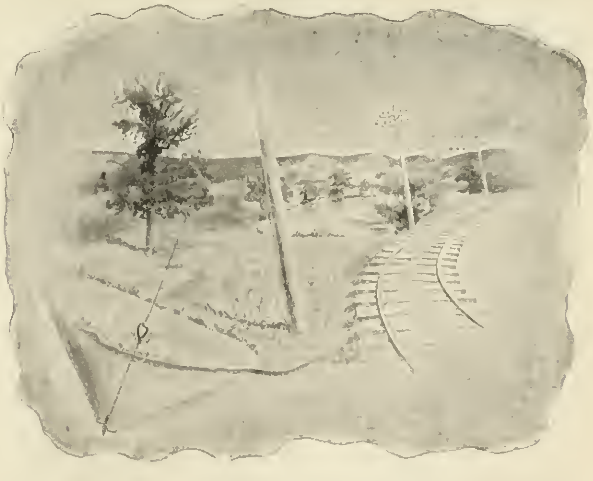
To give the best results, the lamp should be properly focussed in the reflector. The filament can be located at the proper height to place it in the focus line if the dimensions of headlight are stated. A plan, adopted by several companies with excellent results, is to make the socket in the headlight adjustable both vertically and laterally. By the movement of a pair of thumbscrews, this enables the motorman to focus the lamp positively and accurately.

These headlight lamps have been in use on a number of street railways for the past two or three years, during which time they have given thoroughly satisfactory service. They are regarded with favor by all roads that have tried them, as they are inexpensive and simple in their application and operation.

Guy Anchors for Poles.

The accompanying illustration gives an idea of the action of Stombaugh guy anchors. At first glance it would appear that a six-in. anchor, for instance, would only have the resisting power as if a six-in. hole were dug and the anchors slipped into it and the hole filled and tamped. By referring to the cut a dotted spiral line will be noticed. This shows how the helix of the anchor worms its way in, so to speak. The ground is not disturbed any more than a wood screw tears a piece of board.

A second glance at the cuts shows a cone having the anchor point for its vertex. This conical section indicates the manner in which the lines of force work when the strain is placed on the anchor. It will readily be seen that the holding power of the anchor is represented by the cone and not by the spiral section. W. N. Matthews & Bro., Laclede Building, St. Louis, are placing these anchors on the market.



GUY ANCHOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was freely offered by brokers and there was a fair demand, the closing rates being 5¾ a 6 per cent. for 30 to 90 days, and 5¼ a 5½ for four, five and six months. In the stock market there was moderate activity and increasing strength, due to the more favorable money market conditions. Advances were general in the standard stocks, but short covering was the main source of the buying power. Industrial stocks, however, were not prominent, although the United Steel issues were steady. Amalgamated Copper was irregular on the recession in copper prices. The traction stocks were rather quiet, although a good deal of strength was shown in connection with Manhattan and later on in Metropolitan Street Railway shares. The latter made a net gain of 5 points, closing at 138¾, the highest figure of the week being 140 and the lowest 132¾. The shares sold aggregated 60,350. Brooklyn Rapid Transit closed at 67½, thereby making a net gain of 2¼ points. This stock fluctuated between 64 and 68, and 34,000 shares changed hands. Greater strength was shown in the electrics, General Electric closing at the highest figure of the week, namely, 196¾, ex div., being a net gain of 5¼ points. Westinghouse made a net gain of 6 points, closing at 208, which was also the highest figure of the week. Western Union made a gain of ¼ point, closing at 88¾, ex div. American Telephone & Telegraph was the exception, receding 3½ points on the week's business, 164¾ being the quotation throughout the week. American Telegraph & Cable is quoted at 82, being a net loss of ¼ point. On the Boston market General Electric advanced 3½ points and American Telephone & Telegraph was off ½ point. Following are the New York closing quotations of March 24:

NEW YORK.

	Mar. 17.	Mar. 24		Mar. 17.	Mar. 24
American Tel. & Cable......	80	82	General Electric.	192	192⅞
American Tel. & Tel........	164¾	163¾	Hudson River Tel...........	..	..
American Dist. Tel..........	37	35	Metropolitan St. Ry.........	133¾	134¾†
Brooklyn Rapid Transit ...	64⅝	65¾	N. E. Elec. Veh. Trns........	..	⅛
Commercial Cable.	..	..	N. Y. & N. J. Tel............	..	164
Electric Boat.	20	27	N. Y. E. V. T. Co............	8½	9½
Electric Boat pfd..........	35	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	2⅜	2⅜	Western Union Tel..........	89⅝	88
Electric Vehicle...	8½	8½	Westinghouse com....	205	205
Electric Vehicle pfd........	14½	14	Westinghouse pfd...........	218*	200

BOSTON.

	Mar. 17.	Mar. 24		Mar. 17.	Mar. 24
American Tel. & Tel	165	164	Western Tel. & Tel. pfd....	99	98½
Cumberland Telephone....	..	..	Mexican Telephone.........	2⅛	2¼
Edison Elec. Illum.	..	..	New England Telephone ...	138	138½
General Electric..........	..	..	Westinghouse	100	102
Western Tel. & Tel...	22	22	Westinghouse pfd....... . .	100	..

PHILADELPHIA.

	Mar. 17.	Mar. 24		Mar. 17.	Mar. 24
American Railways.........	..	..	Phila. Traction..	97¾	97¼
Elec. Storage Battery.. ...	76½	77*	Phila. Electric	7⅜	6⅞
Elec. Storage Battery pfd..	..	..	Pa. Electric Vehicle....	..	..
Elec. Co. of America.	8⅞	9	Pa. Electric Vehicle pfd ...	..	..

CHICAGO.

	Mar. 17.	Mar. 24		Mar. 17.	Mar. 24
Central Union Tel	..	..	National Carbon pfd........	99	98½
Chicago Edison............	..	..	Northwest Elev. com........	..	..
Chicago City Ry....	210	212	Union Traction	9½	9½
Chicago Tel. Co	..	..	Union Traction pfd.........	42	42
National Carbon	21½	24½			

*Asked. †Ex Dividend.

BELL TELEPHONE FINANCES.—In a recent statement or interview, President Fish, of the American Telephone & Telegraph Company, in speaking of the proposal to increase the authorized capital stock from $150,000,000 to $250,000,000, said that the company is taking this step because at present it has theoretically reached its limit in its power to issue stock. This does not mean, however, that there is now $150,000,000 stock outstanding. The amount in the hands of the public is $109,685,000 stock. Besides this, about $27,100,000 more is held in the treasury of the old Bell Company, leaving about $13,200,000 of authorized stock still unissued. In a circular dated January, 1902, offering for subscription $10,000,000 bonds to acquire control of Western Telephone, President Fish stated that the capital stock of the American Telephone & Telegraph Company was $114,858,400, of which there was outstanding in the hands of the public $82,748,000. The remainder was held in the old Bell treasury. Since that date there has been sold to stockholders at par $21,937,000 new stock, making the total capital stock issued $136,795,400, of which $104,685,000 was outstanding. It is also understood that $5,000,000 of the stock in the Bell treasury was sold privately to New York parties now represented in the directory. This would make the total stock outstanding in the hands of the public at present $109,685,000. The statement that the company is at present theoretically limited in its stock issue is taken to mean that the treasury stock is regarded as issued. As there is only $13,200,000 stock still unissued, it is clear that if the company intends to issue as much stock for construction this year as it did last year, i. e., almost $22,000,000, it must either sell the stock in the Bell treasury or increase the amount of capital stock authorized. The stock sold represents the share that the parent company has to put up as a partner in its growing sub companies.

MEMPHIS (TENN.) LIGHTING MERGER.—The Memphis Consolidated Gas & Electric Company is to be the name of the new concern under which the merger of the Equitable Gas Company and the Memphis Light & Power Company is being effected. It has a capital stock of $4,000,000, $2,000,000 of which is paid in in stock of the companies consolidated. The charter will be filed this week, with the deeds of transfer. The charter was taken out in New Jersey by New York men, including William P. Martin, T. M. Gunderson and John Richey. The transfer was made in New York several weeks ago when Frank G. Jones, president of the Equitable Gas Light Company, and General S. T. Carnes, acting president of the Memphis Light & Power Company, were in New York, and the stock of the two old companies is now in the hands of the Central Trust Company, of New York City. The Board of Directors of the new company is as follows: Anthony N. Brady and C. K. G. Billings, New York; George O. Knapp, president People's Gas Company, Chicago; James Maher, Frank G. Jones and General S. T. Carnes. The New Yorkers hold the bulk of the stock and will, therefore, direct the future policy of the company. The old companies have franchises for 35 years. In consideration of the privilege of merging the two interests a reduction of $90,000 per year in the public charges for lights was agreed upon, besides furnishing a large amount of lighting to the city free. The new company has the right to own and operate lighting plants in other cities with its authorized capital of $4,000,000.

OTIS ELEVATOR COMMON.—The directors of the Otis Elevator Company have declared an initial dividend of 2 per cent. on the company's common stock. The company was incorporated in November, 1898, and a dividend of 1½ per cent. has been paid quarterly on its preferred shares. In September last the authorized amount of preferred stock was increased from $4,500,000 to $6,500,000. The authorized amount of common stock is also $6,500,000, of which $6,350,000 is outstanding. In the year covered by the forthcoming annual report the expansion of the company's business has continued. The plants in operation were worked to their full capacity here and abroad. The company strengthened its position by the purchase of the business of R. Waygood & Co., the leading British manufacturers of elevators, and extended its trade in Canada, by the purchase of plants at Hamilton, Ontario, and Montreal, Quebec. The duty on Otis elevators imported into Canada made the importation of them unprofitable and cut off an expanding business field.

POWER DEAL AT MONTREAL.—It is announced that the Montreal Light, Heat & Power Company has sold to the Bank of Montreal and Messrs. N. W. Harris & Co., bankers of New York city, an issue of $4,000,000 thirty-year 5 per cent. bonds to pay in part for the Lachine Rapids Hydraulic & Land Company, Limited, and its two affiliated companies, i. e., the Standard Light, Heat & Power and the Citizens' Light, Heat & Power Company. The new bonds will be the obligation of the Montreal Light, Heat & Power Company, and will be additionally secured by a lien on all newly acquired properties. The capital stock of the company will be $17,000,000. This makes a consolidation of all the electric power interests at Montreal.

BULLOCK COMPANY MEETING.—The annual meeting of the stockholders of the Bullock Electric Company was held at the office of the company, in Norwood, Ohio, last week. The reports of the officers showed that the business during the past year was exceptionally good and that there are now orders enough on hand to keep the plant in full operation for the next six months. The old officers and directors were re-elected: George Bullock, president; J. S. Neave, vice-president; R. T. Lozier, second vice-president; Stephen R. Burton, treasurer; secretary, J. W. Bullock; W. S. Rowe and J. B. Dill, of New York, additional directors. The company is capitalized at $2,000,000.

ROCHESTER GAS & ELECTRIC.—The Rochester, N. Y., Gas and Electric Company last week filed with the Secretary of State a certificate increasing its capital stock from $4,300,000 to $5,000,000.

LACLEDE POWER COMPANY.—The Laclede Power Company, at a recent meeting of its directors in St. Louis decided to increase its capital stock from $800,000 to $2,000,000. The proposition will be laid before the stockholders at a special meeting on May 18. Business of the company has increased to such an extent that the directors found it necessary to adopt plans for increasing the capacity of its plant. The plant, located at Lewis and O'Fallon Streets, has now a capacity of about 3,000 kw. The increase will add an important factor to the local lighting and power situation. The company has a well-established business, which it will doubtless hold. The Laclede Power Company has not been included in any of the lighting and power consolidation rumors. The directors of the company, it is said, are in favor of running it as an independent concern. The directors are: Henry C. Scott, president; E. V. Matlack, manager; Samuel W. Fordyce, J. C. Van Blarcom and Thomas H. West.

EXPENDITURES AT BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has decided to continue its policy of physical improvements at Birmingham. President Robert Jemison says that the company will expend with the improvements already under way two and a half million dollars. The directors have authorized a meeting of the stockholders to consider the increase of the capital stock from $5,000,000 to $6,500,000. The present capital stock is $3,500,000 common and $1,500,000 preferred. The power plant at Birmingham is to have six new batteries of boilers and two more engines, giving the plant an increase of 3,000 hp. A new building 100 x 100 will be erected to hold the new machinery. The gas plant is to be increased one-third. The steam dummy line from Birmingham to Bessemer will be in operation as an electric line by April 1.

NEW YORK TICKER SERVICE.—The Gold & Stock Telegraph Company has advanced the price of Cotton Exchange tickers from $15 to $20 per month, to begin April 1, 1903. This advance it is understood has necessitated the re-application of each subscriber for the ticker, the application to be accompanied by "ironclad contract" not to use or permit to be used a quotation for bucket shop purposes. It is understood that the contract is very similar to the Stock Exchange contract for use of tickers, Consolidated Exchange contract, the Chicago Board of Trade contract, and that of the Minneapolis Board of Trade. It is intimated that strict enforcement of the contract may result in the weeding out of a good many bucket shops.

ELECTRIC POWER IN MASSACHUSETTS.—Electric power is to be developed on the Farmington River, between the towns of Tolland and Sandsfield, which will furnish power to light cities and towns and run trolleys all over the Berkshires and as far east as Springfield, Mass. New York and Boston capitalists support the venture, on which they are to spend at least $500,000. A great reservoir is to be built on the farm of Cebra Haley, in Sandsfield, and the water will be conveyed four miles to Sandsfield Centre, where a generating plant, of 6,000 hp, will be located. The G. L. Straw Company, of Boston, has obtained options on farms in the section, which is the wildest part of the Berkshires.

UNITED ELECTRIC OF NEW JERSEY.—At the annual meeting of the United Electric Company of New Jersey, in Newark, it was announced that the gross receipts for the year were $1,854,304.77; operating expenses, $1,110,041.40; net earnings, $744,263.37; interest on bonds, $698,533.43; net profit over all charges, $45,729.94. Included in the operating expenses is the sum of $68,945.36 for coal, in excess of contract prices, owing to the coal strike.

MARYLAND TELEPHONE & TELEGRAPH CO.—The Maryland Telephone & Telegraph Co. has filed a general mortgage at Baltimore in favor of the Central Trust Company to secure the issue of $4,000,000 of 50-year 5 per cent. gold bonds. The company's charter authorizes it to carry on an electric lighting business, and it is stated that it is likely that the company will avail itself of this authority.

NORTH AMERICAN COMPANY.—At the special meeting of the stockholders of the North American Company it was voted to increase the capital stock from $12,000,000 to $17,000,000. The increase of $5,000,000 has been made for the purpose of paying for the stock of the Laclede Gas Company, of St. Louis, and whatever amount is issued will be offered to stockholders at par.

DIVIDENDS.—The directors of the American Telephone & Telegraph Company have declared a regular quarterly dividend of 1½ per cent. The Cumberland Telephone & Telegraph Company has declared the regular quarterly dividend of 1¾ per cent., payable April 1.

KINGS COUNTY LIGHTING.—The stockholders of Kings County Electric Light & Power Company, of Brooklyn, N. Y., have voted to increase the capital stock from $2,500,000 to $5,000,000.

MEXICAN TELEPHONE shows for eleven months a net of $102,470, being an increase of $12,242; and 4,458 subscribers, being a gain of 563.

Commercial Intelligence.

THE WEEK IN TRADE.—The reports received by the mercantile agencies continue to be generally favorable. Excessive moisture in the form of heavy rains and floods, or of merely bad roads is, according to *Bradstreet's*, an apparent drawback to distributive trade. To offset this, however, may be noted an improvement in jobbing trade at some leading Western centers; slightly improved collections; perceptible easing of the car shortage trouble and increased strength in the iron and steel trades. There is apparently some improvement in the labor situation, but labor disturbance is still a bad feature, particularly in the building trades. The higher cost of material and the very high wages of labor are undoubtedly also retarding influences at the present time. Railway earnings thus far available for March show an increase of 14.6 per cent. over last year, and 26.1 over 1901. In the metal market copper showed practically no change since our last report. Quotations are entirely nominal and producers say that Lake cannot be obtained under 15⅛c. Quotations are as follows: Lake and electrolytic, 14¾ a 15c.; casting stock, 14½ a 15c., and standard, 14c. The business failures for the week ending March 19, as reported by *Bradstreet's*, numbered 194, against 176 the previous week, and 197 the corresponding week last year.

GAS ENGINE ORDERS.—The advance of the gas engine is well illustrated in the installation now operating in the plants of the Riter-Conley Manufacturing Company, at Allegheny and Leetsdale, Pa., aggregating 1,600 hp in Westinghouse gas engines of the vertical single-acting type. Three of the engines are 280 hp and are direct-connected to polyphase generators arranged for parallel operation. These generators supply current for light and power in the new shops at Leetsdale, Pa. The remaining engines are employed for driving air compressors, pumps, etc. The gas engine is relied upon at both works for the entire power supply. A few other recent installations of a similar nature are: Potosina Electric Company, San Luis, Potosi, Mexico, 1,225-hp producer gas power plant, supplying the City of Mexico with electric light and power. Horizontal double-acting engines used, direct-connected to polyphase generators operating in parallel. Pittsburg Screw & Bolt Company, 245 hp for generator driving exclusive power supply. McClintock-Marshall Construction Company, Rankin, Pa., 585 hp for driving generator and compressors. Marshall Foundry Company, Pittsburg, Pa., 375 hp for generator driving to furnish power for entire works. Consolidated Gas Company, Long Branch, N. J., 608 hp for generator driving, combined gas and electric plant, producer gas used. North Baltimore (Ohio) Electric Light & Power Company, 250 hp, for driving lighting generators. Light and power plants at Sistersville, W. Va., and Hutchinson, Ky., 125 hp each, for generator driving. These installations are now under erection. The machinery was furnished by Westinghouse, Church, Kerr & Co.

STEAM TURBINES.—The total aggregate power of steam turbines in use or under construction or ordered in different parts of the world is put at over 500,000 hp. The major portion is used or to be used for the driving of dynamos. An item in point is the contract recently given to the British Westinghouse Electric & Manufacturing Company, Limited, by the Metropolitan District Railway Company, of London, England, for four turbo-alternators. Each of these is designed for a normal capacity of 5,500 kw, but will be capable of carrying an overload of 50 per cent., giving for each unit a maximum output of 8,250 kw, or about 11,000 hp. These will be not only the largest steam turbines ever made, but also the most powerful single-cylinder engines of any type whatever in the world. Very few multiple-cylinder engines have greater power. The engines are only 29 ft. in length by 14 ft. wide, by 12 ft. high, the overall length of turbine and alternator being 51 ft. 9 in. The steam pressure will be 165 lbs. per square inch, and the speed 1,000 r.p.m.

EXPORT OF AUTOMOBILES.—The United States Treasury Department's annual report on the commerce of the United States for the year ending June 30, 1902, gives the value of the exports of American-made automobiles for that period as $948,528. Of the total valuation given, all but $92,714 worth of machines were shipped from New York. The largest foreign buyer of American motor vehicles was the United Kingdom, whose purchases amounted to $671,553. France took about $60,000, showing that the automobile trade is not all one way, but that our machines are appreciated in the pioneer automobile country.

LONG ISLAND STONE-CUTTING PLANT.—The Westinghouse Electric & Manufacturing Company has taken a contract for a 100-kw generator, a 75-kw machine and 10 motors for installation in the stone-cutting plant at Ravenswood, L. I., operated by Senator W. A. Clark, of Montana. The engines, as already mentioned in these columns, will be built by the Harrisburg (Pa.) Foundry & Machine Works.

TELEPHONE SYSTEM FOR KANSAS CITY.—The contract for the central office equipment for the Home Telephone Company, Kansas City, Mo., and Kansas City, Kan., has been awarded to the Stromberg-Carlson Telephone Manufacturing Company. The contract comprises four exchanges as follows: The main exchange having a capacity for 12,000 lines will be equipped for the immediate operation of 4,500 lines, capacity for 300 trunk lines, present equipment of 120 lines. The east branch exchange will have an ultimate capacity of 7,200 lines, equipped for the immediate operation of 1,200 lines, capacity for 300 trunk lines and a present equipment of 75 lines. The south branch exchange will have a capacity for 7,200 lines and a present equipment of 700 lines, capacity for 300 trunk lines with a present equipment of 75 lines. The Kansas City (Kan.) exchange will have a capacity for 7,200 lines and will have a present equipment of 800 lines, capacity for 360 trunk lines and a present equipment of 80. All of the above boards are to be of the bridged multiple relay lamp signal central energy type. The contract also calls for the necessary wire chief's, monitor's, and chief operator's desks, distributing frames, lightning arresters, power plant, storage batteries and a complete central office equipment. The main exchange is to be in operation September 20, and the sub-exchanges in October and November.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "Chloride Accumulator," has recently closed several large contracts for the installation of storage batteries in connection with street railway work on the Pacific coast. The Los Angeles Railway Company has contracted for three batteries, two consisting of 204 cells having a capacity of 1,000 amp and one of 264 cells having a capacity of 2,000 amp. These batteries are to be operated in connection with differential boosters for the purpose of regulating the railway load and for reserve in any emergency which may arise due to the temporary shut down of machinery at the power house. The Pacific Electric Railroad has also contracted for a battery of "Chloride Accumulators" consisting of 264 elements of 1,000-amp capacity to be operated in connection with a differential booster for regulation, peak work and emergency use. Several batteries are now in process of installation for the following roads in the same section: The Oakland Transit Consolidated, the Los Angeles Pacific Railway and the North Shore Railroad.

ELECTROLYTIC COPPER.—Mr. Titus Ulke contributes to the *Engineering and Mining Journal* a review of the progress of electrolytic refining in 1902. He says the world's average daily production of electrolytic copper is about 883 short tons, of which 764 tons, or 86.5 per cent., are supplied by the United States. Of the balance of 119 tons daily production, or approximately 13.5 per cent., Great Britain furnished a little over 8.8 per cent., Germany about 2.75 per cent. and France a little over 1.6 per cent. The United States now produces annually at the enormous rate of 278,860 tons of electrolytic copper. The by-product recovered daily contains about 741,100 ounces silver and 948 ounces gold, which equals an annual output of over 27,000,000 ounces of silver, valued at nearly $13,000,000 and more than 250,000 ounces of gold valued at $5,167,500. There are now in active operation, or ready to be placed in commission, 33 electrolytic copper refineries in the world, not including the plant of the Osaka Electrolytic Refining Company, now being constructed at Osaka, Japan.

PAWLING & HARNISCHFEGER, crane and hoist builders, Milwaukee, Wis., expect to move from their present location on Clinton, Oregon, Barclay and South Water Streets to a new site just purchased on National and Thirty-eighth Avenues. The property acquired is nineteen and one-third acres, having a north and south frontage of 2,800 feet, and possessing ideal shipping facilities through adjoining the belt line of the Chicago, Milwaukee & St. Paul, and the Chicago & Northwestern Railways. Work will at once commence on the new plant, which will be strictly modern and the best appointed that can be devised. Their plans at the present time are simply to increase their output by the additional buildings to be erected on the new site, although in time it is the intention to transfer their entire works to this new location.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY has recently sold telephones—switchboards and supplies—to the following companies: Wataga Mutual Telephone Company, Wataga, Ill.; Gays Mutual Telephone Company, Gays, Ill.; Cullom Mutual Telephone Company, Cullom, Ill.; Fairbury Farmers' Telephone Company, Fairbury, Ill.; Millikan & Stokes Telephone Company, Edinburg, Ill.; Central Illinois Telephone & Telegraph Company, Lincoln, Ill.; Farmers' Mutual Telephone Company, Ashmore, Ill. The Stromberg-Carlson Telephone Manufacturing Company has also recently closed contracts for switchboards with the Bergholz Telephone Company, Bergholz, Ohio, and the Winona Telephone Company, Winona, Ohio.

ELECTRICAL IRRIGATION is coming to be widely used in the arid regions of the West and is transforming deserts into well cultivated and productive fields. The Consolidated Canal Company, of Mesa, Ariz., is arranging to furnish water for a large area and is installing in its power plant the following apparatus recently purchased from the Westinghouse Electric & Manufacturing Company: A 300-kw, three-phase, revolving-field alternator, running at 400 r.p.m. and 11,000 volts, which is direct coupled to a water wheel; also three 50-hp motors of 200 volts, 7,200 alternations, and 850 r.p.m., which will be used in operating irrigation pumps. All of this machinery has been shipped and is now being installed.

WIRELESS TELEGRAPH FOR PACKING HOUSES.—It is proposed to use the wireless telegraph system between Chicago and other live stock centers. If the scheme is found feasible Armour & Co. will effect an annual saving of almost $100,000. Tests will be made between Chicago and other Western cities, where the packing house has branches. Representatives of the De Forest Wireless Telegraph Company are to make the first experiment, which will be between the packing houses and the offices in the Home Insurance Building, in Chicago, a distance of seven miles. They will be conducted by Mr. White and Mr. Galbraith, agents of the company.

L. & N. SHOPS.—The new electrically-driven shops of the Louisville & Nashville Railroad, which are being built in South Louisville, Ky., will give employment, when they are completed, to 5,000 men and will have four times the capacity of the present shops and yardhouses of the road. The plant will cost $2,000,000. The improved machinery and electrical appliances which will be installed will permit a great increase in the capacity without the necessity of employing a proportionate number of men. The force of employees in the shop and yards will be doubled, however, and more than 2,000 new mechanics will be needed to operate the new plant.

LARGE CONTRACTS FOR CONDUIT.—Mr. G. M. Gest, the conduit contractor, has been awarded a large contract for the underground conduit work in and around the L Street Central Station of the Edison Electric Illuminating Company, of Boston, Mass. This construction will be very heavy, having 186 ducts in one trench. He has also just been awarded additional contracts by the Brooklyn Heights Railroad Company for underground conduit work along Flatbush Avenue, Brooklyn. This will be a large piece of work and will amount to many thousands of dollars.

AUTOMATIC TELEPHONE EXCHANGES.—The Automatic Electric Company, of Chicago, has received an order from the Delaware County Telephone Company, of Manchester, Iowa, for an automatic switchboard of 1,000 capacity with a present installation of 300 lines. Manchester has had automatic telephone service for seven years, the company being one of the early purchasers of automatic apparatus. The business has outgrown the ultimate capacity of the board now in use, and the new equipment was purchased to meet the increasing demands for service.

THE OTIS ELEVATOR COMPANY has been awarded a contract for eighten electric elevators equipped with the push-button system of control—the largest number of elevators of this type ever included in a single contract. These elevators are to be installed, one each, in a row of private residences now being constructed for F. Ambrose Clark on Seventy-fourth Street, between Central Park West and Columbus Avenue, New York.

BOILERS FOR RIO LIGHTING PLANT.—The electrical engineering and contracting firm of James Mitchell & Co., Rio de Janeiro, which represents several American manufacturers, has placed a contract with the Edward P. Hampson Company, 26 Cortlandt Street, for two high-pressure boilers for installation in a local electric lighting plant. The boilers are to be built by the Atlas Engine Works, Indianapolis, Ind.

ELECTRICAL EQUIPMENT FOR CEMENT PLANT.—Martin's Creek Portland Cement Company's plant at Easton, Pa., is to be electrically equipped. The C. & C. Electric Company have taken a contract for a 175-kw generator and four motors, representing an aggregate capacity of 220 hp. This equipment will be utilized for both light and power purposes.

BALL ENGINE CONTRACTS.—The Ball Engine Company, Erie, Pa., is building for the Dayton Arcade Company, Dayton, Ohio, a direct-connected unit. The Pennsylvania Company is installing in its Fourteenth Street station, Chicago, a 175-hp engine, furnished by the Ball Engine Company, which is direct-connected to a Westinghouse generator.

AFTER FORMOSAN LIGHTING PLANT CONTRACTS.—The British electrical engineering and contracting firm of L. J. Healing and Co., Yokohama, is after some substantial contracts for the equipment of Formosan lighting plants. The firm is represented in New York by Francis A. Cundill, whose offices are at 90 Wall Street.

WESTERN ELECTRIC COMPANY GROWTH.—The Western Electric Company has purchased 109 acres of land in Chicago upon which it will erect structures costing $1,200,000. The land was purchased for $313,000. The company has invested $3,000,000 in buildings at its present site.

General News.

THE TELEPHONE.

BOULDER, COL.—The Colorado Telephone Company will erect a new building here.

ATLANTA, GA.—The Southern Bell Telephone Company will soon establish a sub-station at West End to meet its necessary business requirements. A handsome building will be erected. The exchange will accommodate 1,000 subscribers. Cables have already been laid.

EL PASO, ILL.—The El Paso Telephone Company has increased its capital stock from $5,000 to $10,000.

DENVER, ILL.—McClintock Mutual Telephone Company, capital $2,400, has been incorporated by J. H. McClintock, Jas. A. Thompson and others.

GAYS, ILL.—The Gays Mutual Telephone Company has been incorporated with a capital stock of $2,400, by W. E. Storm, S. M. Lythe and A. W. Treat.

JOSLIN, ILL.—The Crescent Telephone Company has been incorporated with a capital stock of $12,500, by Daniel W. Mumms, John Butzer and A. W. Donahue.

WATSON, ILL.—The East Watson & Gilmore Rural Telephone Company, of Watson, has been incorporated with a capital stock of $1,000. The incorporators are E. W. Tucker, C. F. Bernhardt and V. C. White.

CHICAGO, ILL.—The Chicago Telephone Company installed during February nearly 1,200 new telephones, about 90 per cent. of these in residences and small stores. February would have shown a much larger increase had the weather permitted steady outside work. To date the orders on the books are fully 3,000 ahead of the company and applications are coming in from all parts of the city in large volume. Since the first of last October the company has installed 9,391 telephones and the gain in two years has been about 35,000. Altogether the company now has a few more than 63,000 telephones in service in the city and officials predict that with rapid work permitted during the summer months the 75,000 mark will have been easily attained by autumn.

SOUTH BEND, IND.—The New Market Telephone Company, of South Bend, has increased its capital stock from $1,000 to $2,000.

INDIANAPOLIS, IND.—The Fincastle Co-operative Telephone Company, of Putnam and Montgomery counties, has been incorporated with a capital stock of $420.

SANBORN, IA.—The Council has granted a franchise to the Citizens' Telephone Company.

SLATER, IA.—The Slater Telephone Company has been incorporated with a capital stock of $10,000.

LA MARS, IA.—The La Mars Telephone Company has been organized with a capital stock of $50,000.

TRACY, IA.—The Mutual Telephone Company has been organized here by Messrs. P. Heins, Frank Converse, L. Converse and others.

HORNICK, IA.—The Clark Automatic Telephone Company, of Sioux City, is seeking a franchise in this place. A vote on the subject will be taken on March 30.

DAVENPORT, IA.—The Iowa Telephone Company, it is stated, will expend $700,000 during the year in rebuilding and improving its old lines and building new ones.

DES MOINES, IA.—The North Branch Telephone Company, of Guthrie County, has been incorporated with a capital stock of $5,000. Mr. C. Cope is president and O. C. Parsons, secretary.

FARMERSBURG, IA.—The Wagner Telephone Company, of Farmersburg, has been incorporated with a capital stock of $1,500. Henry Walter is president and A. G. Kirshman secretary.

DES MOINES, IA.—The Luana & Monona Farmers' Telephone Company, of Clayton County, has been incorporated, the capital stock being $2,500. Mr. George Daubenberger is president and J. L. Eno secretary.

ATCHISON, KAN.—The Atchison Independent Telephone Association will build a toll line to Rushville and De Kalb and establish exchanges at both places.

PLYMOUTH, MASS.—The Old Colony Telephone Company has been incorporated in Maine with a capital stock of $35,000. The promoters are Anthony Atwood, Walter G. Loring and J. F. Waters.

KALAMAZOO, MICH.—It is stated that the Citizens' Telephone Company, recently organized in this city, has made an offer of $125,000 cash for the purchase of the Michigan Telephone Company's plant in Kalamazoo. The entire property of the Michigan Company, it is reported, will be sold under foreclosure. The Union Trust Company, of Detroit, it will be remembered, was recently appointed receiver of the Michigan Telephone Company.

WASECA, MINN.—The Waseca Telephone Company has increased its capital stock from $10,000 to $40,000.

EMMONS, MINN.—It is stated that the Farmers' Mutual Telephone Company will establish a local system here.

MORRISTOWN, MINN.—A telephone company has been organized here, Mr. H. W. Donaldson being secretary.

REDWOOD FALLS, MINN.—The Rural Telephone Company expects to build about 100 miles of line during the coming summer.

JACKSON, MINN.—The Jackson Telephone Company has absorbed the system of the Fairmount Telephone Company in this city and will extend and improve the same.

WINONA, MINN.—The Winona Telephone Company will make several extensions in the country districts. One line will connect Lewiston and Altura and another will be extended to Almon.

DULUTH, MINN.—The Zenith Telephone Company, of Duluth, proposes to purchase the Iron Range Telephone Company which now operates a system connecting Grand Rapids, Cass Lake, Bemidji and Crookston.

LEROY, MINN.—The Leroy Telephone Company has been incorporated with a capital stock of $100,000. The officers are: President, C. Mearcklein; vice-president, Fred Henslin; secretary, Charles J. Mearcklin; treasurer, A. Edgar Henslin.

ST. LOUIS, MO.—The Bell Telephone Company is preparing to establish a training school in this city for telephone operators. A small salary will be paid while the pupils are in training.

MILES CITY, MONT.—The Custer County Telephone line was recently sold by the sheriff. W. H. Harris, who holds a mortgage on the property, bid it in for $1,500. The original cost was $10,000.

LINCOLN, NEB.—The Western Union Independent Telephone Company, of Chicago, has been granted a franchise for an exchange in this place.

SILVER CREEK, NEB.—The Silver Creek Telephone Company has been organized with an authorized capital stock of $5,000. The following-named officers were elected: J. H. Pollard, president; Fred Johnston, secretary, and J. F. Gagen, treasurer.

JERSEY CITY, N. J.—The Illinois & Indiana Telephone & Telegraph Company has been incorporated here with a capital of $2,000,000, by Louis B. Dalley, Joseph W. Mitchell and Kenneth K. McLaren. According to newspaper reports this company is thought to be a part of the big independent system in the West that is gradually extending East and which is practically a part of the mammoth syndicate of which the Inter-State Company is a branch.

NORWOOD, N. Y.—The Norwood Telephone Company has been incorporated with a capital stock of $25,000. The directors are: W. J. Fletcher, F. L. Smith and A. C. Healey, Norwood.

NEW YORK, N. Y.—The New York & Northern Telephone & Telegraph Company has been incorporated with a capital stock of $50,000. The incorporators are Fletcher S. Hyatt, Jacob V. Jacobs and Charles E. Gardner.

ALBANY, N. Y.—The Albany District Telegraph Company has elected officers as follows: President, James H. Manning; vice-president and manager, F. W. Newman; secretary, W. B. Butler; treasurer, J. J. Fitzsimmons.

ALBANY, N. Y.—The Hudson River Telephone Company has elected directors and they in turn have elected officers as follows: President, James H. Manning; vice-president, Jeffries Wyman; secretary and auditor, Walter B. Butler; treasurer, James J. Fitzsimmons; general manager, Henry E. Hawley.

MARION, N. C.—The Marion Telephone Company has let a contract for a long distance line to Rutherfordton, N. C.

TEACHEYS, N. C.—The Teacheys Bell Telephone Company, of Teacheys, has been chartered with a capital stock of $5,000.

LIMA, OHIO.—The Lima Telephone & Telegraph Company has increased its capital stock from $150,000 to $200,000.

GENEVA, OHIO.—The directors of the Madison Telephone Company have authorized the expenditure of from $5,000 to $10,000 for improvements on the company's lines in Lake and Ashtabula counties.

EL RENO, OKLA.—Representatives of independent telephone companies in Oklahoma and the Indian Territory met in El Reno recently and formed an organization called the Oklahoma Independent Telephone Association. Twelve companies were represented at the meeting. The purpose of the organization is to further the development of and improve telephone service in the two territories.

MONMOUTH, ORE.—The Luckiamute Rural Telephone Company, of Monmouth, has been incorporated with a capital stock of $1,500. The incorporators are L. S. Perkins, H. R. Nehrbas, W. E. Williams, B. F. Smith and J. A. Withrow.

DOYLESTOWN, PA.—The Standard Telegraph & Telephone Company has completed plans for a number of extensions and improvements to its system in Doylestown and vicinity.

YORK, PA.—The York Eastern Telephone Company has been chartered to establish a system in the County of York. The capital stock is $8,000. The names of the incorporators are A. M. Grove, M. H. McCall, Henry S. Merryman, John H. Wilson, B. F. Norris, Joseph A. Gaily and Calvin M. Shaw.

HECLA, S. D.—The Hecla Telephone Company has been incorporated with a capital stock of $50,000.

WAUSAU, WIS.—The Wausau Telephone Company has purchased the property of the Wisconsin Bell Telephone Company in this city.

ALGOMA, WIS.—The Algoma Farmers' Telephone Company has been incorporated, with $500 capital, by Conrad R. Guth, Emil Miller, B. P. Churchill and Emil Maedke.

MT. HOREB, WIS.—The Interstate Telephone Company, of Mt. Horeb, has been incorporated by Martha E. Bell, Frank E. Bell and Lewis F. Heuer. The capital stock is $12,000.

WILTON, WIS.—The Ontario & Wilton Telephone Company has been incorporated with a capital stock of $5,000 by T. A. Surrurier, W. C. La Rue, F. M. Walker, J. H. Harland and F. P. Johnson.

SCHLEISINGERVILLE, WIS.—The Cedar Lake Telephone Company, of this place, has been incorporated with a capital stock of $2,000. The names of the incorporators are John Rosenheimer, John Rosenheimer, Jr., and Mary Rosenheimer.

RICHFIELD, WIS.—The Richfield, Hubertus & Holy Hill Telephone Company has been incorporated to establish a telephone system in Washington and Waukesha counties. The capital stock is $2,000, and the incorporators are H. Klippel, H. G. Meyers and Herbert Serres.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—It is stated that the Birmingham Railway, Light & Power Company will expend about $2,[illegible]00,000 in improvements.

FT. ROSECRANS, CAL.—Bids are wanted April 8 for the construction of a power house. Capt. Edgar Jadwin, Engineers' Corps, U. S. A., Los Angeles, Cal., should be addressed.

LEWES, DEL.—The House has reported favorably on the bill authorizing the town to issue bonds for an electric light plant, water works and a sewerage system.

ATLANTA, GA.—J. M. Stephens, of the Board of Electrical Control, of Atlanta, has visited Nashville, Tenn., to examine the city's lighting plant, with a view to erecting a similar plant in Atlanta.

GAINESVILLE, FLA.—The Gainesville Gas Company has secured the contract for lighting the city for five years. It will construct an electric light plant.

FT. PICKENS, FLA.—Bids are wanted April 4 for the construction of an electric lighting system at this post. Communication should be addressed to W. F. Cole, Q. M., Ft. Barrancas, Fla.

AUBURN, ILL.—The Auburn Electric Light Company has increased its capital stock from $8,000 to $10,000.

MARTINSVILLE, IND.—The Martinsville Light, Heat & Power Company has been incorporated, with a capital of $100,000, by Robt. P. King, Merrill Moores and others.

TERRE HAUTE, IND.—St. Louis capitalists have been looking over the ground preparatory to establishing another electric lighting plant in this city, in opposition to the Terre Haute Electric Company. It is thought the St. Louis men will soon apply for a franchise.

MADISONVILLE, KY.—The town of Madisonvile has ordered all electric companies not having franchises to remove all wires, etc., from the streets. The city is attempting to do away with the plant of the Railway, Light & Water Company. Municipal ownership is being agitated.

NEW ORLEANS, LA.—The City Council has passed an ordinance granting the Consumers' Electric Company a franchise to construct and operate an electric light plant.

NEW ORLEANS, LA.—The New Orleans & Carrollton Railway, Light & Power Company has secured the contract for lighting the city for one year at the following figures: $90 per lamp on the overhead system; $100 on the underground system and 12 cts. net per kw-hour for public offices. The total cost for lighting for the year under this contract will be $168,260.

KENNEBUNK, ME.—The Senate has passed the bill to authorize this city to own and maintain an electric light and power plant.

ANSON, ME.—The House has passed the bill granting a charter to the Carratunk Power Company to build a dam, equip a power station on Carrabasset River and light the towns of Madison and Anson. C. O. Sturtevant is said to be interested.

LANSING, MICH.—The United Electric Heating Company, of Detroit, with a capital stock of $100,000, has filed articles of incorporation. The incorporators are Robert, Frank and Guido Kuhn, Louis C. Wurzer and Arthur Gaukler.

CHEBOYGAN, MICH.—The W. & A. McArthur Company will soon require two or three waterwheels for its new water power plant now in the course of construction. The company has not yet given out any contracts for the electrical equipment, but several concerns, it is understood, have the matter under consideration.

COLD SPRINGS, MINN.—The citizens have voted to issue bonds for water works and an electric light plant.

SOUTH STILLWATER, MINN.—The citizens have voted to issue $23,000 bonds for an electric light plant and water works.

COLLINS, MISS.—The Collins Light & Power Company is in the market for a 40-hp return tubular boiler and a 40-hp high-speed automatic engine, of the Ball & Wood or Skinner type, for the electric light plant and water works which the city is about to install.

JEFFERSON CITY, MO.—The Missouri House has passed a bill which enables corporations operating electric light and power plants in cities of 10,000 inhabitants and under to purchase and operate street railways if they are so disposed. The object of the bill is to permit the consolidation of these plants in small cities.

DILLON, MONT.—A. F. Graeter is interested in the construction of an electric light plant.

PRINCETON, N. J.—The Hopewell Electric Light, Heat & Power Company, the Princeton Electric Works, and the Princeton Light Company, of this city, have been merged under the title of the Princeton Lighting Company, with a capital stock of $500,000, and $300,000 in bonds. The officers are: President, C. P. Fitch; vice-president, O. A. Parker; secretary, T. B. Jackson, Jr.; treasurer, Samuel H. Blackwell.

ALBANY, N. Y.—A certificate of merger of the Ravenna Electric Company with the Upper Hudson Electric Company has been filed with the Secretary of State.

NEWBURG, OHIO.—The citizens are considering the feasibility of constructing an electric light system and water works.

ATHENS, OHIO.—On April 6 the citizens will vote on a proposition to issue $15,000 worth of bonds, with which to establish a municipal electric lighting plant.

PRAIRIE CITY, ORE.—The City Council has granted Reveille Bros. a 20-year franchise for an electric light plant.

CONFLUENCE, PA.—The citizens have voted to issue bonds for the construction of a municipal lighting plant.

JOHNSTOWN, PA.—Reagan & Mulock, of Philadelphia, have secured the contract for constructing a subway for the Citizens Light, Heat & Power Co., to cost about $42,000.

KUTZTOWN, PA.—It is stated that the Keystone Electric Light, Heat & Power Company will expend about $25,000 in improvements, including an addition to the power house, an 800-hp engine and an extra set of boilers.

DOYLESTOWN, PA.—The directors of the Newtown Electric Light Company have elected officers as follows: President, A. W. Watson; vice-president, Thaddeus Kenderdine; secretary, W. M. Watson; treasurer, Robert Kenderdine.

HARRISBURG, PA.—Eight electric light and power companies have been consolidated under the name of the United Electric Company, with M. A. Cumbler, of Steelton, as president. The corporations so merged are the Cumberland, the Lower Allen, the Upper Allen, the East Pennsboro, the Hampden, the Camp Hill, the Shiremanstown and the new Cumberland Light, Heat & Power Company.

SUMTER, S. C.—The Sumter Light, Ice & Power Company has been chartered by Perry Moses, president, and others. The capital is $70,000.

ROCK HILL, S. C.—The Rock Hill Water, Light & Power Company has been organized. George MacDonald, of New York, and associates have bought a controlling interest in the company. Extensive improvements are contemplated.

SPARTANSBURG, S. C.—John B. Cleveland and J. N. Cudd, of Spartansburg and other capitalists have secured a blanket charter giving them the right to construct extensive electric power plants, textile plants, etc. The minimum capital is placed at $100,000 and the maximum at $3,000,000.

COLUMBIA, TENN.—John H. Carpenter is promoting a new lighting company at Columbia.

KNOXVILLE, TENN.—The Knoxville Power Company has petitioned for an increase of its capital from $10,000 to $100,000. Its plan is to dam Little Tennessee River and supply Knoxville with electrical energy.

NASHVILLE, TENN.—It is reported that the Nashville Railway Company will secure electric power from the Great Falls Power Company, which proposes to expend $1,000,000 or more in developing Great Falls on Caney Creek. C. H. Fish, of Ohio, is general manager of the company. The General Electric Company is said to be interested in the deal.

DALHART, TEX.—W. H. Wolff, of Gallup, N. M., has secured the franchise for an electric light plant at Dalhart.

LOUISA, VA.—The town is ready to receive bids for the construction of an electric light plant to cost about $3,000.

WILBUR, WASH.—The city council has granted the Wilbur Electric Company a franchise to establish and operate an electric system.

OLYMPIA, WASH.—D. B. Garrison, Secretary of the State Capitol Committee, would like information regarding the installation of an electric light plant.

COLVILLE, WASH.—Geo. Nixon, of Spokane, is making estimates for an electric plant to be installed at Mayers Falls, to furnish electricity to light Colville and other towns.

TACOMA, WASH.—Extensive improvements are being made to the water works and considerable equipment will be installed, including an air-compressor operated by electric motors to furnish air for three new wells. Bids for this equipment are to be invited in the early future.

WHEELING, W. VA.—It is stated that the electric light equipment of the municipal plant is in jeopardy owing to the leaky condition of the roof of the station. Several armatures, it is reported, have been burned out as a result of this condition of affairs. A new roof for the plant, however, is in contemplation.

TORONTO, ONT.—The Canadian Corundum Company, of Toronto, will establish an electric power plant at Bell's Rapids, Ont.

BERLIN, ONT., has voted an appropriation of $100,000 for the establishment of a municipal electric light plant.

STRATHROY, ONT.—Bids will be received March 31 by the Town Council for $50,000 electric light and water works bonds. F. J. Craig. is town clerk.

ORILLIO, ONT.—The Corporation of Orillio has completed a municipal power plant, the first of the kind in Canada. The power is obtained from the rapids of the Severn River, and the plant cost $71,000.

OTTAWA, ONT.—Hon. John Costigan, of Ottawa; Thomas J. Cochran and John M. Stevens, of Edmunton, New Brunswick, are asking from the Dominion Parliament permission to form a company for the purpose of damming the St. John River at the Winding Ledges, and to manufacture and dispose of electric and other power.

MONTREAL, QUE.—One by one the Montreal Light, Heat & Power Company is gathering in all its rivals, projected or otherwise. The latest acquisition is the purchase of the St. Lawrence Power Company. This company controlled the power rights of the Soulanges canal, and it was from this point that it was proposed to develop electric power to the extent of 40,000 hp if necessary. It is estimated that this power can be developed at a very low cost, and it is thought that this consideration has largely influenced the Light, Heat & Power Company in favor of its purchase.

MONTREAL, QUE.—At the recent annual meeting of the West India Electric Company held in this city, Mr. F. L. Wanklyn was elected president. The report of the directors shows a net surplus for the year of $29,265, which amount has been added to the surplus of the previous year, and has been expended in permanent improvements. Contracts have been entered into for the apparatus required for the installation of the third water power unit, the additional line from Rio Cobre to Kingston and the accessory electrical apparatus required for the utilization of this additional power in the city of Kingston.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—J. W. Worthington, of Birmingham, is working upon plans for an interurban electric railway connecting Sheffield, Florence and Tuscumbia in North Alabama.

SHEFFIELD, ALA.—A company has been chartered in New Jersey, with a capital of $500,000, with Henry Parsons, of New York, president, to develop the town of Sheffield, build an electric railway to Florence and supply power for manufacturing purposes.

HARRISON, ARK.—The Ozark & Sulphur Mountain Traction Company has been incorporated. The capital stock is $600,000, of which $50,000 has been subscribed. The officers are: W. G. Gardiner, of Toledo, O., president; Allen Smalley, of Upper Sandusky, O., vice-president; John J. Geghan, of Harrison, Ark., secretary; Neal Dodd, of Dodd City, Ark., treasurer.

CRIPPLE CREEK, COL.—The Pike's Peak & Cripple Creek District Electric Railway Company has been incorporated.

TERRYVILLE, CONN.—The Bristol & Plainville Tramway Company will extend its system to Terryville.

ANSONIA, CONN.—The Connecticut Railway & Lighting Company has prepared plans and specifications for the extension of its system from Ansonia north through the Naugatuck Valley to Seymour, and bids will soon be invited.

GREENWICH, CONN.—The line of the Greenwich Tramway Company from Port Chester to Sound Beach was open for travel on March 21. This is the last link in the continuous trolley service between New York and New Haven. The cars may now be taken at the Battery, New York, and a trolley ride to the Elm City be made without a break.

COLUMBUS, GA.—The Columbus Railway Company has offered to renew its expiring contract for lighting the city at $50 per light per year.

JOLIET, ILL.—The Joliet & Northwestern Electric Railway Company has been organized, with a capital stock of $500,000.

DAVENPORT, IA.—The City Council has granted a franchise to the Illinois & Iowa Interurban Railway Company.

FRANKFORT, KY.—The Bluegrass Traction Company has increased its capital stock from $10,000 to $350,000. The road will be extended from Paris to Lexington.

LEXINGTON, KY.—The Cumberland Valley Interurban Railroad Company has been incorporated to build an electric railway between Monticello and Somerset and Burnsides, a distancee of about 20 miles. The incorporators are W. J. Loughbridge, D. Gray Faulconer, E. B. Ellis, Rudolph Harting, J. H. Carter, W. C. Goodloe, Jr., and E. P. Farrell, of Lexington.

LOUISVILLE, KY.—The franchise for the construction of an electric railway over the Eighteenth Street Road to River View has been sold to the Kentucky Traction Company, recently incorporated. The officers of the new company are: F. P. Killner, president; H. S. McNutt, vice-president; Charles P. Dehler, secretary; Joseph Herman, treasurer; W. L. Weller, Jr., general manager.

JONESPORT, ME.—The Jonesport Railway Company is seeking incorporation. Edward B. Sawyer, George F. Mansfield and William P. Faulkingham are interested.

BOSTON, MASS.—The Bristol & Norfolk Street Railway and the Easton Street Railway have voted to consolidate.

MILLBURY, MASS.—The selectmen of Douglas granted a franchise to the Uxbridge, Whittinsville & Douglas Street Railway Company to build an electric railway to connect the towns named.

BEVERLY, MASS.—Articles of association are being advertised for the North Shore Street Railway Company. The plan of the company is to build from Gloucester, Essex County, to Beverly, a distance of about 18 miles. The capital stock of the company is $250,000.

SOUTH FRAMINGHAM, MASS.—Articles of association have been drawn for the Framingham & Cochituate Street Railway Company, with a capital of $50,000. The board of temporary directors is composed of Chester B. Williams and Frank E. Yeager, of Wayland; Charles A. Coombs and Horace B. Gale, of Natick; Isaac Damon and John Connolly, of Wayland; Abner Jones, of South Framingham.

LANSING, MICH.—A bill has been introduced in the Legislature providing for the construction by the State of an electric railway from the Capitol in Lansing to the Michigan Agricultural College, or for the granting of a franchise by the State for such a line. The distance is about 3 miles.

CONCORD, N. H.—The Hampstead & Haverhill Street Railway, the Epping, Brentwood & Kingston Street Railway and the Goff's Falls, Litchfield & Hudson Street Railway have been incorporated.

TRENTON, N. J.—The Springfield Railway & Light Company, capital $3,000,000, has been incorporated to build railways and electric light plants. The incorporators are Frank R. Hansell, Joseph T. Cutter and William F. Eidell, of Camden.

TRENTON, N. J.—The Philadelphia & Trenton Rapid Transit Company has been incorporated at Harrisburg, Pa., for the purpose of extending the Philadelphia, Bristol & Trenton Street Railway from its westerly terminus at Torresdale to Philadelphia. The capital stock of the company is $42,000, but it is understool that this will be increased soon. The incorporators are J. W. Ellard, Baltimore; Samuel A. Boyle, Jr., and W. H. Drayton, third, Philadelphia; J. D. Orme, of Baltimore, Md., and W. F. Sadler, Jr., of Trenton, N. J.

MAYVILLE, N. Y.—The Chatauqua Traction Company, of Ashville, has been incorporated to operate a street railway between Lakewood and Mayville. The capital stock is $500,000. Among the directors are William Broadhead, S. B. Broadhead and A. C. Wade, of Jamestown.

DUNKIRK, N. Y.—Articles of consolidation of the Dunkirk & Point Gratiot Traction Company with the Lake Shore Traction Company, forming the Buffalo, Dunkirk & Western Railroad Company, have been filed with the Secretary of State. The principal office is in Buffalo. The capital stock of the new road is $305,000, and the directors are Luther Allen, Jay E. Latimer, James W. Holcomb and E. Bingham Allen, of Cleveland, Ohio; William J. Conners, Truman G. Avery, Clarence M. Bushnell, Albert J. Myer, of Buffalo, and Fred R. Green, of Fredonia.

MARYSVILLE, OHIO.—The Delaware & Magnetic Springs Electric Railway Company has been incorporated with $200,000 capital stock.

URBANA, OHIO.—The Dayton, Springfield & Urbana Railway Company proposes to erect a sub-station in Urbana to assist in feeding its northern extension.

CANTON, OHIO.—The Canton-Akron Railway Company has increased its capital stock from $1,600,000 to $2,000,000, to provide for improvements to the system in Canton.

MARIETTA, OHIO.—The Muskingum Valley Street Railway Company has been incorporated with $10,000 capital. Incorporators: B. G. Dawes, H. B. Hoyt, D. C. Gebhart, G. W. Lansley and L. P. Fleming.

CLEVELAND, OHIO.—The Cleveland, Geneva & Meadville Railway Company has been chartered, with $1,000 capital stock, by D. E. Warner, O. C. Pinney, M. E. Patterson, W. R. McConnell and Thomas Davidon, of Cleveland. An option has been secured on a water power at Mechanicsville with a view to utilizing it for operating the road.

CLEVELAND, OHIO.—The consolidation of the Cleveland, Elyria & Western Railway, the Cleveland & Southern Railway and the Norwalk Gas & Electric Company into the Cleveland & Southwestern Traction Company has been accomplished and the following officers of the Cleveland & Southwestern have been elected: A. E. Akins, president; A. H. Pomeroy, first vice-president; S. C. Smith, second vice-president; F. T. Pomeroy, treasurer; E. F. Schneider, secretary.

WILLIAMSPORT, PA.—The Riverside Street Railway Company has been incorporated by M. B. Rich, C. H. Rich and T. M. Stevenson.

WAYNESBORO, PA.—Walter A. MacDonald, of West Chester, Pa., has been awarded the contract to construct the new line of the Chambersburg, Gettysburg & Waynesboro Electric Railway Company from Waynesboro to Pen Mar, a distance of 15 miles.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company will make several improvements in the way of extensions.

NASHVILLE, TENN.—The Nashville Railway Company has applied for an amendment to its franchise granting the power to build extensive new additions in the city.

BARTLETT, TEX.—It is said that plans are being discussed for building an electric railway to connect Bartlett with Corn Hill, Williamson County, and with Saliva, in Bell County.

RICHMOND, VA.—The Virginia Passenger and Power Company, of Richmond, has authorized the expenditure of $80,000 in suburban lines and other improvements

ROANOKE, VA.—A mortgage of $750,000, given by the Roanoke Railway & Electric Company to the Real Estate Trust Company, of Philadelphia, as trustee, has been recorded. There are outstanding $300,000 first and $190,000 second mortgage bonds. A new issue for $750,000 bonds will take up the old bonds and the surplus will be left in the treasury for improvement on the property.

EVERETT, WASH.—W. L. Johnson, of Seattle, Wash., is to apply to the Council for a franchise for the construction of an electric railway here.

SPOKANE, WASH.—It is stated that the entire right of way has been secured by the Cœur d' Alene & Spokane Railway for its proposed line to Post Falls and Cœur d' Alene City, Ida.

HUNTINGTON, W. VA.—The capital stock of the Camden Interstate Railway Company has been increased from $1,000,000 to $2,000,000.

MOUNDSVILLE, W. VA.—Plans are being made for building an electric railway from Moundsville to Williamstown. Guy A. Wagner, of Wheeling, is said to be interested.

CHARLESTOWN, W. VA.—The Charlestown Traction Company is reported to be considering a plan to build an extension to Montgomery, a distance of about 20 miles.

HUNTINGTON, W. VA.—The work of securing the right of way for an electric railway from Washington to the Falls of the Potomac, a distance of 20 miles, has been begun. Jos. S. Miller, John Graham and Geo. F. Miller, of Huntington, are interested.

MADISON, WIS.—The Madison & La Crosse Street Railway Company, recently incorporated, has increased its capital stock from $200,000 to $250,000.

OSHKOSH, WIS.—It is reported that the Emerson-McMillan Company, of New York, has in contemplation the consolidation of the Winnebago Company and the various interurban companies that plan to build lines in this section.

JANESVILLE, WIS.—The Janesville Traction Company has perfected its organization, electing the following officers: H. H. Clough, president; T. S. Nolan, vice-president; R. W. Hill, secretary and treasurer. Application for a franchise is about to be made.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company is said to be negotiating a loan of $1,000,000 to provide for the refunding of outstanding bonds and for the improvement of the company's property in general. It is said that a new power house is to be built, and that the road is to be extended to Plymouth.

CHATHAM, ONT.—At the next session of Parliament application is to be made for a charter for the Chatham, Wallaceburg & Lake Erie Railway Company.

GUELPH, ONT.—Donald Guthrie, solicitor of Guelph, has given notice that application is to be made to Parliament at its next session for a charter for the Guelph & Georgian Bay Railway Company.

THE AUTOMOBILE.

AUTOMOBILISM IN INDIANA.—A bill has passed the Indiana house which provides that the driver on highways outside cities and towns shall stop upon signal from any passing vehicle and shall remain stationary till the vehicle has passed, and that every automobile owner shall take out a license at the cost of $1 and shall cause his initials to be placed on the back of the machine sufficiently plain to be seen readily.

NEW INDUSTRIAL COMPANIES.

THE MANHATTAN MOTOR & POWER COMPANY has been incorporated in New York City, with a capital stock of $25,000, by James E. Stout, G. W. Crossman and F. P. Schenck.

THE CENTRAL ELECTRIC AND MANUFACTURING COMPANY, of Youngstown, O., has been incorporated to manufacture and sell electric appliances. The capital is $300,000.

THE ADVANCE FURNACE COMPANY OF AMERICA has been organized at Niagara Falls, with a capital of $100,000. Directors: E. L. Wells, Philip Owen, and C. H. Childs, of Utica, N. Y.

THE SOUTHERN TELEPHONE CONSTRUCTION COMPANY has been incorporated at Jersey City, N. J., with a capital of $50,000. Incorporators: Frank Hart, Charles H. Lemmon, C. Bond Lloyd.

THE ALLEGANY ELECTRICAL CONSTRUCTION COMPANY, of Hornellsville, N. Y., has been incorporated; capital, $150,000. Directors. J. H. Backus, O. E. Vars and H. C. Coleman, Andover.

THE AMERICAN THORIUM COMPANY has been incorporated at Jersey City, N. J., to deal in chemicals, capital, $150,000. Incorporators: Joseph M. Mitchell, Kenneth K. McLaren, Louis B. Dailey.

THE EXCELSIOR DRY BATTERY MANUFACTURING COMPANY, of New York City, has been incorporated, with a capital stock of $30,000. The directors are: Charles F. McShane, George Dolman and D. E. Powers, New York.

THE TUERK MANUFACTURING COMPANY, of Chicago, has been incorporated to manufacture electrical machinery and supplies. The incorporators are William H. Duval, Louis Sallinger and George E. Dickson. The company is capitalized at $25,000.

THE ARDMORE ELECTRIC COMPANY, with a capital stock of $25,000, has filed articles of corporation at St. Louis, Mo. The stockholders are W. N. Mathews, Robert W. Hodge, A. J. Wolverton and C. A. Rose. The company also filed notice of removal from Kansas City and of increase of capital stock from $10,000 to its present capital.

LEGAL.

RECEIVER APPOINTED.—A temporary receiver has been appointed for the Augusta Telephone & Electric Company, of Augusta, Ga., known as the Strowger Telephone Company. A. W. Blackshear was appointed.

IMPERIAL ELECTRIC LITIGATION.—Mr. W. Gilmore, of the Gilmore Electric Co., of South Boston, Mass., writes us as follows: "We notice a statement in some of the electrical papers that the suit brought by the General Electric Company against Henry A. Truit, Philadelphia, trading under the name of the Imperial Electric Company, has been decided in favor of the General Electric Company. We wish to say that this statement is misleading. The suit has not been decided as yet, a temporary injunction has been allowed, but that is all. The suit will not be decided for some time to come."

PERSONAL.

HON. W. M. CRANE has been elected a director of the American Telephone & Telegraph Company (Bell system) in place of Mr. John H. Cahill, resigned.

DR. COLEMAN SELLERS, 1301 Stephen Girard Building, Philadelphia, announces that he has admitted S. Howard Rippey to an interest in his general office practice.

MR. GEORGE BULLOCK, president of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio., was in New York this week. The company has just made its report of a most successful year.

PROF M. I. PUPIN is busily engaged developing and improving a large piece of property at Norfolk, Conn., and is making his mark not less as a successful road builder than as an electrical inventor.

LIEUT. E. J. SPENCER, a retired army officer, well-known in the electrical field. has been appointed Grand Marshal of the Civic parade to be given May 2, the third day of the St. Louis Dedication Ceremonies.

MR. H. S. DODD, formerly sales manager in Cincinnati for the General Electric Company, of New York, is now associated with the New York electrical engineering and contracting firm of J. G. White & Company.

DR. CARY T. HUTCHINSON has been appointed a special electrical expert by the New York City Board of Estimate and Apportionment to report on the amount necessary to expend on a city electric lighting plant for street arcs.

MR. W. B. POTTER, railway engineer of the General Electric Company, is taking a trip abroad, and has sailed for Europe. He had of late been actively engaged on the motor and control tests for the New York Rapid Transit subway.

MR. J. M. ZAPATA, of Bilbao, Spain, was a recent visitor at the headquarters of the American Institute of Electrical Engineers. He has gone to Bilbao to become chief engineer of the Sociedad Hidroelectrica of that place.

MR. J. A. MYERS, president and treasurer of the Robbins & Myers Co., of Springfield, Ohio, has been visiting New York City during the past week, in the interests of their large motor and fan trade. The outlook for the current season is excellent.

MR. A. S. SCHULMAN, the Cincinnati (O.) electrical contractor, was in New York last week. He came over from Philadelphia where he has recently secured a contract for the installation of the electrical plant in the new Widener-Elkins office building.

MR. J. L. WAYNE has resigned from the New York Telephone Company, in which he has been engineer in charge of installations, in order to join the teaching staff of the mechanical engineering department of the Massachusetts Institute of Technology.

MR. COLUMBUS O. JOHNSON, ex-water registrar of New York City, has made an interesting and valuable report to the Merchants' Association of New York on the water supply systems of the principal cities of Europe, more particularly with regard to the collection of revenue and the checking of waste.

MR. FRANKLAND JANNUS, the patent solicitor, has sustained a severe loss in the death of his wife, in Washington on March 8. Mrs. Jannus had been ill for two years past, but it was not expected that her complaint would prove fatal. Mr. Jannus has the sympathy of a wide circle of friends in the electrical field and in social New York.

MR. OSCAR T. CROSBY, the well-known electrical engineer, was in New York last week, having lately returned from Mexico, where he met President Diaz. After a short stay at home in Washington he proposes a trip to Thibet, and is now making his arrangements. His previous long expedition was to the hinterland of Abyssinia, in regions where no white man had been seen.

MR. CLARENCE H. MACKAY, the head of the Postal Telegraph and Commercial Cable interests lost his mother-in-law, Mrs. Duer, on Sunday evening, at the Waldorf, the cause of death being paralysis. Mrs. Duer was a granddaughter of the statesman, Reverdy Johnson, of Baltimore. The same Sunday evening a second daughter was born to Mr. and Mrs. Mackay at their Roslyn country seat.

NEW YORK ELECTRICAL SOCIETY.—At the meeting last week, the following members were elected: J. L. Moriarty, Charles E. Mandelick, Charles G. Wingate, Max J. Levy, Robert Lee Hailey, Farley Osgood, W. B. Spellmire, Frederic J. Chisholm, Wm. H. Moon, John L. Flagg, Oskar Friedrich, Joseph Treanor McNaier, John B. Ketcham, Eugene Toussaint, Arthur L. Case and Joseph W. Scott.

LIEUT.-COL. H. A. YORKE, R. A., chief inspecting officer of railways, of the British Board of Trade, who visited this country last year in the fall, has just issued a very interesting account of his trip in blue book form. It is 48 pages, and gives every evidence of shrewd and keen observation. Col. Yorke has many good things to say of American electric railway practice and many useful criticisms to offer.

PROF. W. E. GOLDSBOROUGH, of the Department of Electricity, of the St. Louis Exposition, returned recently after an absence of several weeks. He visited New York, Philadelphia, Baltimore and Washington, attended several conventions and received many applications for space in the Electricity Building. Mr. Goldsborough reports that practically all of the large electrical companies of this country and a number in Europe will exhibit at the World's Fair. The applications from the United States alone are more than sufficient to fill the Electricity Building but foreign exhibitors must be accommodated. Only recently five exhibitors applied for additional space, desiring more than twice as much as they had first asked for.

MR. THOS. A. EDISON.—An item from Washington states that the clerks of the Patent Office began several years ago to keep a systematic account of the patents issued to Thomas A. Edison. They have his various inventions tabulated and indexed, so that they can put their hands on each different idea he has protected by patent from the beginning of his marvelous career of invention. When a pending claim is allowed, as it no doubt will be this month, Mr. Edison will have received 791 patents in all. He is not adding to the list as many ideas nowadays as he did some years ago. Up to 1895 he had taken out 711 patents. Since then he has added to the list from three to twenty-three patents each year. Last year he took out nineteen. This year, so far, he has received six. In ordinary fees for patents Mr. Edison has spent over $51,000.

MR. OREN ROOT, JR., heretofore assistant general manager of the Metropolitan Street Railway system of New York City, has been promoted to the position of general manager of the system. He is only twenty-nine years old. Mr. Root was born in the little town of Columbia, Mo. His father was Professor of Mathematics in the University of Missouri. Oren Root, Jr., was educated at Hamilton College, in Clinton, N. Y., to which his father had removed. In 1895 he entered the service of the Metropolitan Street Railway as a clerk. He attracted the attention of President Vreeland, who determined to teach him thoroughly the street railway business, and sent him out as a motorman, a conductor and gripman. He was gradually advanced through the grades of inspector, car starter, barn superintendent, etc., until he finally became assistant general manager, from which position he has just been advanced. Mr. Root is a nephew of Elihu Root, Secretary of War.

MR. H. O. SWOBODA, electrical engineer of New York City, has just issued a circular part of which follows: "Having during the past twelve months devoted a considerable part of my time to the development of a new and complete line of knife switches, panelboards and switchboards, I am now prepared to enter the market. The National Brass and Iron Works, Reading, Pa., employing about 500 hands in the manufacture of metal goods, have under my supervision equipped an entirely new department with all the latest machines and tools to take care of the manufacture of my entire line and therefore first-class workmanship and prompt delivery can be depended upon. My office at 277 Broadway under the name "The H. O. S. Engineering Company," will take charge of all sales and all engineering work. The designs, electrically and mechanically, no doubt, will meet with approval, as they are based on my experience of the last fifteen years and especially on my experience with the "Falcon" line, so well known in the trade, and of which I am the sole originator."

Trade Notes.

CHANGE OF NAME.—The Chase Electric Sign Company, of Chicago, has changed its name to Chase Electric Company.

EMERSON MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has just issued a net-price sheet which contains all the data necessary in ordering motors for usual voltages and frequencies.

THE MAGNET WIRE COMPANY, New York, has removed its offices from 141 Broadway to larger quarters at 80 William St. It is increasing its factory facilities and can fill all orders promptly. It carries in stock a full line of trolley, magnet and weatherproof wire.

"INDUSTRIAL" RAILWAYS.—Some applications of "Industrial" railways to boiler rooms form the subject of an illustrated sheet being sent out to the trade by the C. W. Hunt Co., West New Brighton, Staten Island, N. Y. Several views of such applications are given.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has purchased the building and machinery of the J. B. Allfree Manufacturing Company in Indianapolis. It is stated that the price paid for the property was $50,000. The Commercial Company will move into the new quarters in a short time.

EQUIPMENT BULLETINS.—No. 1, of Volume I, for March, 1903, of Johnson's Equipment Bulletin, is at hand. It is sent out by Charles F. Johnson, 908 Ellicott Square, Buffalo, N. Y., and is of special interest to parties who wish to buy or sell rails, motors, equipment, generators, engines, boilers and cars.

MR. F. M. HAWKINS, manager of the New York Office of the Crouse-Hinds Electric Co., Syracuse, N. Y., says that the Norbitt specialties have had an immense sale. In addition to the contracts that he has secured for installations for decorative lighting in this vicinity, the sale of these fixtures with their enclosed contacts has been considerable to contractors.

CENTRE GRINDER.—Messrs. L. M. Heald & Son, Barre, Mass., have recently issued a neat booklet descriptive of their American centre grinder. The subject is illustrated. An illustrated description of the electrically driven centre grinder was published in our issue of Nov. 1 last year. This grinder is made in styles to be driven by hand, friction or motor.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has just placed on the market a new telephone bracket made to attach to the side of a desk so that a desk set may be swung out of the way when not in use. This bracket has a double swing joint and an adjustable clamp whereby it may be made to fit the base of any telephone. It is furnished in oxidized copper.

WESTINGHOUSE ALTERNATING FAN MOTORS.—In a neat booklet just brought out by the Westinghouse Electric & Mfg. Co., Pittsburg, the line of alternating current fan motors manufactured by this concern are illustrated and their principal features briefly described. Some excellent illustrations show the construction of these machines, which are made in the swivel and trunnion type.

FLEXDUCT.—The predominant ideas of the last two illustrated Flexduct sheets issued by the Osburn Flexible Conduit Company, 19 Park Row, New York, are that Flexduct affords superior mechanical protection to wires in exposed places, and that it has great strength and toughness. Both of these ideas are illustrated. Each sheet contains information regarding the properties of Flexduct.

THE EUREKA ELECTRIC COMPANY, of 143 South Clinton Street, Chicago, is sending out a variety of literature which will be of general interest to telephone people. There are three cards containing colored illustrations of two types of wall telephones and one with an illustration of a cable head. A folder gives an illustrated description of the Eureka non-infringing, solid-back transmitter.

THE ASHEVILLE MICA CO. has recently moved into new and much larger quarters. The new place was built specially for its own use and the change was made because of the large increase in its business which necessitated larger space. The company is located at Asheville, N. C., where it deals in cut and uncut sheets of mica, ground mica, washers and discs, and mica made up according to special patterns.

THE ST. LOUIS EXPOSITION is to be formally dedicated on April 30. The only electrical display, it is said, will be one outlining completely the administration Building, over which the flag adopted by the Exposition will be shown apparently waving, by means of commutated lamps. The system to be used for this interesting work is that of the Elblight Company of America, of 114 West 32nd Street, New York City.

THE JAEGER MINIATURE LAMP MFG. CO.—The ever-increasing demand for the high class products manufactured by this firm has again forced it to annex additional floor space of the Bible House, New York City. This is the third increase within a year. The firm is now giving telephone switchboard lamps its special attention, which should be of interest to users of signal lamps in general in the placing of their future orders. Mr. C. T. Jaeger is the manager.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, 118 W. Jackson Boulevard, Chicago, has issued its new catalogue for 1903. The catalogue contains about 500 illustrations of telephones and telephone parts and supplies, besides several full-page views of the offices and different departments of the business. The catalogue is accompanied by a trade-discount sheet. The company furnishes everything for telephone exchanges. A copy of the catalogue can be obtained free by any one on request.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has lately added more warehouse room and has increased its carrying capacity for all kinds of wires for which it is agent. It therefore claims to be able to make very quick and satisfactory shipments on wire. Its assortment is complete in "O. K." weatherproof line and house wires, Paranite and Peerless rubber covered wires, Roebling's, galvanized iron telephone and telegraph wires, and in fact everything in wires.

THE WARD LEONARD ELECTRIC COMPANY reports orders from a large number of machine tool manufacturers for its CK type circuit breaker. With this breaker, the circuit cannot be closed upon overload, and it seems to hit the machine tool trade at just the right point. The company reports also that the theatre dimmer business is coming with a rush. The lighting of a theatre to-day is a most important matter, and the Ward Leonard Electric Company is turning out the highest grade of work.

THE ENGINEERING AGENCY, Monadnock Block, Chicago, was started in 1893 by F. A. Peckham, president. Mr. Peckham, in traveling about the country, was constantly asked by manufacturers where they could find competent help. On the other hand his office was visited every day by those who thought his paper might be able to assist them to positions. The agency has grown steadily and during the past ten years has secured positions for over 5,000 technical men. The registrations during the past two years have exceeded 3,000. A. B. Gilbert is treasurer and A. G. Frost is secretary.

BROWN & SHARPE CATALOGUE.—The Brown & Sharpe Mfg. Co., Providence, R. I., has recently issued its 1903 catalogue of machinery and tools. This catalogue has been thoroughly revised and contains 458 pages, much new matter having been added. The number of tables it contains together with other information of a general character make it especially valuable to workmen as a book of reference. A colored insert contains a list of the principal additions this year to the various lines of machines and tools. A copy of the catalogue may be obtained free upon application.

ECK FAN MOTOR.—The name of the Eck "Hurricane" fan motor has been changed to Eck fan motor and is still being manufactured by the Eck Dynamo and Motor Works, Belleville, N. J. Their sole selling agency has been discontinued and all sales will be made direct from the works. The great success that these fan and power motors have enjoyed for the past seven years has been due to their excellent quality and careful construction. This year, it is stated, they are better than ever. The Eck Dynamo and Motor Works are now ready to quote prices and arrange for contracts for this season's supply.

CLIFTON FIRE-PROOF INSULATING CONDUIT.—The Clifton Manufacturing Company, of Boston, Mass., and the Mackie Steel Tube Manufacturing Company, of Hammond, Ind., have concluded arrangements for the manufacture of Clifton iron insulated conduit. The Clifton Manufacturing Company has devoted much time and money to the perfecting of its insulation, and has in Buffalo, N. Y., a complete conduit factory. The Mackie Tube Company makes a fine line of special tubes, and wrought iron pipe of such quality as to especially adapt it to conduit uses. The Mackie Company will sell the Clifton conduit in the West, Northwest and Southwest from its Chicago office, and the Clifton Company in the East through its New York office at 308 West Street, and its Boston office.

THE K. & B. CO. (Kirkpatrick & Binder), 56 N. 7th St., Philadelphia, have issued an exceedingly convenient little catalogue in folder form. This catalogue shows a number of the various styles and sizes of moulding which they manufacture and carry in stock. The sizes of wire which each size of moulding is adapted for being specified. These mouldings are made in a number of seasoned woods and in three standard finishes, viz., plain, painted, or bright finish. A most valuable feature of the catalogue is several entirely new tables giving the outside dimensions of all the prominent makes of weatherproof, fire and weatherproof, and rubber covered wire, and telephone cables. The convenience and accuracy of these tables are more to be appreciated by the trade. A copy of this catalogue will be sent to any one on request.

A MAMMOTH CATALOGUE.—The General supply catalogue of the Western Electrical Supply Company, St. Louis, Mo., just issued, easily ranks among the largest and most complete volumes of trade literature. It measures 7¼ inches wide by 10½ inches high, contains 714 pages gross, and is gotten up in a very substantial manner. A complete and up-to-date line of general electrical supplies and construction material is illustrated. The contents of the volume can be referred to here only in a general way, by stating that practically everything in the way of electrical apparatus and supplies is listed in a very systematic manner. There are hundreds of typical illustrations, each one being accompanied by a brief reference to the principal features and advantages of the device so illustrated, together with a code for the different sizes, styles, etc., besides prices for each size. This classification extends to supplies for every branch of electrical industry represented, and evidences a vast expenditure of time and labor in its arrangement. The code system is very complete and carefully developed, the index of this feature alone occupying over 24 closely-printed 5-column pages, while the general index takes up over 16 2-column pages. Apart from the great utility of the volume, the Western Electrical Company has good reason to feel proud of its achievement in producing a catalogue of such proportions and in so thorough a manner.

UNION COLLEGE, N. Y.—The Engineering School of Union College, Schnectady, N. Y., is one of the oldest technical schools in the country. Founded in 1845 with Prof. Wm. M. Gillespie at its head, it at once took a high rank and for many years was one of the few engineering schools in America. From the first the evident policy of the school was to adapt the thorough training of l'Ecole des Ponts et Chaussees, where Professor Gillespie had finished his technical education, to the demands of professional practice in a vigorous new country where resources and opportunities were abundant, and capital and professional precedent were wanting. From the characteristics impressed on the school at its foundation it has not departed; mathematics, economics and adaptation may be said to have been the leading subjects in its permanent curriculum. The school has kept pace with the development in American technical education and in the increasing demands on professional training. For many years engineering only was taught; then when the principles of modern sanitary science came to be better understood, a course in sanitary engineering was established, and more recently the course in electrical engineering, now being greatly extended, was undertaken. During its whole history the school has stood for broad, fundamental training rather than narrow specialization, and during recent years since its advanced entrance requirements have made room in the course for them, increased time and attention have been given to culture studies and increased academic training.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 17, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

722,6[illegible]. GALVANIC BATTERY, M. M. Bait, Levallois-Perret, France. App. filed March 21, 1901. The cover of the cell is held in place by a spring clamp.

722,680. RELAY, W. W. Dean, Chicago, Ill. App. filed July 20, 1900. The relay is intended to maintain the circuit at its points during the existence of an intermittent current. (See page 525.)

722,684. SELF-WINDING ELECTRIC CLOCK; O. A. En Holm, New York, N. Y. App. filed Dec. 11, 1901. Details.

722,701. METHOD OF TREATING GLOWERS FOR ELECTRIC LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed June 13, 1901. The glower is shrunk by submitting it to the heat of an arc formed between a plurality of carbon electrodes.

722,702. METHOD OF MAKING ELECTRIC LAMP GLOWERS; M. W. Hanks, Pittsburg, Pa. App. filed Oct. 13, 1902. The terminal wire is connected to the glower by molding the latter around the terminal while in a plastic state.

722,727. METHOD OF HEATING RIVETS; H. V. Loss, Philadelphia, Pa. App. filed March 5, 1901. (See Current News and Notes.)

722,728. DEVICE FOR ELECTRICALLY HEATING RIVETS; H. V. Loss, Philadelphia, Pa. App. filed March 5, 1901. (See Current News and Notes.)

722,729. MANDREL FOR CONDUIT SECTIONS; R. W. Lyle, New York, N. Y. App. filed Oct. 17, 1902. A grappling device attached to the mandrel.

722,747. ELECTRICAL HEATING APPARATUS; J. S. Peck, Pittsburg, and K. C. Randall, Wilkinsburg, Pa. App. filed April 6, 1901. (See Current News and Notes.)

722,756. ELECTRICAL APPLIANCE FOR ELEVATORS; J. H. Roberts, New York, N. Y. App. filed Jan. 13, 1903. Automatic stopping switches are arranged in connection with the controller for controlling the movements of the car.

722,772. CURRENT-COLLECTING DEVICE FOR ELECTRIC RAILWAYS, C. A. Terry, New York, N. Y. App. filed December 8, 1896. (See Current News and Notes.)

722,790. SORTING DEVICE FOR ELECTRIC LAMP GLOWERS; A. J. Wurts, Pittsburg, Pa. App. filed May 5, 1902. A machine by which current can be passed through the glowers a sufficient length of time to insure a uniform operative condition after which their resistance can be measured when traversed by a given current in order to determine the voltage to which they are adapted.

722,792. METHOD OF PRODUCING COMPOUNDS CONTAINING SILICON, OXYGEN AND CARBON; E. G. Acheson, Stamford Township, Canada. App. filed Nov. 20, 1902. Heating a mixture of carbon and silica to form a product consisting essentially of silicon, oxygen and carbon in chemical combination. (See page 525.)

722,793. REFRACTORY MATERIAL; E. G. Acheson, Stamford Township, Canada. App. filed Nov. 20, 1902. The product formed by the preceding process. (See page 525.)

722,841. ELECTRICAL MASSAGE APPARATUS; W. F. Hedstrom, Los Angeles, Cal. App. filed Dec. 8, 1902. Details.

722,85[illegible]. ELECTRIC TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Oct. 19, 1895. A sending device consisting of the primary of a converter connected locally to a source of current, the secondary consisting of two parts wound in opposition, the secondary being connected to the line wire and a shunt circuit around one part of the secondary, provided with means for opening and closing the same.

722,862. TROLLEY; S. H. Limbert, Springfield, Ohio. App. filed May 8, 1902. An arrangement enabling the wheel to maintain its normal relation with the wire in passing around curves.

722,913. ELECTRIC IGNITION DEVICE; N. Schmitt and J. Krannichfeldt, Cologne, Germany. App. filed Feb. 25, 1902. Details.

722,916. MOTOR VEHICLE; G. J. Scott, Philadelphia, Pa. App. filed May 16, 1902. An electric motor having a number of armatures arranged in a circle at right angles to their axes of rotation and field magnets forming a magnetic circuit common to all the armatures.

722,936. ELECTRIC BRAKE SYSTEM; C. E. Barry, Schenectady, N. Y. App. filed Nov. 6, 1900. A series motor having a plurality of field coils normally connected in parallel and means for connecting the motor coils in series in a closed circuit to produce a braking current.

722,946. FRAME FOR BATTERY ELECTRODES; H. Cottrell, Newark, N. J. App. filed Sept. 13, 1902. The frame consists of two corrugated plates into the grooves of which the electrodes are slid.

722,947. ELECTRODE FOR REVERSIBLE GALVANIC BATTERIES; H. Cottrell, Newark, N. J. App. filed Sept. 13, 1902. Comprises an interior portion composed of layers of textile fabric carbonized, as an absorbent of a metallic salt in solution and carrier of a metallic oxide to be made active in the battery, and an exterior portion composed of textile fabric carbonized to form a casing for the electrode.

722,991. RAIL BOND FOR ELECTRIC RAILWAYS; T. Kerr, London, Canada. App. filed Aug. 5, 1901. The fish plate contains a groove in which the bond wire is confined.

722,992. RAIL COUPLING FOR ELECTRIC RAILWAYS; T. Kerr, London, Canada. App. filed Aug. 5, 1901. A modification of the preceding patent.

723,007. REDUCING INDIGO, R. Muller and O. Schwab, Hochst-on-the-Main, Germany. App. filed July 29, 1902. Indigo is subjected to the action of an electric current, in the presence of a sulphite solution.

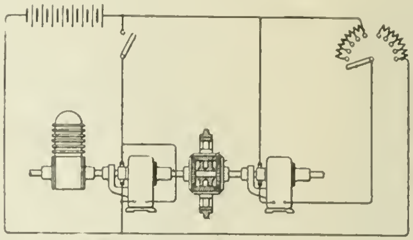
723,016. INDUCTION COIL, A. L. Parcelle, Boston, Mass. App. filed Aug. 15, 1901. A secondary coil, a number of independent primary coils in operative relation thereto and an independent core for each primary coil. (See page 526.)

723,019. FRAME FOR DYNAMO ELECTRIC MACHINES, R. Pfeifer, Charlottenburg, Germany. App. filed Feb. 16, 1902. Details.

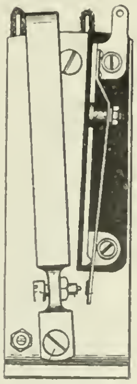
723,032. FUSE PLUG; S. Rothschild, New York, N. Y. App. filed June 23, 1902. Two spring terminals are arranged on opposite sides of an insulating post, over which a fusible ring is passed to embrace the terminals.

723,048. ELECTROMAGNETIC BELL RINGING MECHANISM; J. J. Sheahan, Buffalo, N. Y. App. filed Nov. 3, 1899. A comparatively light current is used in connection with a key-board to control a heavier current which operates the chimes.

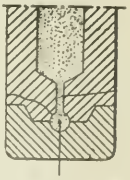
723,062. THIRD RAIL INSULATOR; S. B. Stewart, Jr., Schnectady, N. Y. App. filed Sept. 29, 1900. The insulator is provided with projections of relatively small surface upon which the rail rests to prevent adherence thereto by deposits of rust.



723,168.—Propelling Means for Automobiles.



722,680.—Relay.



722,702.—Method of Making Electric Lamp Glowers.

723,076. RECTIFIER, E. Thomson, Swampscott, Mass. App. filed December 15, 1898. (See Current News and Notes.)

723,082. BINDING SCREW; I. S. Turner, Centralia, Wash. App. filed May 22, 1902. Details.

723,115. CIRCUIT BREAKER FOR THIRD RAIL SHOES; M. M. Wood, Schenectady, N. Y. App. filed Aug. 25, 1902. When the shoe runs off the end of a section of a third rail, its dropping movement opens the circuit to the shoe so that contact with other objects will not cause trouble.

723,119. CONTROLLER; T. Von Sweigbergk, Preston, Eng. App. filed April 23, 1902. A series of solenoids so connected together that the effect of each is added to that of the preceding, said solenoids actuating the switch contacts.

723,168. PROPELLING MEANS FOR AUTOMOBILES; H. Lemp, Lynn, Mass. App. filed Nov. 2, 1900. A gas engine is geared to a generator and connected to one member of a differential gear, the opposing member of which is acted upon by a generator whose torque can be readily controlled, so as to drive the carriage forward or backward at different speeds, the engine meantime working at full speed.

723,183. CIRCUIT BREAKER; R. H. Read, Schnectady, N. Y. App. filed June 29, 1901. The arc at the contacts is blown through tubular electrodes by suddenly generated gas.

723,188. METHOD OF SIGNALING; N. Tesla, New York, N. Y. App. filed July 16, 1900. (See Current News and Notes.)

723,189. RECTIFYING ALTERNATING CURRENTS; E. Thomson, Swampscott, Mass. App. filed December 15, 1898. (See Current News and Notes.)

723,199. ALARM TELEGRAPH SYSTEM; A. Goldstein, New York, N. Y. App. filed April 21, 1900. A system by which fire and other alarms can be sent to headquarters over telephone circuits.

723,205. ELECTRICAL TESTING APPARATUS; H. A. Lewis, Norristown, Pa. App. filed Oct. 14, 1902. A primary circuit containing a generator, one winding of an induction coil and a current interrupter, with a secondary circuit including the other winding of the induction coil, testing terminals and a telephone receiver; the secondary winding and that of the receiver being of a resistance relatively the same as that of the circuit to be tested.

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CONTENTS.

Editorial 545
Mayor Low on New York Subway Roads 548
Student Members of the A. I. E. E. 548
Underground Cables in England 548
Laboratory Electric Furnace Equipment, Owens College, Manchester, Eng. 549
Electrical Manufacture of Steel in Sweden. By G. Lindman 551
A Norwegian Water Power Plant. By Franz Köster........ 552
Electroculture. By Emile Guarini 554
Annual Report of the Bell Telephone System 556
March Meeting of the American Institute of Electrical Engineers........ 557
An Inventor, a Wheel and an Airship to Run to Mars. By F. A. Shepard 561
Iowa Telephone Association 561
Recent Electrochemical Developments. By Clinton Paul Townsend........ 562
New Telephone Patents 562
Construction of Aerial Telephone Lines—VIII. By Arthur V. Abbott, C. E. 563
A. I. E. E. Boston Branch........ 565
Electrical Instruction for Officers at Sandy Hook 565
Current News and Notes 565
LETTERS TO THE EDITORS:
  Three-Phase Measurements. By G. Faccioli 567
  Taxation of Lighting Plants in Michigan. By A. G. Moser........ 567
Digest of Current Electrical Literature 568
New Books 572
Electrically-Operated Printing Presses 574
British Direct-Current Motors 576
Large S. K. C. Transformer 576
Special Circuit-Breakers for Testing Purposes 578
Cosmo Railway System 578
Jewell Circuit-Breaking Ammeters and Voltmeters 579
Power Transmission at Clermont-Ferrand, France 579
Improved Dry Batteries 579
New International Telephones 580
Kelvin Electrostatic Voltmeters 581
Steam Distribution from Central Stations 581
Iron Box Telephone 581
Electric Hoists for Docks and Wharves 582
Lundell Fans for 1903........ 582
Regulating and Reversing Controller for Direct-Current Motors........ 583
Calculating Automatic Time Stamp for Telephone Switchboards........ 583
Adjustable Multi-Spindle Drill 584
Cylinder Oil Atomizer 584
Automatic Electric Pump 585
The De Forest Wireless Telegraph Company 585
News of the Week 586

BELL TELEPHONE STATISTICS.

We publish elsewhere in this issue a copious abstract of the annual Bell telephone report for 1902. It is an impressive exhibition of growth and strength, and might, indeed, be cited in all fairness as a remarkable evidence of the stimulating effect of competition on an industry which had become so "monopolized" it had ceased to keep pace with its legitimate opportunities of expansion. There can be no question in the mind of any one who watches the situation as to the vigor and ability that characterizes the management; nor can the fact be lost sight of that somewhat in proportion as the cry of "monopoly" is ceasing to have any significance or effect, the efficiency of the Bell system and its general cheapness to the public user grow. It is to be noticed, for example, that the number of daily connections is returned at 9,322,951, an increase daily of more than a million and a half over 1901.

President Fish remarks very truly that even now there is hardly a section of the country where the supply of telephone facilities equals the demand. In view of the extraordinary efforts put forth by the independents during the past five or six years, it might seem that the demand had overtaken the supply. But Mr. Fish's statement will stand any test applied to it; and there is no reason to imagine that the introduction of the telephone can catch up with the need for it for many years to come. The percentages of telephones to given population are not particularly illuminative, for while the best show how many telephones there may happen to be in any community, they do not indicate any point of "saturation" or "refusal." In fact, the ease with which electrical output steadily doubles on itself was one of the remarkable exhibits of the late census inquiry; and it is not less true of telephony than of other branches of electrical application that the market does seem to be practically illimitable. Incidentally it may be noted that in copper circles the allegation has been made lately that telephony is calling for copper in greater quantity than either electric lighting or street railway work. We have no means of confirming this interesting assertion, but it is undeniable that the bulk of copper required by telephony at the present rate of introduction is tremendous.

Under these conditions, the increase in Bell capitalization, which will give the parent company at no distant date a total of $250,000,000, should not be surprising. No one can say just how soon that figure will be reached, but the company must meet its proportion of the requirements of the sub-organizations all over the country, and that meant last year nearly forty millions, it appears. If the parent company puts up half that amount annually it will not be long in meeting the upper limit of its new capitalization; while, if present indications mean anything, it should be just as able then as now to maintain its present rate of dividend over the larger amount. It is merely a question of adequate facilities, good service and moderate rates.

◆

THE FOUNDER OF THE SMITHSONIAN.

One of the earliest museums and educational establishments for the people in this country is the Smithsonian Institution in Washington, founded by the liberality of an Englishman named Smithson. It appears that this founder was buried in Genoa and that the cemetery is being removed, so that his remains lack a final resting place. It would have seemed that at this juncture all that was needed was for the authorities of the Smithsonian to know the facts and hasten with prompt alacrity to bring the body of Mr. Smithson here for interment in the grounds at Washington. Apparently they did not take such action, but fortunately at this juncture Prof. A. G. Bell, who is on the board, has offered himself to sustain such expense as the Institution cannot meet. It seems to us that if there was one duty devolving on the Institution, it was to preserve the remains of its generous founder, thus exposed to ignominy and desecration, and we can hardly conceive of any circumstance that would stand in the way of such laudable action. We are very glad to see that Prof. Bell has stepped into the gap, but we hasten to say that if further financial difficulty is expected, this journal will esteem it an honor to raise the necessary funds, or to guarantee the sum required to treat with honor and decency the memory and ashes of one who did so much for science in America through the admirable Institution that was created by his gift to our country.

THE RELATIVE DISPOSITION OF POWER WIRES AND TELEPHONE WIRES.

A paper on this subject, read by Mr. P. M. Lincoln, at the last meeting of the A. I. E. E., deals with the conditions which occur when a telephone circuit comprising a pair of conductors is carried on the same poles as high-pressure alternating-current transmission lines, say of three wires. As is well known, if the telephone wires are transposed relatively to each other, at regular intervals, the disturbing effect of the powerful currents in the power-wires will be neutralized, and destroyed in the telephone circuit. But in addition to transposition of the wires, there must be a symmetry between the two sides of the telephone circuit. If one side is grounded, or has greater leakage than the other, or, if a telephone receiver is inserted in one side, and not in the other, a dissymmetry will be produced, which may render the telephone circuit absolutely useless for conversational purposes. Moreover, the potentials in space in the neighborhood of a high-tension transmission line may be considerable. If a pair of telephone conductors occupies this region, the potential of the circuit may become very considerable, and unless the telephone lines are elaborately insulated, the electrostatic stress may cause a break-down in the insulation of the telephone line, with dissymmetry and consequent powerful inductive disturbance. This effect is enhanced when the power system becomes accidentally grounded on one side.

WATER-COOLED RHEOSTATS

Elsewhere we print an article describing the interesting electrochemical laboratory which Prof. R. S. Hutton has built up in connection with his course in electrochemistry at Owens College, Manchester, England. One of the prominent features of the laboratory that will be noted is the practical character of the equipment, which, moreover, is suitable both for purposes of illustrating theory and for prosecuting original research. One detail to which we desire particularly to refer is the use made of the water-cooled rheostat. A 40-kw furnace employs a rheostat for regulating current up to a maximum strength of 1,000 amperes. The first steps of the rheostat are of manganin wire to carry currents up to 300 amperes. The last steps are of water-conveying german-silver tube, not more than half an inch in diameter, to carry current up to 1,000 amperes.

The range of pressures and currents employed in electrochemistry is considerable. Starting with 2 volts in some electroplating work, there are numerous plants generating dekavolts, and many generating hektovolts. The nitric acid process is said to take 10 kilovolts. Under such variable conditions, an experimental electrochemical plant must possess a considerable degree of elasticity in regard to volts and amperes. In the nitric acid process described as at Niagara, there are about 7,000 arcs formed and extinguished per second, employed in setting fire to some of the nitrogen in the circumambient air. The current is, therefore, a periodically fluctuating one. In calcium carbide production, a purely electro-thermal process, the current is usually alternating. In nearly all other electrochemical applications a direct current is employed.

The current strength employed in electrochemical operations runs up to thousands of amperes, and involves varied problems for adequate and cool conduction, of which the water-pipe rheostat is a particular case. When it is desired to dissipate much thermal energy locally, there is nothing like water. There is scarcely any cure for obstreperous thermal activity so effective as a little cold water. A gramme of water per minute will readily wash away a watt. The energy storage capacity of ordinary water is something marvelous. The principle has been made use of in a great variety of electrical applications aside from electrochemical processes. Not only is it used in the cooling of the oil in which transformers are submerged, but it is also used to cool pipes themselves employed as conductors. A large dynamo may be short-circuited on a rheostat made of iron pipe enclosing flowing water, without any danger of destroying the apparatus by excessive heat. Indeed, where the quantity of electrically-generated heat to be dissipated is at all considerable, to use at this day an ordinary wire rheostat instead of the water-pipe resistance would be an anachronism.

ELECTRIC WAVE MODELS.

An interesting model of the wave motion along a single-phase alternating-current line was exhibited by Prof. Franklin at the last meeting of the A. I. E. E. It is well known that a helical line drawn upon the surface of a transparent cylinder gives rise to a peculiar optical effect when the cylinder is uniformly rotated, and regarded from one side. The rotating screw-line looks like a series of advancing waves, if the direction of rotation is in one sense, or like a series of retreating waves if the rotation is in the opposite sense. By making the pitch of the screw equal to the wave-length on the model, and by giving the cylinder as many twists or revolutions per second as the periods or frequency of the single-phase current, the waves move along the model with the proper speed corresponding to the actual transmission of waves along the actual line imitated in miniature. By placing two screw-lines of the same pitch, on the rotating shaft, but one right-handed and the other left-handed, the optical effect is to show the waves advancing from the sending end to the receiving end, and then, after reflection, retreating towards the sending end.

Such undiminished waves would correspond to the transmission of waves along a circuit of perfect conductance and perfect insulation. Owing, however, to the effects of resistance and leakage, the waves steadily attenuate as they run, and, on the model, this is imitated by giving to the screw-lines a correspondingly diminishing radius along the revolving shaft. By placing on the shaft a right-handed dwindling screw for the advancing waves, and a left-handed screw dwindling backwards for the reflected waves, as well as a compound screw to represent the sum of these two components, the model is made to show to the eye the two component sets of waves and also the resultant set. Either component set alone would show a series of waves dwindling logarithmically, but their joint effect is a series of waves that mutually superpose and oppose at successive distances of a quarter wave length. The resultant waves may thus indicate marked humps and hollows with an amplitude exceeding that at the origin, or the condition commonly called line resonance.

Of course, the model described can only illustrate the waves corresponding to one set of terminal conditions. It might be possible to carry the plan a step further, and employ a model in which the screw lines could be adjusted and clamped in phase and magnitude to correspond to different terminal conditions, so as to represent to the eye the effects of a very wide range of terminal conditions such as the change from no load to full load. Any such mechanical illustration possesses great power to aid the mind in grasping the phenomena of alternating-current transmission, which, being invisible in nature, require full elucidation to apprehend.

THREE-PHASE MEASUREMENTS.

In our correspondence columns this week we print a letter from Mr. Faccioli on a subject which has recently drawn the attention of some of our readers. The power-factor of a single-phase alternating-current circuit is the ratio of the real to the apparent power, or of the watts to the volt-amperes. Corresponding to this power-factor is a virtual angle of lag or lead in the current, whereby a sinusoidal e.m.f. would produce at the stated lag or lead a sinusoidal current of strength equal to that observed in the real circuit. The cosine of this phase angle is then the power-factor. But whereas the power-factor always has a real existence if the volt-amperes be measured, the angle of lag corresponding thereto may be entirely fictitious, a mere figment of the imagination, when the voltage and current are not sinusoidal.

In the case of a three-phase system, if the volt-amperes are measured in the same definite manner, that is, delta-fashion, then the ratio of the real power in watts to the sum of these volt-amperes, is the power-factor of the circuit; but if the volt-amperes are measured in any other way, the apparent power of the circuit may be different, and, therefore, the power-factor different. The relations of the power-factor to the various lag angles will be simple when the system is balanced, and the periodic quantities are all sinusoidal. It will be complex when the system is out of balance, and when the periodic quantities are complex. In general, the lag angles have but little importance, while the power-factor of the system is a definitely measurable quantity. The power-factor of the system differs, however, from the power-factor of the three sides of the system, when the system is not in balance, and will generally be different from the arithmetical mean of the power-factors on the three sides of the system, considered separately.

Power-factor indicators are sometimes found on central-station switchboards, in triplets, one for each side of the system. It is, however, possible to arrange the apparatus in such a manner that a pointer will indicate on a dial the power-factor of the three-phase system considered singly, or as a whole. Mr. Faccioli gives another demonstration of the proposition that two wattmeters connected on a delta, three-phase system will jointly indicate the total power delivered over three wires. This demonstration is, perhaps, the simplest yet offered. It involves considering the vector sum of two electromotive forces as equal to the third side of their triangle. This demonstration would have been most acceptable in the past when the two-wattmeter method was first discovered, and when the demonstration of the method was harrassing in its complexity.

THE ELECTRIFIED FARMER.

It is seldom that this journal can claim place as the mouthpiece of the horny-fisted agriculturalist. But this week we get close down to the sod and begin our bucolic log-rolling in earnest. If at some later date we seek rural support as the organ of the farmer's candidate for President, we feel that we have made a good beginning. In brief, it gives us joy this week to present to our agricultural readers an account of experiments on the relation of kilovolt-amperes and such like things to the growth of beans and tobacco. A distinguished Norwegian professor has spent many years in the study of this world-astonishing theme and has derived, albeit by somewhat empirical methods, certain conclusions that will shake the Produce Exchange with inextinguishable merriment. We were not aware that they raised much in Norway save timber and men, both of admirable quality, but if Prof. Lemstrom's results are to be trusted it needs only the application of electricity—negative if you do not wish to break the spell—to bring the Norwegian carrot crop where it could supply food for all the rabbits between the North Cape and Van Diemen's Land. We say carrots, because Prof. Lemstrom has shown for that succulent root an increased crop to the extent of 182.7 per cent. (do not forget the decimal) under the benign influence of the negative charge. We cannot learn whether the carrots were or were not ionized, and would suggest that samples be sent to Prof. J. J. Thomson in order that so important a point be not neglected.

Lemstrom has devised several ingenious plans for applying the electrical stimulus. In one instance he covers his experimental carrot or cabbage patch with a network of wires much like that constructed of string by those bent upon scaring away crows, and thus forms his electrode. A static machine furnishes the power, and if the stimulation is carried on in the dark of the moon and the experimenter carries the left hind foot of a graveyard rabbit in his hip pocket, the crops will be greatly increased—except cabbage, which is a hoodoo plant, and seems to break the spell. Incidentally, the crop in cereals seems to be improved in quality as well, but we greatly regret to say that details are lacking on the quality of the tobacco. If Prof. Lemstrom's ingenious process can be depended upon to transform the Connecticut leaf into genuine Vuelta Obaja wrappers we will start a movement for making its use compulsory in all the territory of the United States. Another very interesting conclusion is that certain plants only bear the electrical treatment when they are well watered. We believe that this coincides with many results recently obtained at the Wall Street experiment station.

But these and all similar experiments seem to us to belong to a class which cannot be reckoned as of the first order of precision. It reminds us of some psychological experiments in which the law of averages is worked overtime. There are many factors in the growth of plants besides electrification, and experiments on such subjects are notoriously subject to great uncertainties. The conditions are exceedingly difficult to control and the results can often be made to fit almost any preconceived theory that happens to be handy. Some thirty years ago the blue glass cure was rampant, for everything from measles to old age, and in the discussion of its virtues the stimulating effect of the blue rays on vegetation was the subject of many experiments, and if we recollect aright, a mass of evidence was collected vastly more imposing than anything which electroculture can show. Some of it may be found in the *Comptes Rendus* and other scientific journals. It was even found that light filtered through blue gauze would quicken the germination of seeds and keep away insects. The explanation vouchsafed for this remarkable fact has so familiar a sound that we venture to quote it: "The sunlight negatively electrified in passing through the meshes of the blue gauze of the frame, which is positively electrified, excites an electromagnetic current, etc., etc." It only needs a few words about ionization and electrons to pass for the vernacular of 1903. We cannot quite take electroculture seriously on the present evidence. It may or may not be true that electricity can be used practically to stimulate plant growth, but even if it can we shall only be the wiser by the electrical equivalent of barn-yard manure. The bearing of electric stimulus on plant physiology may lead to results of theoretical interest, but we do not think the farmer will lay down the fork for the influence-machine just yet.

Mayor Low on New York Subway Roads.

A letter was sent recently by Mayor Low to President Orr, of the Rapid Transit Commission, advocating the extension of the system of subways along the lines formulated by Chief Engineer Parsons and the placing of such extensions in one system. He said that the city could not advocate the plan for the purchase of the rights of the Interborough Rapid Transit Company, and he declared against the plan of Comptroller Grout for an independent tunnel to compete with the Interborough Company's system.

Mayor Low outlined the difficulties that the city experienced in getting capitalists to undertake the construction of the rapid transit tunnel, and said that the supposed $6,000,000 of profit which the Belmont syndicate may make on the construction of the subway for $35,000,000 will be offset by the loss of $6,000,000 that the company is sure to suffer on account of the low bid on the extension of the system under the East River to Brooklyn. The estimates for the work were $9,000,000, but the Belmont syndicate, in order to defeat its only competitor, the Brooklyn Rapid Transit Company, bid $3,000,000.

After declaring for a unified system of rapid transit throughout the city the Mayor said: "Four things seem to me to be absolutely essential: (1) A uniform rate of fare over every mile of road built by the use of the city's credit, from one end of the city to the other; (2) that this uniform rate of fare, at first to be 5 cents, shall be reduced as rapidly as circumstances will permit; (3) that year by year while the control of the city's system is in private hands, the city shall receive as large a percentage as possible of the earnings of the road; (4) that the city, and not the railroad, shall dictate the character of the service to be given."

Student Members of the A. I. E. E.

The board of directors of the American Institute of Electrical Engineers voted on March 27 in favor of extending certain privileges to students of electrical engineering. The official announcement is as follows:

The American Institute of Electrical Engineers has arranged to extend certain privileges to those who are regularly pursuing studies in electrical engineering. Such individuals will be designated as students of the American Institute of Electrical Engineers. A large number of students in electrical engineering in the universities and technical schools of the country can be greatly benefited by an association with the Institute. At the commencement of the present year an important step was taken for the establishment of local or branch meetings of the Institute in connection with universities and technical schools. These meetings are held, in some cases, under the direction of a professor of electrical engineering, and in other cases in connection with an electrical society or other organization conducted by the students themselves. The local meetings are held in connection with the following institutions: Massachusetts Institute of Technology, Union University, Lehigh University, Cornell University, Columbian University, Pennsylvania State College, Western University of Pennsylvania, Ohio State University, University of Cincinnati, Purdue University, University of Illinois, University of Wisconsin, University of Missouri, University of Minnesota. Meetings of these branches as well as other branches which have been formed by members of the Institute in different cities without any connection with educational institutions are usually held ten days or two weeks after the monthly meetings at New York. The papers presented at the New York meetings, together with the discussions, are furnished to the branch meetings. After these papers are presented in full or in abstract, the session is open for the presentation of additional papers by local members and for general discussion.

Experience shows that although students in these schools have become interested in the Institute, yet in many instances they are not prepared to join the Institute. For the purpose of extending valuable privileges of the Institute to these young men, and also to others who are looking forward to electrical engineering as a profession, it has been arranged that upon the payment of a very small fee, eligible students may attend the meetings of the Institute and receive copies of the meeting announcements and monthly transactions, and also purchase the semi-annual bound volumes of the transactions. To cover these privileges the following regulations have been adopted:

Students regularly pursuing electrical studies may have the following privileges, viz.: 1. The privilege of being present at all meetings of the Institute except such business meetings as relate to the management of the Institute. 2. The privilege of receiving the regular announcements and printed copies of monthly transactions. 3. The privilege of purchasing the semi-annual bound volumes of the Transactions of the Institute at the price of $3.50 per copy, or such other price as may be hereafter fixed by the board of directors. Upon the following conditions: 1. Endorsed by one member or associate of the Institute. 2. Recommended by the board of examiners and approved by the board of directors. 3. Payment in advance of the annual sum of $3 for such privileges. 4. Be enrolled by the secretary as a student of the American Institute of Electrical Engineers. No student, however, shall have these privileges for more than three years, and these privileges may be withdrawn from any student, at any time, by a majority vote of the board of directors.

It will be noted that these privileges render eligible not only those students who are pursuing studies in higher technical institutions, but also young men who are pursuing electrical studies either through the help of correspondence schools or privately. The purpose of the Institute is to assist these young men by bringing them into closer contact with the electrical engineering profession, and furnishing them with the monthly Transactions containing valuable papers and discussions, which will be of great assistance to them in their work.

Underground Telegraph Cables in England.

Extensions have recently been planned or made for the underground telegraph service from London northward, the first section of the system, to Birmingham, having proved very useful in the last two years. The extraordinary manner in which the British aerial circuits get out of order or become useless can only be realized by those who have to study the subject, and the underground wires have become absolutely necessary. The next stage to be completed is to Warrington, the ultimate idea being to extend the cable as far as Glasgow. The line of route to be taken from Birmingham is through Walsall, Bloxwich, Bridgetown, Cannock, Stafford, Eccleshall, Woore, and Nantwich to Warrington. Roughly speaking, this is about 80 miles, and when this section is completed the total length of cable will then be 200 miles or so. The London and Birmingham cable carries 76 wires, but the Warrington extension will comprise 60 wires only.

The preliminary work of constructing the line of pipes between Birmingham and Warrington for the reception of the cable itself has already been completed, and as a temporary safeguard against the disintegrating effects of the winter storms a temporary cable of seven wires has been drawn in. The wisdom of this precautionary measure was amply demonstrated recently, for had not these wires been available on the day immediately following the gale which swept across the country with such destructive force, the telegraphic interruptions with Northern towns would have been much more serious than they were. The permanent cable of sixty wires is now in course of preparation, and early this month a start will be made to place it in position inside the three-inch iron pipes. Great care has to be exercised in the making and completing of the cable. Like the one in use between Birmingham and London, it is a paper cable. Only the most skilful and trustworthy workmen are employed and some idea of the magnitude of the job may be gathered from the fact that in connection with the Birmingham and London cable there are no fewer than 2,000 "wiped joints." Though sixty is mentioned as the probable number of wires which the cable will comprise, the number has not yet been definitely decided upon. Testing stations will be provided at Walsall, Stafford, Woore and Nantwich. The laying of the cable will, it is expected, take close upon twelve months: and by this time next year it is anticipated that the whole affair will be in working order. This British example might well be imitated by the American telegraph companies, which are also serious sufferers from the interruption of traffic by wintry storms. The telephone lines in the United States have also proved great sufferers from storms: and it will be recalled that the report of the New York & New Jersey Telephone Company printed recently in these pages, showed a most severe loss of income from damage done to aerial circuits.

Laboratory Electric Furnace Equipment, Owens College, Manchester, England.

The publication of a recent British Institution of Electrical Engineers' paper [1] gives us an opportunity of publishing an account of the experimental equipment for electric furnace work at Owens College, Manchester. The accompanying description and illustrations are taken from the first part of this paper, but are supplemented by further details which it was thought would be of more particular interest to our readers.

This laboratory is closely in connection with the electrical engineering department of the Physical Institute from which it derives its power. Unfortunately, the university is not equipped with a central power plant as is so usual in this country, so that the available power is limited to about 50 hp, being taken from a gas engine and an electric motor, which can be used either separately or in parallel. On the other hand, the dynamo house having been fitted up to meet the requirements of experimental work, the machines are of a very varied type, and are moreover at all times available.

Any of the following units can be directly switched on to the cables leading from the dynamo house to the electro-chemical laboratory. The first unit of 40 kw direct current is capable of being connected so as to give any e.m.f. between 10 and 200 volts, the maximum current being 600 amp. This dynamo is most frequently used for arc furnace work at 50-100 volts, and there is a dynamo specially intended for electrolysis capable of giving 1,000 amp at 15 volts. With regard to alternating currents a 40-kw, three-phase and a 20-kw, single-phase machine are provided. The latter can be connected so as to give anything between 30 amp. at 600 volts and 250 amp. at 75 volts. A plant used some time ago by Mr. McDougall for the manufacture of nitric acid was presented by him to the laboratory, which will give alternating current up to 16,000 volts.

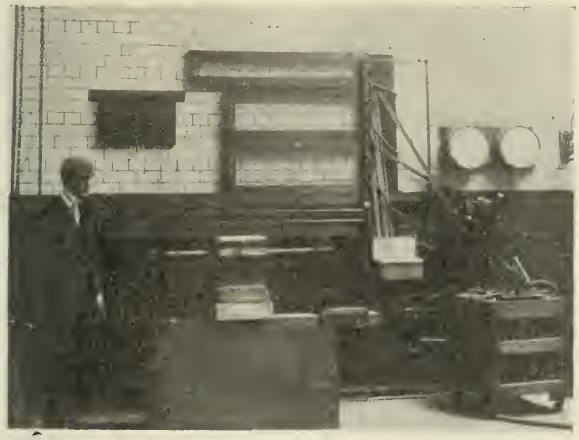

FIG. 1.—REGULATING RESISTANCE, 40-KW MOISSAN FURNACE.

In the electrochemical laboratory itself, the first problem is the exact regulation of these comparatively large currents, since for satisfactorily studying some of the electrolytic processes it is absolutely essential to have the current entirely under control. A series resistance is used for this purpose, which is divided into two parts, the first of manganin wire designed particularly for starting an arc furnace, and capable of being used for currents up to 300 amp.; the second consisting of German silver tubes, water-cooled, and with maximum carrying capacity of 1,000 amp. After some consideration the water-tube resistance was chosen as being the most suitable for regulating large currents. To the right is the portable resistance, and above are the 500, 600 and 1,000-amp. short-circulating switches. Bare copper strip 1¼ x ¼ and 2 x ¼ in. connect these switches with the different frames seen in the center. The two carbons are carried in massive copper holders which can be adjusted to any given height, the leads being bolted to the vertical standard of the holder of 2¼ sq. in. cross-section. The design of the water tube frames is shown in Fig. 1, which gives a general view of the frames.

The frames are of two types, the first being made of parallel ¼-in. tubes for currents of 600 amp. and below. These tubes are let into ½-in. by 1-in. gun metal strips, which are fixed to wooden frames; each strip carries two ⅜-in. set screws serving as terminals. One of these is used for the permanent leads, the other is useful to fix any temporary connection. The second type of frame for 1,000 amp. consists of two ½-in. German silver tubes, 6½ ft. long, connected in series, and has a resistance of 0.024 ohm. Two sliders are provided, by which the actual resistance in circuit can be varied, and the current adjusted with accuracy to the value desired. There is a stiff central spring, by means of which the sliders are kept in contact with the tubes during adjustment. They can be clamped in any given position by two thumb screws.

In considering the maximum power which may be dissipated in a water tube resistance there are two principal factors. Firstly, the maximum rate at which water can be passed through the tubes; secondly, the maximum rate at which heat can be transmitted from the metal to the water. In all practical cases the first limiting factor will intervene long before the second would show its influence. The design of the water tube frame will, therefore, depend on the dimensions of the tube and the available head of water. A general guiding factor is that a flow of one litre per minute will dissipate up to 2½ kw. The larger tubes are distinctly the more satisfactory, since in this case there is no difficulty in obtaining an efficient flow of water from the ordinary supply. With the smaller tubes it is necessary to have numerous inlets and outlets, as their resistance to the flow of water is considerable.

Close to the water tubes a resistance is provided by which the exciting current of any of the dynamos can be most effectively regulated; it is in constant use for the considerable variations of voltage necessary during the progress of some of the furnace operations.

Two sets of leads are run from the dynamo house to the laboratory. The first for currents up to 1,000 amp. is there directly connected to bare copper bars running round the room. The copper bars are drilled at frequent intervals with ½-in. holes, and thus a number of different furnaces placed in any required position can easily be connected by flexible leads. The second cable from the dynamo house is for currents up to 400 amp, and is brought up to terminals in three different positions. Thus it is possible to run continuous and alternating-current furnaces at the same time. To connect the furnaces with the bus-bars a number of flexible leads of standard length are provided, in this case of 3 yards length, and each of 300 amp. carrying power.

The furnace terminals are so arranged that 2, 3 or 4 of these flexibles can be bolted on according to the current required. This system has been infinitely more convenient than a single heavy lead.

The diverse apparatus described below has been designed expressly for experimental work of this nature and is the result of a good deal of consideration and practical trial of various forms of apparatus. The main object in view has in each case been to obtain a furnace which could easily be adapted to a number of varied requirements, and which should possess in the highest degree the advantages of strength, rigidity and simplicity of design, the question of producing the apparatus at the minimum of cost being also kept in mind. The result has been more practical than original, and whilst no claim is made to the production of any new form of furnace, the apparatus illustrated has proved itself capable of being fitted up for representing most of the more successful forms of technical furnaces in use.

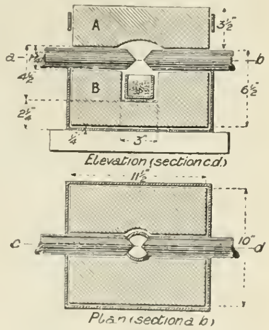

FIG. 2.—40-KW MOISSAN FURNACE.

Of experimental furnaces, that of Moissan takes of course a foremost place. A dimensioned drawing of this type for a power of about 40 kw is given in Fig. 2, whilst a view of the complete furnace is shown in Fig. 1. It is constructed of blocks of Monk's Park bath stone, which after trials with various limestones has proved to be the most suitable. The furnace is composed of two blocks, the first, *A*, forming the cover, the second, *B*, the furnace proper. This latter has two grooves of slightly greater diameter than the carbons to be used. As the blocks are apt to split under the influence of the heat, they are held together by iron bands; these are provided with sockets (not shown in figure) which enable the furnace or cover to be lifted by long iron bars. The central hole, which may be of diameter 2½-4 in., according to size of crucible in use, is lined at the bottom by a layer of powdered magnesia, which prevents the carbon crucible coming in direct contact with the lime. An annular space should be left around the crucible, which not only facilitates the heating, but also prevents the lime and carbon from entering into combination.

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[1] Journ. Instit. Electr. Engineers, Vol. 32, Part 1, pp. 222-247, 1903. "High Temperature Electro-Chemistry: Notes on Experimental and Technical Electric Furnaces," by R. S. Hutton and J. E. Petavel.

Provided that care is taken in the selection of the limestone used for the blocks, and that pure carbon crucibles and electrodes are employed, many most valuable preparations can be effected, as is sufficiently evidenced by the now classical work of the French savant.

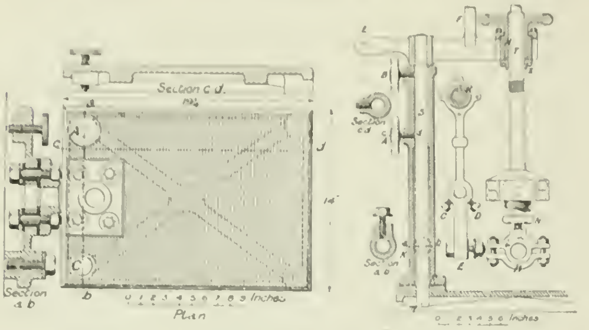


FIG. 3.—PLAN AND ELEVATION VERTICAL ELECTRIC FURNACE.

Much use can also be made of such a furnace for preliminary trials before fitting up an experiment on a larger scale, for instance the nature of a fusion product can be examined, the necessary amount of flux for the satisfactory reduction of an ore of one of the rarer metals can be approximately determined, and in many ways a good deal of time and valuable material can be saved by such small scale experiments. Largely owing to the difficulties of running such a furnace for more than a very short time and of making a process carried out by its aid continuous, the Moissan furnace gives very little assistance in indicating methods of preparation capable of being employed afterwards on a large commercial scale.

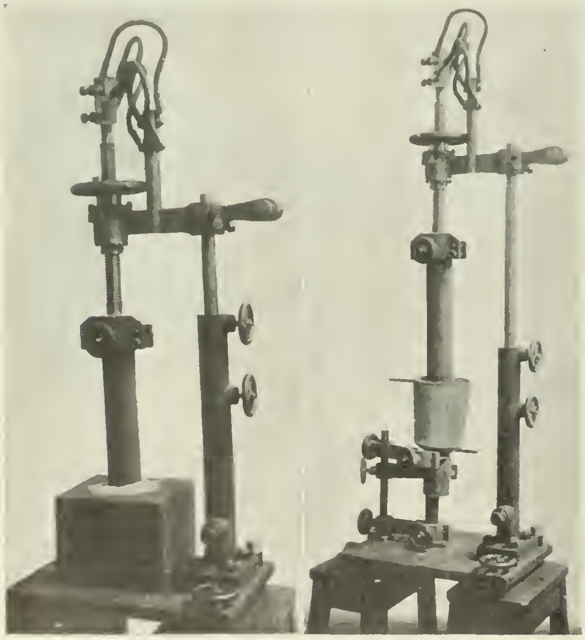


FIG. 4.—VERTICAL ELECTRIC FURNACE.

With a view to bridging over this gap between laboratory experiment and technical process several other forms of furnace have been adopted, which to a certain extent well fulfill this object. Fig. 3 shows the construction of a vertical furnace built very strongly and capable of the most varied uses.

The apparatus consists of a cast iron base, an adjustable standard and a feeding gear. The base is ½ in. ruling thickness, strengthened with rims and cross ribs 1 in. thick. At one corner a ¾-in. bolt, *C*, serves as a terminal. *A* is a levelling screw. The square base of the standard is insulated by a slab of vulcanized fibre, and held down by four ¾-in. bolts. See section *A B*. A hollow cast-iron column, *R*, 2½ in. diameter, is fixed on to the base shown in the previous figure, but insulated from it, the height of the gun metal cross-bar carrying the screw-feeding gear can be adjusted within wide limits by means of the 1¼ in. steel rod, *S*, which is clamped in position by the hand wheels, *A* and *B*. Connection can be made at either of the terminals, *K* or *E* (the latter for currents above 600 amp), the opposite pole being connected to the base. To avoid sliding contacts, which would be objectionable for such large currents, connection from the cross-bar to the screw carrying the carbon rod is made by means of four ½-in. flexibles not shown in this figure, but which can be clearly seen in Fig. 4. The gun metal rod, *T*, which carries the carbon, is 1½ in. diameter with a square screw thread (4 threads to the inch), giving a feed of about 1 foot; it is raised or lowered by means of a 7-in. cast-iron hand wheel. The design of the carbon holder is clearly shown; it is provided with rings of various diameter, so that carbons of very different sizes up to 3 inches can be held.

Employed on a small scale as shown in Fig. 4 it can be applied to the study of the electrolysis of fused salts and in this case the exact adjustment of which the vertical carbon is capable is particularly valuable. Upon the cast-iron base which forms the negative pole is placed a large block of carbon, having a cavity which serves as a crucible. The positive electrode is formed by a carbon 3 in. in diameter, which is fed by the screw-gear described above. In the second illustration the apparatus is fitted to be used for the electrolysis of fused salts; the water jacket, by causing a layer of the fused mass to solidify, enables the electrolyte itself to form the crucible lining. This is frequently necessary, since with many substances it is impossible to find a furnace material capable of withstanding their corrosive action at the high temperatures which prevail. The negative pole is in this case formed by a vertical carbon, which is held in a clamp sliding on a gun metal vertical rod fixed to the base.

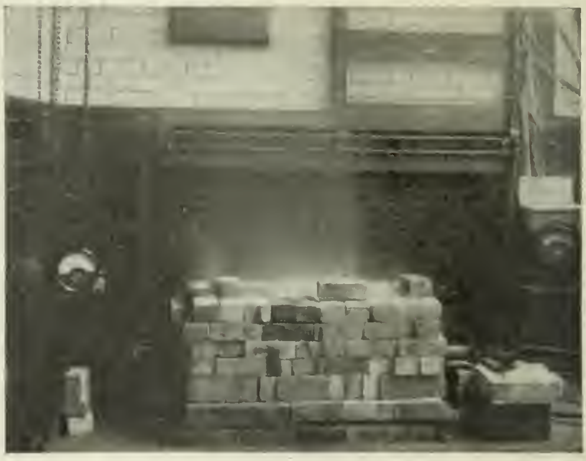


FIG. 5.—EXPERIMENTAL CARBORUNDUM FURNACE.

On the other hand the common equipment of the laboratory of fire bricks, cast-iron pots with carbon lining, etc., enable tests of such processes as the manufacture of calcium carbide, ferro-chromium and fused alumina to be carried out on quite a satisfactory scale. The furnaces of the Acheson resistance type can also be inexpensively fitted up from the stock of fire bricks, a few pieces of flat thick boiler plate and graphite rors and blocks of varying sizes; and if constructed with due regard of the relative proportions of the materials to the power employed, exceptionally fine products of carborundum, etc., can be obtained. Such a furnace in operation is shown in Fig. 5. As clearly indicated in Fig. 6, which represents a form of carbide furnace used with much success in the laboratory, by carefully adapting materials which are usually available in a laboratory it is possible to cheaply fit up any modified plant which is required. The two carbons, which are clamped side by side in a single holder, but insulated one from another, are raised and lowered by means of a crane fitted to the wall. The current is led in by flat copper bars, which by sliding in grooves prevent any oscillation or side motion of the apparatus. The body of the furnace consists either as shown in figure, of fire bricks, or of a large cast-iron pot; in both cases the material itself forms the actual lining.

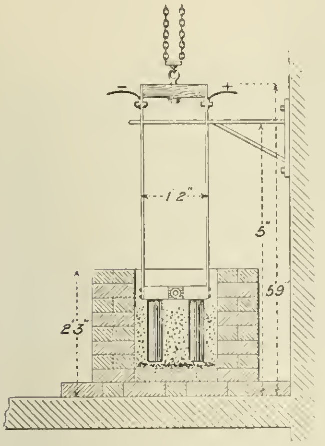


FIG. 6.—40-KW EXPERIMENTAL CARBIDE FURNACE.

In conclusion it may not be out of place to mention that besides being equipped with the object of intelligently following the valuable achievements of the technical processes and if possible elucidating some of the problems of a like nature which urgently require study, experimental work of a purely scientific character is being carried out. The object of the work in progress consists in the study of the effect of high gaseous pressures on the course of some of the high-pressure reactions.

The apparatus employed is shown in Fig. 7. It is intended for currents up to 1,000 volts and is capable of being permanently worked at 200 atmospheres pressure.

The apparatus is practically a steel enclosure, placed horizontally or vertically, which can be used for any of the different types of furnace. It is air-tight, and designed for a working pressure of 200 atmospheres, being tested at 500 atmospheres. On the right and left will be seen the screw-gear by which the carbons are fed, whilst in front and behind are windows which will stand the full pressure, but which can be replaced by additional connections when a circulation of gas through the apparatus is desired. The main valve, which serves also to connect the pressure gauges, will be seen on the top. The apparatus is water-jacketed throughout, the refractory material of which the furnace proper is made being contained in a cast-iron lining, thus insuring the protection of the main forging. The construction of this apparatus has been carried out by Messrs. Lennox, Reynolds and Fyfe to the designs made at the college.

The construction of this furnace has been provided out of funds received from the government grant committee of the Royal Society, London. Although it is too early to deal with any of the results of such work, it is evident that much interest attaches to the investigation of the additional influence of pressure on the reactions brought about at high temperatures attainable in the electric furnace. It is interesting and encouraging to find this appreciation in educational circles of the importance of the new domain of electrochemical work, as a branch of engineering; while the facilities afforded may well result in some original research of value.

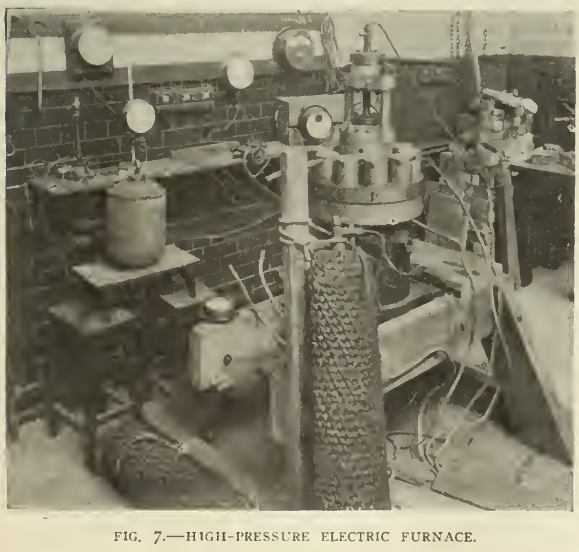


FIG. 7.—HIGH-PRESSURE ELECTRIC FURNACE.

Electrical Manufacture of Steel in Sweden.

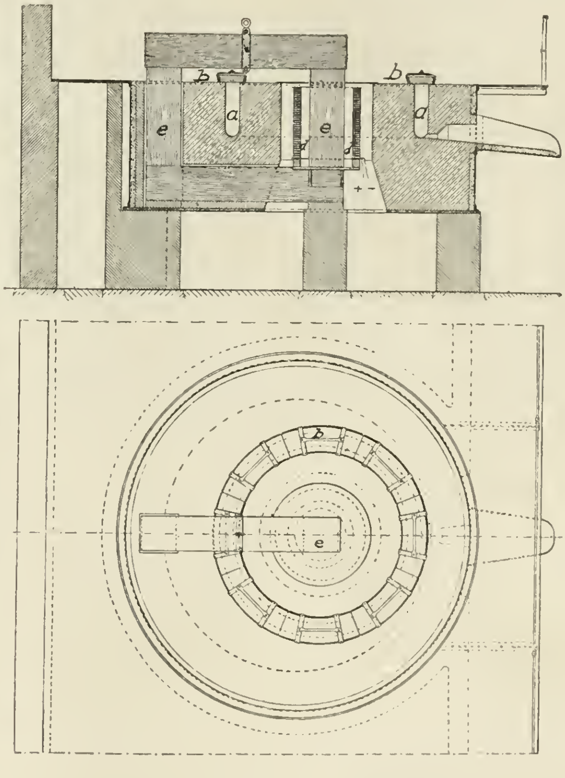
By G. Lindman.

THE idea of making steel electrically is not new. In 1879 C. W. Siemens designed for this purpose an electric arc lamp furnace, in which the arc was formed between coal and the metal contained in a crucible of graphite as electrodes. This scheme had several disadvantages, for the steel was heated irregularly—too much near the arc and too little in the opposite end—and became impure from contact with the coal electrode; the carbonic acid received at the oxidation of the latter made it more difficult for the steel to get rid of absorbed carbonic acid and at the same time the consumption of the electrode has a great influence on the cost.

A more equal heating of the steel is obtained if a strong current passes through it, the resistance of the metal generating the heat. One has to work with a large current because the resistance of the metal is so small, and as a consequence one has to give the copper conduits at least the same area as that of the steel band. Dr. De Laval, of Sweden, tried to decrease this disadvantage by passing the current through a layer of slag, the resistance of which is considerably more than that of iron. The greatest difficulty with such furnaces is in relation to the electrode, because the coal electrode produces by its great resistance a considerable potential drop and at the same time is soon consumed.

To avoid these disadvantages, Mr. Kjellin, of Sweden, in 1899, invented an electric furnace without electrodes, which scheme was immediately carried out by Mr. Benedicks, director of several iron works at Gysinge, Sweden. The accompanying illustration shows the principle of the construction of the furnace.

A circular channel, *a a*, is the "fireplace," the bottom and sides of which are fireproof brick walls. At the top the furnace is covered with the lids, *b b*. In the middle of the circle is a core, *c*, of square section made of thin, soft sheet-iron plates and surrounded by a coil, *d d*, of insulated copper wire. The core is continued outside the "fireplace" and forms a rectangle, which is related to the fireplace as one link of a chain to another. The coil, *d d*, is connected to the poles of an alternating current generator.



ELEVATION AND PLAN OF FURNACE.

The whole construction can be considered as a transformer with its secondary coil short-circuited. The secondary consists of the metal in the fireplace. Since this forms only one turn around the core, the current in it is approximately equal to that delivered by the generator multiplied by the number of turns of coil, *dd*. The potential, of course, decreases when the current increase. In this way it is possible to use a high potential alternator and obtain a low potential strong current without using energy consuming electrodes and heavy copper conduits.

In February, 1900, the first steel furnace was ready and experiments were made. The first tapping was made March 18, and the steel was of excellent quality. The problem was solved technically, but not economically, for with a dynamo of 78 kw not more than 270 kg of steel were obtained in 24 hours, and the furnace contained only 80 kg. Several furnaces have since been built, giving better results each time. The latest plant has a turbine of 300 hp, direct connected to a generator. The furnace holds 1,800 kg, and the production is figured to be 1,500 tons per year, charging with cold raw material.

The potential of the generator is 3,000 volts, thus decreasing the size of the copper conductors, and the operation has proved to be very satisfactory, the coil being in a well protected position.

The operation at Gysinge, where the best quality of steel for tool making is produced, is as follows:

After a tapping, when a little more than half of the metal is taken out, the furnace is charged first with cast iron pieces and then with case-shot, as much as experience shows to be suitable in order to get from cast iron, whose quantity of carbon has decreased, steel of desired carbon content. When everything has melted and is sufficiently heated, some manganese iron is added and the heating is continued for half an hour. The steel is then ready for tapping, which is done through a hole in the brick wall just as in the case of a common Martin furnace.

The steel resulting is of a superior quality and is distinguished by its strength, solidity, uniformity, toughness and ease of working in cold, unhardened condition, even with a very high percentage of carbon, at the same time being less liable to crack or warp in the hardening. The superiority of the steel compared with other steel, especially with respect to its softness in unhardened condition, lies in its freedom from gases, particularly hydrogen gas, resulting upon the fact that the steel during its melting is not subjected to the presence of burning gases of any kind. The manufacturing of special steel with nickel, chrome, manganese or wolfram is not beset with any difficulties. For making of permanent magnets the wolfram steel produced at Gysinge has proved to be better than other wolfram steel and does not, like the latter, warp in the hardening.

The cost of manufacturing by this process depends principally upon the cost of power. It has been estimated that the new furnace at Gysinge will give, using cold, raw material, 29 kg steel per electric horse-power per day, or 8,700 kg per horse-power per year of 300 working days. If the iron is instead taken melted to the furnace, the quantities become 64 kg and 19,200 kg per horse-power. In order to obtain low cost, it is necessary to build large furnaces, which necessitates large power plants. At a price of 75 kronor ($1.00 = 3.70 kr.) per year and electric horse-power, the cost for the power will be about 8.6 kr. per ton of steel with cold material, and 3.9 kr. using melted iron, figuring about 300 working days a year.

The cost of rewalling of the furnaces is considered to be 2.6 kr. per ton of steel for a furnace of 600 hp when the process is carried on as has been done at Gysinge. The cost of erecting such a furnace is 15,000 kr., the most of which goes for the electrical equipment.

From these figures it can be seen that the small and easily handled furnace in use at Gysinge can compete with other steel producing processes, especially since it gives a superior quality of steel.

Cheap Power from Culm.

Mr. Thomas H. Watkins, of Scranton, Pa., proposes to supply New York with electricity by utilizing the waste products of anthracite coal. His plan is to erect electric generating plants in the heart of the anthracite district and convey the power to New York by high-potential aerial transmission circuits. The project has passed the experimental period and is already well-defined and elaborated. Mr. Watkins is in a position to command almost unlimited capital. He has already employed a commission consisting of electrical engineers to pass upon the project and to advise him as to its practicability. At the head of this commission is Mr. L. B. Stillwell, who has pronounced himself as favorably impressed with the plan.

A Norwegian Water Power Plant.

By Franz Koster.

An interesting water power electrical generating plant has recently been completed at Hafslund, about 56 miles southeast of Christiania, the principal city of Norway, and near the little town, Sarpsborg. The plant was designed by the Elektrizitats-Aktiengesellschaft, vormals Schuckert & Co., of Nuremberg, Germany, and will ultimately supply 25,000 hp for lighting and power distribution. Part of its output is transmitted to the city of Fredrickstadt, about 9½ miles distant, another portion has been contracted for by a carbide manufactory, located near the power plant, and provision is made to supply current for electric traction, to be used on a branch of the railroad, "Christiania-Ausland," running to the harbor of Sandesund.

The main source of power is the waterfall, Sarpsfoss, in the River Glommen, the largest in Norway. The total fall is about 59 ft., with a minimum supply of from 3,500 to 4,200 cubic ft. per second; but by damming the water of Lake Mjösen, which is located some distance above the fall, a constant supply of about 10,500 cubic ft. per second is made available. This was necessary, as at times, at changes of the season, the flow of the Glommen is greatly augmented, while at other times its volume is insufficient for the purpose. Allowance was made for the water already used for industrial purposes and the plant was designed for a steady supply of 4,600 cubic ft. per second.

The construction of the entire canal, basin and other portions of the hydraulic equipment was completed simultaneously with the erection of the first portion of the power plant, one-third of the entire structure. This first division has been in operation since 1899; the second is now being finished and the third will soon be begun. The whole canal and basin had to be blasted out of solid granite, as well as the site of the power house. The construction of the canal was accompanied by other difficulties, the protecting dams being once washed away by an unexpected torrent. The location of the power house was such that no dam could be effectively constructed to protect that portion of the work which had to be prosecuted only when the water was very low, the foundations being submerged during the greater part of the year.

A general plan, showing the location of the power house first finished, is given in Fig. 1. The water from the river enters a canal starting about 380 ft. from the plant. This canal is 33 ft. wide at the bottom, has a 5 per cent. pitch, and ends in a basin. In the canal is a rack as shown in Fig. 1, marked "A," and in detail in Figs. 6 and 7. The object of the rack is to arrest all floating material such as logs, ice, etc. This rack, which is of I-beam construction, is 28 ft. in length, resting on the bottom of the canal at an angle of about 40°. It is hinged on an I-beam and an arch-shaped concrete construction which spans the canal and protects the inner basin.

In the event of high water the rack is lowered in order to prevent too great a flow of water and to catch any logs, ice blocks or branches of trees that may come down. At the usual level timber is floated down the Glommen and caught at a station above the canal, and floated through a channel parallel to the canal and to saw mills immediately south of the power house. These mills have turbines of their own, but these are no longer wholly used, since the erection of the second portion of the power plant.

The difference in level between high water in the canal and in the basin varies from 10 to 13 ft. and is regulated by the rack, *A*, the lock shutter, *B*, and the sluice gate, *C*.

The floor of the basin below the rack is a step higher than the floor under the rack. This step runs diagonally across and where it reaches the north side of the wall there is an aperture through which all sand, rocks and other matter sweeping along the bottom of the canal are expelled, which otherwise would be carried on to the screen.

Originally the turbines of the mills were supplied by a canal which now shows in the plan as a "blind alley." A small triangular abutment will be noticed above the rack. This was subsequently built to deflect timber over the north wall of the canal at high water, as timber showed a disposition to collect at the inner corner of the rack.

At *D* is a sluice gate through which the ice naturally forming in the basin is gotten rid of. When any repairs have to be made or when it becomes necessary to clean the basin, the water is drained off through this gate, the lock-shutter at *B* being closed and the flow going through the sluice gate, *C*. All these gates are operated both by hand and by electric motors, the motors being used particularly when quick work is desired or when the gates are to be fully opened. Over the gates are small houses and between *D* and *B* above the overflow wall of the basin, is a bridge. Access is also had to the house over C across the concrete arch below *A*. The top of the overflow wall of the basin is 5 ft. lower than the south wall and the fall over this, the overflow wall, is about 70 ft.

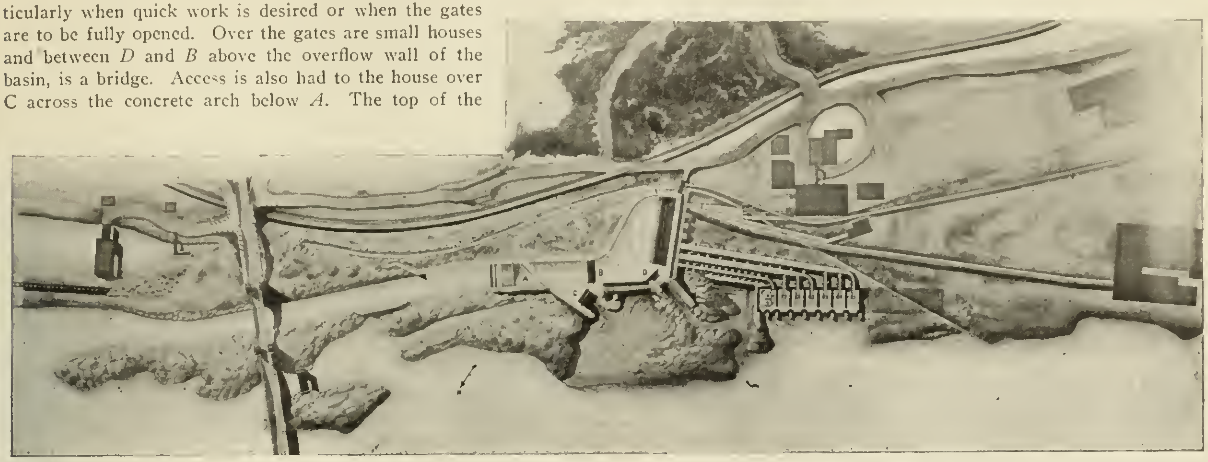
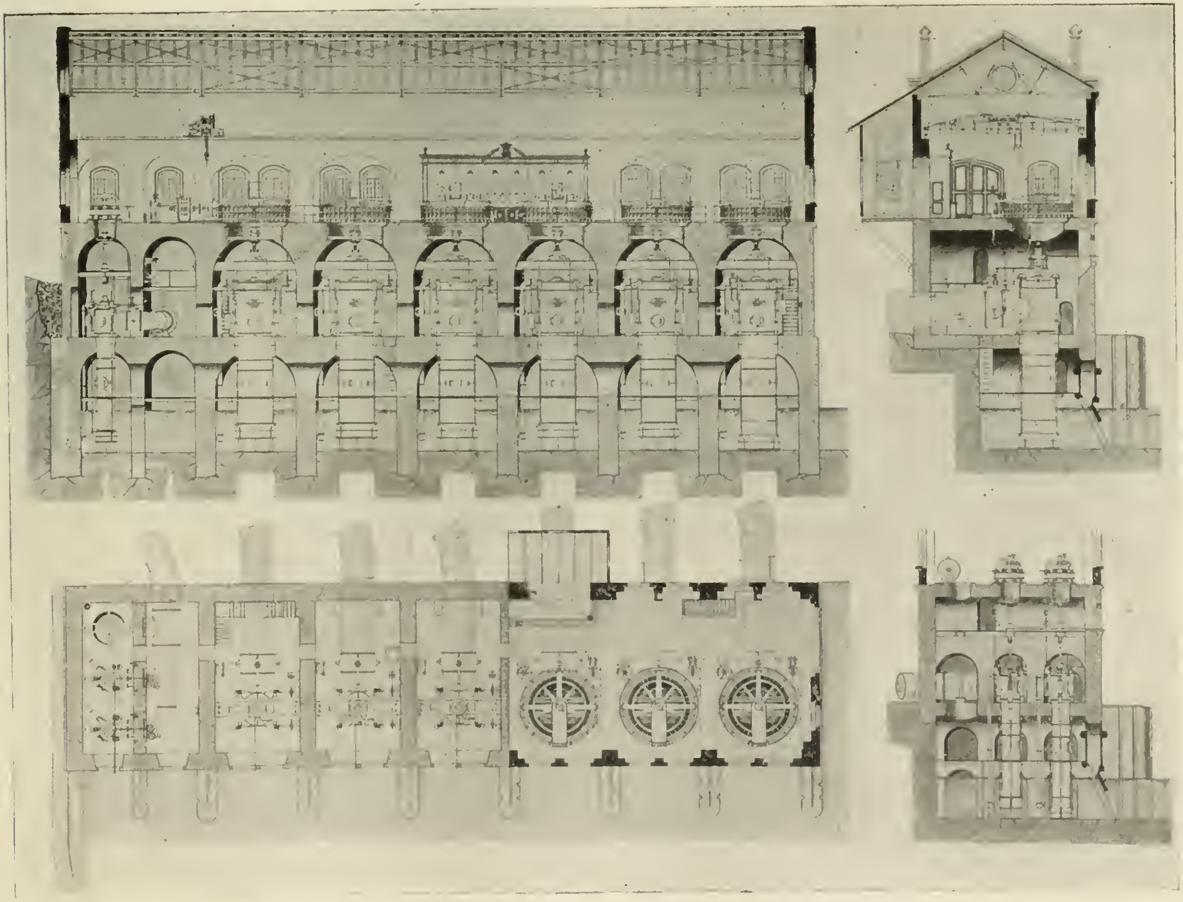


Fig. 1.—General Plan of Water Power Plant at Hafslund, Norway.

The dam wall of this basin is constructed with seven chambers, from which the water runs through seven pipes to the turbines. These chambers are protected by fine screens of flat iron. The pipes can be closed independently. The first pipe, counting from the overflow wall, is 6½ ft. in diameter. At the power house this flow is used to operate the direct-current exciter dynamos. It will ultimately have three branches, only two of which are now finished. The remaining six pipes are 10 ft. in diameter each, and the two which lead to the first portion of the power house, divide into three branches just before entering the house; a throttle valve being placed in each tube inside the power house to cut off the turbines when necessary.



Figs. 2, 3, 4 and 5.—Plan and Sections of Hafslund Power House.

The power house—that is, the portion first completed—is shown in plan in Fig. 4; in longitudinal section in Fig. 2; Fig. 3 a cross-section of the main turbines, and Fig. 5 a cross-section of the turbo-exciter room. The building is 147 ft. long, 36 ft. wide and divided into 8 chambers, each 16 ft. wide, with the exception of two, which are only 10 ft. Grooves will be noticed in the abutments. Into these planking is fitted when it is desired to shut out the tail water, and the space is filled with a good quality of horse manure well tamped down, the water inside then being pumped out. To prevent the tail water and ice from backing in too suddenly, a flap gate the length of the distance between the abutments and about 5 ft. wide swings down against I-beams placed for the purpose.

The main or dynamo floor is about 37 ft. above tail water at low water level. The turbines are of the Jonval type, with vertical shafts, and develop 1,200 hp at 143 r.p.m., with a fall of 51 ft., or 1,400 hp with a fall of 59 ft. The six main turbines are regulated by sleeves on the bottom of the draft tubes, which are worked by means of electric governors. The dynamos are three-phase, 5,000-volt generators, developing 865 kw. The two direct-current 200-kw exciter dynamos are coupled with turbines which develop 280 hp at 280 r.p.m. These turbines are regulated by sleeves similar to those regulating the larger turbines, except that the governor is mechanical instead of electrical. One of these turbo-exciters is ample to do the work, the other being held in reserve. Provision is made for feeding the trolley of the branch line referred to by reducing the voltage from 5,000 to 600.

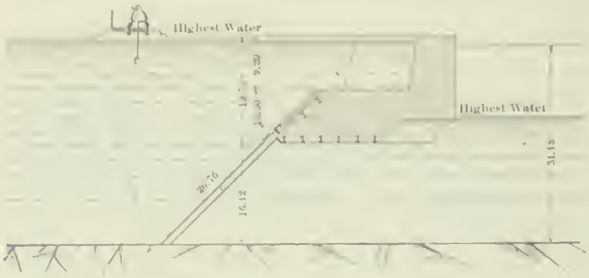


FIG. 6.—DETAIL OF RACK.

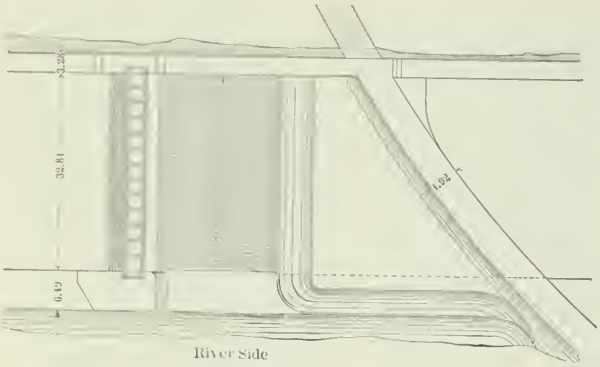


FIG. 7.—DETAIL OF RACK.

The four turbines in the second portion of the power house, which are of the Francis type, are of 2,050 hp each. When the three portions of the power house are completed the total output will, as stated, exceed 25,000 hp.

Marconi News for England.

A London dispatch of March 30 says: "The *Times* publishes two messages of over 100 words from its New York correspondent, giving items of American news sent from America by the Marconi wireless system. In an editorial article the *Times* says these messages mark the establishment for the first time of the regular commercial transmission of news by the Marconi Company. The paper announces that the day-by-day transmission of news between the New and Old Worlds by the Marconi system has been undertaken for the *Times* upon a contract basis. It says this marks an epoch in the development of telegraphy. It is added that messages can be sent between England and America by the new system at a rate not much in excess of that for messages between England and France by the old system." This ought to put a stop to the silly slanders in circulation, to the effect that Mr. Marconi has never sent even signals across the Atlantic.

Electroculture.

By Emile Guarini

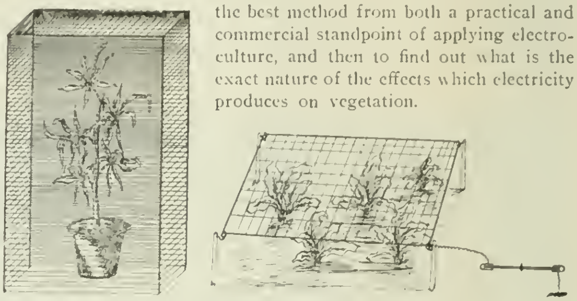
THE researches concerning the influence of electricity on vegetation had their origin at the same time, it may be said, as the science of electricity itself, dating back a century and a half. The name of M. Selim Lemstroem, professor of physics at the University of Helsingfors, is closely associated with this history through the great number of articles which he has published on electroculture since 1885.

We shall not take up his early experiments nor the studies which the learned Russian professor made on this subject in 1886, but examine successively his more recent experiments. I mean those which took place from 1898 to 1901, and the results of which have been recently communicated.

The influence of electricity on vegetation is now a fact well known to science. Should this be contested, reference may be made to the experiments of Grandeau and Leclercq. These two investigators surrounded the plants with a cage of wire (Fig. 1) so as to prevent the action of atmospheric electricity. By this means they found that a very harmful influence was brought to bear on vegetation.

Grandeau reports that when the electricity of the air has free access it produces an increase in the crops of from 50 per cent. to 70 per cent. in the leaves and stems and from 50 per cent. to 60 per cent. in the seeds and fruits.

The question once decided, there remains to be determined, first, the best method from both a practical and commercial standpoint of applying electroculture, and then to find out what is the exact nature of the effects which electricity produces on vegetation.



FIGS. 1 AND 2.—ELECTROCULTURE.

The experiments of M. Lemstroem have no bearing on the first question, but on the second they furnish very interesting and probable explanations, although they do not seem, as yet, quite complete. The first investigations of the learned professor established that negative electricity is better for plant than the positive. They had also the purpose to determine whether the action of electricity was independent of the latitude under which the experiment takes place; whether heat is injurious to the treatment of plants by electricity; and, lastly, whether the vigor of the plants and the fertility of the soil have an important bearing on the crops submitted to electrical treatment. The actual experiments have had for an object to solve the following questions:

1. Which hour of the 24 in the day is the most favorable to apply electricity? Is the latter effected by the time during which it is employed?
2. In what proportions are the plants submitted to this treatment actually increased?
3. Of what does the influence of electricity upon plants consist?

In all these experiments he used the current furnished by an electrostatic machine of his own invention. This new machine was considered superior to any of the older types in as much as for the same amount of work it furnishes three or four times more electricity; because it is possible to accelerate very considerably its rotation and therefore to charge a great deal larger surface of wire. Besides this, it is not as easily affected by humidity as the older machines, and can work three or four months without very much cleaning.

The cylinders used in its construction are about 30 cm in diameter and about 40 cm in length. The cylinder used in the interior is smallest in diameter and not quite as long. The machine worked generally from 4 o'clock in the morning to about 7 or 11 o'clock, and from 4 in the afternoon to 8 in the evening. A complete uniformity, however, could not be maintained, for during wet or rainy days the machine could not work. But on the other hand it worked longer when the sky was cloudy.

The metallic circuit attached to the machine was placed around the fields in the following manner (Fig. 2): A galvanized wire of 1.5 mm thickness was placed on supports around the fields. On this wire there were stretched transversely and horizontally other wires of 0.5 mm at a distance of 1.25 metres from each other. This wire was fixed to these supports by means of ebonite isolators well protected and invented for the purpose by the author of the experiments.

The length of the sparks between the discharging spheres of the machine was measured at the time it was started and when the movement was stopped, and sometimes also in the intervals. They generally greatly varied.

The length of the sparks is measured by the potential at which the circuit may be charged. It depends upon the external meteorological conditions, among which the degree of humidity of the air is the most important factor. The potential of the circuit of a given machine is weaker as the electricity escapes more rapidly. Thus the electricity meets a smaller resistance in the layer of air between the circuit and the plants. The resistance is greater during the day, when the air is drier, than during the night, when there is a great deal more humidity. The electrical current which goes from the circuit to the plants is, therefore, slightly different during the day from what it is in the night, and besides there exist radical differences in the life of the plants during the day and the night. It is for these reasons that in 1900 M. Lemstroem reserved the electrical current especially for the night.

The great difficulty to overcome in all experiments of this kind is found in the fact that the fertility of the ground cultivated is very uneven, even when the plots are very small and very near each other. M. Lemstroem tried to eliminate this factor without, nevertheless, ever completely succeeding.

In his experiments of 1898 the electrical machine worked from 5 to 9 in the morning and from 4 to 8 in the evening. After 164 hours of treatment the plants in the tobacco field used for experiments and those in the field used for comparison, showed a marked improvement in the favor of the first one. The increase in the crops were 39 per cent. for tobacco, of 8.7 per cent. for carrots, 11.2 per cent. for beets and of 11.1 per cent. for lima beans.

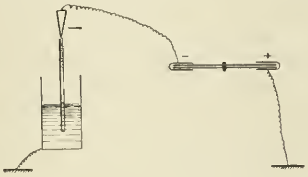


FIG. 3.—ELECTROCULTURE.

In 1899 care was taken to classify the plots according to their respective fertility and to increase the number of plots used for experiments and those used for culture in order to obtain average results as exact as possible.

Nevertheless, on account of the insufficient preparation of the ground and the late season in which the seeds were sown, the crops were inferior to those resulting from the experiments preceding. The electrical machine worked as regularly as possible and the sprinkling was carried on with great care. Following were the results: Oats showed an increase of 28.7 per cent.; barley, 23 per cent.; carrots, 37.5 per cent., and potatoes, 50 per cent. Peas showed a decrease of about 7.5 per cent., and cabbages 19.1 per cent.

If the unfavorable circumstances under which the experiments were conducted are taken into account the results were equal to those of 1898.

In his attempts of 1900, M. Lemstroem purposed, as we have already said, especially to look into the effects of electricity on the plants during the night. But since the increase may be attributed to the greater length of the treatment during the previous season of 1899, the results do not prove any specific fact as to the relative values of the treatment during the day and during the night.

The increase obtained in 1900 was very high, being about 26.4 per cent. for barley, 55.7 per cent. for peas, 17 per cent. for potatoes, 88.7 per cent. for strawberries, 92.7 per cent. for carrots, and 33.3 per cent. for lima beans. Moreover, the average of the first crops of the experimental fields surpassed the average of the first experiments in the ordinary fields, which gives the first ones a far more rapid development.

The trials on the cereals in 1899 showed that the germination of wheat as well as of rye was far more prompt. The plants were more vigorous, and the crops of a better quality. In fact, the increase of the wheat was 26.9 per cent. for the first quality, the total increase being 15.8 per cent. For the rye it was of 32.1 per cent. for the first quality and 28.4 per cent. for the whole crop.

Judging from the results obtained, M. Lemstroem infers that, since the increase is greater when the electricity acts both day and night, there must exist some ratio between the time of treatment and the proportion of increase. As to whether there is also some bearing between these last proportions and the length of treatment, that he is not able to decide as yet. He thinks, on the other hand, that it is possible that the difference of potential and of resistance might be such that the current was constant. But what is more probable is that the current undergoes great variations, and that the relations between the application and the increase must vary, and it follows that the action of the current on the plants must be modified by external causes.

But what is the exact action of electricity on plants? The author has taken pains to discover it by a few experiments in the laboratory. By plunging (Fig. 3) a capillary tube in the water of a vase placed in communication with the ground and placing a metallic point in close communication with the negative pole of an influence machine, there is formed, after the machine is worked a few moments, small drops of water in the upper part of the tube. In order that the experiment may succeed, however, it is necessary to wet the inside of the tube, and the positive pole of the machine should communicate with the ground. Under these conditions the water goes up the sides of the tube and forms one or several drops of liquid. The quantity of water that thus rises is in direct proportion to the strength of the current and inversely as the square of the distance of the plant to the level of water in the tube.

The quantity of water also depends upon the length and the diameter of the tube as well as on the resistance which the current meets. Thus a current of electricity is produced attracting the liquid in the positive direction.

Comparing these phenomena with his experiments in agriculture, the author deduces the following conclusion: "The current produced by the influence machine whose positive pole is grounded "goes from the earth through the plants towards the points of the "isolated circuit, and from there to the negative pole of the machine. "This causes the ascension of the liquids, that is to say of the sap, in "the capillary tubes of plants. In this manner an increase in the "energy is produced to which is due the circulation of the sap."

M. Lemstroem found that there were produced at times in his machine an inversion of the poles which had for effect to charge the circuit less often with positive electricity than with negative electricity.

He then made some new experiments in which the direction of currents was submitted to very close regulation. With this end in view, he placed twelve pots in four series, the pots containing the same kind of seeds. Above the sections 1, 2, 3 was suspended a circuit of iron wire fitted with points.

Bands of zinc were passed from the bottom of the pots, which were placed on saucers of clay supported by panes of glass with supports of ebonite. In section 4 were pots without electrical connections.

The negative pole communicated in the first section with the bands of zinc; in the second section with the upper circuit and the third section with an insulated commutator making it possible to establish a communication alternatively with the bands and the circuits and respectively to place, as desired, the circuit or the band in communication with the soil. The cereals and the strawberry plants showed an increase which went as high as 60 per cent. in section 1; for the carrots the proportional increase was 182.7 per cent. in section 1, 32.4 per cent. in section 2, and 13.2 per cent. in section 3.

The positive current in section 1 thus gave a result very superior to the negative current. The electrical current of the air, besides aiding the ascension of the sap, therefore, increase also the development in a greater proportion, yet when it is produced in an inverse direction.

M. Lemstroem concludes that the negative current aids the ascension of water and increases in this manner the circulation of the sap. The positive current brings to the plant the different elements of the atmosphere and circulates them through the capillary tubes present, to undergo there a process of assimilation.

From these series of experiments the learned professor thinks he is justified in offering the following propositions:

a The proportion in which the plants were increased may be estimated at 45 per cent.

b This proportion relates to the nature of the soil.

c. Certain plants only bear the electrical treatment when they are well watered. Their increase in duction is then very remarkable.

d. The electrical treatment is injurious during solar heat; it therefore should be discontinued in the middle of the day.

e. Different methods are necessary to produce overproduction.

The question of the influence exercised by an artificially created electrical air current cannot be considered definitely solved. M. Lemstroem is the first one to recognize that. Nevertheless, experiment has furnished a plausible explanation, based on exact facts, as to how this influence is exercised.

* * *

Annual Report of the Bell Telephone System.

In the annual report of the American Telephone & Telegraph Company for the year ended December 31, given below, President Fish remarks that there is scarcely a section of the country where the supply of telephone facilities equals the demand. The report shows an increase in earnings from dividends received of $1,035,315, from telephone traffic of $66,262 and from interest of $299,237. Gross earnings reached the large sum of $13,277,457, an increase over the previous year of $1,670,640. Expenses, however, increased $1,233,654, which left a gain in net earnings of $436,986. In consequence of new issues of stock dividends paid increased $1,534,380, hence the balance after dividends decreased $1,097,394 from the previous year. The amount carried to reserve was much smaller than in 1901, say $522,245, against $1,377,650; and the final surplus was $728,623, a decrease of $241,989.

The detailed report covering the operations for the fiscal year ended December 31 shows:

Earnings:	1902.	1901.	Increase.
Dividends	$6,023,523	$4,988,208	$1,035,315
Rents of instruments	2,299,378	2,647,908	*348,530
Telephone traffic	4,199,709	3,533,447	666,262
Real estate	56,031	36,680	19,351
Interest	698,816	399,579	299,237
Miscellaneous	......	995	*995
Total earnings	$13,277,457	$11,606,817	$1,670,640
Expenses:			
Admin. expenses	$964,827	$772,424	$192,403
Interest and taxes	1,970,948	1,276,559	694,389
Legal expenses	124,646	99,139	25,507
Telephone traffic	2,381,764	2,060,409	321,355
Total expenses	$5,442,185	$4,208,531	$1,233,654
Net earnings	$7,835,272	$7,398,286	$436,986
Dividends paid	6,584,404	5,050,024	1,534,380
Balance	$1,250,868	$2,348,262	*$1,097,394
Carried to reserve	522,245	1,377,650	*855,405
Surplus	$728,623	$970,612	*$241,989

* Decrease.

The balance sheet as of December 31 is as follows:

Assets:	1902.	1901.
Construction, equipment and surplus	$22,496,191	$19,116,200
Telephones	6,522,106	5,113,408
Real estate	1,745,280	1,665,598
Stocks and bonds	114,864,798	84,339,912
Patent account	166,014	150,000
Machinery and tools	48,126	35,987
Cash and deposits	6,933,364	1,694,342
Bills and accounts receivable	15,528,621	10,972,535
American Bell Telephone Co.	22,110,400	22,110,400
Total	$190,414,903	$145,198,394
Liabilities:		
Capital stock	$114,946,500	$104,650,600
Capital installments	11,172,472	....
Surplus	3,493,290	2,764,668
Bonds	28,000,000	15,004,500
Reserves	6,079,262	4,047,476
Accounts payable	*8,078,168	2,760,938
Contingent	18,645,210	15,970,210
Total	$190,414,903	$145,198,394

* Of this amount $1,976,312 is for dividend payable January, 1903.

Comparative statistics from the reports of the past three years are as follows:

	1902.	1901.	1900.
Telephones, Dec. 20	3,150,320	2,525,606	1,952,412
Exchanges, Jan. 1	1,514	1,411	1,348
Branch offices	1,861	1,594	1,427
Miles wire underground	1,328,685	883,679	705,269
Miles wire marine	6,048	4,200	4,203
Total miles wire	2,443,750	1,729,019	1,354,209
Number of circuits	724,654	592,467	508,262
Number of employees	50,350	40,864	32,837
Number of stations	1,277,983	1,020,647	800,880
Number of daily connections	9,322,951	7,719,139	5,668,986

President Fish remarks: "The total amount added to construction and real estate by all the companies constituting our system during 1902 was:

For exchanges	$26,014,800
For toll lines	8,282,900
For land and buildings	3,038,800
Total	$37,336,500

"The amount added in 1900 was $31,619,100; in 1901, $31,005,400.

"The expenditures in 1902 for the construction, equipment and supplies required for its long-distance lines was $3,379,982, making the total investment in long-distance lines and equipment to the close of the year $22,196,191.

"There is hardly a section of the country where the supply of telephone facilities equals the demand. During the past year the operating companies have made larger gains in their subscribers than in any previous year. The estimate for the coming year merely for new circuits on the now existing long-distance lines calls for an amount equal to about 10 per cent. of the entire investment made to date on the company's long-distance plant.

"During the past year the company received from the issue of new stock offered at par to its stockholders the sum of $21,226,122; $9,965,550 of this amount was received in January, 1902, and $11,260,572 in September, 1902. The balance of the proceeds of the latter issue was received in January, 1903. Further stock issues will undoubtedly be necessary in the future.

"At present about 55 per cent. of the entire mileage of wires used for exchange service throughout the country is underground.

"Since the last report there has developed a recognition on the part of many of the competing telephone companies that the rates generally adopted by them were much too low. The public will be educated to a recognition of what are proper and reasonable rates for telephone service, in which event our companies will be in a position to relieve themselves of what is substantially the only ill effect that has followed from competition, namely, the reduction in certain localities of the rates charged to subscribers to a point which allowed no profit, and in some cases involved a loss.

"If a reduction in metals had not been made the amount carried to surplus on the books of this company for the year 1902 would have been substantially greater."

The directors of the American Telephone & Telegraph Company were re-elected at the annual meeting of stockholders on March 31. The personnel of the board is as follows: Charles W. Amory, Francis Blake, George L. Beardsley, T. Jefferson Coolidge, Jr., Frederick T. Fish, Henry F. Howe, Charles E. Perkins, Nathaniel Thayer, John I. Waterbury, George F. Baker, Charles T. Bowditch, Alexander Cochrane, W. Murray Crane, J. Malcolm Forbes, Charles Eustis Hubbard, Thomas Sanders, Theodore N. Vail, Moses Williams.

President Fish emphatically denied the report that has been repeatedly circulated to the effect that the new stock would be used for purchasing a controlling interest in the Western Union Telegraph Company. Mr. Fish says: "The Western Union report is all nonsense."

At the special meeting of the American Telephone & Telegraph Company, 968,735 shares out of a total of 1,500,000 were voted in favor of increasing the capital stock from $150,000,000 to $250,000,000. There was no opposition. President Fish stated at the special meeting that the increase has been made so that the directors will have the power to issue it as the occasion may require during the next few years. He also stated that of the $150,000,000 previously authorized only $135,000,000 had been issued.

March Meeting of the American Institute of Electrical Engineers.

The attendance Friday, March 27, at the monthly meeting of the American Institute of Electrical Engineers was larger than usual, doubtless owing to the interest of the topic to be discussed, "High-Tension Transmission." The dinner which preceded the meeting was also unusually well attended, more than sixty members being present. Secretary Pope announced that at a meeting of the Board of Directors in the afternoon, the following nominations of officers were made: President, B. J. Arnold; vice-presidents, Calvin W. Rice, W. S. Barstow and Ralph D. Mershon; managers, Dr. Samuel Sheldon, W. C. L. Eglin, George F. Sever and A. H. Armstrong; treasurer, George A. Hamilton; secretary, Ralph W. Pope. It was also announced that 200 associate members were elected at the afternoon meeting, and that more than that number of applications are awaiting action.

An important action of the Board of Directors was the establishment of a grade of membership to be known as "Students of the American Institute of Electrical Engineers." These students will not be corporate members of the Institute, owing to the fact that the Constitution limits such members to those in the grades of member, associate member and honorary member.

In introducing the topic of the evening, President Scott spoke of the steady advance made during the past ten or twelve years in electrical transmission of power at high tensions, and gave illustrations from the statistics of one of the large manufacturing companies. Units recently built have three times the output of the largest transformers of five years ago, and the aggregate output has been over a million kilowatts. The average kilowatt output per month during the last year is equal to the total output during the past seven years, and the output of the past two years has exceeded that of the preceding ten years.

The discussions of the evening were participated in by Messrs. W. N. Smith, P. H. Thomas, R. D. Mershon, P. M. Lincoln, T. A. W. Shock, F. M. Waterman, C. C. Chesney, W. L. Waters C. E. Skinner, C. O. Mailloux, H. W. Buck, C. L. De Muralt and Philip Torchio.

The first paper presented was one by Mr. Ralph D. Mershon entitled "Mechanical specifications for a Proposed Standard Insulator Pin." After setting forth the theoretical considerations which should guide in fixing the dimensions of the standard insulation pin, the following specifications were given:

Threaded End.—It is proposed to make the diameter of the small end of the pin 1 in.; the length of the threaded portion 2½ in., and the diameter at the lower end of the threaded portion 1.25 in., so that the threaded portion will taper from 1.25 in. to 1 in. in a length of 2½ in. The threaded portion of the insulator should have the same dimensions and taper as that of the pin.

Shoulder.—It is proposed to make the shoulder 3-16 in. on all pins. That is, the diameter of the pin just above the cross arm will be ⅜ in. greater than the nominal diameter of that portion of the pin in the cross arm; it is proposed to carry this diameter ¼ in. above the cross arm before tapering the pin.

Dimensions in Cross Arm.—It is proposed to make the diameter of that portion of the pin in the cross arm, just below the shoulder, 1-32 in. less than the diameter of the hole in the cross arm and at the lower end of the pin 1-16 less than the diameter of the hole in the cross arm. It is proposed, also, to designate this portion of the pin as having a nominal diameter equal to that of the hole in the cross arm into which the pin fits. Therefore, that portion of a pin which is to fit a 1½-in. hole in a cross arm will have a nominal diameter of 1½ in., but will have an actual diameter just below the shoulder of 1 15-32 in., and at the lower end of the pin of 1 7-16 in.

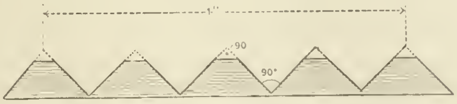


FIG. 1.—FORM OF THREAD.

Thread.—It is proposed to use on all pins a thread having a pitch of ¼ in. or 4 threads to the inch, the form of thread to be that shown in Fig. 1 (scale four times full size). As there shown, the angle between the faces of the thread is 90° and the top of the thread is flattened by cutting off, from the form the thread would have if not flattened, one-fourth its unflattened depth. The form of the thread in the insulator should be the same as that on the pin. If this is done it will insure the bearing surface being always on the sides of the threads and never on the edges.

Designation.—It is proposed to designate that portion of the pin above the cross arm as the "stem" of the pin. That portion in the cross arm as the "shank" of the pin. It is proposed to designate a pin by the length of its stem, i. e., a pin whose stem is 5 in. long will be designated as a "5"-in. pin, one 6 in. long as a "6"-in. pin, etc.

Dimensions of Standard Pins.—In accordance with the above the following table has been prepared, giving a number of sizes of pins, and their dimensions, which it is proposed to make standard. The diameter of the shank has in each case been fixed by making it approximately equal to (slightly larger than) the diameter of the theoretical pin corresponding to the length of the stem of the pin in question. The headings of the columns of the table refer to the lettering of Fig. 2. Fig. 2 is a dimensioned unthreaded 5-in. (proposed standard) pin.

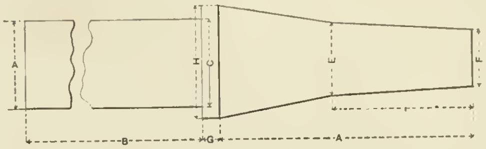


FIG. 2.—STANDARD PIN.

Size of Pin.	A	B	C Nominal.	C Actual	D	E	F	G	H	I
Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
5	5	4¼	1½	$1\frac{15}{32}$	$1\frac{7}{16}$	1¼	1	¼	1⅞	2½
7	7	4¼	1¾	$1\frac{23}{32}$	$1\frac{11}{16}$	Same for all sizes of pins.	Same for all sizes of pins.	Same for all sizes of pins.	2⅛	Same for all sizes of pins.
9	9	4¼	1⅞	$1\frac{27}{32}$	$1\frac{13}{16}$				2¼	
11	11	4¾	2	$1\frac{31}{32}$	$1\frac{15}{16}$				2⅜	
13	13	4¾	2⅛	$2\frac{3}{32}$	$2\frac{1}{16}$				2½	
15	15	4¾	2¼	$2\frac{7}{32}$	$2\frac{3}{16}$				2⅝	
17	17	5¾	2⅜	$2\frac{11}{32}$	$2\frac{5}{16}$				2¾	
19	19	5¾	2½	$2\frac{15}{32}$	$2\frac{7}{16}$				2⅞	

Following the presentation of his paper, Mr. Mershon, as chairman of the Committee on High-Tension Transmission, read several written communications on the subject. Mr. M. H. Gerry, Jr., of the Missouri River Power Company, favored a diameter greater than one inch at the top of the pin proposed by Mr. Mershon and a thread of greater length than 2½ in. Wooden pins most frequently fail by shearing, and a pin of larger diameter and a longer thread has an advantage in preventing the insulator from tipping out of line when the fitting is loose between the thread of the pin and that of the insulator. The shoulder suggested was criticised, the sharp corner of which introduces an element of weakness. Mr. Gerry suggested a shoulder which tapers at an angle of 60° and fits into a counter-bore in the top on the cross arm, thus giving a firm bearing which has the effect of steadying the pin and increasing the strength at that point. Instead of the form of thread proposed by Mr. Mershon, Mr. Gerry suggests a square top to the thread as wide as the groove; this form of thread may be easily and readily cut in either seasoned or unseasoned wood, and the depth not being so great, the pin is stronger at the bottom of the thread. Pins of the above construction have been used by the Missouri River Power Company with excellent results on a 50,000-volt line.

Mr. W. R. C. Corson gave the results of some tests in a Sellers machine to determine the fibre stress of pins in pounds per square inch. Six standard locust pins were tested supported in a 1½-in. hole in a hard wood block and the measured tension applied about 4½ in. from the block. The average value of the constant was 11,130 pounds per square inch, but the test showed that it is probably best to assume that for a maximum load this constant should not be greater than 9,000. In conclusion Mr. Corson said that the dimensions of the pin suggested by Mr. Mershon would prove to be of ample strength to withstand the side strains to which it may be subjected.

Prof. C. L. Corey also gave the results of some tests on pins, the purpose being to determine how near those in general use in California conform to the proposed standard pin suggested by Mr. Mershon. The California pins do not exactly conform in size and length of stem with any of the proposed standard pins, but in general the dimensions of the proposed and tested pins agree fairly well. It seemed evident, however, that one inch is not a sufficient diameter for the thread of a pin for all sizes, and the shank was shown to be the weakest part in the 6⅛ in. pins, while the stem, and particularly the upper portion of the stem at the thread, was the weakest part of the 10⅛ in. pins. Prof Corey stated that on the 33,000 volt, 83 mile, double circuit, 3 phase transmission line of the Edison Electric Company from its Santa Ana power house to Los Angeles, iron pins with porcelain sleeves are used.

He considered an iron pin in many respects better than one of wood and described a pin of this kind designed by Mr. Wynn Meredith for use on the extensive lines of the Vancouver Power Company. This consists of a 12-in. steel bolt; a cast-iron sleeve 4¼ in. long fitting closely to the cross arm, fills the space between the thread and corresponds to the stem of the ordinary wooden pin. A lead thread is cast on the end of the steel bolt, the bolt first being chopped or made ragged to enable the lead to hold.

Mr. D. L. Huntington, electrical engineer of the Washington Power Company, Spokane, Wash., described some experiments with iron pins. As the result of these experiments, a pin was adopted 18 in. long, made of 1⅛-in. round, mild steel bar having a shoulder and shank cast upon it.

Mr. W. N. Smith did not see how a single standard table of dimensions for an insulator pin could be laid down to cover all the conditions of various power transmission lines, which ranged in size from No. 4 wire up to a 300,000-cm cable, such as is used at Niagara. He thought it would be well to have a tabulation for sizes of conductor from No. 6 to No. 3, another from No. 3 to 0, another from No. 3 to No. 4-0, and another from No. 4-0 up. Mr. Smith agreed with Mr. Gerry that the top of the proposed pin is rather small for the very heavy insulators required for transmission above 30,000 volts. Mr. P. H. Thomas thought that a shoulder should be arranged so that a pin will not go to the top of the insulator, for when a pin comes to a bearing at the top on the inside of an insulator, the expansion of the pin may crack off the top of the latter. Mr. Mershon in replying to the criticism by Mr. Gerry said that the reason given for having the top of a pin larger does not hold. If an insulator is properly designed it will not tip and if it does it is the fault of the insulator and not of the dimensions of the pin. The thread proposed by Mr. Gerry would have no greater shearing strength than the thread of the suggested standard pin, and as to up strain, a line should be so designed as to make this so slight that it would not have any particular bearing on the shearing strength of the pin. Mr. Mershon considered that if a standard were adopted and though changed from year to year, we could not be any worse off than we are now without any standard. At present the only way to get a pin to fit an insulator is to send the insulator to the pin manufacturer, or vice versa.

A paper presented by Mr. F. O. Blackwell, entitled "The Testing of Insulators," after dealing with some general considerations, gives instructions for the testing of insulators. He stated that since reliable transformers not excessive in cost can be made for twice the voltage that any line yet constructed will stand, the length of transmission lines is to a great extent limited by the insulator. He pointed out that the shape of the potential wave has a pronounced effect in breaking down insulation, the maximum instantaneous potential being greater with a peaked than with a flat top wave for the same value of the effective pressure. In testing insulators, the conditions should be duplicated as nearly as possible with respect to the electric and mechanical strains set up in insulators under the most severe conditions that would ever be met with in the transmission line:

The alternators generally used for long-distance transmission plants give very nearly a sine wave and therefore the testing generator should be one which will give a sine wave under all conditions. It is not sufficient to do so at full potential and no load, as tests are made with all degrees of excitation and with both leading and lagging currents.

The armature reaction should be as small as possible, which means that the generator should be much larger than would ordinarily be thought necessary. It is also desirable to have a high reluctance in the magnetic circuit to secure stability when running with weak fields and permit of control with a reasonable amount of field resistance.

There should be but one transformer used to step up to the highest potential required and its reactance should be as low as possible. A number of transformers in series is particularly bad, as it gives poor regulation and leads to great uncertainty as to the actual potential to which an insulator is being subjected.

Testing sets with transformers in series and a generator of poor regulation have been known to vary widely in the relation of the generator volts and the length of the spark gap due to change of wave form with different magnetic saturations of the apparatus and different numbers of insulators and consequently various capacities on the testing circuit. The only certain way to determine the real potential is to have a step-down instrument transformer on the high-potential circuit.

Assuming that insulators are to be passed upon for a specific transmission plant, they should first be inspected to see that they are free from cracks, bubbles or pits that will impair their strength or in which moisture can lodge. If of porcelain, the glaze should cover all the outer surfaces. The glaze is of no insulating value in itself, but dirt sticks to unglazed surfaces. Experience has shown that porcelain insulators which are not absolutely non absorbent are worthless. The best porcelain shows a polished fracture like glass. If there is any doubt about the quality of the porcelain in this respect, it should be broken into small pieces, kept in a hot, dry place for some time, weighed and immersed in water for a day. When taken out of the water the weight should be the same as at first. A puncture test should be made by setting the insulator in a cup of salt water, filling the pin hole also with water and slowly increasing the potential between the top and bottom until the desired test potential is reached or the insulator either punctures or arcs over the surface.

If an insulator is built up of several parts, each part should be able to withstand a pressure greater than it will have to sustain when the complete insulator is tested. If it is to be tested for 100,000 volts and is made in two parts, each part might, for instance, be tested with 70,000 volts. The object of this is to have the weak parts rejected before they are assembled. A fair puncture test for an insulator is twice the potential for which it is to be employed, applied between the head and the interior for one minute. For example, the insulators for a 50,000-volt line should each stand 100,000 volts. As the potential from any wire to ground on a 5,000-volt, three-phase system would only be about 30,000 volts, a 100,000-volt test gives a factor of safety of nearly three and one-half to one. If one branch were grounded, as sometimes occurs in practice, the factor of safety would be but two to one. A one-minute test is not so severe as a continuous application of an equal potential, but insulators that have passed this test stand up well in service. New types of insulators should be mounted on iron pins and tested both wet and dry, to determine the potentials which will arc over them. The dry test is of little value, as the potential at which the arc jumps from the head to the pin can be pre-determined by measuring the shortest distance between them and referring to a curve of arcing distances in air. In a wet arcing test, a stream of water from a sprinkler nozzle under a pressure of at least 50 pounds to the inch should be played on the insulator at an angle of say 30° from the horizontal. This will be similar to the condition which exists in a rain and wind storm. The insulator should not arc over from the wire to the pin at less than the potential which will exist in service between any two conductors.

In no case should wooden pins be relied on for insulation, as their value is only temporary. All wooden pins in time become dirty and absorb moisture. Eventually they burn off unless the insulator is good enough to be used with an iron pin. If an insulator is going to fail, it is better to have it do so at the start and not interrupt the service by breaking down perhaps years afterwards.

In addition to the electrical tests, it is well (if the insulator is of a type that seems to require it), to try samples for mechanical strength. When mounted on pins the insulator should stand a side strain of at least ten times the pressure exerted by the air on the conductor with a wind velocity of say 100 miles an hour. It should also be able to slip the conductor through the tie wire should the former break.

The above tests are particularly desirable with built-up insulators in order to be certain that the parts will not separate. With such insulators, it would also be well to test them in tension along the axis of the pin. In transmission lines crossing depressions, such an upward pull is not infrequently exerted on the insulator.

A communication on Mr. Blackwell's paper from Mr. M. H. Gerry, Jr., said that several important matters in connection wtih the testing of high-voltage insulators were not touched upon. Insulators are tested for two purposes: First, to determine the design, shape, material and dimensions best suited for a given voltage and separate conditions; and second, as a matter of routine to determine if manufacturers have complied with specifications regarding material and workmanship. There can be no complete set of tests to cover the first purpose, as such tests are not only a matter of experiment, but also of skill and judgment in properly interpreting the results of the tests in relation to service conditions. The testing of insulators for the second purpose is comparatively simple. For glass insulators it is usually sufficient to inspect them for physical defects and incorrect dimensions and a certain percentage should also be tested for proper annealing and mechanical strength. A mechanical analysis of the glass of a few of the insulators is also desirable. Electrical tests of glass insulators are unnecessary as the physical inspection will reveal anything that should be found by an electrical test. Owing to many defects being covered by the glaze for very high voltages, porcelain insulators should be tested electrically and also carefully inspected during the process of manufacture before the glaze is applied. This is especially desirable for insulators built up of several parts and cemented together by glaze or other material, as defects in this type are difficult to detect even by electrical tests.

Referring to Mr. Blackwell's remark that the puncture test of insulators with twice the potential between wires is generally desirable where the insulators are to be exposed to severe lightning strains, Mr. Mershon said that he does not consider the latter an important point, since lightning will flash around but will not puncture an insulator. In tests of glass used in insulators he has never found that it differed in any way from ordinary glass. Mr. Lincoln took issue with the statement that glass insulators do not need testing beyond usual inspection. He cited an incident where insulators were inspected mechanically, but did not give a voltage test, where quite a number broke down in actual service, the defects of which would have been revealed by a voltage test. Mr. Lincoln agreed with Mr. Mershon that there is not much danger of insulators breaking down from lightning strains. In reply to an inquiry, Mr. Mershon said that between glass and porcelain, the only advantage the latter has over the former is that of mechanical strength, and sometimes it does not have even this advantage. However, in complex forms the porcelain insulator is cheaper than the glass one owing to the difficulties in constructing those of glass due to unequal cooling. As to the advantage claimed for porcelain over glass on account of less hygroscopic effect, he considered that in most power transmissions the leakage will dry up any moisture that should be deposited.

Mr. T. A. W. Shock agreed with Mr. Blackwell that in testing insulators the testing voltage should be at least three times that of the ordinary line voltage. Mr. Waterman criticized Mr. Blackwell's proposition to test separately the parts of the double insulator, as this would practically bar out this type. Moreover, in the baking or vitrifying of the two parts it is not desirable to take the entire shrinkage out on the first heat and consequently if the insulators are to be tested before being filled by glaze and vitrified, they are not tested at all in their final condition. Furthermore, there is more or less chance of getting sound porcelain in double insulators since the porcelain would be thinner. If the insulators stand up well under the mechanical test and show a glaze substantially free from large air spaces, they will usually stand up under the electrical test exceedingly well.

Mr. Thomas referred to the importance of annealing glass insulators and said that the breakage of such insulators during rain may more often be due to sun exposure on one side of a poorly annealed specimen than to electrical operation. He suggested that some tests should be gotten up to determine when glass is properly annealed. Mr. Chesney agreed with Mr. Thomas and referred to some experience in California in which very large insulators are used; after a very cool night they would drop off when the sun struck them on one side. Mr. Mershon said he did not entirely agree with Mr. Blackwell concerning the use of one transformer for testing purposes. A series of transformers need not affect bad regulation or seriously distort the wave form, and such a testing set has a very great advantage in that a transformer breakage is much less serious than in the case of the single testing transformer. He could not agree either that insulators should necessarily be tested on iron pins, since such a pin is likely to be the means of putting upon the insulators a mechanical strain out of all proportion to any which it will meet with in practice if installed upon a wooden pin. An insulator which will stand up well under a salt water test will often break down quickly when it is on a metal pin. Mr. Mershon considers that the wooden pin should not be condemned for any use where there is apt to be no trouble from burning; if the insulator is good enough to prevent burning, a wooden pin may be used unless there be some mechanical requirement which it cannot meet. He considered that any new type of insulator should be given a test while water is being sprayed thereon in imitation of rain. If a wooden pin is used in this test, it should be covered with tin foil from a point inside the body nearest the pin to a point two or three inches below, the voltage being applied between the foil and a wire around the neck of the insulator, representing the line wire. Mr. Mershon said that it had been his practice to adjust the spray for a precipitation of one inch in five minutes.

Mr. W. L. Waters, in a communication referred to the fact that the form of potential wave given by modern alternators differs very much from a sine wave, the worst case being that of the three-phase alternator having three slots per pole; in this case the wave form shows pronounced harmonics of five and seven times the fundamental frequency. However, few commercial machines having wave forms which would affect insulators are now seldom met with. An insulator will stand momentarily a voltage strain that if continued long enough will break it down, and this time effect is most marked in solid insulators, not applying to air. Porcelain insulators will stand a much higher potential if applied instantaneously than they will if applied continuously, and are practically unaffected by wave form.

The "Transposition and Relative Location of Power and Telephone Wires" was the title of a paper by Mr. Paul M. Lincoln. In opening the subject, to illustrate the extraordinary sensitiveness of the telephone receiver, Mr. Lincoln quoted an authority to the effect that the energy in a 16-cp incandescent lamp is sufficient to produce an audible sound in thirty billion receivers. Three ways in which telephone circuits may be disturbed by high-tension circuits are by electromagnetic induction, electrostatic induction and leakage. The electromagnetic effect may be entirely neutralized by transposing the telephone wires rgardless of whether the transmission wires are transposed or not, and a system of transposition which is designed to correct electromagnetic induction will also correct electrostatic induction.

Although a proper system of transposition will prevent the establishment of an induced e.m.f. between circuits, it does not necessarily prevent the telephone wires from assuming a potential which differs from that of the earth. A grounded power line may cause a potential between the telephone wires and ground which will reach well into thousands of volts, and even a bad power line insulator may cause an e.m.f. measured by hundreds of volts. This voltage strain comes not between the telephone wires, but between them and the ground. When it is realized that the potential between the telephone lines and ground may be as high as 30 per cent. of the potential between power wires, the importance of insulation will be appreciated. The insulation, however, should extend throughout the entire line, as there is little use in providing high insulation of poles and then inside buildings attach the telephone wires direct to woodwork which may be damp or to an instrument mounted on a damp wall, or include in the circuit a lightning arrester breaking down at 300 volts, as the standard telephone lightning arrester is expected to do.

So far as the telephone line is concerned, transposition of the power wires is not so important. An untransposed power line cannot induce either electrostatic or electromagnetic effects between two transposed telephone wires, but only between these two wires and ground. If the telephone line is insulated to meet the worst conditions, it will be ample to meet the normal conditions of an untransposed power line.

The series telephone is particularly objectionable for use on a circuit in which static induction takes place to any great extent, and bridge circuits only should be used where the lines are run in the vicinity of power lines. The capacity of telephone wires to earth should be made as great as possible and that of power wires to earth as small as possible. To decrease the possible potential of telephone wires to more than normal, one must either decrease the capacity of the power wire, telephone wire condenser or increase the capacity of the earth wire, earth condenser, or both. This may be accomplished by increasing the distance between power and telephone wires and decreasing the distance between telephone wires and earth. One or more ground wires may be run in close proximity to the telephone wires, thereby increasing the capacity of the telephone wire-earth condenser to almost any desired limit. By this means the possible potential between telephone wires and earth may be brought within limits where it may be taken care of with safety.

In the discussion of Mr. Lincoln's paper a communication was read by Mr. M. H. Gerry, Jr., who said that there is no especial difficulty in installing a telephone circuit which will give satisfactory service and reasonable safety on a pole line carrying from 50,000 to 60,000 volts. In addition to the requisites mentioned by Mr. Lincoln, there might be added the use of certain safety devices to reduce the danger in handling the telephones. Mr. Gerry considers, however, that in addition to transposing the telephone wires, it is desirable also to transpose the main power circuits in order to reduce to a minimum the voltage to ground on the telephone circuits; but a few transpositions of the power circuits are required and the service is materially improved thereby. Where there is considerable lightning, the telephone circuits should be protected by lightning arresters of a design similar to those used on lighting circuits. The Missouri River Power Company regularly maintains a very satisfactory telephone service on its 50,000-volt transmission lines over a distance of 64 miles. Mr. Lincoln said that a telephone line ought to be so installed that it will at all times operate even if one leg of the power line is dead grounded. If it will operate under these conditions, it will operate under the normal conditions of an untransposed power line, since the normal static potential induced in the telephone line by an untransposed power line is vastly less than that which will be induced by grounding the power line.

Mr. Mershon said that assuming the electromagnetic and electrostatic effects as of constant potential, telephones should be wound for as high a resistance as possible. He did not agree in the objection against the use of series telephones, for they will operate properly if connected at even transpositions, and shunt instruments should be connected in the same manner. Instead of running a grounded wire in proximity to telephone lines, auto-transformers may be connected across the telephone lines at a number of points, preferably at each of the telephone stations, each having its middle point connected to ground. Such a device would protect the users of telephones from disagreeable and dangerous shocks, whether due to crosses, leakage or electrostatic induction, and would also help to minimize disturbances due to ground.

Mr. P. H. Thomas considered that the trouble on telephone circuits is chiefly due to electrostatic induction; there will also be a momentary disturbance if there is a discharge from a lightning arrester or any static discharge in the neighborhood. He suggested that it is possible to insulate the telephone wires to 30,000 or 40,000 volts in an extreme case, and at the end of the line connect to the primary of a transformer, the telephone being on the secondary, a very high insulation between the primary and secondary being provided. The same result may be possibly be accomplished with condensers. Another suggestion was to use for each set of telephone wires a twisted pair, one wire of the pair for the telephone circuit and the other of the pair grounded; this method would make a large capacity between the telephone wire and ground, but would not actually ground the telephone wire itself. Mr. Thomas also suggested the use of transmission wires themselves for sending signals by connecting a high resistance between each wire and a common point, the latter being connected to ground and similarly at the other end; a high-frequency generator being placed between the ground and the common connection at one end of the line, and the same kind of receiving apparatus at the other. The high frequency would prevent the transformers from taking too much current. He said that at the plant of Mr. Gerry he saw sparks from ground to telephone line something like half an inch long, indicating perhaps 20,000 volts. He dwelt upon the importance of protecting the man using the telephones, and Mr. C. E. Skinner also emphasized this point. Proper arrangements should be made so that the man need not touch anything which would connect him with the ground.

Mr. C. O. Mailloux said that he had observed that a transmission line may become spontaneously discharged electrostatically without being connected to any operating machinery. He noticed this about a year ago in Arizona on a 25-mile line, repeatedly observing that the three wires would become charged to a considerable tension under various conditions, if discharged by making connection with earth, they would become charged again. On one occasion the potential was so high that sparks of half an inch length could be drawn, and in no case were there any indications of lightning or storm. Another phenomenon which he noticed also at Phoenix, Ariz., is that a lightning arrester located at each end of the line had generally a tendency to a frying discharge, which is more pronounced between the lightning arrester gap of one line than the other.

Mr. Lincoln reiterated that the series telephone does not give good satisfaction when the circuit is run in proximity to power lines, as he has learned by experience. An objection which he brought against the use of auto-transformers, regular transformers, condensers or possibly resistances employed to reduce the potential between telephone wires and ground is that it takes the charging current off at points, whereas the current induced in the telephone wires is distributed along the whole length; and if taken off at points there will be a flow of current which would probably cause a disturbance in the telephone. Mr. Mershon said concerning the use of condensers on telephone lines that it seems desirable to keep the capacity of the lines as low as possible to get good operation from the telephone. As to signalling with the power lines themselves, it would be better to signal to neutral ground and receive messages at corresponding places at the end of the line. He considered that the objection of Mr. Lincoln against the use of an auto-transformer for each telephone does not hold, as the current would flow in the same direction in both lines, and the e.m.f. induced in each of the telephone wires would neutralize the current as far as the telephone is concerned.

Mr. C. C. Chesney then presented a communication entitled, "Burning of Wood Pins on High-Tension Transmission Lines." He considered that the success secured in the operation of the great majority of transmission lines is due to the good insulation of the insulator, the insulation of the pin not entering; and that for 40,000 volts and higher, the insulators at present made do not have the same factor of safety as those for lower voltages offered by the same manufacturers. This difference is due more particularly to the general shape of the insulator and the dimensions of the insulating surfaces and petticoats. In localities subject to salt storms, heavy sea fogs, or where there are chemical factories, there has been more or less pin burning without regard to the type of .insulator used or to the potential of the system. In one case, owing to deposit on insulators from a neighboring chemical factory, trouble was experienced from the burning of pins at 440 volts, though 10,000-volt insulators were used. The paper includes engravings of insulators and pins to illustrate the discussion on the causes of the burning out of the latter. The conclusion of the paper is that the evidence presented, while not conclusive, points to the advisability of using iron pins with modern insulators properly chosen for the line potential.

In the discussion of Mr. Chesney's paper a communication was read from Mr. M. H. Gerry, Jr., who stated that in his experience, where burning of insulator pins has occurred it has been due to leakage of current from the surface of insulators coupled with resistance conditions in the pin such that sufficient heat is developed to char the wood. A thoroughly dry wooden pin 15 in. long will stand indefinitely 100,000 volts, while a green pin the same length will break down very quickly under 1,000 volts. Paraffining the pins on the outside or coating them with asphaltum paint or linseed oil is of no value. If the pins when thoroughly dry are dipped into an insulatig material, they may be given a high insulation. In order to prevent burning of pins, they should have either very high or very low resistances. Mr. Gerry said there is nothing especially mysterious in the burning of pins on high-tension lines, as it is merely a matter of total resistance to ground and the relative resistance of insulators, pins, cross arms and poles. Wherever burning occurs, it can be remedied by altering the design of the material or dimensions of the insulators and changing the quality of the pins.

Mr. H. W. Buck said he had found many pins on the Niagara transmission in which disintegration had occurred at the top of the pin; this would crumble into white powder which, when analyzed, was found to be a nitrate salt. This would appear to indicate that nitric acid was formed by the static discharge of the pin and had attacked the wood. He gave an account of an experimental 75,000-volt, single-phase line, the conductors of which were of iron tied with copper wires. At the end of five months the galvanized iron had turned black, although the iron guy wires remained in their original bright condition, thus indicating that the blacking was not due to atmospheric conditions. It was noted that the wire became discolored on the surface to the depth of several thousandths of an inch, and the copper tie wire was also attacked to a certain depth, but not as much as the iron; this would appear to indicate that a nitrogen compound formed in a thin layer around the conductor at high voltage, due to brush discharges, and uniting with moisture, attacked the metal.

Mr. Lincoln considered that pins should be treated with a view to preserving them and not making insulators of them. Mr. Mershon pointed out that when pins burn, the insulator, the lower part of the pin and the cross arm have their surface resistance lowered by moisture or otherwise; but the upper part of the pin, being protected by the insulator, does not have its surface resistance so much decreased, the consequence being the burning of the unprotected surface. In some cases the inner surface of the insulator next to the pin, and the pin itself, are so well protected by the insulator that the current instead of leaking over the surface of the insulator to the pin, jumps in a brush discharge from the edge of the petticoat to the lower part of the pin. Mr. Mershon mentioned three possible remedies for trouble due to charring pins, as follows: First, making the design and pins of the insulator such that for all conditions the surface resistance will be so high as to control the leakage and keep it below a point which cannot harm the pin. Second, make the pins fire-proof, but non-conducting. Third, make the pins conducting.

The latter remedy involves the use of iron pins. Mr. Mershon thinks, however, that there is a chance of trouble from the use of iron pins due to the unyielding character of both the iron and the porcelain or glass, and their widely different coefficients of expansion. The use of a wooden thread upon iron pins may still permit charring. If a wooden cross arm is used with an iron pin, the seat of the charring trouble may be transferred to the cross arm, unless the pins be connected by a conductor. It would seem better to make the design of the insulator such as to protect the pin.

Mr. De Muralt said that in Europe practically all high-potential installations use iron pins, and quite frequently the poles are constructed entirely of iron, the only insulation relied upon being that of the pole insulator. He does not think that much difficulty will be found from mechanical strains; and if there is, a way to avoid such strains is to fix the pin into the insulator by means of a cement that will take up such strains. In a great many installations with which he is familiar, such a cement is made of a mixture of litharge and glycerine. He considers that the best plan is to put the entire insulation into the insulator, and then let the rest of the pole take care of itself. He referred to two installations operating at 26,000 volts, which use American glass insulators on iron pins and iron poles; and another one of 25,000 volts using porcelain insulators. None of these installations has given any trouble whatever.

Mr. W. N. Smith said that the question of cost will usually govern. Iron poles, for example, in this country cost anywhere from $30 upward as against from $7 to $20 for wooden poles. The kind of pin also affects the cost of the cross arm, and where lumber is high an extra cost may run into a good many thousand dollars.

Mr. Chesney, referring to the remarks of Mr. Mershon in reference to the use of a wooden thread on an iron pin, said that in the particular case which he mentioned, the burning was not serious, simply consisting of a puncture in the thread at one point. He said that litharge and glycerine had been used to some extent for iron pins in this country, but lately Portland cement has been substituted. One of the largest new transmission lines now being erected in Mexico uses Portland cement and iron pins and instead of iron poles, iron towers will be used having a distance between the insulators of from 420 to 500 ft.

Prof. W. S. Franklin exhibited a model by means of which the distribution of e.m.f. or current along a single-phase, alternating-current transmission line can be illustrated. It rests upon the principle that a helical line drawn on a transparent cylinder rotating about its axis appears to an observer looking at it from one side as a wave line traveling along the axis. A rotating right-handed helix would represent the e.m.f. or current waves and a left-handed helix rotating in the same direction along the axis would represent the e.m.f. or current waves reflected back from the receiver, the condition applying to a line having neither resistance nor leakage. By choosing a helix-like line satisfying an equation given in the paper, the model may be made to illustrate a transmission line having inductance, capacity, resistance and leakage.

An Inventor, a Wheel and an Airship to Run to Mars.

By F. A. Shepard.

The writer is a poor inventor who has worked years on a wheel and only recent discoveries in the scientific inventions of to-day has enabled him to get power out of it to run a special kind of motor. It is no humbug, you can rest assured, but I cannot give away the secret of the detail parts without some other inventor gobbles it up and claims it with some little improvement as *his own idea.* It is a magnetic wheel that will run of itself and also by wind, at the same time. This wheel would run for years or until it clogged up with oil. It would have power enough to run two fan wheels to propell a 20-ft. airship at the rate of about 100 miles an hour, perhaps more, but not against the wind. The airship would be the shape of a sun fish almost and feather to the wind and point upward. It would be built in six sections of aluminum, glass and mica. The wheel has a hollow rim and spokes, has drop magnets inside, and a wrought-iron ball; also a small quantity of radium. The dropping and raising of the magnets cause the wheel to revolve (we do not propose to give the secret details). The spokes of the wheel are feathered with a wind fan that will cause the wheel to revolve also, but we do not depend on that, but on the magnets and the ball and the radium. Once set the wheel has got to revolve and in turn gives off electromagnetic power to two small motors that run the fan wheels.

This wheel was first invented in 1876, but had no power until two new inventions recently discovered came out. Now the power is at hand; radium is one that makes it work and keeps it working over and over again. Once on the move the wheel cannot stop of itself. This wheel would send a 20-ft. airship to another planet. It can be done now.

Iowa Telephone Association.

The seventh annual meeting of the Iowa Telephone Association was held in the Ordinary of the Savery House, Des Moines, March 10 and 11. The report of the committee on credentials showed that about seventy companies had paid dues and were entitled to vote. The Treasurer's report showed a comfortable balance in the bank. The annual address of President U. S. Alderman called attention to the Association's work in the past and in a measure outlined its future course and the need of co-operation among the independent telephone men of the state.

The programme executed and list of papers follows: "Cedar Poles," B. J. Carney, Grinnell; "A New Set of Arbitration Rules," U. S. Alderman, Nevada; "The Recent Supreme Court Decision," J. C. Hume, Des Moines; "A Uniform System of Toll Accounts," Miss Flora B. Herr, Ottumwa. "The Rules for Arbitration" were referred to a committee and were reported back and adopted by the association without change. They are very complete and will doubtless aid in settling many controversies.

Mr. Hume's address was of special interest as many companies are affected by the decision of the Supreme Court, which is that companies doing business prior to October, 1897, have the right to occupy the streets and alleys of incorporated towns without franchise from the municipality. Mr. Hume represented the apellee in the case and was therefore thoroughly qualified to handle the subject.

Following Miss Herr's paper the Association decided to attempt to unify the toll account system by bringing together toll operators from various exchanges and giving them uniform instructions.

The following officers were elected: President, H. S. Herr, Ottumwa; vice-president, J. C. Sullivan, Creston; secretary-treasurer, Charles C. Deering, Des Moines. Executive Committee—H. S. Herr, Ottumwa, H. C. Raney, Fairfield, Geo. N. Bandy, Des Moines, U. S. Alderman, Nevada J. S. Bellamy, Knoxville. The following arbitration committee was appointed: J. S. Bellamy, Knoxville, A. T. Presson, Iowa City, U. S. Alderman, Nevada. The meetings were well attended; the manufacturers and supply men made good exhibits and the convention was a success.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

ELECTRIC FURNACE

Mr Charles S Bradley, of New York, patents a modified form of the rotary type of continuous electric furnace, the improvement consisting in providing the several sections which constitute the rotating drum or annulus with lining plates of carbon or graphite, the idea being that these refractory faces will permit the fusing operation to be extended throughout the entire body of the charge without injury to the furnace structure, instead of being confined to the central portion as heretofore. It has been customary to leave portions of the charge adjacent to the walls as a protection against the intense heat of the converted mass, and it is argued that this involves waste not only of the raw material, but, through the necessity for freeing the product from the unconverted or partially converted charge of the finished product. However, a carbon or graphite lined furnace is not new in the art. The present construction is presumably intended for the manufacture of calcium carbide.

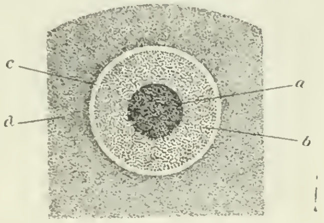
PRODUCTION OF ELECTROLYTIC CAUSTIC.

Mr. Ernest A. Le Sueur, of Sault Ste. Marie, Canada, patents an electrolytic method involving the use of a caustic cell comprising anode and cathode compartments separated by a diaphragm of asbestos. The diaphragm is vertical and the cathode of wire net is in contact with it and supported by a frame of slate. The anode compartment is filled with the solution—brine—to be decomposed and the cathode compartment with water in which the caustic dissolves as formed, the level of the liquid being maintained somewhat higher in the anode compartment in order to secure a regulated flow through the diaphragm and cathode.

The invention is directed to the reduction of diffusion from the cathode to the anode side through the diaphragm, and consists in adding continuously to the liquid in the cathode compartment cold water, thereby displacing an equal volume of the alkaline solution. The effect is two-fold, first a dilution of the alkali in the negative compartment, whereby an equal volume diffused through the diaphragm carries less caustic, and second a reduction of the temperature whereby the diffusion itself becomes less rapid. It follows, of course, from the first effect that the caustic lye obtained as the product of the cell is less concentrated than would otherwise be the case.

METHOD OF HEATING MATERIAL.

Mr. Acheson patents a method, the purpose and effect of which is expressed as follows in one of the claims: "The method of conducting reactions which proceed under definite temperature conditions, which consists in maintaining within a mass of material regions of definite maximum and of minimum temperature, both of which are comprised within the temperature limits of the reacton, whereby the operation is conducted throughout the entire mass of the material under treatment." The specific example given is an interesting one, being the production of the amorphous compound technically known as "white-stuff"—a body consisting largely of silicon and carbon, and formed incidentally and in relatively small quantity in the carborundum furnaces.



METHOD OF HEATING MATERIAL.

As shown in the accompanying drawing indicating the relation of the several materials remaining in the furnace at the close of the ordinary carborundum operation, *a* is the carbon core, *b* the surrounding mass of carborundum and *d* the unconverted charge. The narrow strip indicated by *c* is the "white-stuff," and the fact that the region in which it is found is so limited indicates that the difference between the temperature at which it forms and that at which it decomposes is, relatively speaking, but slight. Mr. Acheson's immediate problem was to construct a furnace in such manner that these upper and lower temperature limits should not be transgressed, so that the entire body of the charge might be converted into "white-stuff."

The furnace now described by Mr. Acheson utilizes a series of equally spaced carbon cores distributed throughout the body of the charge, the distances between the cores being so related to the heat developed within them and to the heat conductivity of the charge, that while the regions of maximum temperature around the cores do not exceed the upper limit of the reaction, the intermediate minima do not fall below the degree of temperature requisite for the production of the compound. By this arrangement, as will readily be understood, the formation of the compound occurs throughout the body of the charge.

Electric furnaces have, of course, hitherto been constructed with a plurality of resistance rods, but this is quite distinct from the present invention. The conception of a relation such as is now disclosed is a novel one.

New Telephone Patents.

The majority of the patents bearing the date of March 24 relate to receiver holders. No less than four of these appear, ranging from the simplest semi-flexible support to fairly complicated affairs having automatic switching and other functions to perform. Some time since comment was made upon the relatively great number of patents which are appearing covering these devices for relieving one of the labor of holding the receiver during conversation. At that time the encouragement to leave the receiver "off the hook," which such devices give to the subscriber, was noted. In no less than three of the present devices this defect is largely overcome.

Two of the new receiver holders invented respectively by F. J. Becker and D. W. Shiek are based upon the same principles, differing only in the manner in which the apparatus is constructed. Both use a base adapted to be secured to the wall near a telephone wall set, which base carries a receiver-supporting arm, extending in a substantially horizontal direction and pivoted about a vertical axis. A spiral spring surrounding the pintle of the hinge normally maintains the mouth of the receiver nearer the center line of the transmitter than convenient for use. Thus, when one places his mouth in position before the transmitter for speaking, his ear will engage the receiver and force it away from the normal position against the spring. This action serves, by means of linkages, to operate the telephone switch-hook just as though the receiver had been removed from it at that instant. Again, just as soon as the pressure upon the receiver is removed the supporting arm returns and depresses the hook. For the purpose of enabling one to hold the line, both inventors provide gravity locks, which, when set by hand, will retain the receiver arm in an intermediate operative position. When, however, the pressure is again applied to the receiver, the lock automatically releases.

J. P. Riedinger is the inventor of a third of the new holding arms. This is only applicable to magneto instruments wherein it is necessary to call and clear out by magneto generator. Mr. Riedinger dispenses with the usual magneto crank, arranging his receiver-supporting arm so that it will operate the magneto when being moved either to or from the listening position. The pivoted receiver arm swings in a vertical plane, carrying with it a sector gear. Engaging with this gear are two trains, one direct and one reverse, connected to the magneto shaft by right and left-hand ratchets respectively. The receiver arm also carries the contact springs which control the talking circuits. The device is unnecessarily complicated by the supposition that a magneto must be operated solely in one direction. There seems to be no necessity of imposing such a condition, especially when attended by considerable expense.

The fourth receiver-holding arm is of the simplest sort, comprising a base and two adjustable arms. The main arm moves about an axis substantially parallel to that of the transmitter arm hinge, while the second arm moves in a plane parallel to the wall. The patent for this arm is granted to Sigmund Konigstein, of San Francisco.

A reissued patent covering the special receiver circuits devised by Charles G. Burke, of Brooklyn, is also included in the patent issue of March 24. These circuits were noted at some length in these columns a few weeks ago.

The Construction of Aerial Telephone Lines—VIII.

By Arthur V. Abbott, C. E.

DISTRIBUTION.

THE pole line has always been a favorite with the telephonist from the ease with which it enabled him to reach sub-stations. The customary method of distribution has been to drop off a pair of wires at each station. This has been usually accomplished by dead-ending the pair and attaching each side of the drop wire to a corresponding side of the line by a McIntire joint at the insulator, or by clamping the drop wire to the line wire by means of a brass or copper clamp, such as is shown in Fig. 14. Neither of these methods has proved satisfactory, although both are still commonly applied. The drop wires are usually more loosely strung than the line wires, and are, consequently, greatly affected by the wind and are constantly swaying. This tends to twist off the McIntire, or else to turn the clamp upon the line wire. Both of these actions operate to rupture either the line wire or the joint between the line and the drop; consequently, broken house connections are a constant "bug-bear" to the wire chief.

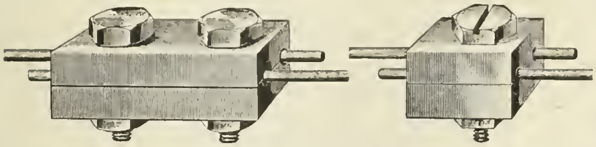
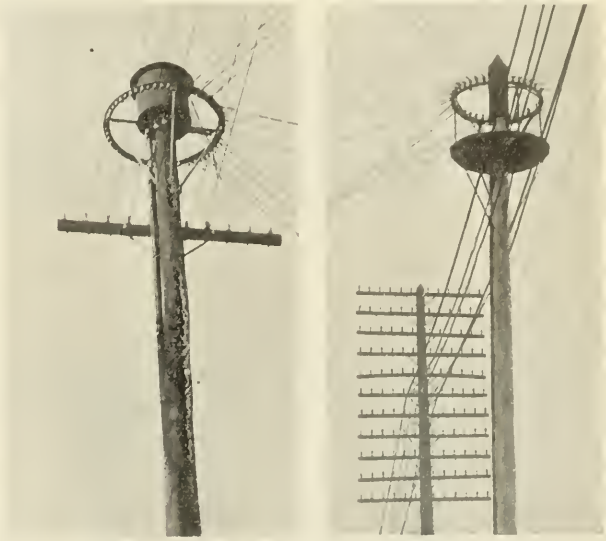


FIG. 14.—CLAMPS.

The increasing employment of aerial cable upon pole lines is rapidly multiplying the distributing pole, and there seems to be no reason why the distributing pole should not be used as a method of distributing open wire as well as aerial cable. As its name indicates, the line wires converge to the distributing pole, and from it the drop wires run to the subscribers. Present practice tends to a distributing pole, provided with a circular ring, some five or six feet in diameter, that is placed upon the top of the pole. This ring is supplied with a number of insulators, to which the line wires run and are there dead-ended. Drop wires are made usually of a twisted pair of double-braided okonite or similar material. Each drop is attached to its pair of insulators and then swung in a single span to the premises of the subscribers which it is intended to serve. Samples of the tops of distributing poles are shown in Figs. 15, 16, 17, 18 and 19, while Fig. 20 shows the pole in process of construction; that is to say, the pole is erected, the ring in place, and the linemen are engaged in attaching the line and drop wires. Figs. 16, 17, 18 and 19 are examples of good construction—15, 17, 18 and 19 being particularly commendable, while Fig. 21 is an illustration of what not to do. The pole, as will be seen, is top-heavy, and badly proportioned, having a top of greater diameter than that of the pole some feet beneath it, and, in general, is in an exceedingly disorderly and untidy condition. Formerly it was customary to construct the pole ring, carrying the insulators, of seasoned hard wood, supported upon iron braces, but recently designs, which are much more mechanical and substantial, have appeared. Thus Fig. 22 shows a pole top which is constructed by bending a light channel into a ring, to



FIGS. 16 AND 17.—DISTRIBUTING POLE TOPS.

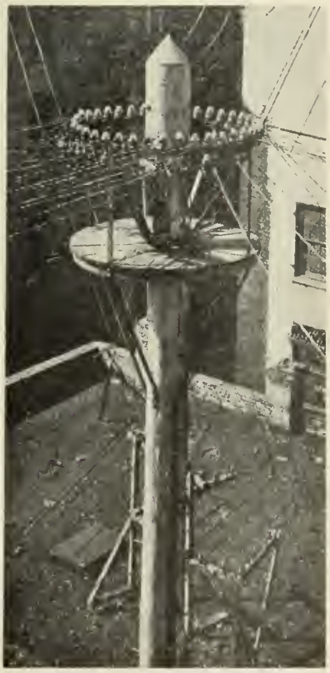


FIG. 15.—DISTRIBUTING POLE TOP.

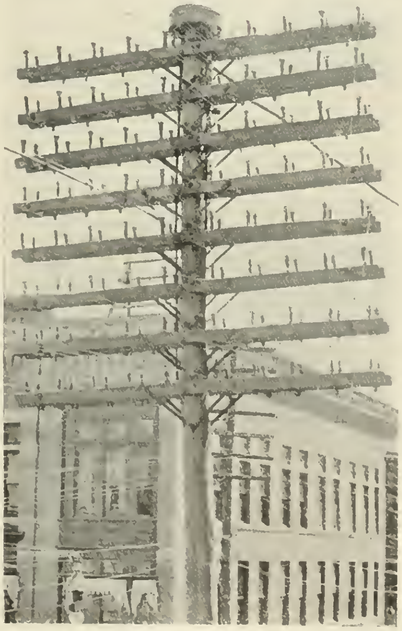


FIG. 19.—DISTRIBUTING POLE TOP.

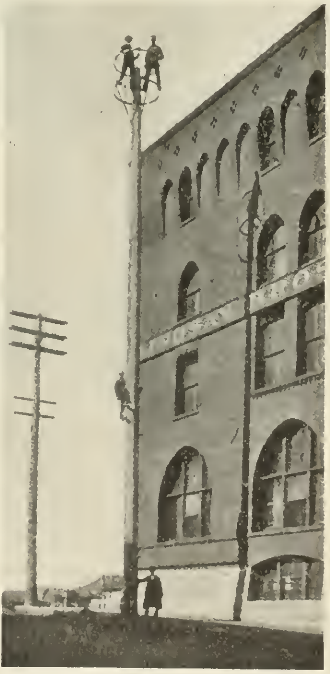


FIG. 20.—CONSTRUCTING A POLE TOP.

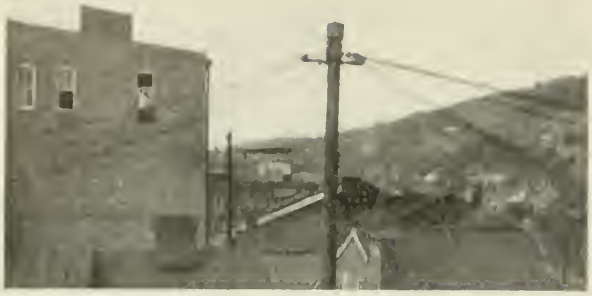


FIG. 18 —DISTRIBUTING POLE TOP.

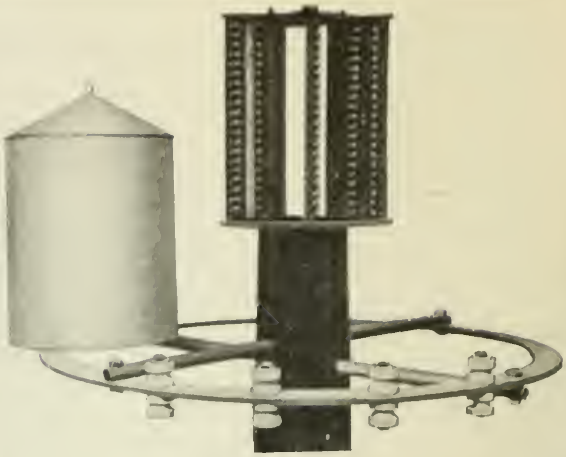


FIG. 23.—POLE TOP.

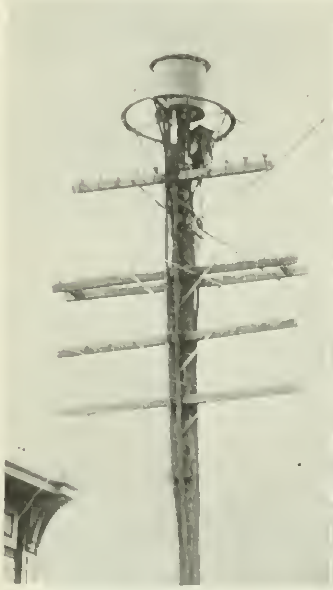


FIG. 21.—POLE TOP OF BAD DESIGN.

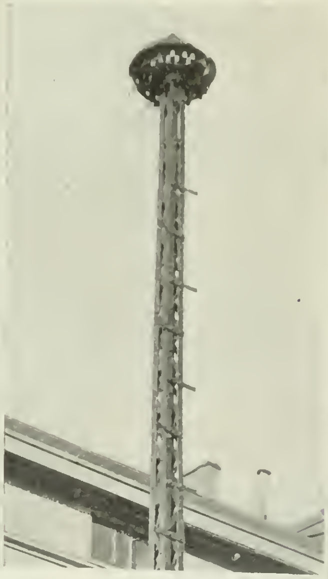


FIG. 25.—LATTICED DISTRIBUTING POLE.

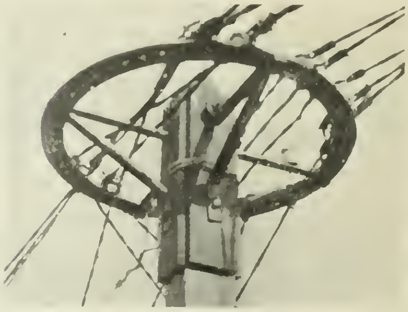


FIG. 25.—POLE TOP.

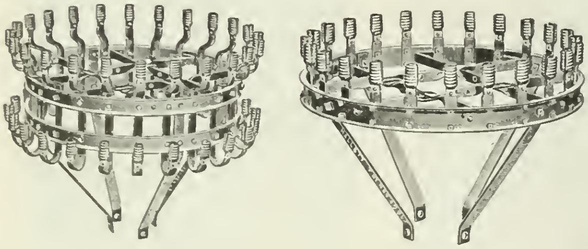


FIG. 22.—DETAILS OF POLE TOP.

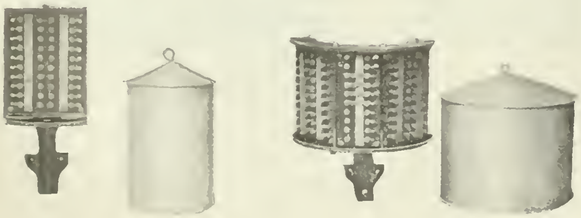


FIG. 23A.—DETAILS OF POLE TOP.

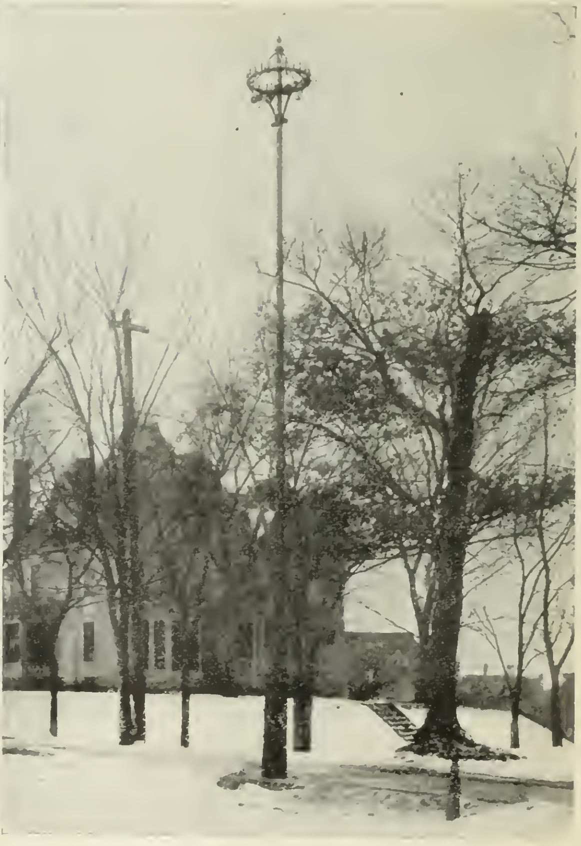


FIG. 26.—ORNAMENTAL DISTRIBUTING POLE.

VARIOUS DESIGNS OF TELEPHONE DISTRIBUTING POLES.

which the insulators are attached by bolting to the ring a bracket pin, upon which the insulator is placed. The whole top is then secured to the pole by bolting both by diametrical braces in the inside of the ring, and by the vertical braces extending from the circumference to the pole. A still more elaborate design is shown in Figs. 23 and 24. The pole is provided with a kind of cable terminal, the ten and twenty-five-pair size being shown in Fig. 24, and fifty-pair size complete erected upon the pole, in Fig. 23. The ring is composed of a circular flat iron secured to the pole by two transverse pipe braces. Upon the circumference of the ring insulators are bolted, one of each pair being respectively on the top and the bottom of the ring. Upon the top of the pole the cable box is placed which consists of vertical strips, as shown in the illustrations, which are mounted between two parallel rings. The strips are made of hard rubber, and carry cable terminals to which the protecting fuses are attached, and from which the bridle wires run downwards to the distributing ring. A metal cover surmounts the whole of the terminal, and protects it from the weather. A near view of the top of a distributing pole of this kind is shown in Fig. 15, while Fig. 24 shows the top of a ring-distributing pole, carrying wires from an open wire line. Owing to their importance, it is necessary to be more careful in the construction of distributing poles than those in the ordinary line, and the writer is glad to note that the use of iron poles is beginning to make some headway. Figs. 25 and 26 show two poles of this nature. Fig. 25 is a light distributing pole of four angles, latticed together and used by the New York and New Jersey Telephone Company in Brooklyn. Fig. 26 is a much more pretentious, elaborate and handsome pole, and is erected by the Twin City Telephone Company in Minneapolis. To a structure of this description no exception can be taken, and the Twin City Company is certainly a pioneer in the excellent character of the pole line work which it is doing.

A. I. E. E. Boston Branch.

At a meeting of the Boston branch of the American Institute of Electrical Engineers March 26, the organization of the branch was completed by the election of officers, as follows: Chairman, C. L. Edgar; secretary, Ralph W. Eaton. Executive Committee—C. L. Edgar, R. W. Eaton, Dr. Louis Duncan, Dr. A. E. Kennelly and C. B. Burleigh. At the meeting a paper was presented by Mr. James F. McElroy on a new system of train lighting. The papers of Messrs. Bliss and Farnsworth presented at the February meeting of the Institute were read in abstract by Messrs. Welsh and Porter, of the M. T. I. Electrical Engineering Society, and discussed by Messrs. Duncan, Lee, Fleming and McElroy. Refreshments were served after adjournment.

Electrical Instruction for Officers at Sandy Hook.

As an aid in the instruction of officers of the army in electricity and electrical apparatus, the government has recently ordered from the Westinghouse Electric & Manufacturing Company a 30-kw, alternating-current, composite-wound, belt-driven generator, delivering two-phase current at 220 volts, and 7,200 alternations, running at 1,200 r.p.m.; one 1½-kw, direct-current, direct-connected, compound-wound, multipolar exciter of 125 volts and 1,300 r.p.m., and a 1-hp, single-phase, alternating-current motor of 200 volts, 7,200 alternations and running at 1,600 r.p.m., together with starting rheostat and other auxiliary apparatus. There is also being supplied a 10-kw rotary converter, two and three-phase, 220 volts, alternating-current, 7,200 alternations and 1,800 r.p.m. This rotary converter is provided with an extended shaft for operation as an alternating-current and as a direct-current generator, together with two autotransformers, which provide for the raising of the alternating-current voltage from 175 to 220 volts when the rotary converter is operated from the direct-current side; and a direct-current, 125-volt, compound-wound multipolar exciter of ¾-kw capacity. Added to the above are four 7½-kw transformers, 2,200 volts primary and 220 volts secondary, arranged to operate on two-phase or three-phase. These are to be installed at the Sandy Hook Proving Ground, with complete switchboard and detail parts, having recently been accepted by Captain Dunn, U. S. A.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN CHICAGO.—Experiments are being made with the use of the wireless telegraph between the downtown offices of the Armour Company, of Chicago, and their offices at the Union Stock Yards, about four miles distant.

GERMAN WIRELESS TELEGRAPHY.—A cable dispatch from Berlin of March 31 says: While Emperor William was riding through Under den Linden two or three days ago, says a weekly paper, he noticed Director Rathenau, of the Allgemeine Elektricitäts Gesellschaft, and, beckoning him to his side, the Emperor said it pleased him to see his company had obtained from the United States Government a contract to erect wireless telegraph stations in Alaska.

LITERATURE FOR RIVER PLATE.—The secretary of the Institution of Engineers of the River Plate, Buenos Ayres, Argentine Republic, writes us as follows: "The council would esteem it a favor if you would kindly publish a notice in your paper to the effect that we shall be pleased to receive catalogues for placing in our library from manufacturers, etc. These will all be properly classified and the result is certain to be beneficial to those who favor us with their catalogues. Thanking you in advance. The address is Calle 475, B. Mitre, Buenos Ayres.

MARCONI IN ENGLAND.—In London, on March 31, at the annual meeting of the Marconi Company, Mr. Marconi said he attributed the criticism of his system chiefly to the "cable companies and the sections of the English technical press controlled by the cable companies." He announced that Lord Kelvin, Lord Rayleigh and Prof. J. A. Fleming, professor of engineering, University College, London, were soon going to Poldhu, Cornwall, at his invitation to examine thoroughly his transatlantic wireless system of telegraphy. An extension of the plant, he added, was necessary before the company entered into commercial business of large scope. The capital of the company was then increased from $1,000,000 to $1,500,000.

DRESDEN EXPOSITION OF MUNICIPAL GOVERNMENT.—Consul-General Charles L. Cole writes from Dresden, February 13, 1903, that an exhibition will be held in that city from May 20 to September 30, 1903, which has for its object the study of improvements in municipal government and welfare. This will include street railways, street paving and cleaning, gas and electric lighting, cabs, automobiles and kindred subjects. Invitations are sent to the prominent cities in the United States of America to appoint delegates to this exposition. Further information may be obtained by interested parties by addressing Oberbürgermeister, Geh. Finanzrath a. D. D. Beutler, Dresden, Saxony. Circulars (in German) setting forth the scope of the exhibition are filed for reference in the Bureau of Foreign Commerce, Washington.

N. E. L. A.—Mr. Henry L. Doherty, chairman of the Committee on the Analysis of Flue Gases, will make a very complete report at the twenty-sixth convention of the National Electric Light Association, to be held at Chicago May 26, 27, 28, and will give practical demonstrations of a simple method of detecting and preventing the loss of a great deal of power that is often allowed to go to waste. This report will undoubtedly be of great interest to central station managers who are not satisfied with the results they are obtaining from fuel consumed. Among the new members recently added to the membership list are the following: Union Electric Company, Dubuque, Iowa; Mountain Electric Company, Denver, Colo.; De Kalb-Sycamore Electric Company, De Kalb, Ill., and New York & Queens Electric Light & Power Company, Long Island City, N. Y. The manufacturing and supply companies are also showing that they appreciate the usefulness of the association, and there are a number of new associate members, among them being the Crocker-Wheeler Company, Ampere, N. J.; Chase-Shawmut Company, Boston; Chas. F. Johnson, Buffalo, N. Y.; Gregory Electric Company, Chicago, Ill.; the Buckeye Electric Company, Cleveland, Ohio; Adams-Bagnall Company, Cleveland; Hemingray Glass Company, Covington, Ky.; Stanley Instrument Company, Great Barrington, Mass.; the Green Fuel Economizer Company, Marreawan, N. Y.; Alberger Condenser Company, New York City; Standard Vitrified Conduit Company, New York; Doubleday-Hill Electric Company. Several others have signified their intention of taking membership.

N. A. M.—The annual convention of the National Association of Manufacturers will be held at New Orleans on April 14, 15 and 16, when a number of interesting and important subjects will be up for discussion. Mr. Marshall Cushing, 170 Broadway, is secretary. Hotel reservations can be had from Mr. Edward Davis, St. Charles Hotel, New Orleans. A large attendance from the North and West is expected.

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.—Italian newspapers of recent date announce an invention by Signor Turchi, an engineer, and Prof. Brune, by which telegraphic and telephonic messages can be transmitted simultaneously over the same line. It is further stated that Signor Galimberti, Italian Minister of Posts and Telegraphs, is about to test the invention on the government lines, and that if its operation is satisfactory it will be adopted by the government.

ROLLER TROLLEY.—A patent granted March 17 to Charles A. Terry describes a trolley consisting of three contact rollers so supported that at least two of the rollers will always be in contact with the trolley wire when the device is in use. The three rollers are mounted on a triangular frame pivoted at its center of gravity to the trolley fork. There will thus always be two of the rollers in contact with the trolley wire, and as the roller frame is revolvable in the trolley fork, the bearing at different times will naturally be on different pairs of rollers.

THE MARCONI SYSTEM IN NAVIES.—Under a tentative engagement 32 British warships have, according to a recent despatch from London, been equipped with the Marconi system of wireless telegraphy. It is stated that the Admiralty has agreed to pay the Marconi Company a substantial sum of money which will entitle it to equip the entire navy. It is stated that the U. S. Cruiser "Topeka" is being fitted up with the Marconi system. This ship is said to be the first one of the U. S. Navy to be equipped with wireless telegraph apparatus.

SIGNAL CORPS AND GOLD.—A special dispatch from Washington, D. C., says: General Greely, chief signal officer, has found himself much embarrassed in the construction of telegraph lines in Alaska by the reported recent discoveries of gold deposits in the Tananah section of the country. Almost to a man the civilian employees of the Signal Corps have deserted their work and started for the new diggings. The gold fever also infected the enlisted men of the corps, and undoubtedly there would have been many desertions could the men have made sure of getting out of the country without being arrested. As it is, applications for discharge are coming in from them in regular form, but not many of them can now be granted.

ELECTRICITY FOR SWEDISH ROADS.—Mr. Arvid Westerberg, who furnished a very interesting article to our issue of March 21 on the proposed adoption of electricity for railways in Sweden, writes us pointing out that the plan is intended not for all the railways of the country, but specifically for the government network. He adds: "The map used, in this connection and with its present title, gives the impression that the railroad system of Sweden is rather insignificant, while in fact the mileage per inhabitant in Sweden is higher than in any other European country. On the other hand, there is no doubt that the private railroads will follow the example given by the government roads, which of course will improve considerably the economy of the whole system."

LOCATING METALS.—A cable dispatch from London of March 27 says: "The *Times* publishes an account of a demonstration of the Daft and Williams system of locating mineral ore which was given at the Telacre lead mine in North Wales. An alternating current of high potential is used to energive the ground thought to contain mineral deposits. The current is taken from terminals to two metal rods pushed an inch or two into the earth. These act as distributors of the electric force, which is detected by means of a delicate telephonic receiver attached to another pair of rods stuck in the earth in any required position. The presence of ore is indicated by the greater or less intensity of the sound produced in the telephone." The Daft referred to is Mr. Leo Daft, so well known in this country on account of his pioneer work on electric motors and electric railways 20 years ago.

SELECTIVE WIRELESS TELEGRAPHY IN GERMANY.—A cable dispatch from Berlin of March 21 says: "Experiments have been made before representatives of the Admiralty Secretary and the commander of the torpedo division with a new system of wireless telegraphy, which directs electric waves exclusively to one point, obviating the danger of outsiders catching messages. The result is obtained through a series of parabolic mirrors, which give all the electric waves a parallel course. The system is available for distances of twelve to fifteen miles and is intended principally for communication between vessels in harbor or along the coasts. The transmitting velocity is twenty five words per minute and the inventor is Ernst Ruhmer, a report of whose experiments with a wireless telephone system was cabled to America last fall." Mr. Ruhmer's work has already been noted in these pages last December.

MARCONI SERVICE IN ENGLAND.—With regard to the handling of Marconi messages by the British Postal Telegraph system, the *London Daily News* says: "The government consents to the two systems being linked, but it does not consent to messages being exchanged. So far as immediate advantage is concerned, therefore, neither the Marconi Company nor the public has cause for exuberant rejoicings. True, the concession involves one immediate boon, which, though of modest dimensions, is not to be disregarded. It will be possible for the public to visit the London office of the Marconi Company, and there hand in messages intended for ships at sea or for Canada. For, as the reader will scarcely need to be told, the decision of the Post Office not to consent at present to intercommunication between the system of visible wires and the system of invisible waves reposes on a purely negative basis. No prohibition will be necessary. Nay, there will be nothing to prevent the public sending to Poldhu from any part of the country messages intended for Hertzian transmission from Cornwall. All that will happen is that the clerk in the telegraph office will decline to accept payment for wireless transatlantic transmission."

A CONEY ISLAND THRILLER.—The "circle swing" is a new "fool-killer" and thriller at Coney Island this year. There is a central tower 100 ft. high, from the top of which radiate six arms, the distance apart being 48 ft. at the outer ends. To the ends of these arms are attached wire cables, and to these in turn are attached the cars, each car being constructed to seat six persons. The arms are revolved by electricity, and the power is increased with each revolution. It is estimated that five and a half revolutions will swing the cables, with cars attached, out to such a distance that the space between the cars instead of being 48 ft. will be 200 ft. When the cars are swinging around the tower at the extreme distance they will be traveling 700 ft. each time they revolve and at the rate of 22 miles an hour. It is calculated to give the passengers about twelve turns, which will occupy about three minutes, and to charge them ten cents a ride. It is asserted that there is no danger in this two-mile ride through the air, a gradual reduction of speed allowing the cables to narrow their circles until they assume their original vertical position. If there be not sufficient passengers to properly balance the cars weights will be used. This ought to draw the crowd.

CABLE CODES are said to be occupying the attention of exporters and others. A new official "vocabulary" has been prepared by the Bureau of International Telegraphs at Berne, Switzerland, to which the International Telegraph Convention, at the coming conference in London next May will give consideration, with a view to adopting it permanently. Some opposition to the new vocabulary has developed, principally on the ground that it may not contain many of the words in the several cable codes now used, and that, owing to the growing complexity of modern business methods, a compulsory adoption of an official vocabulary of code words would tend to restrict the use of the cable as an instrument of trade. Moreover, exporters say, a new vocabulary will do away with numberless private codes consisting of "made-up," or spurious words, in that they are not to be found in dictionaries of any language. The Bureau of International Telegraphs at Berne adopted the "vocabulary" accepted by the convention in 1896 and which contained 250,000 words. The "vocabulary" now in use has as many as 1,250,000 words. The larger "vocabulary" has come into vogue because of efforts at condensation. The telegraph conference which meets this year in London is long overdue.

THE SOUTHERN CALIFORNIA ELECTRO-MEDICAL SOCIETY has been organized in Los Angeles, Cal., with a large membership of physicians, who have made a special study of electrical science as applied to the practice of medicine and surgery. Dr. O. Shepard Barnum is president and Dr. A. O. Conrad is secretary. The society will meet on the first Tuesday evening of each quarter, when exhibitions and demonstrations of new instruments will be made, to keep members up-to-date in the use of electrical appliances.

LIGHTING BIG BEN.—This celebrated big London clock is having the dials on each of its four sides illuminated with 60-cp Nernst lamps. The clock was formerly lighted by gas jets, twenty-four being used to each dial, and on each 365 nights of the year a man had to climb up and light each of these 96 jets. Two men are still required to wind the clock, spending three afternoons of each week for the purpose. A motor might help. Big Ben is considered reliability itself, and the average Londoner would as soon think of the world ceasing to revolve on its axis as to imagine the hands of this clock failing to move around its dials unceasingly night and day. Except for a short time once in fifteen years, when the clock has a short rest in order that it may receive a thorough cleaning, it has "marked time" for the Empire and the British Parliament

BROOKLYN RAPID TRANSIT.—Mr. W. B. Parsons, chief engineer of the Rapid Transit Commission of Greater New York, has presented a plan to improve Brooklyn conditions, which may be summarized as follows: A second tunnel from Maiden Lane, New York City, to Nassau and Orange Streets, Brooklyn, to handle the elevated railway traffic, by means of connections with the Manhattan and Williamsburg Bridges. The removal of all elevated trains from the present bridge, trolleys to be operated on the elevated tracks, and the roadways used for vehicle traffic. A four-track subway from Flatbush and Atlantic Avenues to Prospect Park, a three-track subway under Eastern Parkway to East New York Avenue, and a two-track route in Flatbush Avenue to East Broadway. A combination subway and elevated route from Flatbush and Atlantic Avenues to Fort Hamilton, with a third tunnel under the East River, from Atlantic Avenue to Whitehall Street, New York City. Extensions and improvements in the elevated system of the Brooklyn Rapid Transit. Total number of miles of new road proposed by new plan, 37; total trackage, including new routes and extensions, 120. Estimated cost, $52,000,000.

LETTERS TO THE EDITORS.

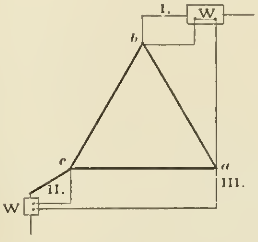
Three-Phase Measurements.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of March 14 I have seen that the question on the "Three-Phase Measurements" has been revived, and have read with great interest the preceding articles by Mr. A. S. McAllister and L. L. Perry. The subject is a very important one and Mr. McAllister has done well in bringing it forward; however, permit me to observe that the discrepancies and the uncertainties to which he alludes in no way exist.

In the first place, the "power factor" must be distinguished from the "angle of lag" (leaving aside the case of a leading current). Frequently the cosine of the latter has the same value as the "power factor" and is a most convenient representative of it; but, generally speaking, they are not one and the same thing. As it is universally known, the angle of lag is the angle formed by the two vectors representing in magnitude and phase a current and an e.m.f., while the power factor of a circuit is the ratio between the true watts and the apparent watts of the same circuit. Consequently, the power factor has always, in every circuit, a single and determined value, since the true or apparent watts have always, in every circuit, a single and determined value. In fact, by "apparent watts" of a circuit (this denomination, "apparent watts," is obviously a reference to the direct-current phenomenon) we understand the sum of the products of the e.m.fs concatenated with the circuit, times the currents by them generated upon the reactances to which they are applied (referring to effective values of the sinusoidal quantities). As to the true watts, they can be measured—taking the original case of a three-phase system—with three or two wattmeters. That two wattmeters are sufficient we can, leaving aside the well known mathematical demonstrations, readily conceive by the following:

The wattmeter, *I*, reads the current, *I*, and pressure, *a b*; but the current, *I*, is the resultant of the currents of the legs, *a b* and *b c*; therefore, the wattmeter, *I*, reads the power of the leg, *a b*, plus the fictitious power of the current of *b c* and pressure, *a b*. Analogously, we see that the wattmeter, *II*, reads the power of the leg, *a c*, plus the fictitious power of the current of *b c* and pressure, *a c*. Summing up algebraically the readings of the two wattmeters, we will have the power of the phase, *a b*, plus the power of the phase, *a c*, plus the power of the current, *b c*, and pressures, *b a* and *a c*; that is to say, of their resultant, *b c*, which actually constitutes the power of the third phase, *b c*.



THREE-PHASE MEASUREMENTS.

Any other combination, not analogous, of two wattmeters will not suffice to record the power of the three phases. We thus know the "apparent watts" and the "true watts" of the circuit. Their ratio is the power factor of the circuit, no matter how unbalanced it may be.

For instance, referring to McAllister's particular case, the "true watts" are 6,000, and the "apparent watts" are 100 × 10 + 100 × 20 + 100 × 30 = 6,000. Therefore, the power factor is $\frac{6{,}000}{6{,}000} = 1$.

Any other method for obtaining the power factor is not general; no wonder, therefore, that it is not applicable to all cases. For instance, the formula, $\tan \theta = \sqrt{3}\,\frac{W_{bc} - W_{ac}}{W_{bc} + W_{ac}}$ is deduced by working out the two formulas:

$W_{ac} = \sqrt{3}\, Ei \cos (30° + \theta)$,

$W_{bc} = \sqrt{3}\, Ei \cos (30° - \theta)$, and eliminating E and i, on the assumption that i and E are the same in both formulas—that is to say, that the system is balanced; thus, if $\cos \theta = 1$, the formula gives $W_{ac} = W_{bc}$.

Furthermore, in the power factor, $\frac{W}{\sqrt{3}\, I\, E}$, the denominator plainly shows that the formula applies only to balanced circuits, in which case it would give both the power factor of the system and the "angle of lag" of the currents behind their e.m.fs. But this formula, as the preceding one, if used in case of unbalanced circuits, gives results such as to render them useless. There is a case, however, that better shows the possible difference between power factor and angle of lag. This is when the three phases of the circuits have different values of $\cos \theta$. In such a case the power factor of the whole system has always the usual value above mentioned, but what is the "angle of lag?" It is the same as asking, "what is the current of an unbalanced three-phase system?" It is necessary to mention the amperes flowing in each lag. In the same way, in our case we must find the $\cos \theta$ of each phase, reading for each one of the volts, amperes and watts; but we cannot represent the power factor of the whole system by the cosine of an angle, and have it retain any practical significance. In this case it is even impossible to use the graphic representation of Mr. Perry as he has illustrated it, because the Y of the currents would be distorted and it would be impossible to superpose it on the Y of the pressures.

G. Facciolі.

New York, N. Y.

Taxation of Lighting Plants in Michigan.

To the Editors of Electrical World and Engineer:

Sirs: I have gone over your analysis of the annual report of the Public Lighting Commission of Detroit carefully, and find you have covered the field thoroughly. Your handling of this report shows that you were well informed of the local Detroit conditions, and I doubt if anyone could have analyzed it as well, certainly not better.

There is only one suggestion that I can make and that is in regard to the amount allowed for lost taxes in the Commission's report. This amount is very much too small. The fact is the State Tax

Commissioners in the last two years have raised the taxes on every lighting and power plant to the limit. They claim the property should be assessed for what it will bring in the market. If the amount you suggest should not be practically equal to the sum of your capital stock and bond issue, they promptly assess you for this total, and summon you to show cause at some subsequent meeting why you should not pay taxes on the amount so arrived at. The hard part of this lies in the fact that the State Tax Commission of Michigan is a law unto itself, there being absolutely no redress. You can protest until you are black in the face, but to no avail.

In my opinion, if the Detroit municipal plant was assessed on the same schedule that all Michigan electric plants are, their amount would be nearer to $700,000 than it is to $400,000.

SAGINAW, MICH. A. G. MOSER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators in Parallel.—BENISCHKE.—An article on the theory of surging of alternators operated in parallel. Goerges has given a theory based upon the assumption that this is a resonance phenomenon which may be considered as analogous to acoustic resonance. The present author claims that this analogy is improper because the acoustic vibrations are strongly damped and because the reaction of the vibratory systems upon one another is not taken into consideration. He gives an outline of a mathematical theory of the phenomenon.—*Elek. Zeit.*, March 12.

REFERENCE.

Operation of Alternators in Parallel.—MANDUIT.—An illustrated summary of recent papers by Rosenberg, Benischke, Goerges and Goldschmidt on this subject.—*L'Eclairage Elec.*, March 7.

LIGHTS AND LIGHTING.

Nernst Lamp.—A long note stating that the Reichsgericht (the highest German court) has reversed the decision of the lower court in the suit between the General Electric Company of Berlin and Boehm concerning the validity of the fundamental Nernst lamp patent. This patent is now upheld. The progress of Nernst over Jablochkoff is explained in the decision.—*Elek. Zeit.*, March 12.

Small Economical Arc Lamp.—Some notes on a small arc lamp devised by an Italian engineer, Rignon, and acquired by the General Electric Company of Berlin. On account of pending patents no details are given, but it is stated that this arc lamp has about the size of a Nernst lamp for 1 amp. It is an enclosed arc lamp and the main feature appears to be the use of impregnated carbons (like the carbons in the Bremer arc lamp); the impregnation of the carbons is said to have two very important results: first, it increases the illumination obtained per unit of power, and second, it prolongs the life of the carbon. The regulating mechanism is said to be very simple, so that a small and very economical lamp is produced, the light from which is said to be more steady than that of other enclosed arc lamps. The life of the carbons, which have a thickness of about 1 mm, is 20 hours; the power consumption is 0.6 watt per candle-power. Rignon states that the lamp can be made from 50 cp upwards, the selling price being not over $5.00.—*Zeit. f. Beleucht.*, February 28.

Theatre Lighting.—An illustrated description of the lighting installation of the New Theatre in London. Current is furnished by a supply company at 100 volts, the three-wire system being split outside the theatre, so that there is never a difference of potential of 200 volts between adjacent mains in any part of the house; the two main distribution boards and switchboards on the stage and the other in the front of the house, are each supplied from two distinct and separate pairs of mains. On the stage there is provision for over 1,000 lights and 13 arc projectors. The whole of the stage wiring is repeated four times over, in white, amber, blue and red; the arrangements for controlling the stage lighting have been specially designed, the whole of the prompter side of the flies having been given up to the electrical plant. The main stage board, the dimmer gear, the dimmers themselves, the arc lamp resistances and the controlling resistances for the ventilating fuse are all situated thereon, so that the engineer in charge has never to move from the fly-rail during the performance should any hitch occur. The dimmers are of the Lyons liquid resistance type, and are mounted on insulating trays.—Lond. *Elec.*, March 13.

REFERENCE.

Incandescent Lamp Lighting.—YORKE.—A brief article comparing American and English practice. Americans favor lamps of 3 to 3¼ watts per candle, while the British favor 4 to 4½ watts, because the latter have a longer life. He shows that the British practice is quite uneconomical.—Lond. *Elec. Rev.*, March 6.

POWER.

Steam Power Versus Hydraulic Power.—HECKER.—An article in which he discusses the prospects of a proposition made in a special case in practice, to erect a hydraulic installation which, if all the available water is utilized, would give a power of 600 hp. The cost of the hydraulic plant alone without the electric plant is estimated at about $375,000. The cost of a steam plant of the same capacity is estimated at $100,000. As the cost of operation is higher for the steam plant than for the hydraulic plant, the question arises under which conditions the one is financially more economical than the other. The author discusses this question under the following supposition: Interest in both cases, 4 per cent.; depreciation in both cases, 1 per cent. of first cost of installation; deterioration, 5 per cent., and 2 per cent. of first cost for the steam and the hydraulic plant respectively; maintenance, 2.5 and 15 per cent. respectively. The price of coal is assumed as ½ per cent. per kgm; the steam consumption as 9 kgm per effective horse-power-hour; the cost of fuel consumed per horse-power-hour, 0.75 cent. The cost of cleansing, oiling, packing, etc., materials, is assumed to be 0.036 cent per horse-power-hour more in the steam plant than in the hydraulic plant. The wages are assumed to be $1,500 more per year in the steam plant than in the hydraulic plant. Under these suppositions, the author reaches the conclusion that the hydraulic plant is more economical than the steam plant only when a load factor of more than 60 per cent. is generated during the total time.—*Elek. Zeit.*, February 19.

Greek Transmission Plant.—A long illustrated description of the light and power installations of Athens and its harbor town, Piræus. The main generating station is situated near Phalberos and contains direct and alternating-current generators and exciters. The direct-current dynamos are 750-kw, 600-volt machines and supply current to the tramway between Athens and Piræus, in the vicinity of which road the power plant is situated. The alternators give 5,500-volt, three-phase currents and supply three transmission lines, which will be mentioned below. Besides these main generating sets, there are auxiliary steam-driven sets, each consisting of an engine, on the axle of which are mounted a 75-kw, direct-current machine for the excitation of the alternators, and a 75-kw alternator for transmitting energy to Piræus for lighting the harbor and cities during the hours in which the main sets are not running. There are three transmission lines, the shortest one being overhead throughout and having a length of 1 km and supplying the converter sub-station of Phalerus from which the 230-volt, direct-current, three-wire network is supplied. The second transmission line is throughout overhead and has a length of 2.7 km and supplies the sub-station of Piræus, which furnishes current to 70 arc lamps in series for lighting the harbor and also current to a three-wire network for lighting the city. The third transmission line has a length of 7.8 km and supplies the two sub-stations of Athens; 6.3 km, i. e., from the plant to the suburbs of Athens, is overhead, and the rest is underground cable. In the first sub-station the 5,500 three-phase currents are converted partly by means of transformers and 200-kw synchronous converters into

250-volt direct current for lighting purposes, and partly by means of transformers and 250-kw synchronous converters into direct current for the tramways between Athens and Piræus. This sub-station also contains two storage batteries; one of 3,400 amp-hours' capacity works in parallel with the converters for lighting, the other of 900 amp-hours' capacity serves for traction. The load in the second sub-station in Athens is extremely variable and for this reason motor-generators with synchronous motors have been installed, which permit of a wide regulation of tension by means of exciting rheostats. The synchronous motors have 70 kw capacity, and the coils are wound directly for 5,500 volts; they receive the current from the first sub-station; the direct-current machines give normally 60 kw at 250 volts. This second sub-station supplies the lighting network of Eastern Athens. The total installation has to govern the following amounts of power for various purposes: 400 kw for lighting of Athens, 950 kw for traction between Athens and Piræus, 250 kw for lighting of Piræus, 60 kw for lighting of Phalerns, 1,200 kw for lighting of Kiphissia and for traction between Athens and Piræus.—*L'Ind. Elec.*, February 25.

REFERENCES.

California.—A well-illustrated article on the systems of the United Electric Gas & Power Company, with detailed descriptions of the plants at Santa Barbara and Santa Monica.—*Jour. of Elec.*, January.

Los Angeles.—Low.—A very long, exhaustive and profusely-illustrated article on the generating, transmission and distribution systems of the Edison Electric Company, of Los Angeles, Cal.—*Jour. of Elec.*, January.

South Yuba.—Van Norden.—A long and profusely-illustrated description of the water and electric systems of the South Yuba.—*Jour. of Elec.*, January.

TRACTION.

Third Rail.—Young.—An article on the third rail on the Baltimore & Ohio Railroad, and an account of the reasons for changing from the overhead to the third-rail construction, and the methods followed. Electricity is used for hauling the steam trains, including the locomotives, weighing about 90,000 pounds each, through a tunnel in the City of Baltimore. The third rail weighs 43 kgm per meter and is mounted on a reconstructed granite insulator, which is carried on a malleable-iron stand, which also has upright standards at the sides for supporting the wooden guards. A construction in the station first installed was one in which the shoe ran along the under side of Z-bars, which carried the current. This was changed to another form which is illustrated. At certain points it was found necessary to provide a third rail, which could be lowered to allow steam engines to pass over it and afterwards raised to give contact to the electric locomotives. The methods of accomplishing this and views of the movable third rail itself are illustrated. The shoe is attached to the bumper block of the locomotive and is mounted on a vertical sliding rod, so that it can have an up-and-down movement, while springs allow a horizontal movement. The shoe is prevented from dropping too low by a bolt on the sliding rod. The up-and-down movement is 2½ in. and the horizontal movement is 1¾ in. on each side of the central support. The entire weight of the sliding rod, shoe and all attachments is 150 lbs., and this weight is necessary on account of the large currents required by the locomotive. The wearing part of the shoe is steel with a flat surface 4 in. wide by 20 in. long. On straight track the third rail is alive all the time, but in stations and switch yards a sectional conductor is used with electric switches; there are 26 sections. The design of the switch was an important consideration, as it had to be able to open and close circuits of from 500 to 2000 amp with reliability and without sparking. It must also be able to close the circuit and keep it closed with a small current. The current used for closing the circuit in the switch is 25 amp, or about one-hundredth of the maximum current carried by it. As at present employed, the switch will operate at any voltage between 175 and 700, which latter is the voltage used on this line. Magnetic blow-outs have been installed on the main jaws of the switch and also at the final point of break of the arc, as the circuit is broken in three places. Other details of the switch are described. Another feature of the sectional conductor system is the method of closing this switch. Originally storage batteries were used, but the method now employed is to use a small generator on the locomotive, driven by a compressed-air motor. This motor is supplied with compressed air from the same tanks which are used for the air brakes. When the pressure at the tanks falls below a certain limit and current is being received from the third rail, the generator is run as a motor and the compressed-air motor acts as an air compressor to supply air to the compressor.—*St. R'y Jour.*, March 14.

Third Rail.—An editorial discussion of third-rail supports, the necessity of providing a strong mechanical as well as good electrical support being pointed out. Current will inevitably leak from the third rail to the ground so that these supports will corrode more quickly than if not under electrical strain; hence, substantial construction is necessary. Moreover, it will undoubtedly be necessary to use considerable pressure on the shoe which slides on the third rail to remove the ice and sleet, so that this is another reason against poor construction.—*St. R'y Jour.*, February 28.

Electric Railway Practice on the Continent of Europe.—Vellguth.—An article in which he briefly discusses electric railway practice in the continental countries of Europe outside of Germany, Switzerland and France, which were discussed in a previous article. The writer refers to the extension of electric traction in Austria, and states that in November, 1901, there were 27 electric lines in that country, the most extensive being in Vienna. This city, when all roads are electrically equipped, will have 200 miles of track. Part of this system is equipped with the bow trolley and part with the conduit. The writer also refers to the Vienna Lokalbahn and to the Stadtbahn. Some particulars are also given of a short three-phase railway at Wollersdorf on which 3,000 volts are used. The principal electric roads in Hungary are in Budapest, which was the first city to introduce the conduit system on a large scale. Particulars of these roads are given, as well as of the Franz Josef Underground Railway, which is 3.7 km in length. Italy has done a great deal in electric traction, especially in the direction of the equipment of the steam roads with electric power. The city systems do not differ in any material respect from those in other countries. Denmark contains electric railways worthy of mention only in Copenhagen. The companies in this city are under very strict municipal regulations, some of which are mentioned, and at one time allowed only accumulator cars. The double trolley has been used to a considerable extent in that city through the fears of the authorities in regard to electrolysis. The conditions in the other European countries are then briefly summed up.—*St. R'y Jour.*, March 7.

Sub-Station Practice.—An article on the sub-station practice on the Toledo & Western Railway; the sub-stations are of small capacity and are located in passenger and freight stations, where the station agent looks after the machinery; the machinery is examined by a skilled man only occasionally. This reduces the cost of inspection. No serious difficulties have been experienced, and if a breakdown occurs in one station it does not seriously interfere with the operation of the road, as there are a large number of sub-stations. The road also makes use of a portable sub-station which consists of a rotary converter, transformers, etc., mounted in a car, which can be run to any part of the line desired.—*St. R'y Jour.*, March 14.

REFERENCES.

Single Motor Tram Cars.—Wilkes.—An article in which the writer says that there are many tramways on which the requirements of the schedule hardly ever call for the use of the parallel combination of motors. He tries to make out a case for the four-wheel single motor truck with simple rheostatic control, as against the eight-wheel maximum traction car. The advantages claimed for the former are decreased first cost of the electrical equipment and increased economy of power.—Lond. *Elec. Rev.*, March 6.

Collector Shoe ond Sleet Cutter.—A description of a device made of eighteen plates in the form of sectors of a circle. The plates dove-tail together and are supported from alternate ends and are hinged at the center. The object of the shoe is to cut the sleet and ice from the third rail. Only one shoe of this type has been built and it is being tried on the Manhattan Elevated.—*St. R'y Jour.*, March 21.

Chipping Ice from the Third Rail.—The writer recommends a reciprocating pneumatic chipper to remove the ice instead of the usual brushes.—*St. R'y Jour.*, March 14.

Fighting Sleet and Snow on a Third Rail.—A description of the methods used on a third-rail road in Grand Rapids. The scrapers employed were tie-plates, the base of which has sharp corrugations. This road has found these steel scrapers more desirable than brushes, although a rattan brush follows the scraper to remove the broken ice from the rail.—*St. R'y Jour.*, March 14.

Street Railway System of Havana.—A review of the electric railways of Havana. The principal line owns about 30 miles of track and 110 cars, and is equipped with the double trolley. The same company is also planning another system in the neighborhood of Havana with 100 miles of track.—*St. R'y Jour.*, March 21.

Rothesay.—An illustrated description of the trolley line of Rothesay, Scotland, the extent of the line at present is $2\frac{1}{2}$ miles double track.—Lond. *Elec. Rev.*, March 6.

Telephony for Railways.—Soulier.—An illustrated description of the Basanta system of telephone intercommunication between trains while running.—*L'Ind. Elec.*, February 25.

Installations, Systems and Appliances.

Dangerous Rise of Voltage Due to Resonance.—Finckh.—A description of a case in which a dangerous rise of voltage was observed in a 2,000-volt, 1,000-kw, three-phase generator; the 4-mm thick mica insulation of the armature winding was broken through at a certain place and the coil was burned, there being simultaneously a formation of strong sparks from which the existence of very high voltages could be concluded. It was found that at the same time there existed a variable earth in the high-voltage network. It was also observed that when the stator iron of this machine was touched, heavy shocks were felt. Both facts were found to be interconnected. The earth fault destroys the symmetry of the potentials of the terminals against earth and causes in the machine a changing current from the stator iron to earth. On the other hand, the shocks received in touching the other stator iron indicated that between the same and the earthed machine frame, there was an insulating layer, perhaps of dust or dirt. The charging current due to the earth fault could not flow directly to earth, but had first to pass this insulating layer and there formed a spark gap. He states that it may be considered to be a general rule that whenever there are resonance phenomena which cause a dangerous rise of voltage, there are always spark gaps also, and threfore, currents of high frequency and comparatively small wave length. In the present case this was proved by short-circuiting the spark gap, i. e., by connecting the stator iron with the frame; a charging current flowing from the stator iron to earth no longer caused serious sparks in the armature, which, however, appeared again when the metallic connection between stator and frame was broken. This metallic connection was, therefore, definitely adopted and since that time no trouble was experienced with the machine.—*Elek. Zeit.*, March 12.

British Power Plant.—The first part of an illustrated description of the Trafford Park power supply plant. Besides the lighting load, considerable power is used in connection with the docks and warehouses. The price charged for electric power is very low, viz.: 3 cents per unit for the first 1,200 hours of maximum demand per year and 1 cent per unit for all further units; this is calculated on a basis of a regular load of 54 hours per week; for lighting, 8 cents charged per unit for the first 400 hours of maximum demand per year, and 3 cents per unit for all further units. The power plant contains three generating sets, each of 1,000 hp; two are direct-current machines and the third a double-current generator; the latter is said to be the largest installed in England up to the present day. Direct current is generated at 500 volts and alternating current is obtained from the 20-pole, double-current generator at 340 volts three phase and a frequency of 30 periods per second. It is arranged for mining, either as a shunt or a compound machine, as required; when running compound the e.m.f. is constant at 550 volts for all loads. The boiler house contains two sets of electric pumps in which the motors have double-wound armatures and are regulated on the series-parallel control system.—Lond. *Elec.*, March 13.

Charging High-Tension Cables.—Woodhouse.—A communication referring to the note of Garrard, recently abstracted in the Digest. He says that a charging device such as that mentioned by Garrard has been used and given up on several transmission lines, as an unsatisfactory arrangement. To safeguard a high-tension system, he recommends using spark-gaps of the Wurtz type and to put plenty of metal in them; not to use step-up transformers at the generating end, but if they must be used, to do the switching on the high-tension side; not to use an alternator which gives a wave form differing considerably from a sine curve.—Lond. *Elec.*, February 27.

Rules and Regulations.—An editorial giving a review of the work done since 1894 by the special committee appointed by the German Association Electrical Engineers for drawing sets of rules and regulations. Up to 1897 two sets of regulations had been issued, one for low tension (below 250 volts) installations, the other for high tension (above 1,000 volts) installations. A set of regulations for medium tension (between 250 and 1,000 volts) was issued in 1899; regulations for tramways in 1900. It was then decided to issue only two sets of rules—for low tension and for high-tension—instead of the three—for low, medium and high-tension—for electric installations in towns, and issue also special regulations for theatres and mines, and safety rules for the protection of workingmen. This programme has now been completed. These regulations have now been accepted and will go into force on January 1, 1904, with the exception of the safety rules for the protection of workingmen, which will go into force on March 1, 1903. The same issue contains, on more than 14 full pages, the full text of the following regulations. Regulations for low-tension installations, low-tension being defined by the rule that the effective voltage between two conductors, which are insulated from earth, should be not more than 500 volts, and that the effective voltage between any conductors and earth should not be more than 250 volts; regulations for high-tension installations, high tension being defined by the rule that the effective voltage between any conductor and earth is more than 250; for storage batteries the discharge voltage is the decisive figure. Safety rules for the protection of workingmen. The special rules for theatres are included in the regulations for low-tension installations, the special rules for mines are included in both the regulations for low and for high-tension installations. There is also published a proposed set of rules for erecting and maintaining the poles for transmission lines in "strong current" or "heavy" electrical engineering ("Starkstromanlagen"), i. e., excluding telegraphy and telephony; the term "heavy" electrical engineering was used by Swinburne in his presidential address and has since been used by others. —*Elek. Zeit.*, February 19.

REFERENCES.

British Lighting Plant.—An illustrated description of the electric plant of Barnstable. It contains three 125-kw, 500-volt, direct-current dynamos and a storage battery of 240 cells. The three-wire system is used, the supply pressure being 230 volts for lighting and 230 or 460 volts for power.—Lond. *Elec. Rev.*, March 6.

Large Capacity Switches.—Hewlett.—A profusely-illustrated description of the various types of large capacity switches used in electrolytic work.—*Electrochem. Ind.*, March.

Electro-Physics and Magnetism.

Electrodeless Discharges.—Davis.—An account of an investigation of the conductivity produced in gases at various pressures when an electrodeless discharge passes through them. Special care was taken to secure an absolutely uniform discharge potential, and this was attained by a spark micrometer immersed in hydrogen and inserted in a shunt circuit. The vacuum vessel consisted of two coaxial cylinders of the boiling tube pattern, with their upper rims welded together so as to leave a cylindrical space between them; they were surrounded by a coil of wire having the same axis, which coil is necessary for producing the electrodeless discharge; to measure the ionization produced by the same, ring electrodes were mounted in the upper and lower portions of the vacuum. At ordinary pressures the conductivity produced is very small, with decreasing pressure it rises suddenly to a maximum at about 0.6 mm, remaining at that maximum up to 0.04 mm, and falling suddenly to zero at 0.03. The energy absorbed increases in a somewhat similar manner. The oscillations in the circuit are damped by this absorption, and the heat thus produced in the vessel is enough to heat a platinum wire to a white heat.—*Phys. Zeit.*, February 15; abstracted in Lond. *Elec.*, March 6.

Radio-Activity and Gravitation Energy.—Forch and Kucera.—Two articles referring to Geigel's recent paper in which the author tried to prove experimentally that the energy given out by radioactive substance is equivalent to a loss of gravitation energy. Kucera shows that Geigel's mathematical calculation is incorrect. Forch has repeated Geigel's experiments under modified conditions in which, if there is really an absorption of gravitation energy, he ought to have obtained 40 or 50 times the effect obtained by Geigel, but his results were negative.—*Phys. Zeit.*, March 1.

Induced Actinium Rays.—Debierne.—An account of experiments showing that while an induced radio-activity can be obtained not only from radium salts, but also from actinium salts, yet the character of the induced radio-activity allows of a clear distinction between the effects of the two substances. The activity induced by radium is sensibly uniform in its distribution throughout the vessel, while that due to actinium is practically confined to the immediate neighborhood of the active body. Radium requires an open space to induce its radio-activity upon a second body, while actinium requires a very narrow space. He believes with Curie that these substances send out "activating ions" which lose their activating power rapidly in the case of actinium and slowly in the case of radium. Thorium stands in this respect between the two.—*Comptes Rendus*, February 16; abstracted in Lond. *Elec.*, March 6.

Sensitiveness of Tissues to Radium Rays.—Danysz.—An account of an investigation of the effect produced by radium rays upon the skin. A radium preparation applied to the skin produces no immediate effect, but leads to the development of a very painful gangrene within 8 to 20 days. Different tissues are sensitive to very different degrees. A radium preparation, 500,000 times as active as metallic uranium, produces an effect upon the human skin after a few minutes. The same preparation applied to the skin of a guinea pig for 24 hours produces the complete destruction of the epidermis and dermis, but if applied below the skin the effect upon the skin is much reduced and very little effect is produced upon the underlying tissues. Of the latter the nerve tissue is the most sensitive; it is well protected by the bones of the spinal column.—*Comptes Rendus*, February 16; abstracted in Lond. *Elec.*, March 6.

Selenium.—Giltay.—A description of improved lecture apparatus for exhibiting the sensitiveness to light. Referring presumably to some former apparatus, he substitutes a glass plate with six windows for the ebonite plate with eight windows for intermittent illumination, and makes the dark intervals somewhat larger than the light ones on account of the lag in the light effect. Another species of intermittent illumination is produced by mounting a radiometer in the path of the beam. The author uses one with eight vanes, and obtains a good effect in the telephone. The illumination may also be made intermittent by means of a marometric flame. The best for the purpose is an acetylene flame, but in order to increase the effect the author uses three such flames side by side worked by the same membrane. It is then possible to make the distance between the selenium cell and the flame as much as 10 cm, and thus save the former from injury by heat. He finally warns against an effect he has observed when the circuit containing the selenium cell, battery and telephone is broken. The extra current then induced often short-circuits the selenium cell, and to avoid this he shunts the cell by means of a commutator in which he inserts a plug before breaking the circuit.—*Phys. Zeit.*, February 15; abstracted in Lond. *Elec.*, February 27.

REFERENCES.

Resonance in Electric Circuits.—Field.—The first part of an illustrated paper on a study of the phenomenon of resonance in electric circuits by the aid of oscillograms. He discusses the conditions under which electrical resonance may occur with one of the higher harmonics of the e.m.f. wave of the 2,500-kw, 6,000-volt, three-phase Glasgow municipal tramway generators. A series of curves is reproduced which are taken by means of a Duddell high-frequency oscillograph and synchronous motor-driven mirror.—Lond *Elec. Rev.*, March 6.

Magneto-Friction.—Pellat.—A French Physical Society paper on the resistance of magnetic fields to the passage of cathode rays across them. It is necessary to assume that the anode or cathode flux experiences in a strong magnetic field a resistance of a frictional character, which is zero or very feeble along the lines of force, and considerable in a direction at right angles to them.—*Bull. Soc. Fr. de Phys.*, February 20; abstracted in Lond. *Elec.*, March 6.

Electro-Chemistry and Batteries.

Electrolytic Preparation of Iodoform from Acetone.—Abbott.—An account of a series of experiments made to find the best conditions for this purpose. They were found to be as follows: A current density of not more than 1.35 amp per square decimeter, a temperature of 75° C., with an anode solution consisting of six grammes of sodium carbonate, 10 grammes of potassium iodide, 100 cc water, and 5.5 cc acetone added at the rate of 0.5 cc per 10 minutes during electrolysis. These gradual additions are necessary, as in order to keep the acetone from oxidizing and from forming condensation products, only a small quantity must be present in the anode solution at one time.—*Jour. Phys. Chem.*, February.

Reduction Factors for Electrolytic Deposits.—Hering.—A table of numbers for determining the amount of any material formed electrolytically, from the amount given in other units. The figures have all been calculated from the legal weights and measures of this country. The author also points out a number of easily remembered approximate relations; for instance, 5½ pounds per day are almost exactly a ton of 2,000 pounds per year; or 5½ kgs per day are equal to 2 metric tons per year; every gramme per minute is about 3 pounds per day, or nearly 1½ kgm per day; a ton per year is about 1¾ grammes per minute; a metric ton per year is about 6 pounds per day, or ¼ pound per hour.—*Electrochem. Ind.*, March.

Steel Production in the Electric Furnace.—An illustrated description of the Stassano process, with a detailed account of the results of a test made by Goldschmidt. He reaches the conclusion that the electric furnace method of producing iron and steel can come into consideration everywhere where cheap water power and zinc iron ores are available. He thinks that for other countries, like Germany, the process could not compete with the usual metallurgical methods; for crucible steel, however, the case may be different; eventually the process might be used in such a way that ordinary pig iron would be refined in the Stassano furnace; but further experiments are still necessary to prove such a possibility.—*Electrochem. Ind.*, March.

REFERENCES.

Copper Refining.—Ulke.—An article giving notes on the history of electrolytic copper refining in America, and especially on the work of the Balbach Company. *Electrochem. Ind.*, March.

Electrochemical Development.—Krueger.—A summary of the development of the scientific and industrial electrochemistry during the year of 1902, giving brief references to articles published and patents issued.—*Electrochem. Zeit.*, January, February.

Industrial Electrochemistry.—J. B. C. Kershaw.—Continuations of his serial on industrial electrochemistry and electrometallurgy, giving brief notes on recent progress in Europe and America. The notes refer to the following: The Elmore electrolytic copper process; the calcium carbide patents; the use of electricity for glass manufacture; nickel production in Canada; new water power centers in America; the electric production of iron and steel; production and use of aluminum in the United States; electric laboratory furnaces; electric chlorates; electrogalvanizing; the works of the Ampere Electrochemical Company; electrochemical instruction in Germany; metallic sodium as a reducing agent; nitric acid and nitrates from the air; electrolytic antimony; peat-charcoal; barium and its compounds; purification of salt and brine; the efficiency of ozonizers; carbon disulphide.—*Elec. Rev.*, January 24 to March 7.

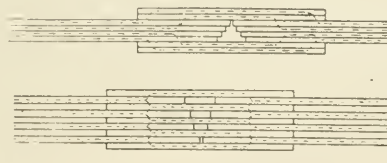
Electrometallurgy.—Beadle.—The conclusion of his serial on electrometallurgical problems, giving brief notes on iron, tin, tungsten, nickel, cobalt, mercury and antimony.—Lond. *Elec. Rev.*, February 27.

Acetylene Lighting for Small Cities.—An illustrated description of the acetylene central stations in Zinkau, Grieskirchen, Poechlarn and Strass in Austria.—*Zeit. f. Calciumcarbid Fcb.*, February 13, 20.

Polishing and Plating.—Hawkins.—A continuation of his illustrated serial on the polishing and plating of metals. In this part he discusses various kinds of buffs, wheels, polishing materials, etc., and scratch brushes.—*Am. Jeweler*, February.

Units, Measurements and Instruments.

Testing the Magnetic Properties of Sheet Iron.—Brion.—An article in which he suggests some modifications of the method of Richter, which was described in the Digest last year. The principal advantage of Richter's and the present author's methods is that the iron sheets are tested as a whole, so that a value of the mean magnetic quality of the material is obtained, and it is this mean value which is alone of interest for the engineer. Fig. 1 represents the method by which Richter joins the ends of the plates together and makes a closed magnetic circuit, while the present author suggests instead the method shown in Fig. 2; in this the reluctance of



Figs. 1 and 2.—Testing the Magnetic Properties of Sheet Iron.

the air-gap is reduced to about one-fourth and the eddy current loss is also considerably diminished. He recommends the apparatus shown in Fig. 3, the test thus becomes very easy. The sheets to be tested are not bent at all; they are first placed into the two coils, then the wooden blocks, *A*, are introduced and afterwards the auxiliary sheets (shown at the left and right hand of the figure). With this arrangement the stray flux may be made very small. The influence of the two sets of auxiliary iron sheets is taken into consideration by determining the loss in them separately; these auxiliary sheets are covered with paper, except at the ends, where they overlap; these two sets are joined together so that they form a closed magnetic circuit by the same method by which each set is joined to the sheets under test in Fig. 3; then the loss of the two sets of auxiliary sheets is separately determined. These auxiliary sheets may be considered the weakest point of the method, but the loss in them can be determined to any desired degree of accuracy; when sheets of 2 m length are tested and the distance between the upper and the lower sheets is 5 cm, the average length of an auxiliary sheet is 15 cm, i. e., 7.5 per cent. of the total length. The constancy of the auxiliary sheets should be tested from time to time.—*Elek. Zeit.*, March 5.

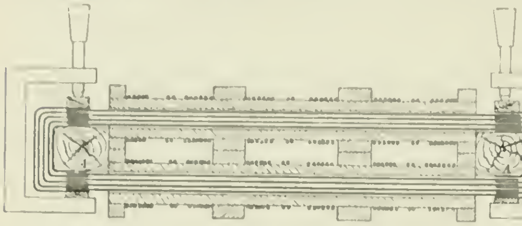


FIG. 3.—APPARATUS FOR TESTING.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—FLEMING.—An abstract of a Cantor lecture on this subject. In discussing the question of the voltage obtainable at the balls, he showed by an experiment the great effect which the capacity of the air wire or connected condenser has on the spark length. The longer the spark in the air, the greater the pressure between the balls, so that greater voltages may be reached simply by increasing the spark-gap. But such a process, by increasing the resistance, finally causes the discharge to lose its desirable oscillatory character. A far better way of getting greater potentials has been used by Fessenden, who found that by allowing the spark to occur in a gas compressed to 20 atmospheres or more, the voltages attained are much greater for a given spark length, while, in addition, the breakdown is much more sudden. This increased suddenness in the breaking down of the air between the balls is found also to give greater radiating power to the connected air wire. When it is attempted to form a spark in air between two balls connected with an oscillation transformer whose primary is fed by the oscillations set up by an induction coil or alternating-current transformer, an arc is formed; for the purposes of wireless telegraphy the spark has to be separated out from this arc. He points out the importance of the oscillation transformer method in wireless telegraphy. In the first place, by storing energy in the oscillations in the primary circuit of the Tesla transformer (which circuit includes the winding, a condenser and a spark-gap) it is possible to radiate from the secondary a sustained train of waves: and in the second place, higher potentials are given to the radiating air wire. Thus more energy is stored on the air wire in each of its periods. The fact that in reality it is in the dielectric that the energy is stored, makes the design of the condensers of importance. To accommodate a given amount of energy the dielectric of condensers must have a certain bulk. The quantity of energy which can be stored electrically in a certain volume of a dielectric is much smaller than the amount it is possible to store mechanically. Thus, in a cubic foot of air only one foot-pound of electrical energy can be accumulated. From this point of view, one of the best commercial materials for condenser working is "micanite," a matted mass of mica and shellac, which has the advantage over glass, not only of storing two or three times as much energy, but also of being very free from flaws. On a simple air wire operated by an induction coil about one-fourteenth of a foot-pound in energy may be accumulated. When the spark occurs this is indicated in practically a single rush. He distinguishes the following types of Hertzian wave apparatus: the first is the early Marconi type in which the air wire was connected directly to one side of the spark gap; the second is the Braun type in which the air wire is attached to a freely oscillating independent circuit placed as a shunt to the spark gap; the third is the latest Marconi type in which the air wire is set into vibration by means of a second or further transformation.—Lond. *Elec.*, March 13.

Theory of Wireless Telegraphy.—LECHER.—An article in which he elaborates his theory of wireless telegraphy, according to which electric waves are transmitted along the earth's crust as waves are along wires. Signals could be transmitted in this way over the whole earth if it were possible to raise the potential of the earth a few volts; this could only be effectively done if the negative electrification could be removed to a point outside the earth; otherwise it would be impossible to construct condensers of capacities not very small in comparison with the earth's capacity. What the antenna or mast wire does in wireless telegraphy is some such action as that postulated. It conducts the opposite electrification away from the earth for some distance, say 150 ft., and conducts it back at the next reversal; its foot, therefore, gets charged positively and negatively in alternation, and these charges are transmitted at a rate depending on the dielectric constant and magnetic permeability of the earth. He suggests the following experiment: Let a wire be earthed at two points in a direct line from the antenna, and let its length be half the wave length of the oscillations; its ends will then be always oppositely charged and the maximum alternating current will pass through it. If placed at a right angle to the wave, it will show no response.—*Phys. Zeit.*, March 1; abstracted in Lond. *Elec.*, March 13.

REFERENCES.

Wireless Telegraphy.—ARCO.—A translation in abstract of his recent German article on a new method for tuning wireless telegraphy stations.—Lond. *Elec.*, February 27.

Wireless Telegraphy.—WILKE.—A translation in abstract of his recent German articles on the use of wireless telegraphy for military purposes.—Lond. *Elec.*, February 27.

Cable Ships.—The first part of an illustrated description of the two new British cable ships, *Restorer* and *Patrol.*—Lond. *Elec.*, February 27.

Trans-Pacific Cable.—MCADIE.—A very well illustrated article on the laying of the American trans-Pacific cable.—*Jour. of Elec.*, January.

MISCELLANEOUS.

Safety Clothes for Protecting Workingmen.—ARTEMIEFF.—An illustrated paper read before the Berlin Electrical Society. Two radically different methods may be used for protecting workingmen against fatal shocks: either the body is placed in an insulating cover (rubber gloves, etc.), or it is surrounded by a material of very good conductivity. The latter method is used by the author, who has devised a suit consisting of a very firm flexible metallic fabric with which the whole body, including head and hands, are covered. If this suit has a resistance of 0.002 ohm from one hand to the other, and if the resistance of the human body between the two hands is about 2,000 ohms, it is evident that only one-millionth part of the total current passes through the body. In his suit, which has a resistance of 0.002 ohm between the hands, he could stand continually a current of 350 amp, and for a short time 1,000 amp. The limits of current are given by the burning of the suit.—*Elek. Zeit.*, March 12.

New Books.

ELEKTROTECHNIK IN EINZEL-DARSTELLUNGEN. By Dr. G. Benischke. Heft. 1, Die Schutzvorrichtungen der Starkstromtechnik Gegen Atmospharische Entladungen. Heft 2, Der Parallelbetrieb von Wechselstromaschinen. Braunschweig: Friedr. Vieweg & Son. 42 pages, 43 illustrations; 55 pages, 43 illustrations. Price each 1.6 marks.

The two pamphlets of which Dr. Benischke is the author treat of two very important subjects. The first describes the protective devices of power and lighting circuits against atmospheric discharges, and the second occupies itself with the parallel operation of alternators. The great experience of the author, who is chief engineer of one of the largest German electrical manufacturing companies, is a guarantee that his views will be of interest to electrical engineers, and especially to men in this country. It is of value for us to know what is being done in Europe. While these pamphlets do not contain anything that will be new to the reading electrical engineers, they are a condensed review of the subjects they treat of, and will be found useful on that account.

Secondary Batteries: Their Theory, Construction and Use. By E. J. Wade. New York: D. Van Nostrand Company. 492 pages, 265 illustrations. Price, $4.00.

This is a most complete treatise on the storage battery, including, in addition to the lead-lead couple, the cells which have been brought forth from time to time having electrodes other than lead.

There are ten chapters, the first being a short introductory. The second, under the caption, "Historical," comprises 100 pages, and shows the evolution through which the lead accumulator has passed. Nearly every type and character of electrode that has been devised since the time of Planté is clearly shown. This chapter, together with Chapter X—the latter headed "Present Day Cells," and covering 90 pages—form a record of nearly every lead battery that has appeared on the market since the inception of the art. Chapter III describes those secondary batteries other than lead. Chapter IV is a discussion of the properties and behavior of lead cells. The charge and discharge reactions, variation of e.m.f. with acid density, change in capacity with changing conditions of output rate, influence of temperature, efficiency and internal resistance, are all fully discussed from a scientific standpoint, but no useful practical conclusions seem to be drawn from the discussions.

Chapter V is on the chemistry of lead cells. Here the author puts forth his "Polymerization Theory" of a large number of lead oxides being possible, forming a series of varying degrees of oxidization and producing correspondingly varying e.m.fs, and which theory he presented before the British Institution of Electrical Engineers in March, 1900. With this theory, however, the profession generally does not agree, as all the phenomena of a storage cell may be accounted for in much simpler and more probable ways.

Chapter VI is on the design of lead cells and Chapter VII on their manufacture. These are good, practical discussions, so far as they go. Definite methods of Planté formation and of making up active material mixtures are not given, though they are taken up in a general way.

Chapter VIII is on the treatment and testing of lead cells. Chapter IX covers erection and regulation of lead cells. This last is the only chapter in the book that essays practical information for the installing engineer. Two of the numerous successful booster systems are described, but no methods for calculation of sizes of machines or their windings are given. Altogether it is a work which shows a high order of knowledge and ability and is a most valuable book for such engineers as are engaged in storage battery design and production, though it is rather too theoretical to be of the greatest assistance to the practising electrical engineer.

Die Wechselstromtechnik. Edited by E. Arnold. Volume I, Theorie der Wechselstroeme und Transformatoren. By J. L. la Cour. Berlin: Julius Springer. 425 pages, 263 illustrations. Price, 12 marks.

A work on the theory of alternating currents composed by a writer of great ability cannot fail to attract attention even if it be written in a foreign language. The work of Mr. La Cour is a comprehensive treatise on the phenomena connected with alternating currents. It is divided into two parts, the first part dealing with the general theory of alternating currents, the second part dealing with the theory of the transformer for single-phase and polyphase currents, and with the theory of transmission of power by means of alternating currents. We cannot help expressing our admiration for the erudite manner in which the author has swept over the vast subject, but in doing so we cannot suppress our opinion that it would be possible to simplify the methods so as to make them more lucid and perspicuous, even if this would, here and there, lead to a sacrifice of generalization. It is, after all, a clear conception of the physical aspect of the phenomenon that we wish to impart to students and engineers rather than a general theory which covers every imaginable case, but which is baffling to a man not thoroughly familiar with every detail of the problems, the solution of which is covered by the general method. To the expert who is familiar with the subject of alternating currents, this book cannot fail to be an inexhaustible mine of knowledge, but as a treatise for the use of men whose time is naturally limited, whose knowledge has to cover not only the subject of alternating currents, but the whole vast subject of applied physics, this book will, we fear, be less useful than it would have been if it had been written with the understanding of what has been so pertinently called "The Economy of Science."

Most engineers are familiar with the use of differential equations, but few like to have these equations put before them without even so much as an assistance for solving them. We find, for instance, on page 36, the equation 22 is given as a solution of the preceding differential equation, instead of giving the necessary substitutions which would aid in the understanding of the solution. Such procedure is not conducive to the development of the understanding of the student. The subject of alternating current theory is treated admirably with the help of vector diagrams, the most recent contributions to this subject having been given due consideration. Thus the circle diagrams have received a great deal of attention, and the student who is painstaking enough to familiarize himself with these methods will certainly find them most useful in the solution of new problems. A large number of examples is given to illustrate the graphical methods. The use of theoretical methods in the treatment of engineering problems in this volume might have been greatly enhanced by the omission and cancellation of factors which have only a second or third-rate importance. Thus, in the theory of the transformer results can be obtained which are extremely clear and useful if the resistance of the primary winding is neglected, an assumption which can usually be made without introducing any serious error. Such assumptions greatly contribute to the understanding of a problem and make a theory useful which otherwise would be altogether too complex for application.

In treating of Fourier's theory, it might have been well if the author had given Prof. Clifford's method of deducing the coefficients of the various harmonics, a method which is not only very quick but also helps to understand the theory.

In treating of the measurement of power in alternating-current circuits, it is surprising that the author does not give the graphical theory of the wattmeter, which permits at a glance to understand a process which looks so abstruse if nothing else is given than the formulæ. It is marvelous how a simple subject can be presented in such a manner that it takes hours to obtain only a general understanding.

The most interesting chapter in the second part of the book is the theory of long-distance lines. It is surprising to find that the author derives the formula for the inductance of two parallel inductors, while he does not deem it necessary to give a derivation of the formula for the capacity of two parallel conductors excepting by giving the result based on the theory of Lord Kelvin's images which Mr. Steinmetz used in obtaining the constants for parallel conductors. In going back to the principles of electrostatics, it is easy to obtain direct without this artifice the formulas for the constants of parallel conductors; but as engineers are far more familiar with electromagnetic than electrostatic formulas, it would seem more necessary to give the derivation of electrostatic constants of long lines than the electromagnetic. The solutions of the differential equations for long lines are illustrated by plain diagrams, but, while the formulæ cover the problems pretty thoroughly, their interpretation should certainly have been enlarged upon as the complexity and importance of the phenomenon would require.

Directory of Electrical Societies, Etc.

American Electrochemical Society, Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

American Order of Steam Engineers, Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

American Street Railway Association, Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies, Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State, Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association, F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Iowa Electrical Association. Next annual convention, Davenport, April 8 and 9.

National Association of Manufacturers, Secretary, Marshall Cushing, 170 Broadway, New York. Annual convention, New Orleans, La., April 14, 15 and 16, 1903.

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 26, 27 and 28, 1903.

New York Electrical Society, Secretary, G. H. Guy, 114 Liberty Street, New York.

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

Electrically-Operated Printing Presses in England.

In the electrical operation of printing machinery, the principal difficulty to be overcome is in the matter of control. If large rheostats are used in series with the motors for controlling the same, much trouble is found in obtaining a sufficiently large number of contacts to give the motor a steady motion from step to step, and at the same time allowing sufficient area of contact to carry the total current of the motor at various speeds, without making the rheostat too large and clumsy. In some forms of rheostatic control for printing presses, as much as 90 per cent of the current is wasted in the resistance wires when the machine is operated at very low speeds for adjustment and making ready. In some cases the main motor is not used for the very slow operation, another smaller motor being installed.

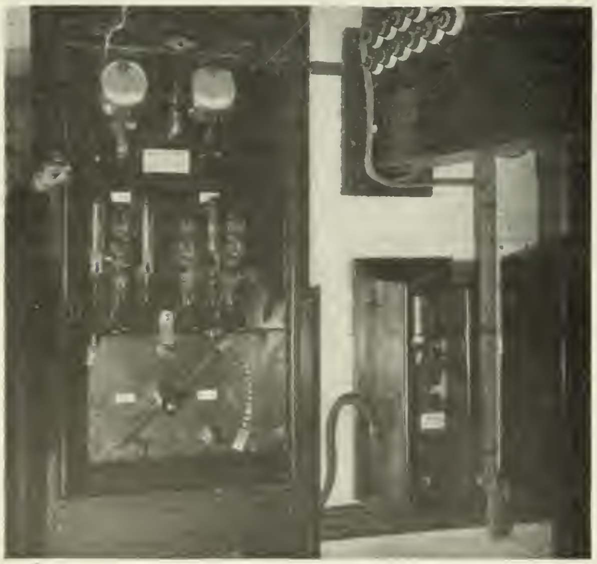


FIG. 1.—SWITCHBOARD.

The accompanying illustrations show the electrical details of an English printing press to which the Ward Leonard system of control is applied. The motor shown in Fig. 2 has a capacity of 62 hp and operates a sextuple Hoe press. Fig. 3 shows the controller connections as arranged for handling the motor under various conditions, and Fig. 4 shows the electrical connections, with the controller at the right. The plant was installed by Messrs. Geipel & Lange, of Westminster, for Messrs. Edward Lloyd, Limited, the proprietors of *Lloyd's Weekly, Daily Chronicle* and other publications.

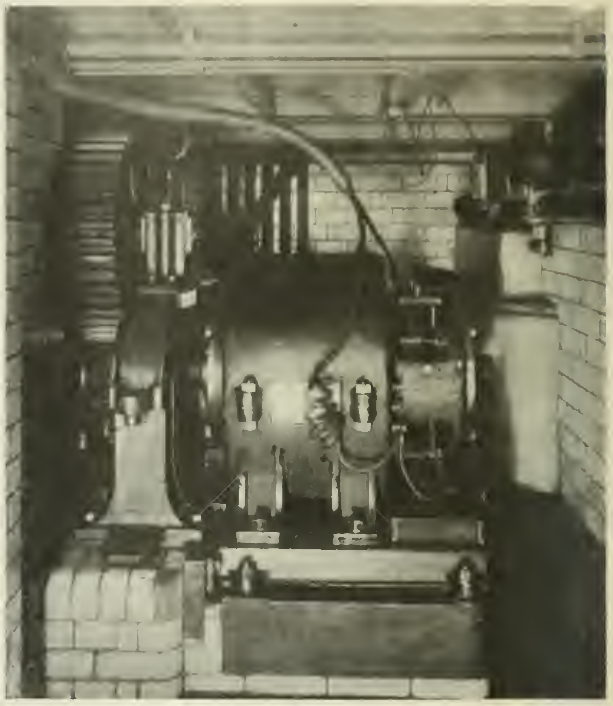


FIG. 2.—MOTOR FOR DRIVING PRESS.

With this equipment, which has been in operation almost two years, the press is started or stopped without jars or shocks of any kind and operates at very, very slow speeds for long periods without difficulty. The loss of power in regulation is stated to be less than 2 per cent., even at the lowest speed; this, of course, not including the loss in the motor-generator group. The press may be started from rest and accelerated to full speed with great rapidity and certainty, or it may be brought from a state of rest to full speed very gradually by hardly perceptible increments, and is absolutely under control at all speeds regardless of the load. If the electrical equipment is set to run at a definite speed and the load varies, the speed remains constant.

The latter consideration is one of considerable importance, for it is well known that the load on a printing machine varies from time to time according to the condition of the rolls and the ink, the pressure on the paper, the thickness of the blankets and the time the machine has been in operation, etc. With the series rheostat system, as the load varies, so do the controlling effect of the rheostat and the voltage at the motor.

The Ward Leonard system of control, as here applied, consists in delivering current to the press motor at a variable voltage suited to the precise speed at which the motor is running from time to time. For this purpose it is necessary to have a generator with a rheostat in the field thereof for varying the voltage. This generator may be driven by another motor, or by some external source, which may generate the whole of the electrical power required, or as in the case of Messrs. Edward Lloyd, Limited, only one-half thereof.

Here the generator is only half the size of the press motor and it is driven by another motor, which is also about half the size.

As will be noted in the diagram, Fig. 3, *A B* is a motor-generator, of which *A* is the motor and *B* is the generator, of 25 hp; the armatures of both are wound for 200 volts. *E* is the press motor of 50 hp, the armature of which is wound for 400 volts. *C* and *F* are the fields of the generator and press motor respectively. Both of these fields are separately excited and *C* has a reversible rheostat in circuit with it, having a large number of contacts. It will be seen that the current supplied from the line to the armature of *E* passes through the armature of *B*, which runs continually at full speed. When starting up, the field, *C*, is fully excited, and the voltage of the armature is equal to that of the line, but in a counter direction. Consequently no current passes through *E*. The switch of the rheostat is now moved in a clockwise direction and a small resistance is inserted in the field, *C*, so that the armature voltage is slightly reduced below that of the line. A current sufficient for the full torque then passes through *E* and the motor begins to turn slowly.

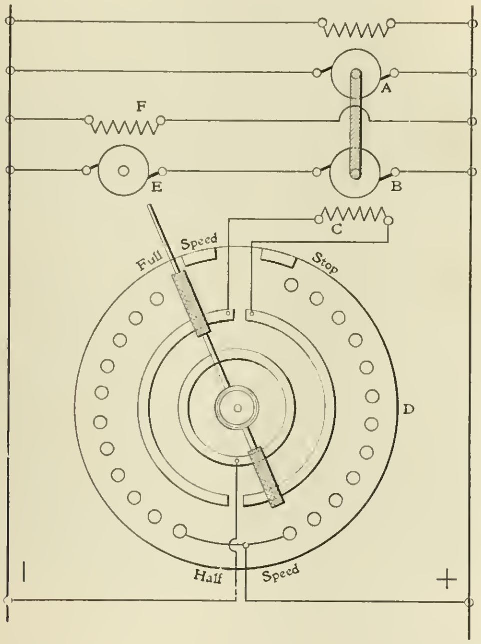


FIG. 3.—DIAGRAM OF CONTROLLER CONNECTIONS.

To increase the speed more resistance is gradually inserted until there is no magnetism remaining in the field, *C*; the motor, *E*, then runs at half speed, the voltage being that of the line. By still further moving the switch of the rheostat in a clockwise direction, the field, *C*, is reversed and gradually strengthened. The voltage of the armature, *B*, is now gradually increased in a direction which assists the voltage of the supply mains, and as soon as the whole of the resistance is switched out, the voltage of the supply mains is doubled and the motor, *E*, attains its full speed. This is the position of the switch as shown in the diagram. It will be seen that as the controller has only to regulate the field current, it may be a very small size and yet have a very large number of contacts, thus affording a very gradual control and securing absence of that destructive sparking of the contacts which is so common with rheostats carrying large currents. Further, the space occupied by this controller is but a small fraction of that required by the rheostats used on the series control system.

The loss in the motor-generator as ascertained by Messrs. Edward Lloyd, Limited, from actual records is small, while the loss in the controller varies from zero at half speed up to the maximum of only 2 per cent. at slow speed, or at full speed. The machine can be reversed if desired, but in the case of the Hoe presses it is only necessary that this reversal should be applied at low speeds. For this purpose it is provided that the motor-generator is capable of giving a voltage slightly in excess of that of the line, so that when it is in opposition to the line this excess causes a flow of current through the armature, *E*, which then rotates in a reverse direction.

The accompanying diagram as well as the illustration, Fig. 1, shows the switchboard and connections for this system of control for operating the presses. The numbers 1, 2 and 3 represent the single-pole switch, the slow-speed creeping switches and the field-reversing and regulating switches. The booster is noted at 7, and the motor for driving it at 10, while at 14 may be seen the starting switch for the motor. The motor, 5, is used for driving the machinery, 6 being its field coils. The single-pole circuit-breaker, 13, and emergency tripping coil, 12, as well as the double-pole circuit-breaker, 16, may be noted also on the switchboard, Fig. 6, as well as the meter at the right.

The switchboard is of enamelled slate, mounted with a motor-starter for the motor-generator, an ammeter having a two-way switch, by which means the current supplied to the press motor, or the total current taken from the supply mains, respectively, can be measured; and a voltmeter with a two-way key, which permits the voltage at which the press motor is working, or the voltage of the mains, to be read. Circuit-breakers take the place of switches and fuses, so that should an excess of current due to a jam in the press open the circuit, it can be quickly closed again when required, thus saving the loss of time due to replacing the ordinary fuse, an important consideration in the production of a paper.

The energy used is metered by a watt-hour meter, which not only integrates the energy by the usual dial, but also registers the rate at which it is used on a chart.

The flexibility of this system is well illustrated in the three creeping switches, which are placed round the machine at different points. These switches have 7 or 8 steps in parallel with the early steps of the controller, so that the machine tenders may themselves operate the press at the low speeds required for fixing the plates and threading the paper before the actual process of printing begins.

The whole regulation of the speed and direction of rotation is effected by the small controller; there is only one small hand wheel to work, which effects the whole of the operations in sequence, so that it is impossible, even for an expert attendant to make any mistake. The controller is carried on a pedestal which is fixed on the floor near the machine in the most convenient place. The main switchboard which carries the measuring instruments, etc., is fixed on the wall some distance off, out of the way, for it is not necessary for the attendants to use this board in operating the machine. As there is no large rheostat, the heating of the coils thereof is avoided and the plant will run for long and indefinite periods even at the very slowest speeds, while the wear and tear of the coils in the rheostat and contacts are obviated.

It may be of interest to add the following description of the signalling apparatus and switchboard arrangements, which, however, do not form a necessary part of the motor system. In order to signal to the attendant who operates the controller, a bell and indicator having three different colored lights are fixed near the controller, which are operated by pushes fixed at various points round the machine. The colors represent "start," "full speed" and "stop," while the bell calls attention to a change in the signals. The color of the light remains constant until another signal is sent.

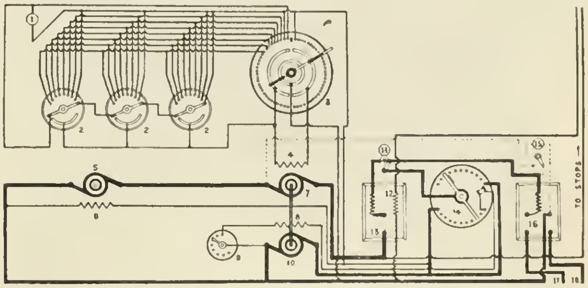


FIG. 4.—CONNECTIONS OF ELECTRICAL EQUIPMENT.

In case it is necessary in an emergency to stop the machine instantly, a circuit-breaker is provided which is operated by pushes placed round the machine alongside the pushes for signalling, and the circuit may be automatically opened by pressing any one of these pushes, which instantly stops the machine.

British Direct-Current Motors.

The accompanying illustrations show a type of direct current motor made by the British Thomson-Houston Company. The sizes in which these motors are manufactured are ¼ to 15 hp for slow speed, and 2 hp to 20 hp for moderate speed. Standard windings have been developed for the nominal voltages of 115, 200, 230, 400 and 500, but the motors can be used on circuits differing considerably from these nominal voltages.

The motor frame, which is also the magnet yoke, is of cast iron, and in the smaller sizes is rectangular in shape with rounded corners, in the larger sizes the circular form being adopted. At the commutator end the frame is provided with a projecting shell which protects the brush gear, while at the same time it allows ample space for it. In the sizes above 5 hp, the frame is divided horizontally, so that the upper half may be easily raised to facilitate inspection or removal of the armature. The armature may also be removed by taking off the pulley and shield, as in the smaller sizes. Ventilation is provided by hand holes, both at pulley and commutator ends, the latter being large enough to permit ready access to the brush-holders.

The pole pieces are made of sheet iron laminations, so as to reduce eddy current losses to a minimum, and are so supported that they can be readily removed from the frame. The field coils are held in place by the extended tips of the pole pieces. This construction allows the pole to cover a large portion of the armature surface without increasing the size of the field coil, and adds materially to the efficiency of the motor.

The bearings are carried by the cast-iron end shields, which are bolted to the frame. The end shields carrying the bearings may be rotated through angles of 90° or 180°, so that the motors may be easily adapted for bolting to a wall, or in an inverted position to a ceiling. The bearings are lubricated automatically by oil wells and revolving rings, and are provided with oil gauges. The linings are of solid gun metal in one piece.

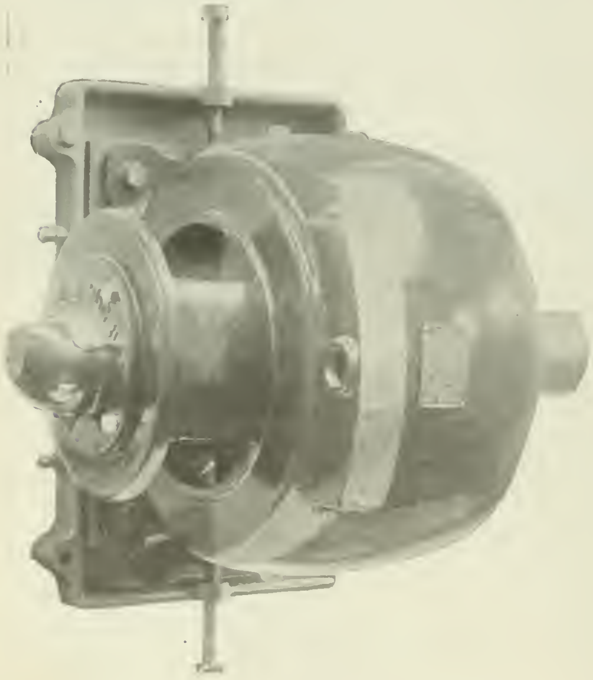


FIG. 1.—MOTOR ON WALL.

The armature core is composed of sheet-iron laminations, assembled direct on the shaft. Each lamination is japanned, to prevent eddy currents, and air ducts are arranged for ventilating the core and winding. The laminations are clamped solidly between two cast-iron spiders. The "cylindrical" armature winding is employed. The armature coils are made of copper wire wound on a form, and are embedded in slots punched in the armature discs, and extend over the end flanges. The cylindrical winding provides large radiating surface for the armature conductors, reduces the length of wire, and consequently the loss due to resistance. It therefore conduces to cool running and high efficiency. The separately formed coils, of which the winding is composed, are easy to remove and replace.

The brush-holders are arranged for carbon brushes, which slide in finished ways, and are pressed against the commutator by independent pressure fingers, an adjustable spring in the rear of the holder enabling the pressure to be regulated throughout the whole life of the brush.

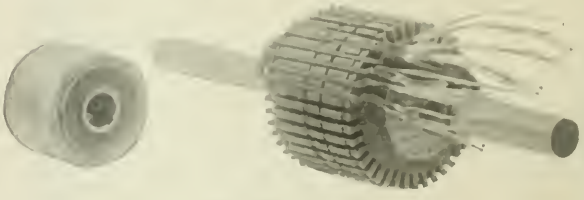


FIG. 2.—ARMATURE.

The standard motors are shunt wound, but series wound motors can be supplied for use on cranes, winches, etc., where a variation of speed with load is required, while for printing presses and other machines requiring large torque at starting, compound-wound motors are recommended.

The motors operate practically without sparking at the commutator, and changes from no-load to full load require no shifting of the brushes. The partially enclosed motors run with full load at an unusually low temperature. After running for 10 hours at their rated load and voltage, the rise in temperature above that of the surrounding air will not exceed 40° C., as measured by thermometer on any part of the motor. They will run for one hour under a 25 per cent. overload, and will stand a momentary overload of 40 per cent. without injurious heating, or sparking at the brushes.

Large S. K. C. Transformers.

The large transformers herewith described are built by the Stanley Electric Manufacturing Company, which, from its inception, has devoted special study to the perfection of transformer design. These transformers are installed in many locations, particularly in transmission systems operating at unusually high voltages, such as those on the Pacific coast, and are used to a considerable extent by interurban roads throughout the country.

Fig. 1 shows very clearly the construction of the S. K. C. oil-insulated, water-cooled transformer. The windings, both primary and secondary, are subdivided into from four to eight separate coils, each coil being wound in a number of layers, thus permitting the voltage between layers and across the terminals of any one coil to be kept low, and allowing each individual coil to be thoroughly insulated both internally and externally before assembling. In the smaller transformers, the coils are placed on both legs of the iron as in Fig. 3, and the design is known as the "Core Type." Those wound for 30,000 volts and higher and of 200-kw capacity and larger have the iron built on both legs of the coil, forming a complete shell around the coil, from which the design is called the "Shell Type." This style of construction is shown in Figs. 1 and 2. In both designs the coils are placed side by side, a secondary coil between any two primary coils, and are insulated from each other and from the iron by sheets of insulating material, liberal space being left so that the oil can circulate freely around the various coils and between the coils and iron.

A particular feature of S. K. C. transformers is that the casing is of heavy boiler plate, which cannot be broken or torn or punctured so as to release the oil and allow it to flow out, as not infrequently happens to transformers with sheet iron casings. The boiler plate is riveted to the cast-iron base and then thoroughly calked. The mass of coils and iron is also rigidly fastened to the base and is not in any way supported by the casting, this robust style of construction being shown in Fig. 1. Heavy eye-bolts with turn buckles pass through the base and cover, making a most secure and substantial combination, and one in which strains due to shipping and lifting cannot cause leaks.

The spiral through which the cooling water passes is made of brass, which is preferable to iron because it does not corrode even when salt water is used. Being of thinner gauge and higher conductivity than iron it conducts heat with greater facility, therefore dissipating a given heat with the consumption of less water.

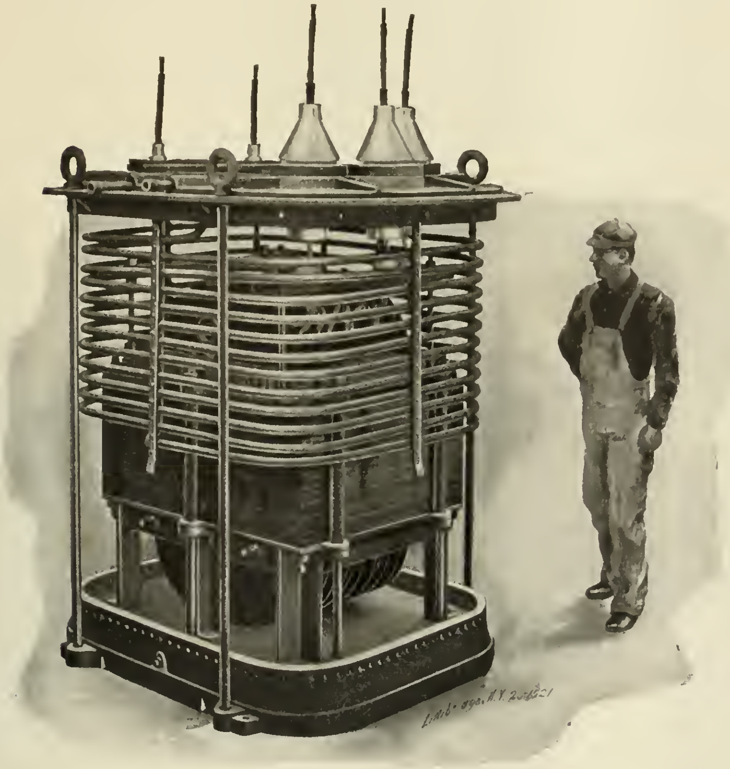


FIG. 1.—800-KW TRANSFORMER WITHOUT CASING.

The coils and core can be removed from the tank without disturbing the spiral coil and its connections. All the interconnections between the coils are made at the top so as to be readily accessible. The main primary and secondary leads are brought up to the terminal boards, rigidly supported above the coils, the primary board being on one side and the secondary on the other. From these boards the leads are brought out through porcelain insulators of unusually liberal proportions. Type W transformers will stand large overloads for a reasonable time, the supply of water being proportionately increased. They will also carry full load for from three to six hours without the use of water and without a dangerous rise in temperature. They are wound for voltages up to 60,000 and are made in capacities up to 2,000 kilowatts.

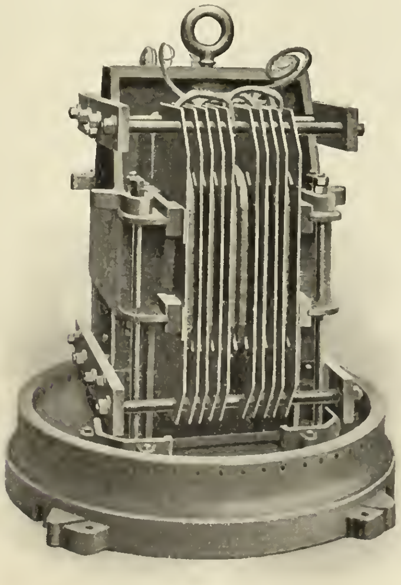


FIG. 3.—40-KW TRANSFORMER WOUND FOR 40,000 VOLTS.

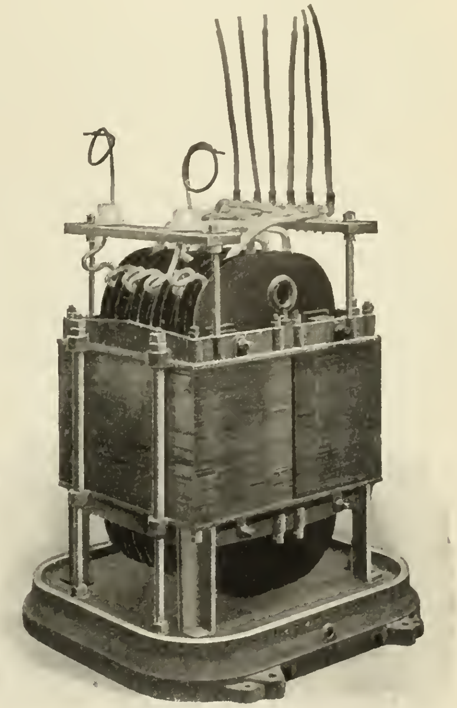


FIG. 2.—500-KW TRANSFORMER COIL AND CORE BUILT UP.

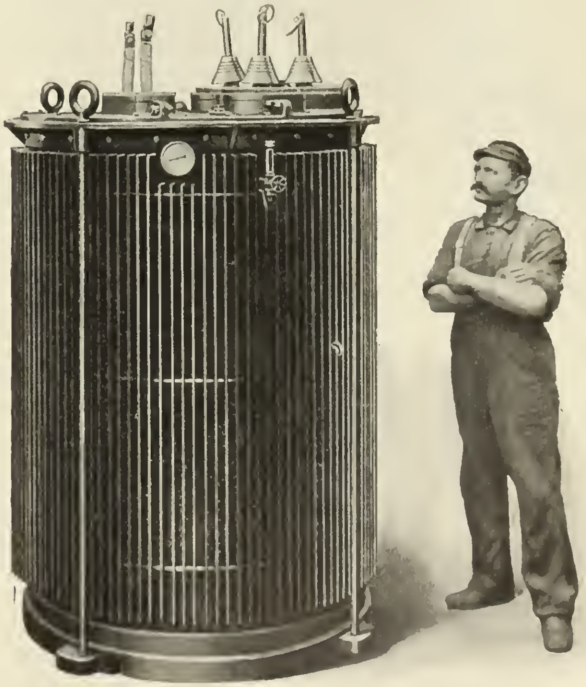


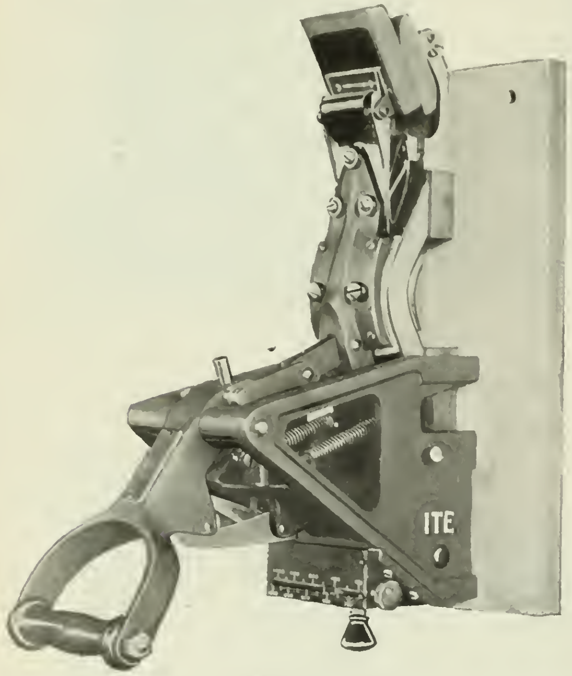
FIG. 4.—110-KW. 25-CYCLE TRANSFORMER.

The S. K. C. type of oil-insulated, self-cooled transformers shown in Fig. 4, are built along the same general lines as the other type excepting, of course, that they depend upon their large radiating and convective surface and the natural circulation of the insulating oil for the dissipation of the heat caused by the iron and copper losses. As will be observed from the illustration, remarkably large surface is provided by strips of iron fastened on edge around the outer surface of the tank or case.

Type F transformers are wound for voltages up to 35,000 and are made of from 10 to 500 kw capacity. Type F transformers are intended for continuous heavy duty and have a high efficiency, close regulation and low heating and are suitable for use in all places where the smaller sizes of this type would be used, but where water is not available for cooling purposes.

Special Circuit Breakers for Testing Purposes.

With the development constantly going on in the electrical art, circuit-breakers have come to play an important part. One pressing condition has recently been brought to bear upon circuit breaker engineers with peculiar force, and the Cutter Company responded with instruments having a range of adjustment greatly in excess of the figures which were once deemed inadequate. Frequently this call comes from professors of electricity and engineering in the large technical schools. The use of circuit-breakers in such institutions becomes daily more imperative, and it is of importance that the instruments upon which they rely in class and laboratory work be up-to-date. More frequently, however, the inquiry comes from the engineer in charge of the electrical equipment of a manufacturing plant, with enlargements in view; and while suitable protection must be provided for the smaller units at first employed, the protective devices are required to have sufficient capacity and range which will admit of their use after the extension of the plant. In the testing laboratories of generator and motor manufacturers also, with whom it has become the universal practice to test each unit at its full load, and upon stated overloads, circuit-breakers are employed upon the testing circuits in order that the assigned conditions of test may not be exceeded. Where units of greatly varied capacities are tested, the number of breakers required may be minimized by the employment of types with the widest possible range and relatively high current-carrying capacity.



A TESTING CIRCUIT-BREAKER.

The illustration shown herewith was made from a circuit-breaker recently built for the testing laboratory of a large manufacturing establishment. It has a normal rating of 1,000 amp, which it will carry continuously without heating over 20° C. While somewhat similar in construction to the standard apparatus, the solenoidal magnet has been replaced by a peculiar form of horseshoe magnet, concealed beneath the housing. By this construction a special range of adjustment is attained, namely, from 150 to 1,500 amp, and it operates satisfactorily for any voltage of 750 or less. The tripping mechanism is so designed that the restraining latch is acted upon with great positiveness at all points within its especially wide range. The adjustment is readily effected, as will be seen by referring to the illustration, and is constant throughout. The calibration scale being nearly four inches long, the divisions are of ample size for convenient reading. It will be noticed that the scale is horizontal instead of vertical (as is usual), and is upon the front of the circuit-breaker, where it may be conveniently read from a distance. The same form of construction has been applied to instruments of larger capacities, where even greater proportionate ranges may be secured.

Cosmo Railway System.

An operative model of the Cosmo railway system has been on exhibition at 307 Fifth Avenue, New York, where it has been inspected by many railway men. The system is notable for its comprehensiveness, and the many functions which it performs would seem to provide for every contingency in the safe operation of a railway.

The system is designed particularly for use in steam railway yards and elevated and tunnel electric roads, and embraces many interesting and novel features. It includes two methods of moving trains, i. e., by the third-rail system and by the overhead contact system. In connection with either one there is an automatic block signal system, a multiple-unit system of control, magnetic brakes and a despatcher's selective control system.

On page 698 of our issue of April 19, 1902, was given a brief description of the overhead and signal systems, which were then on exhibition in New York. Other features have since been added with a view to making the system more comprehensive and meeting the more exacting requirements of practical work, particularly on suburban lines, whether on the surface, underground or overhead. The overhead and signal systems have not been materially changed since the time of the earlier exhibition, therefore the description of them will apply in the present case, without repetition.

In the third-rail system the current for the operation of the automatic signal apparatus is derived from the third rail through an auxiliary contact, thus obviating the necessity of carrying storage batteries on the cars, or locomotive. The signals and the method of their operation are precisely the same as described in the former article, and indicate to the engineer, or motorman, as the case may be, the nature of an obstruction ahead, whether it be a broken rail, an open bridge or a train on the same block.

One of the most interesting features of the system is the despatcher's selective system of controlling cars or trains out on the line. It provides means for communicating with any office on the line telegraphically by selection, and stopping a car anywhere on the road by simply cutting off its supply of current by means of the same selective apparatus. Each telegraph office is equipped with a recording register similar to a stock ticker, upon which any communication to the agent or operator may be recorded, whether the attendant is present or not. Since the instrument operates only when it is selected by the despatcher, it is not in circuit at other times. The system is, therefore, a secret one, and no office can get a despatch not intended for it. The entire line is under the control of the despatcher at all times. If one office desires to communicate with another the despatcher, upon receiving proper request, makes the necessary connections by simply inserting a plug in the proper hole in the selective keyboard.

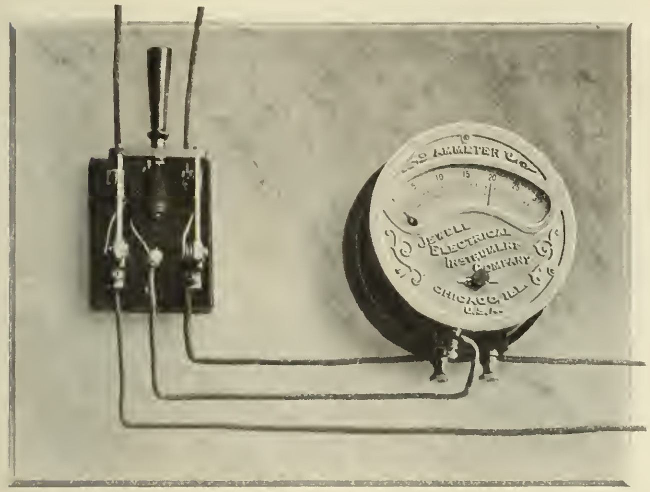
In case the despatcher wishes to stop a train at a station that would otherwise be passed without a stop, he puts a plug in the proper opening which in effect cuts off the traction current supply at the station. After this is done and the train is brought to a halt orders for the train crew are transmitted as above.

In the operation of the model the two trains, with which it is equipped to represent actual working conditions, were under perfect control at any point along the line, and to further represent an actual road, crossings, switches, etc., were also provided. The readiness and ease with which the rear train was brought to a standstill when the block ahead was not entirely clear, and then started up again when it became clear, give one the impression that collisions are entirely avoidable. The model is 41 ft. long and 14 ft. wide and every part is made to scale.

Mr. Robert J. Sheehy, the inventor of the system, will sail shortly for England, where, he states, the system is to be installed on an English road. He will take the model with him and exhibit it in practical operation for the benefit of English railway men.

Jewell Circuit Breaking Ammeters and Voltmeters.

An interesting and useful combination of circuit-breaker and ammeter has been made by the Jewell Electrical Instrument Company. This combination, for circuits of small capacity, is illustrated herewith. The ammeter is one of the Jewell "baby" type of instrument and is provided with contacts, so that when the needle of the instrument swings above the point for which the circuit-breaker is set, a circuit is closed which energizes a magnet and trips a double-pole switch in the main circuit. For larger circuits, the regular circuit-breaker with carbon breaks can be used in connection with the instrument. The contact arm of the instrument is set at any desired point on the scale by revolving a milled head on the front of the instrument. It will be evident that this device can be used as an underload as well as an overload circuit-breaker, by providing two contact arms instead of one, one of these always remaining below and the other above the index needle. The same device applied to a voltmeter can be arranged so that an excess of voltage or an absence of voltage will open the switch.



CIRCUIT-BREAKING AMMETER.

An application of these instruments which at once suggests itself is that of automatically opening the charging circuit through a storage battery. The charging circuit can be opened either by the underload contact of the ammeter, thus cutting out the cells when the current falls to the minimum desired, or by the over-voltage contact of the voltmeter opening the switch when the voltage of the cells reaches the maximum, thus preventing the overcharge of the batteries.

It is said that a circuit-breaking instrument of this kind affords a much more accurate and sure method of opening the circuit at any predetermined point than the circuit-breaker coil on an ordinary circuit-breaker, which has to work against a certain amount of friction which is uncertain in quantity.

Where tools are driven by electric motors, they are often worked in excess of the rated capacity for some time, simply because of the ignorance of the operator of the machine as to what current is being taken. If the operator has a reliable instrument indicating at all times the power he is using, together with a circuit-breaker which stops the motor in case too much is used, there is almost absolute protection against burning out of the motor by overload. These circuit-breaking ammeters and voltmeters are made by the Jewell Electrical Instrument Company, of Chicago.

Power Transmission at Clermont-Ferrand, France.

An interesting hydroelectric plant is now being installed by the Gas Company of Clermont-Ferrand, to reinforce their existing electrical plant. The new works are situated on either side of the River Sioule, below the dam, which will be 30 m in height with a maximum width of 25 m, forming a lake about 6 km long, with an average breadth of 120 m and a surface of 100 hectares. Independent pipe lines fixed in masonry will supply each turbine, the turbines will be six in number, of 1,000 hp each, of the horizontal axle "Francis" type. They are made for a head of 20 to 25 m, with a minimum quantity of water 6 c m per second. At such times as after a heavy thaw, the river can supply as much as 500 c m per second. Each turbine will be connected to a three-phase alternator of 800 kw at 1,000 volts, 50 periods and 333 r.p.m. The two exciters of 37.5 kw each are driven by small auxiliary turbines. The voltage will be stepped up to 20,000 by means of Westinghouse monophase transformers, grouped in threes.

The overhead transmission line will be double, and about 45 km in length. Poles and cross beams will be of wood, the latter being boiled in paraffin and then covered with a layer of tar. The setting up of the line, as well as the construction of the electrical and mechanical apparatus, has been undertaken by the Société Anonyme Westinghouse, of Havre. The hydraulic part of the work has been hurried forward during the last year and is now well advanced, while the mechanical and electrical equipment is just finished. Power will be sold at Clermont-Ferrand, which is a great center for the rubber trade, for both lighting and power, and considerable development of the existing works will be expected with the advent of a power so simple and so cheap as electricity.

Improved Dry Batteries.

A variety of types of their dry battery and of apparatus applying it have been put on the market by the Hydra Battery Company, of 70-72 Reade Street, New York city, two types of whose cells are herewith shown. This semi-dry form of battery was introduced from Germany, where it was perfected by Prof. P. Schmidt, C. Koenig and R. Krayn. The cell comprises a cylinder of zinc closed at the bottom end and open at the top, holding in its interior a special liquid electrolyte, and connected by an insulated wire to the outer thick zinc cylinder. The zinc cylinder is placed within the carbon cup with an absorbent paste depolarizer between the two surfaces, the cup having a terminal at its upper end and its lower open end sealed up with pitch. Outside the carbon cylinder is a dry-pressed generating depolarizer inclosed in a network of linen, which is encircled by the outer zinc from which the other terminal rises to the top of the cell. Over all the elements at the top is saw-dust and absorbent cotton, and from this rise vent tubes which pass through the asphalt top. The whole is enclosed in a thin outer metal or wood casing insulated from the outer zinc cylinder by which the battery is protected from dampness and other injury. A small chamber in the carbon cylinder at the top just above the inner zinc allows the electrolyte in the latter to overflow occasionally and keep the absorbent paste slightly moistened. The moisture thus absorbed passes through the porous carbon to the dry absorbent, thereby maintaining it in proper condition for the generation of a current when the terminals of the battery are connected. The perfectly dry condition of the generating depolarizer prevents any local internal action when the cell is not in use. The double surface of zinc provided by having an inner and outer zinc cylinder as well as the depolarizing material on the inner and outer side of the carbon cylinder, give the battery a remarkably constant voltage, low internal resistance and high capacity,

DRY BATTERIES.

with the added advantage that the moist electrolyte is brought to the relief of the decomposing paste, keeping it permanently humid, giving the cell excellent power of recuperation after long use.

These batteries are already coming into large application in this country, and abroad have, it is said, been adopted by five European governments. The literature of the company includes in its descriptions not only various forms of cell, but special groupings for automobiles, spark coils, etc.

New "International" Telephones.

A variety of new and ingenious apparatus has just been placed upon the market by the International Telephone Manufacturing Company, of Chicago. The portable telephone, as a rule, having more hard usage and careless handling than any other instrument in a telephone system, is most subject to becoming out of order. The International desk telephone (shown in Fig. 1) was designed with a view of securing a neat-appearing, convenient and reliable and durable instrument. The pedestal is an artistically-designed stand of heavily nickel-plated cast brass. It is hollow, to allow the transmitter cords to pass through it. The standard and bottom are clamped firmly together with a heavy binding nut in the base. All exposed parts of the instrument are strong, smooth and solid, and are made of nickel-plated brass.

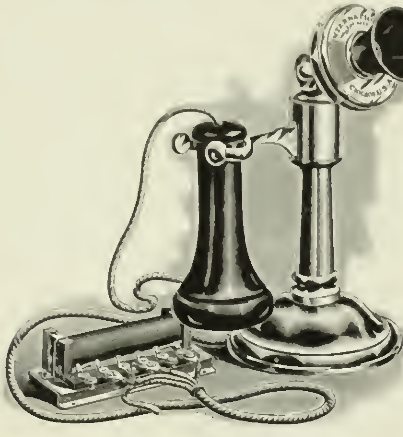
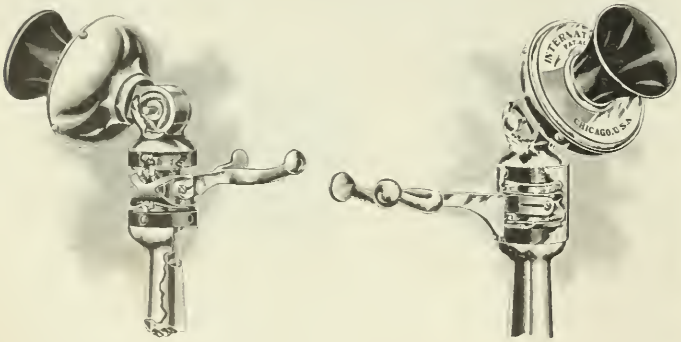


FIG. 1.—DESK SET.

The entire switch in the desk set is built in the spring post or head of the pedestal (as shown in Figs. 2 and 3). The spring post can be readily removed from the pedestal and all parts conveniently inspected. The switch and restoring springs are mounted on hard rubber blocks, supported by the spring post and are completely enclosed with a dust-proof cover. The contact springs are all long and are made from the best German silver, and are provided with platinum contacts. The hook is provided with an insulated pin near its base, to which the restoring spring is connected. This insulated pin is provided at both ends with platinum contacts, which make and break the connection when the hook is raised and lowered. This connection gives a switch in which the platinum contacts make a clean, positive sliding connection and require but a very small movement of the springs.



FIGS. 2 AND 3.—DETAILS.

The hook restoring spring is so designed that it has three inches of heavy spring German silver for a restorer, making the switch very active and durable. The springs are firmly clamped with heavy, specially stamped nuts, fastened with machine binding screws passing through the rubber block from the opposite side. All binding screws are threaded into metal, leaving no binding screws depending on threaded rubber. The hook takes its bearing in the spring post on special steel screws. These screws are not pivot screws, but extend into the post and form a bearing fully 3/16 of an inch in length. The back of the hook, where the steel bearing screws enter, is slotted and is firmly clamped to the screws to prevent any possibility of the bearing working out or becoming loosened. The hook stops directly on a heavy brass screw that is shouldered against the brass spring post to make an absolute and positive stop and avoid any liability of weakening or breaking the lower contact spring.

The movable head or lug is provided with a concealed stop of the same design as in the knuckle-joint. All springs and connecting wires are entirely enclosed and perfectly insulated, positively leaving no exposed metal parts to form a part of the circuit at any time. All exterior or visible parts are of heavy, smooth brass and are nickel-plated and highly polished.

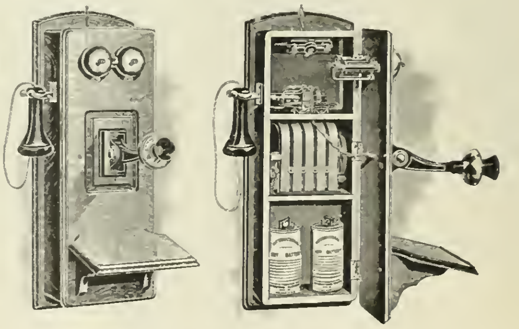
The International generator-call wall telephones are especially designed for rural village exchanges and heavily loaded country party lines where any and all small trouble in a telephone system is very annoying and invariably costs seriously for removal. The type shown in Fig. 4 is neatly designed, compact and strongly built. Fig. 5 shows the instrument open. The lightning arrester, line terminals and ground post are mounted inside at the top of the box. The arrester is of original design and strongly built. The insulated line wires pass directly into the magneto box and terminate at the line posts inside, leaving no room for the wires to become accidentally disconnected or for any foreign material to get into the arrester, short-circuiting the instrument and throwing it out of adjustment.

The hook-switch is of the long lever, gravity type and is provided with a five-inch restoring spring. The switch has no rubbing or scraping parts excepting at the contact points, which form a positive sliding connection. The springs are all insulated with hard rubber and mica, and the hook forms no part of the circuit.

The ringers of the series and bridging instruments are all of the long frame type, allowing change of the ringers from series to bridging by changing the windings on the coils only. This also makes all parts of the various instruments in an exchange uniform throughout. The bell hammer is protected by a nickel-plated guard.

The generator armature cores are laminated and the cores thoroughly insulated with specially prepared linen and wound with silk-covered wire. The pole pieces are of extra soft malleable iron, and the bearings are heavy brass castings and are provided with oil cups. The permanent magnets are evenly bent from heavy bars of the highest grade of magnet steel and strongly magnetized.

The main gear is as wide as practicable and has a wide face, evenly cut, to insure its running smoothly and practically without noise. The small gear is of hard steel to give it wearing qualities equal to the large gear. This gear is provided with a spring and is flexibly attached to the armature shaft so that the armature cuts the fields quickly without any jerking when turning the generator. The ends of the armature are provided with a fibrous guard to prevent oil or other foreign material getting into the armature winding. The

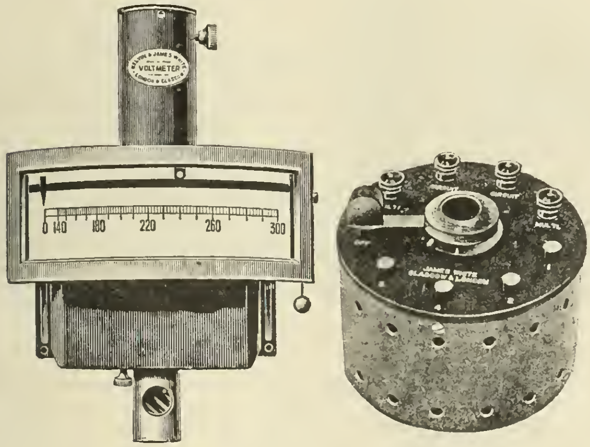

FIGS. 4 AND 5.—WALL TELEPHONE.

generator is equipped with a positive shunt, which is provided with a spring, short-circuiting the armature when in its normal position, to avoid burn-outs from lightning or other heavy electrical currents. It is also provided with heavy terminals, mounted so that connections may be conveniently made.

All the International telephones are equipped with the company's regular double-pole adjustable horseshoe magnet receiver and long-distance adjustable transmitter, both of which are well known in the telephone field for the high-class work in their construction and their clear and distinct working. Their form of construction leaves absolutely no connecting wires, terminal screws or binding posts or any metal parts to form any part of the circuits exposed.

Kelvin Electrostatic Voltmeters.

An improved switchboard type of the Kelvin multicellular electrostatic voltmeter has lately been put on the market by Messrs. Kelvin & James White, Limited, of Glasgow, Scotland. It has been thought by some engineers that these instruments are too delicately constructed for ordinary switchboard use, but there is hardly a central station in Great Britain which has not one or more instruments of this class fitted on the board, and experience has shown that there is far less trouble through breakage with this class of instrument than with others in use. The only objection to the more universal use of this instrument has been the shortness of the scale obtained, but in the improved form this difficulty has been overcome, a scale of 6 in. and even 10 in. being used. The 6-in. instrument is approximately the same size as the older pattern, and this increased scale has been obtained without in any way increasing the distance which the instrument projects from the board. The method of supporting the instrument has also been improved, Lord Kelvin's well-known method of the hole, slot and plane being used so that the instrument can be quickly and accurately leveled.



FIGS. 1 AND 2.—ELECTROSTATIC VOLTMETER AND MULTIPLIER.

Fig. 1 shows the 6-in. switchboard form of instrument having a range of 140 to 300 volts, but any range from 80 to 1,400 can be obtained on this particular form. For higher ranges where the full pressure is connected directly to the instrument, another type is used, but the form illustrated can of course be employed with a potential transformer.

The accuracy guaranteed for these instruments is $\frac{1}{3}$ of 1 per cent., which is sufficiently good for switchboard work. A valuable adjunct to these instruments is a multiplier lately put on the market by the same firm. This multiplier enables any desired range to be obtained on one instrument, but the standard multiplier (Fig. 2) gives four ranges from 30 to 600 volts.

Steam Distribution From Central Stations.

The American District Steam Company, of Lockport, N. Y., originator and patentee of underground system of steam distribution, has built over 250 steam-heating plants in different cities in the country. It reports that during the past year it has installed over thirty-five new underground steam-heating plants, besides making extensive additions to ones previously built. The majority of these have been built for electric current supply companies for the utilization of the exhaust steam for heating purposes.

The subject of exhaust steam heating appeals especially to electric and power companies, which regard their exhaust steam as a wasted by-product, or one from which they get small compensation by the use of condensers. It is the impression of some that exhaust steam is saturated with moisture and that it does not contain an equal number of units of heat as compared with live steam. This is a fallacy. Steam of equal pressure has equal temperature. It is demonstrated from actual experience that the exhaust steam from each 100 hp of engines operated, will heat from 1,000,000 to 1,300,000 ft. of space in average buildings, in zero weather.

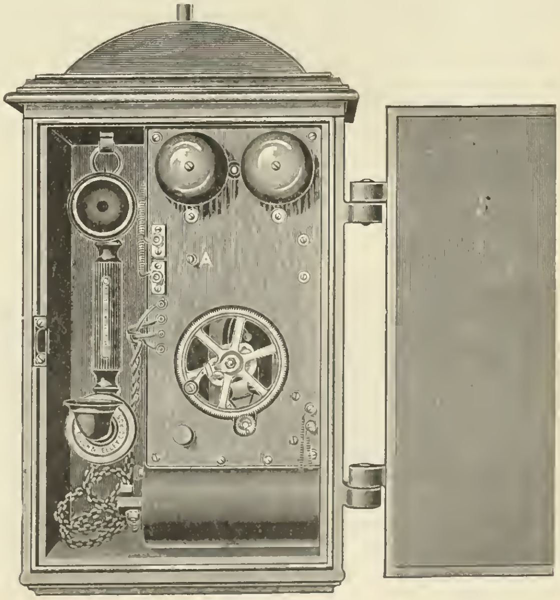
Electric companies operating exhaust steam heating report that the receipts of the sale of steam are enough to pay all their fuel and labor bills for the entire year, and interest on the investment for the steam mains. The great advantage of district steam heating over any other system is that buildings already piped for steam, or hot water heating, and having their own boilers, can be connected with the steam mains without any change in the piping of the building.

The American District Steam Company also manufactures a meter for use in recording the amount of steam used in each building, which is very accurate and inexpensive, and is being used very generally by companies operating a district system of steam distribution.

During the past year the business of the company has grown so rapidly that it was necessary for it to double the capacity of the works both in Lockport and North Tonawanda, N. Y. The company is just now engaged in installing exhaust steam-heating plants in Baltimore, Md.; Birmingham, Ala.; Paducah, Ky.; Rockford, Ill., and is shipping material for a large extension of steam mains to the plant installed by it at Atlanta, Ga., some two years ago. It is also making several other extensions in other cities.

Iron Box Telephones.

We illustrate herewith a telephone specially designed for street railway work. It consists of a very heavy iron box containing a complete telephone with a very powerful signaling equipment. These instruments are made weather-proof and practically damage-proof. When the door is closed it engages with the pin marked *A* in the cut and disconnects the entire apparatus from both sides of the line. This not only prevents "burn-outs" from lightning and crossing of line wires, but allows of an infinite number of stations being put on one pair of wires, as only the station in use is connected across the line at any time. The hand micro-telephone, combining both receiver and transmitter, has been found to be peculiarly well adapted for this particular work. It allows of the box being supported a good distance from the ground and yet it can be used by



IRON BOX TELEPHONE.

either short or tall people with equal convenience, while as the construction compels the person using it to speak directly into the mouthpiece good transmission is assured.

This particular style of box is being installed by a large number of the prominent trolley roads on the turn outs, and is said to be very satisfactory. It is manufactured by the Couch & Seeley Company, Boston, Mass., who also make other forms of telephones with an iron housing, suitable for mines or other places where it is necessary to locate a telephone amidst damp and dusty surroundings.

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Electric Hoists for Docks and Wharves.

Electric motors are fast displacing steam engines and shafting on account of their economy in operation, and nowhere is this saving more apparent than in intermittent hoisting work such as that in handling freight at docks and wharves. With electric hoists there is no loss due to condensation in long steam pipes, which loss frequently amounts to 25 per cent. of the power used, and there are no pipe lines with joints to be kept tight as with steam engines. With shafting the loss in transmission of power due to the friction at the bearings is very high. At one steamship dock in New York City, it was estimated that it took three tons of coal per day to run the shafting alone. This loss is practically eliminated with electric power.

An electric hoist may be stationary on the wharf where a great deal of work is to be done, or its base carried on wheels, or it can rest on a small wagon. If the hoisting is to be done along the face of a dock the hoist may be mounted on a narrow-gauge railway car, the track for which extends the length of the dock. For supplying power to portable hoists the electric mains are run to boxes stationed at intervals.

With a cable having a plug terminal which is inserted in the box, the hoist can be moved anywhere within the radius of the cable; beyond this the plug is inserted in another box. Such a hoist is shown by Fig. 1 and built by the C. W. Hunt Company, West New Brighton, Staten Island. A 500-volt street railway type of motor is employed for driving. Either direct or alternating-current motors of any commercial voltage may be used.

The three essential parts of the hoist are the rope drum, the gearing and the electric motor. These are made in a series of sizes, and by a suitable combination of each a hoist of any desired capacity and speed, within the limits of modern practice may be built.

There are four factors that materially affect the size and cost of the hoist, namely the load, the speed, the height to which the load is hoisted and the frequency of the trips. These factors affect the size, operation and cost in the following manner:

If the load is increased, the size, weight and strength of the mechanism will be increased; that is, a larger size must be used. If the velocity of hoisting is increased, the size and power of the motor will be increased, the other parts remaining the same. If the height to which the load is hoisted is increased, the drum must be increased to hold a longer rope, the motor remaining the same. If the frequency of the trips is increased, the size of the motor will be increased, the other parts remaining the same.

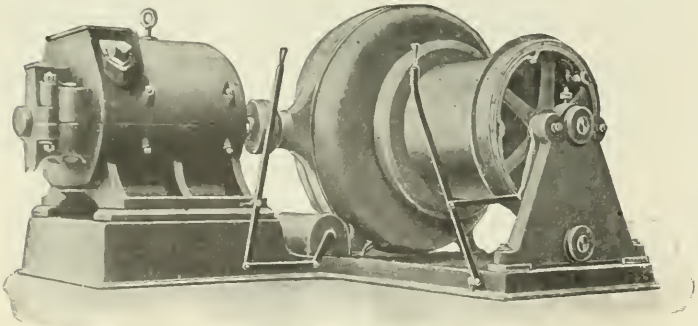

FIG. 1.—ELECTRIC HOIST.

There are three methods of operating electric hoists: 1. Running the motor continuously, hoisting the load by throwing in a friction clutch and lowering by a band brake. This method is suitable either for alternating or direct current motors. 2 Starting and stopping the motor for each lift, lowering by a band brake. This is better suited for direct current than alternating motors. 3. Running the motor forward to hoist and backward to lower. A direct-current motor, with reversing drum and switches is used for this work. The mechanism of the hoist is so arranged that any size or make of electric motor may be used. The motor is connected to the hoist by a flexible insulating coupling.

The great flexibility of electric transmission allows hoists to be installed to advantage in many situations where it is difficult or inexpedient to use steam-driven machinery. One of the great advantages is that the expense for power begins only when the hoist is started, and entirely ceases when the motor is stopped

The illustrations show two types of electric hoists, built by the C. W. Hunt Company for this particular class of work, and which possess the advantages enumerated above. The remarkable convenience of electric hoists for use on docks and wharves have been found an important element in their favor. They are always ready for service by simply switching on the electric current for driving the hoist. When loading or unloading is completed the switch is opened, and the operator can leave the machinery at once.

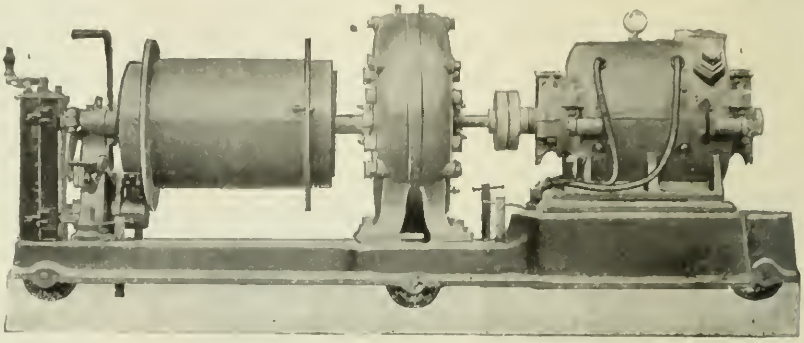

FIG. 2.—ELECTRIC HOIST.

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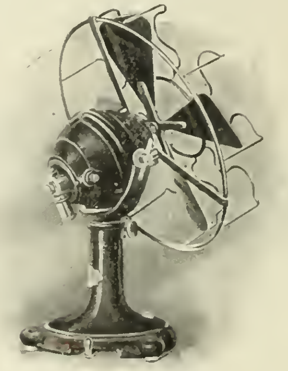
Lundell Fans for 1903.

The Sprague Electric Company has brought out its 1903 model of electric fan, as shown herewith, being along familiar and approved lines of construction. Lundell fans have always sold readily, and given universal satisfaction because of economy in current consumption, great durability, quiet running and attractive appearance.



ONE OF THE 1903 FANS.

The motor is of the single field coil type, of great simplicity and compactness. A single coil energizes directly both pole pieces and the armature. The motor has a strong torque, which permits the use of fan blades with considerable pitch, thus driving a large volume of air with a minimum amount of current.

The self-feeding oil cups invented by Mr. Lundell have proved so successful that to-day they are a standard feature in fan motor design.

The Sprague Electric Company has already received large orders for this season's supply.

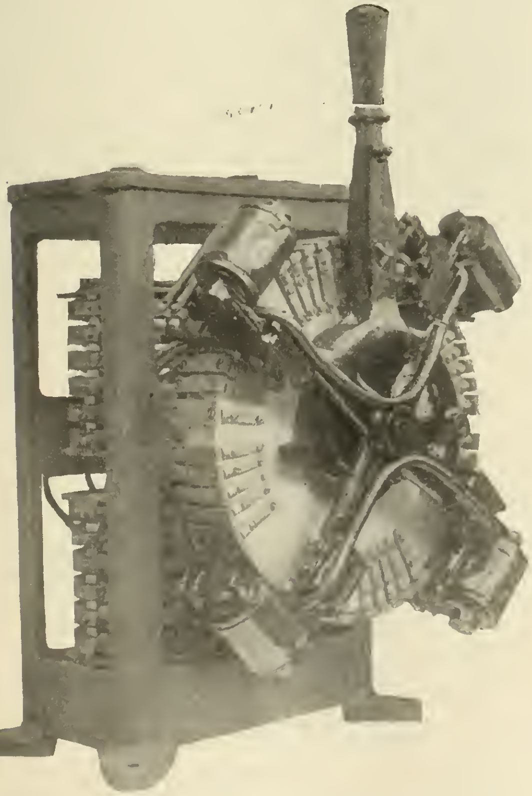
Regulating and Reversing Controller for Direct Current Motors.

For the control of direct-current motors operating cranes, hoists, etc., and similar appliances requiring variations in speed and frequent stops and reversals, the Westinghouse Electric & Manufacturing Company has placed upon the market an improved controller of the commutator type which has been designed especially for this class of work.

This controller is similar to the Westinghouse commutator type controller which has been in general use for some years, but embodies several changes and improvements. The necessary resistance is mounted inside of a cast-iron frame, on the outside of which is attached the commutator, or contact dial, for regulating the amount of resistance in circuit and for reversing the motor.

In the smaller sizes the resistance is of the ventilated cell type as shown in the cut. This construction is the same as that used in the Westinghouse standard railway controller resistance, a service where its efficiency and durability have been proved by years of the hardest usage. The resistance in the larger sizes consists of cast-iron grids of very durable construction. These grids are capable of withstanding very severe use, it being practically impossible to burn out or otherwise injure them. They are also the same as those used in railway service.

The contact dial is made up of copper contacts which are fastened to the periphery of a circular stone of good mechanical strength and toughness, affording a firm support and giving excellent insulation for the parts. The contacts are simple and so made that they may be easily renewed when injured by wear or any possible arcing. Their total makes possible a correspondingly large number of steps of resistance, giving a very gradual regulation to the motor.



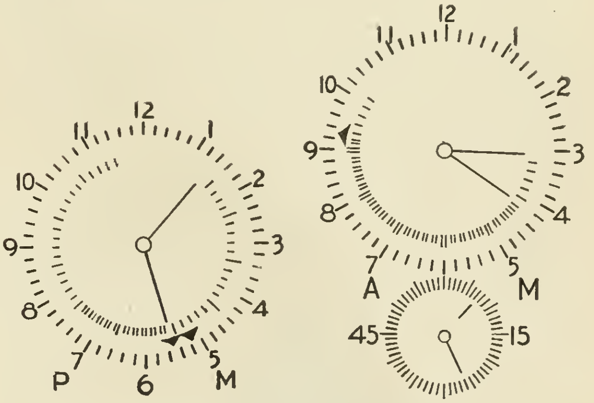
REGULATING AND REVERSING CONTROLLER.

The brush-holder is fitted with four contact arms, which, when the circuit is opened, divide the arc into four breaks. Each contact arm is provided with a powerful blow-out magnet, which reduces the arcing to a minimum and makes the maintenance of an arc impossible.

The whole construction has been made as compact as possible, every care being used to make this controller peculiarly applicable to crane use, while it answers equally well for the operation of elevators, hoists, and other classes of work where series motors are used intermittently.

Calculating Automatic Time Stamp for Telephone Switchboards.

No argument is necessary to prove the advantages to be gained by the employment of an accurate automatic time-recording and calculating machine in connection with the operation of telephone toll lines. A new invention for this purpose called the Timemometer is being put upon the market by the Automatic Stamp Company, of 160 Congress Street. Boston, Mass. The timemometer is the invention of Mr. John C. Wilson, of Boston, Mass., and is an adaptation of the automatic time stamp, to print the exact hour, minute, quarter minute or second, A. M. or P. M., and the date when a toll line conversation begins and when it ends, and to calculate and print the elapsed or intervening time to a quarter of a minute, or to the exact second as required.



FIGS. 1 AND 2.—AUTOMATIC TIME STAMP.

FIGS. 3 AND 4.—TWO STYLES OF TIMEMOMETERS.

The Timemometer is made in three forms, one of which, model No. 3. is shown in Fig. 3. Models No. 1 and No. 2 may be fitted with either wheel or type-dating devices, while model No. 3 is restricted to the use of the latter. The other models are shown in Fig. 4. In timemometer model No. 1 the time is not visible, while models No. 2 and No. 3 are provided with visible clock dials and with hands which move in unison with the time printing hands, these machines thus serving both as time pieces and stamps.

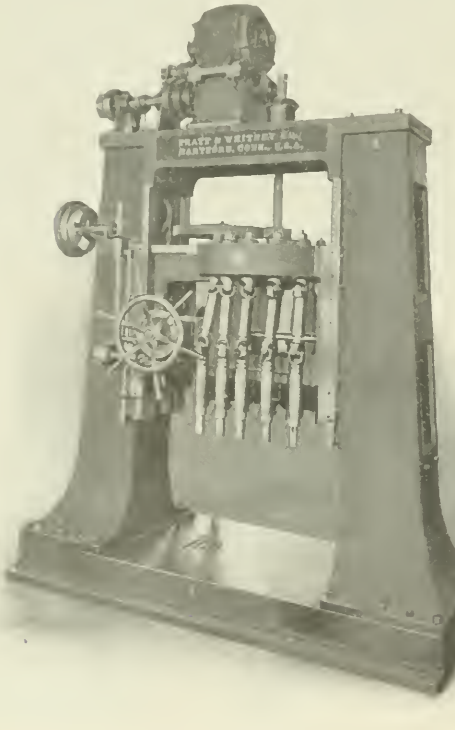
Model No. 2, although generally similar to model No. 1, is larger and has its visible clock dial placed perpendicularly in front, while model No. 3 is rectangular in shape and has a visible clock dial in a horizontal position on top. Models No. 1 and No. 2 print upon the bottom of the toll ticket, and are operated by a blow, while model No. 3 prints upon the top of the toll ticket, and is operated noiselessly by a press lever, which moves the ink ribbon forward automatically at each operation. Either model may be used also as an automatic time stamp for time stamping letters, telegrams, orders, etc.

Model No. 3 is especially adapted to be fitted into the telephone switchboard shelf, so that its base will be on a level with the shelf, the operating lever being underneath the same; or it may be placed upon a pedestal or other suitable support. Its ink ribbon is 24 ft. in length, and feeds automatically and a new ribbon may be easily inserted at any time.

The machines are all very strongly made and finely finished. The clocks are good timekeepers, are enclosed in dust-proof cases, especially model No. 3, and are not interfered with in the slightest degree by the operation of printing. Models No. 1 and No. 2 do not print seconds, but are arranged to print the actual time and the elapsed time to a quarter of a minute upon a toll line slip or ticket, as shown in Fig. 1. Model No. 3 may be arranged to print a time record similar to that of models No. 1 and No. 2, or to print the actual time and the elapsed or intervening time to the exact second, as shown in Fig. 2.

Adjustable Multi-Spindle Drill.

The Pratt & Whitney Company, of Hartford, Conn., has added a number of new types of adjustable multi-spindle drills to its already long list of machinery designed for drilling simultaneously a number of holes in electric car motor frames, automobile hubs, flanges and other work of a similar character. The whole series of these machines have been remodeled, making them more rigid and convenient to handle than before and some new features have been added, making the machines more suitable for general use. The standard heads are built in two shapes, square and rectangular.



MULTIPLE-SPINDLE DRILL.

The new type, which is illustrated herewith, is one designed especially for drilling ten holes simultaneously in the steel frames of electric railway motors. The drill head is counterbalanced by weights within the columns, is fed automatically and has an automatic stop for the feed motion. The adjustment for position of the head is by hand. The spindles are all driven through universal couplings from the center gear and may be set in any required position by means of adjustable arms clamped to the under side of the drill head. The spindles are made to take the No. 4 Morse taper shanks and have ball-bearing thrust collars. They have an independent vertical adjustment by rack and pinion of 4-inch in order to compensate for different lengths of drills or to enable the drilling to be done at different levels, if desired. The vertical travel of the drill head is 24 inches.

The largest cluster of holes which this machine with a rectangular head will drill is a rectangle 40 inches by 32 inches, the smallest, a rectangle 24⅝ inches by 13½ inches. With a circular head the largest cluster is a circle 37 in. in diameter and the smallest a circle 18 inches in diameter. The least distance between any two spindles is 4¾ inches and the greatest distance between the ends of spindles and base plate is 52 inches, the surface of the latter being 62 inches by 50 inches. The weight of the machine is 28,000 pounds. This machine is selected merely as a type of the class of machines built by this company and applicable to electrical manufacturing purposes. A number of these machines are already in use in electrical manufacturing plants.

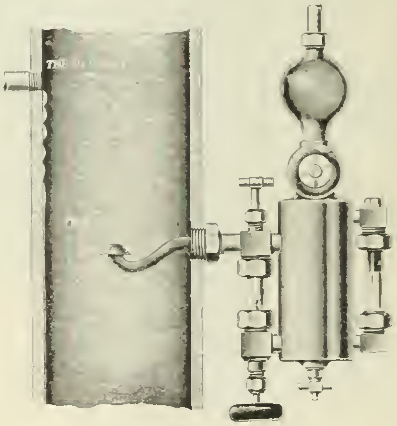
Cylinder Oil Atomizer.

The device shown herewith has for an object to atomize the cylinder oil fed to an engine so that the steam will carry it to all parts. By this means it is claimed a saving of oil is accomplished, a perfect lubrication is maintained and there is less oil to be extracted from the exhaust in order to use the condensed steam again.

The device delivers the oil in a thin sheet to the steam having the greatest velocity, distributing the oil in a vapor through the steam and delivering it to all parts of the cylinder, thereby oiling the upper part as well as the sides, and so effectually that it is claimed one-half the oil ordinarily used will, with this device, oil the cylinder better than the amount usually required.

This cylinder oil vaporizer consists of a bronze casting so shaped that the outlet is on a level with the inlet opening, one end of which is tapped into the steam pipe, as shown in the cut, which end is also tapped for the lubricator or oil pump. The action of the device is as follows:

Oil flows in from the lubricator and, passing through the body of the vaporizer, is heated to the temperature of the steam. By the time it reaches the outlet at the top of the cone it is sufficiently thin and limpid to spread out over the surface in a thin film, and as it reaches the lower edge of the cone is carried along with the steam. This cone is always small enough to go through the opening in the steam pipe; all the work necessary to install it is to unscrew the lubricator connection, tap the pipe for the atomizer, screw into place, then screw the lubricator back into the atomizer.



OIL ATOMIZER.

This atomizer is the invention of Mr. C. E. Sargent, Chicago, and is manufactured and for sale by the North Chicago Machine Company, North Chicago, Ill.

Automatic Electric Pump.

The accompanying cut shows a new electric pump manufactured by the Automatic Electric Pump Company, 170 Broadway, New York. The water cylinders are of the standard double-acting duplex type used in pumping machinery for many years; the pistons have flexible packing which may be cheaply and quickly renewed when necessary. The mechanism for driving the pistons, and for transmitting the power of the motor to the pump, are combined and enclosed in a case containing oil enough to run a year without refilling. By this means the necessary lubrication of all working parts is automatically secured. The motor, as may be seen, is connected directly to the pump, without the intervention of belts, spur-gearing or similar devices.

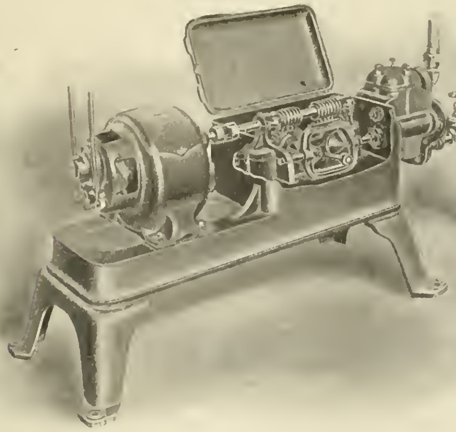


FIG. 1.—ELECTRIC PUMP.

As illustrated very clearly in the cut, the power of the motor is transmitted through a shaft and double worms to double-worm gears, and from cranks upon one of these gears to the yoke pieces which are connected to the piston rods. This makes an absolutely noiseless mechanism, and the double worms and gears eliminate all end thrusts. In fact, the mechanism is such that it dispenses with any necessity for attention or mechanical skill, which especially suits it for domestic service. These worms reduce the high speed of the motor to a moderate speed for the pump, thus insuring a smooth and noiseless pumping action. The motor is connected to the pump by means of a universal compensating clutch, securing flexibility to the motor and worm shafts, and avoiding friction loss.

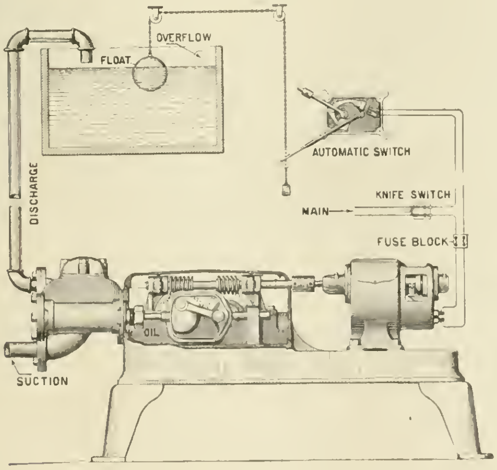


FIG. 2.—VIEW OF PUMP AND CONNECTIONS.

A very important feature in the installation of these pumps is the electric switch placed at the tank for starting and stopping the pump automatically. Thus the tank is always kept full without requiring the services of an attendant. Of course, this is only necessary where automatic operation is required, as the pumps are especially advantageous for any class of pumping, whether or not automatically controlled.

Every pump comprises a bed plate, with the pump, motor and mechanism, properly assembled and bolted thereon, ready for starting, and is mounted upon four legs ready to be set in place where desired without any foundation or preliminary work or expense. For this reason the pump as shipped can be located, connected up and started as soon as received without any delay, labor or expense other than that required for the requisite wiring and piping.

De Forest Wireless Telegraph Company.

The De Forest Wireless Telegraph Co. of Canada has been incorporated in Toronto and two stations at Toronto and Hamilton, 40 miles apart over the lake, have been opened and are now in commercial operation. A public demonstration accompanied the opening of communication at which there were present city officials, professors of the Toronto University, officials of the Canadian Pacific, Grand Trunk, Canadian Pacific Telegraph, Great Northern Telegraph Company, and others. It is reported that several prominent men of the Canadian General Electric Company are financially interested in the enterprise, and that the Canadian Company proposes to establish communication on the Pacific Coast from Vancouver north, ultimately reaching Dawson, and is endeavoring to secure governmental subsidy for this work. Stations are also to be opened by the Canadian Company this spring on Lake Huron. It is stated that signals have been received at Toronto from the Glace Bay Station.

The De Forest Company announces that it has purchased land on the lake at Buffalo, Cleveland and Grosse Isle, Detroit, and that stations are now under way at these three cities, that at Buffalo to be completed first. All three of these stations are to be of 10-hp and will comprise two masts at each station, each of 200 feet in height, placed 100 feet apart. Between the tops of these masts a horizontal wire supports 20 vertical wires which converge into the station house placed midway between the two masts. The plans of the company are to carry on private "leased wire" service between these three cities, and it is stated that arrangements have already been completed with newspapers in Cleveland and Detroit for transmitting their local news at night between these cities.

It is also annonced that a contract for equipping the boats of the Cleveland and Buffalo line has been obtained. The Detroit and Buffalo line boats will make use of the service upon the completion of the Detroit station and it is hoped to have wireless apparatus on a large number of lake carriers before the close of this season, and to get the above three stations into operation early in May, after which other small stations will be erected at Port Huron, Sault Ste. Marie, Mackinac, Marquette and Duluth. It is stated that a site for the Chicago station has been obtained near Evanston, and there a tower of 200 feet in height will be erected, to be followed next year by two others of similar height, the three to comprise a very powerful station for operating with St. Louis during the World's Fair. The Chicago station will completely cover Lake Michigan, Milwaukee and St. Joe being also in the circuit. At White Fish Bay and Grand Island, Lake Superior, are harbors of refuge into which vessels are frequently driven by storm, and where they lie sometimes for several days without means of communicating with their owners. It is under consideration to connect these two points with the Soo and Marquette respectively by wireless during the summer.

A demonstration plant has been installed at Armour's stock yards and another station upon the roof of the Home Insurance Building, La Salle Street, Chicago, where are Armour's general offices. The officials of Armour & Co. are reported to be much interested in a proposition to connect their offices at Chicago and Omaha, and from Omaha to Kansas City, as with wireless telegraphy they will be enabled to save several thousand dollars per year which is now paid for leased wires to the Western Union Telegraph Company. It is expected that the Northwestern Commercial Company of Seattle, Wash., will establish communication by this system with its stations in Eastern Siberia.

NEWS OF T K.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was practically unchanged, there being a good demand for short periods and liberal offerings. The closing rates were 5½@5¾ per cent. for 30 to 90 days, and 5@5½ per cent. for four, five and six months. Several factors of a depressing nature affected the stock market and caused a lowering of prices. The bank statement of the week previous was unfavorable and during the past week the banks lost money to the U. S. treasury on a fairly large scale, while shipments of funds have also been in progress to the interior in answer to the demands connected with April dividend disbursements. In the industrial group Amalgamated Copper was the active member, the stock being successfully raided by the bears, and it declined from 73¾ to 66½. In the tractions, Metropolitan Street Railway received some support, the revelations of the pending court proceedings growing out of the recent vicious attack on the company having a tendency to diminish any feeling of apprehension about its position. It reached 139 during the week, but closed at the lowest figure of the week—134¾—this being a net loss of 2¼ points. The shares sold aggregated 30,800. Brooklyn Rapid Transit was irregular, closing at 65¼, which was 2¼ points below the closing price of the week previous. This stock fluctuated between 64½, the lowest figure, and 68⅛, the highest. The steel stocks were dull and rather heavy. Electrics also showed the effect of the adverse influences which weighed down the general market, General Electric closing at the lowest quotation of the week, namely, 190¼, representing a net loss of 6½ points. Westinghouse is quoted at 207, being a loss of one point, and Western Union 87⅜, a loss of 1⅜. Following are the closing quotations of March 31:

NEW YORK.

	Mar. 24.	Mar. 31		Mar. 24	Mar. 31
American Tel. & Cable.	82	81	General Electric.	192⅜	188
American Tel. & Tel.	163¾	159†	Hudson River Tel.	..	..
American Dist. Tel	35	32	Metropolitan St. Ry.	134¾†	135¾
Brooklyn Rapid Transit	65¾	66	N. E. Elec. Veh. Trns.	⅛	⅛
Commercial Cable.	.	.	N. Y. & N. J. Tel.	164	165
Electric Boat	27	23	N. Y. E. V. T. Co.	9⅛	8¾
Electric Boat pfd	10	37	Tel. & Tel. Co. Am	.	..
Electric Lead Reduction.	2⅝	1½	Western Union Tel.	88	87⅜
Electric Vehicle	8½	8⅝	Westinghouse com.	205	198
Electric Vehicle pfd	14	13	Westinghouse pfd.	200	198

BOSTON.

	Mar 24	Mar. 31		Mar. 24	Mar. 31
American Tel. & Tel	164	158½	Western Tel. & Tel. pfd.	98½	97½
Cumberland Telephone	.	..	Mexican Telephone	2¼	2⅛
Edison Elec. Illum.		..	New England Telephone	138½	139*
General Electric		189½	Westinghouse	102	100
Western Tel. & Tel	22	21	Westinghouse pfd.	..	100

PHILADELPHIA.

	Mar 24.	Mar 31		Mar 24	Mar. 31
American Railways	..	50¼	Phila. Traction	97½	97
Elec. Storage Battery	77*	77*	Phila. Electric	6⅞	6¾
Elec. Storage Battery pfd.		.	Pa. Electric Vehicle	..	..
Elec. Co. of America	9	9	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Mar 24	Mar 31		Mar. 24.	Mar. 31
Central Union Tel	...	..	National Carbon pfd.	98½	98½
Chicago Edison			Northwest Elev. com.	..	..
Chicago City Ry.	212	212	Union Traction	9½	9
Chicago Tel. Co	.	.	Union Traction pfd.	42	..
National Carbon	24½	24⅝			

* Asked. † Ex Dividend.

COMMERCIAL CABLE.—The Commercial Cable Company has filed with the Massachusetts Commissioners of Corporations a certificate of condition as of March 1, 1903. Compared with the previous year it is as follows:

ASSETS.

	1903.	1902.
Cables, land lines, and plants	$37,277,442	$35,539,220
Spare cables, stocks, supplies	418,207	352,714
Patent rights	......	564
Investment in stocks and bonds	4,784,847	4,449,796
Cash and debts receivable	1,191,157	1,498,342
Total	$43,671,655	$41,840,638

LIABILITIES.

Capital stock	$13,333,300	$13,333,300
Debts, bonds, etc.	20,774,771	21,015,717
Reserves	5,794,719	5,111,017
Extension of cables and plant	3,621,334	2,250,000
Balance profit and loss	147,529	130,604
Total	$43,671,655	$41,840,638

ANOTHER HUDSON RIVER TUNNEL.—The Hudson & Manhattan Railroad Company, of New York City, has been incorporated in New York State with a capital of $3,000,000. It is to construct a tunnel railroad approximately one mile long from Broadway and Cortlandt Street underground in New York City and under the bed of the Hudson River to the boundary line of the State of New Jersey, there to connect with the railroad of a New Jersey corporation extending westwardly to a point in Jersey City. The directors are George P Lester, of Bloomfield, N J; Howard Slade and William H Siegel, of New York City; Clinton Graham, of Flushing; Robert Maroney, Charles H. Aron, James Davidson and A. F. Richter, of Brooklyn, and A B. Proctor, Jr., of Boonton, N. J. William G McAdoo, president of the New York & Jersey Railroad Company, which company is to build the trolley tunnel from Fifteenth Street, Jersey City, to Morton Street, New York, is interested in the company chartered.

WASHINGTON RAILWAY & ELECTRIC.—The Washington (D. C.) Railway & Electric Company shows as follows for the year ended December 31:

	1902.	1901.	Changes.
Gross	$2,325,775	$2,162,560	Inc. $163,215
Expenses	1,251,814	1,187,419	Inc. 64,365
Net	$1,073,961	$975,111	Inc. $98,850
Other increase	19,644	16,015	Inc. 3,629
Total income	$1,093,605	$991,126	Inc. $102,479
Charges and taxes	892,476	892,476	....
Surplus	$201,129	$98,650	Inc. $102,479

This includes properties owned and operated. The company represents large traction and lighting interests in Washington.

CONSOLIDATION AT LOS ANGELES.—The Edison Electric Company, of Los Angeles, Cal., is soon to reach out again and gather in more of the lighting plants of surrounding towns. This announcement is in line with the consolidation policy inaugurated last fall, when a $10,000,000 bond issue was made and many power plants east of Los Angeles in the Southern California district were absorbed. Now negotiations are reported looking toward merging the United Electric, Gas & Power Company, which controls plants at Santa Barbara, Santa Monica, Ocean Park, Redondo and Long Beach. The latest work of the Edison Electric Company is its Kern River plant. The scheme, when complete, will comprise twenty-six tunnels. The plant is so located that with only 800 lineal feet of flume the water is conducted to the wheels. Work has now begun on a second Kern River plant, involving the construction of over eleven miles of canal.

COMBINATION IN CANADA.—The combination of the Quebec & Jacques Cartier Electric Company and the Quebec Railway, Light & Power Company has about culminated. Mr. E. McMillen, of New York, has resigned the presidency of the former company and has been succeeded by J. M. McCarthy, of Quebec. It is learned that a third company is in process of formation and will take over the two Quebec electric concerns. The new company will be known under the name of the Quebec Railway, Light & Power Company and will ask for powers to issue $500,000 additional preferred stock, with which to pay off the floating debt of the two Quebec companies, which amounts to about $300,000, and will then have a reserve fund of $200,000 for operating expenses, improvements, etc.

NEW ENGINEERING FIRM.—The firm of Mackenzie, Quarrier & Ferguson has been incorporated under the laws of the State of New York for the purpose of acting as contracting engineers. The concern includes the names of W. P. Mackenzie, formerly manager of the New York offices of the Harrisburg (Pa.) Foundry & Machine Works, and S. F. Ferguson, lately Boston sales agent for the Ludlow Valve Company, of Troy, N. Y. The new firm—which is capitalized at $50,000—will represent the Harrisburg company in the East.

CINCINNATI ELECTRIC MOTOR COMPANY.—The stockholders of the Cincinnati Electric Motor Company have decided to increase the capital stock from $50,000 to $250,000, half 6 per cent. preferred and half common. The company will select a site near Norwood and erect a factory to cost $20,000.

NATIONAL CARBON.—The following item appears in the financial papers: For over eighteen months, General Electric interests have been steadily buying National Carbon common and preferred, and interests closely identified with the company now own a practical majority of the shares.

CHICAGO & MILWAUKEE ELECTRIC.—According to dispatches from the West the Chicago & Milwaukee Electric Company has increased its capital stock by $4,700,000 for equipment and better service.

TRACTION & POWER SECURITIES.—The first annual general meeting of the Traction & Power Securities Company, Ltd., was held recently at the offices, Westinghouse Building, Norfolk Street, London, Mr. Robert Benson presiding. The report showed that the profits suffice (1) to pay for the period of seventeen months a 6 per cent. dividend on the capital as paid up; (2) to pay off preliminary and formation expenses and leave it with a perfectly clean balance sheet; (3) to start a reserve account of £10,000 and carry something handsome forward beside. The amount carried forward (after allowing for income tax) will be about £7,500, which, added to the reserve, is equal to about 4 per cent. on the paid-up share capital of £421,000. The idea of the concern is to assist in the financing of new enterprises based on electric light and power, especially such as may use Westinghouse apparatus abroad, and may wish to place securities to promote the work. The company has apparently a very bright future, as a number of sound enterprises are coming forward.

NEW MANHATTAN STOCK.—The $55,200,000 stock of the Manhattan Railway Company just listed is the stock issued according to the rental agreement with the Interborough Rapid Transit Company, which has leased the Manhattan Company, and takes the place of the Manhattan capital now outstanding. Interborough Rapid Transit Company is a railroad corporation, incorporated May 6, 1902, under the provisions of the general law of the State of New York. It is organized, principally to maintain and operate the electrical system of the Rapid Transit Railroad at present being constructed by John B. McDonald, under contract with the city of New York, which railroad has been leased to the Interborough Rapid Transit Company for the term of fifty years, with the privilege of a renewal for the further term of twenty-five years, and which railroad it will operate as soon as the same is completed. The authorized capital stock of the company was fixed in its certificate of incorporation at $25,000,000.

THE ST. LOUIS RAPID TRANSIT COMPANY has under consideration a proposition to issue $20,000,000 in 5 per cent. refunding gold bonds. The purpose of the issue is to take up certain 6 per cent. obligations, thus saving 1 per cent. The proposition is purely a refunding one, and will not increase the indebtedness of the company in any respect. One of the obligations to be taken up with the proposed bond issue is the collateral trust notes, amounting to $6,000,000, and drawing 6 per cent., which mature in November, 1904. Of the new issue it is proposed only to dispose of from $5,000,000 to $5,500,000 in 1903. The proceeds will be applied to a funding obligation of the company of $2,225,000, and drawing 6 per cent., and to the purchase of equipment. The remainder of the issue will be held as a reserve, to take obligations as they mature. The issue will be secured by certain bonds and stocks of the United Railways Company, now held in the treasury.

LITTLE ROCK REORGANIZATION.—The Little Rock (Ark.) Railway & Electric Company has been reorganized. The company is in succession to the Little Rock Traction & Electric Company, incorporated June 8, 1895, and is the result of the recent transfer of the management of the property from the Union Securities & Electric Company, of Boston, to Isidor Newman & Son, of New York and New Orleans. The incorporators and directors are as follows: D. H. Cantrell, president; J. H. Loughborough, vice-president; H. T. Bunn, secretary; W. H. Thorp, treasurer. The capital stock is $2,250,000, compared with $500,000, the capital of the original Little Rock Traction & Electric Company. The stock is divided into two classes, $750,000 preferred and $150,000 common stock. All the preferred stock may be redeemed by the company at its option at 110.

CHICAGO ELEVATED.—It is expected by stockholders in the South Side Elevated that about $6,500,000 in new securities will be issued by the company to build the extensions contemplated in the ordinance just passed by the Council. The new securities will undoubtedly be in the form of stock, it being the policy of the management to avoid bonded debt. The road has outstanding now only $750,000 4½ per cent. bonds out of an authorized issue of $1,500,000. The improvements contemplate the completion of the third track from Twelfth to Forty-third Street and extensions to the stock yards and Lake Avenue over the junction railway and an Englewood branch.

STROMBERG-CARLSON STOCK.—The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, has filed with the Secretary of State of New York a certificate of increase of capital stock from $3,000,000 to $4,500,000. The certificate is signed by Hiram W. Sibley, John C. Woodbury and Charles E. Angel.

U. S. STEEL.—Material for electric street railways, equipment and rails is placed at about 7 per cent. of the output of the U. S. Steel Corporation. There is also a variety of electrical work in the miscellaneous 14 per cent.

DIVIDEND.—The New England Telephone & Telegraph Company has declared a regular quarterly dividend of 1½ per cent., payable May 15.

Commercial Intelligence.

THE WEEK IN TRADE.—The one word "improvement" tells the story of last week's trade conditions, and is applicable to the weather, crops, distributive trade and even collections. The price situation, according to the summary of one of the mercantile agencies, shows few important changes, but so far as actual indications are concerned, demand shows no hesitancy on account of increased cost. Railway earnings continue excellent, those for the third week in March showing the large gain of 17 per cent. in gross. Heavy rains in the West and Northwest have put the ground in good condition for planting, and the weather is better at the South. Winter wheat crop reports are uniformly favorable, and are far better than last year's. Retail trade is improving with the warmer, dry weather and the approach of Easter. Industry is hopefully active, although labor agitation menaces some important lines. Iron and steel are active and the demand still exceeds the supply. The tendency is still toward increased strength in finished products. Large sales of steel rails to traction companies are noted. Interesting features were the sale of some Lake Superior charcoal iron to France, and the report from Providence that large orders for finished machinery for export to Italy have been received. Building material of all kinds is active and 30 to 50 per cent. higher than a few years ago. In copper there was little done. At the nominal figure of 15⅜c. there were no sellers, but after the interruption of the fictitious rise there were plenty of sellers at 15⅛c., but no buyers. Quotations are entirely nominal as follows: Lake and electrolytic, 14½c. a 15c.; casting stock, 14¼c. a 15c.; standard, 13¾c. The business failures for the week ending March 26, as reported by *Bradstreet's*, numbered 175, against 194 the week previous, and 183 the corresponding week last year.

EQUIPMENT FOR AUSTRALIAN NEWSPAPER PLANT.—Davis Syme & Company, proprietors of the *Melbourne Age and Leader*, which concern operates the largest newspaper printing plant in the Antipodes, have let a contract to the electrical engineering and contracting firm of Noyes Brothers, Melbourne and Sydney, for the complete equipment of their works. The contract calls for specially designed Westinghouse apparatus for driving printing presses and auxiliary machinery. The whole of the equipment will be driven without belting or shafting, as the motors will be direct-connected to the machines which they are intended to operate. All wires will be run in insulated tubing and no joint will be allowed in wiring. The motors will be arranged for control, both by no-voltage release and double-pole automatic overload circuit-breakers. The elevators in the building will also be driven by electricity. The equipment will also generate current for lighting purposes.

EQUIPMENT FOR AUSTRALIAN TANNERY.—The Westinghouse interests, represented in Australia by Noyes Brothers, of Melbourne and Sydney, have secured a contract for the complete electrical equipment of the large tannery at Foots-cray, near Melbourne, operated by Michaelis Hallenstern & Co., Proprietary, Limited. This is the first contract ever let in Australia for the complete electrical equipment of a private industrial plant. The alternating system will be employed. The equipment will comprise Westinghouse engines and three-phase generators, several motors, switchboards, etc. The boilers and superheaters will be furnished by Babcock & Wilcox. The condensers and feed pumps will be built by the International Steam Pump Company, the Worthington branch having secured the contract.

AMERICAN EQUIPMENT FOR QUEENSLAND.—Westinghouse equipment is to be installed on an extensive scale in the locomotive shops now under construction at Ipswich, Queensland, for the government railway. The plant will have a capacity of 1,400 hp. It will be the most important electrically-operated manufacturing plant in Australasia. There will be three 300-kw generators direct-connected to engines of 450 hp each. The motors, two-phase type, will be 150 in number, varying in capacity from 5 hp to 100 hp. Several heavy machine tools will be of Niles-Bement-Pond build, driven by motors. The entire contract for the equipment has been allotted to Noyes Brothers, Melbourne and Sydney.

NEW ZEALAND LIGHTING PROJECT.—The Eltham (New Zealand) Borough Council has adopted an electric lighting scheme submitted by Miller, Wilson & Co., of Wellington. Arrangements are being made to finance the undertaking and contracts for equipment will shortly be let.

MEXICAN WATER POWER TO SMELT ALUMINUM.—Valetin Elcoro y Cia Sen C. Apartado 161, Mexico City, are acting as purchasing agents for a Mexican concern which is about to construct a large aluminum smelting plant to be operated by water power.

NEGOTIATIONS FOR ST. PETERSBURG TRACTION.—Notwithstanding the fact that the Russian Minister of the Interior rejected the proposition of the Verner-Balinsky syndicate regarding the construction of the St. Petersburg electric traction system, M. A. Verner, of Pittsburg, who, with Sellers McKee, of the same Pennsylvania city, is primarily interested in the syndicate, when seen at the Holland House by a representative of Electrical World and Engineer, said he was far from disheartened at the present decision, and that he would renew negotiations on the first favorable opportunity The St. Petersburg municipal authorities have been particularly aggressive in their attitude toward foreign competitors for the franchise in general, more especially the American syndicate. The *Nuova Vremya*, the leading Russian newspaper, has also been very bitter against the contemplated Yankee invasion. The construction of the St. Petersburg system, according to the plans submitted by Mr. Verner and his associates, would result in an estimated expenditure of no less than $60,000,000. The project would involve the building of a complete network of trolley lines in the Russian capital, the drying up of the St. Catherine's Canal, the construction of 16 large bridges across the River Neva, the purchase of a large hospital to serve as a central power station, and the building of another hospital, which alone would cost $3,000,000.

AUTOMOBILE COMBINATION.—The officers of the Association of Licensed Automobile Manufacturers, a recently formed organization, are Frederick L. Smith, of the Olds Motor Works, Detroit, president; Barclay H. Warburton, of the Searchmont Automobile Company, Philadelphia, vice-president; Henry B. Joy, of the Packard Motor Car Company, Detroit, secretary and treasurer, and George H. Day, of the Electric Vehicle Company, Hartford, general manager. The association secures to its members the use of the Selden hydrocarbon automobile patent, the suit over which was decided recently in favor of the Electric Vehicle Company against the Winton Company, and the firm of Smith & Mabley. Four hundred other patents are secured by the association, one of the chief objects of which is to save $20,000,000 that would be spent in litigation on the basis of the cost of the fight over the Selden patent. In the organization are included about thirty concerns, among them being the Winton, Olds Mobile, Packard, Peerless, Searchmont, Haynes-Apperson, Apperson Brothers, Locomobile, Knox Auto-Car, Pierce. Pan-American, International, United States Long Distance, Pope-Robinson, Waltham, Stevens-Duryea and Franklin Companies. Litigation falling upon any member is undertaken by the association.

ANOTHER MEXICAN WATER POWER PROJECT.—A concession has been secured by Leon Pegot, of Mexico City, for the purpose of utilizing the waters of the River Santiago, State of Jalisco, for motive power. The franchise permits the use of 10,000 litres per second. The locality selected by Mr. Pegot for his hydraulic works and the scope of his concession begins where the franchise held by the Hidraulica Mexicana Company, the Mexican Hydraulic Company, terminates. and continues to the point where the Martinez Negrete & Enrique Schondube grant commences. The terms of the concession are the same as those embodied in all similar federal water grants. Surveys must begin within six months and plans must be submitted to the proper Mexican authorities within a period of twelve months. Free importation of material and exemption from taxation other than the stamp tax are allowed for five years. The concessionaire guarantees compliance with the obligations assumed by a deposit of $5,000 in bonds of the 3 per cent. silver debt, constituted in the federal treasury.

TELEPHONE FRANCHISE FOR MEXICO CITY.—Jose Sitzenstatter, of the City of Mexico, has been granted a concession for the establishment of a system of underground or aerial telephones in the Mexican capital and in the federal district. The franchise, according to Mexican advices, may be taken advantage of by any company which Mr. Sitzenstatter may organize. In granting the concession the Mexican authorities reserve to themselves the right to allot other franchises for similar systems. The concession requires the payment of $10,000 annually after the sixth year on to the fifteenth year, and from the beginning of the sixteenth year until the termination of the thirty-first year the contract stipulates that $15,000 must be paid yearly to the federal government.

TO BUILD LARGE ELECTRICAL MINING PLANTS.—Extensive works are to be constructed in the Pittsburg district for the purpose of building the "New Era" gold extraction plants for placer and river bed mining—the invention of Erastus S. Bennett, formerly of Denver, Colo., now at 52 Broadway, New York. The works will be electrically operated. Eventually they are expected to cover 10 acres and have a capacity of turning out three "New Era" plants daily. The equipment for each Bennett plant will consist of a 200-hp boiler, a 200-hp direct-connected engine. a 200-hp dynamo, a 1,600-gallon-per-minute pump, a 125-hp, direct-current motor, a 25-hp series motor, a 20-hp standard motor, two 5-hp series motors, a 5-hp standard motor and four 7½-hp series motors.

ELECTRICITY IN NAVY YARDS.—The United States naval appropriation bill provides $30,000 for electrical extensions at the New York Navy Yard and $75,000 for the same purpose at League Island At the Norfolk yard $20,000 will be spent for electrical work. A large amount is to be spent on the power plant at Charleston, S. C. At Mare Island, Cal., $40,000 will be spent on a light and power plant and $25,000 on extensions of the electrical shops. The naval powder depot at Dover, N J., is to expend $19,600 for four electric elevators, etc A large amount is to be spent in extending the Puget Sound yard electric light plant. Electric cranes are to be put up at the Boston and Norfolk yards.

ORDERS FOR WARREN ALTERNATORS.—The following are recent shipments of Warren alternators from the works of the Warren Electric Manufacturing Company, at Sandusky, Ohio: Hulton Dyeing & Finishing Company, Philadelphia, Pa.; Camden, S. C., three; De Forest Wireless Telegraph Company, New York, five; Portland, Ind.; Charleston, W. Va.; Battle Creek, Mich.; Greenwich, Ohio; Wolcott, Ind.; Charleston, Ill.; Davenport, Wash.; Port Deposit, Md.; Durand, Mich.; Hopewell, N. J., three; Chelan, Wash.; Soda Springs, Idaho; Big Springs, Texas; Ada, Ohio, two.

EXTENSIONS PROJECTED TO MEXICAN POWER.—The Electric Power Transmission Company of the State of Hidalgo, Mexico, is considering the question of augmenting its capital so as to increase its electric installations. The present capital of the concern is $700,000 Mexican. The company paid 17 per cent. dividend on this sum last year. Another Mexican concern which contemplates an extension to its system is the San Ildefonso Compania Explotadora de Fuerzas Hidro-Electricas.

BALL ENGINE ORDERS.—The Institute for Blind, Janesville, Wis., is installing a direct-connected unit, the Ball Engine Company, Erie, Pa., furnishing the engine, and the Northern Electric Company, Madison, the generator. The Mineral Point Zinc Company, Mineral Point, Wis., has recently installed a direct-connected unit, the engine being furnished by the Ball Engine Company and the generator by the Crocker-Wheeler Company, of Ampere, N. J.

PROPOSED BIG MEXICAN INTERURBAN RAILWAY.—The construction of an electric interurban railway is projected between Mexico City and Puebla. The distance between these two cities is 116 miles. The Federal District Street Railway Company, which operates the electric traction system in the Mexican capital, has made application to the Mexican authorities for the necessary franchise to build the road.

JAPANESE CONTRACTS OPEN.—Frazar & Company, of Japan, 63-65 Wall Street, are at present estimating on two electric lighting contracts pending in the Mikado's kingdom. They are also figuring on an extensive electric traction contract. The Frazar people do not represent any particular American manufacturing concern of electrical equipment, etc., in the Far East. They purchase in the open market here.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, through its Montana office, has sold to the Bismark Nugget Gulch Consolidated Mining Company a complete power equipment consisting of inductor alternators, induction motors, hot wire voltmeters and ammeters, lightning arresters and the attendant controlling and regulating apparatus.

THE NILES-BEMENT-POND COMPANY, Hamilton, Ohio, has secured a contract to furnish $130,000 worth of tools to the new locomotive plant of the Locomotive & Machine Company, Montreal, which will be under the management of Americans. Nearly all the tools will be of large size and many of them will be electrically-driven.

THE SALT LAKE ELECTRIC SUPPLY COMPANY, Utah agent for the Nernst Lamp Company of Pittsburg, Pa., has recently secured the lighting contract for the large department store of the Keith-O'Brien Dry Goods Company, of Salt Lake City. There were several competitors for this contract, but the Nernst lamp won.

EQUIPMENT WANTED FOR MEXICAN TRACTION.—Contracts are about to be let for the construction and equipment of an electric traction system in the City of Aquascalientes, a place of some 35,000 inhabitants, located in the Mexican State of the same name.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY has sold a complete equipment of telephones and material to the Glasford & Canton Telephone Company, of Glasford, Ill.

MONTEVIDEO TRACTION PROJECT.—The construction of a new electric traction system is pending in Montevideo, Uruguay. The road is projected by Ramez Suarez, of the same South American city.

ROSARIO TELEPHONE SYSTEM.—Considerable alterations and improvements in the Rosario (Argentine Republic) telephone system are being contemplated.

ELECTRICAL EQUIPMENT FOR MILLIKEN STEEL PLANT.—The structural steel plant now being built in Staten Island for Milliken Brothers, 11 Broadway, New York, which concern has furnished the steel for several foreign electric power plants, is to be furnished with considerable electrical equipment. The machine tools, nearly $100,000 worth of which have already been contracted for with Manning, Maxwell & Moore, 85-89 Liberty Street, New York, will be electrically driven. Manning, Maxwell & Moore have also secured the contract for the overhead traveling cranes. There will be fifteen all electrically operated. The Shaw Electric Crane Company, of Muskegon, Mich., will build the cranes as well as the motors. The contract calls for three equipments, each to have a capacity of 10 tons and to operate over a 100-ft. span. The hoist will be 35 ft. The motors are to be of 26-hp capacity each. These cranes are intended to be installed for the purpose of handling structural material outdoors at the Milliken plant. Twelve cranes of 5-ton capacity each to operate over a span of 25 ft. 6 in. and to have a hoisting capacity of 16 ft., have also been requisitioned. These cranes will be operated by 16-hp motors. The value of the contract is about $50,000.

MANHATTAN ELEVATED.—The transfer of the Manhattan Elevated system to the Interborough Rapid Transit Company has taken place this week. The transfer will not make any great change in the working of the elevated system, but General Manager E. P. Bryan, of the Interborough, says that great efforts will be made to relieve the present congestion. General Superintendent Frank Hedley will direct the operation of the road. Auditor E. F. J. Gaynor, Treasurer D. McWilliams, and Vice-President Alfred Skitt will remain with the Manhattan Company until 1906. The latter, it is said, will not be entrusted with any duties relative to the operation of the road, but will serve only in an advisory capacity. In an interview General Manager Bryan is reported as saying that for relief purposes 500 cars built for the subway will in two months be used on the Second Avenue Elevated line, and the cars now in use on that line will be transferred to other lines. The subway cars are longer than the present elevated cars, and because of the sharp curves on the Third, Sixth and Ninth Avenue lines they would not be available except on the Second Avenue line.

WESTERN ELECTRIC NEW WORKS.—Note has already been made in these pages of the recent acquisition by the Western Electric Company of the Richmond property in Chicago on the lines of the Burlington & Western Indiana Railroads. It is 109 acres, at a price of $218,000. The cost, $1,200,000, of the structures planned by the Western Electric Company is exclusive of machinery, which will be installed in the buildings. The plans have already been made for a cable factory, comprising a group of one-story buildings with an aggregate floor area of about 150,000 square feet. Plans have also been made for a large machine shop and iron foundry ground. The present capacity of the power plant will be 4,000 hp and the works will employ about 1,200 hands. This undertaking is in addition to the present vast interests of the Western Electric Company. The company has invested $3,000,000 in buildings at its present principal site on the Chicago West Side, and is in process of laying out $500,000 on the Polk Street tract. This is of course outside of the amount of money represented by machinery and equipment.

THE VILTER MANUFACTURING COMPANY, builders of refrigerating and ice-making machinery, Corliss engines, brewers' machinery and bottling outfits, Milwaukee, Wis., has recently closed contracts with the following parties for Corliss engines: Shawmut Clay Manufacturing Company, Shawmut, Pa., 24 x 48; Garland & Williams, Devers, Tex., 18 x 42; W. Toepfer & Sons, Milwaukee, Wis., 12 x 30; W. W. Cargill Company, Green Bay, Wis., 16 x 30; Racine Trunk Company, Racine, Wis., 14 x 30; Great Northern Moulding Company, Chicago, Ill., 24 x 48; Hartman Trunk Company, Racine, Wis., 18 x 36; Winnebago Paper Mills, Neenah, Wis., 20 x 38 x 42 cross-compound; B. D. Eisendrath Tanning Company, Racine, Wis., 20 x 42; Wisconsin Bridge & Iron Company, North Milwaukee, 15 x 36; P. Becker & Company, Chicago, Ill.; 18 x 42; Skandia Furniture Company, Rockford, Ill., 22 x 42; Milwaukee Rubber Works Company, Cudahy, Wis., 22 x 42.

SOME A. D. GRANGER ORDERS.—The A. D. Granger Company, contracting engineers, 85 Liberty Street, New York, have taken a contract for two 75-hp. direct-connected engines for installation in the factory of Walter Ermmerich Company, at Park Avenue and Ilner Place, New York. The engines will be built by the Skinner Engine Company, of Erie, Pa. The generators will be manufactured by the C. & C. Electric Company. The Granger Company has also secured a contract for an 800-h.p. horizontal return tubular boiler plant, four units, 200-h.p. each, for installation in connection with the electrical plant of the Brooklyn Institute of Arts and Sciences. The boilers will be built at the Union Works, Erie, Pa.

SOME HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson, Engineering Building, 114 Liberty Street, have secured a contract for a 120-h.p. Harrisburg standard engine to be direct-connected to a 75-kw. General Electric generator, for lighting purposes in the plant of the Berlin (Conn.) Construction Company. The Cooper-Wigand-Cooke Company, which is building a plant at Delawana, N. J., for the manufacture of steel castings, has also placed a contract for a 150-h.p. Harrisburg standard engine for direct- connection to a 100-kw. generator to be built by the Crocker-Wheeler Company. This equipment will be used for power purposes.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY, of Meriden, Conn., has incorporated recently with the following officers: E. C. Wilcox, president; B. L. Lawton, vice-president and treasurer; B. C. Rogers, secretary. The business has hitherto been carried on as a partnership, and its product has become widely known. It has lately moved into a new plant where the company has a very fine equipment for the manufacture of telephones. They make every part entering into the construction of their apparatus and under the new régime will have every opportunity to enhance their reputation and extend their trade connections.

ALBERGER CONDENSERS FOR LONDON.—The Alberger Condenser Company, 95 Liberty Street, New York, have secured the contract for the condensing equipment for the Neasden, London, N.W., power station of the Metropolitan District Railway. The equipment will be a high-vacuum one and of a similar type to the Alberger equipment to be installed in the New York Rapid Transit power station. The Neasden contract calls for three 3,500-kw. outfits for turbine use. The contract for the entire equipment of the plant was awarded some time ago to the British Westinghouse Electric & Manufacturing Company, Limited.

PELTON WATER WHEELS FOR SPAIN.—The Pelton Water Wheel Company, New York offices, 143 Liberty Street, is about to make shipment to Spain of a 2,500-h.p. plant for the purpose of operating a cement factory now under construction in the vicinity of Barcelona. The entire factory will be furnished with American equipment. There will be 10 Pelton wheels, varying from 24-in. to 96-in. in diameter. The contract also calls for the shipment of three miles of steel riveted pipe, 25 in., 28 in. and 31 in. in diameter. The Pelton people have also recently received a number of fair sized Mexican orders for water wheels and pipe.

EQUIPMENT FOR BRITISH WORKS.—E. W. Buckley, works superintendent of the British engineering firm of Mather & Platt, Limited, one of the most prominent concerns of its kind in Europe, is now in the United States for the purpose of purchasing a considerable quantity of American equipment, etc. The firm manufactures engines, dynamos, etc., on an extensive scale. Mr. Buckley at time of writing was in Pittsburg at the Queens Hotel, but is expected in New York during the early part of next week. While in New York he will be at the Holland House.

AMERICAN EQUIPMENT FOR SWEDISH GRANITE QUARRIES.—The Halmstads Stenhuggen Aktiebolag, of Halmstad, which operates some of the largest quarries in Sweden, is about to place contracts for considerable Yankee equipment as a result of the recent visit to this country of Otto Petersen, the manager. The quarries are to be operated by current generated by water power located near by. The machinery from this side will include cableways, pumps, hoists and derricks, etc.

LARGEST INTERLOCKING INSTALLATION.—A contract for the largest interlocking installation ever placed in America, and probably much the largest in the world, has recently been given to the Union Switch & Signal Company for the St. Louis Terminal. The Westinghouse electro-pneumatic system will be adopted, and the contract calls for 258 working levers, with 51 spare levers, which will perform 748 functions.

BOSTON ELECTRIC ROADS.—The *Boston Advertiser* says it now looks as if all plans for the electrical operation of steam roads between Boston and the suburbs will be abandoned. The reasons given are the high price of coal, the continued agitation for lower fares and the threat of strikes. The advance in wages on the systems running into Boston will amount to something like $2,000,000 a year.

SCHENECTADY TROLLEY.—The Schenectady (N. Y.) Railway Company has authorized an issue of $7,000,000 additional bonds to extend lines to Amsterdam and other points for improvements. The bonds are 4½ per cent. 50-year bonds. They will be issued on a basis of 75 per cent. of the actual cost of improvements.

THE GLASGOW (SCOTLAND) CORPORATION, which is a municipal concern, has contracted with the British Westinghouse Electric & Manufacturing Company, Limited, for the electric motor equipment of 100 cars, costing approximately $87,645.

CINCINNATI LIGHTING.—Stockholders of the Cincinnati Gas & Electric Company, at their annual meeting on May 4 will act on a proposition to increase the company's capital $1,000,000 for improvements.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—Application has been made to the Board of Supervisors by the Pomona Valley Telephone and Telegraph Company for a permit to erect the poles necessary for ten to twenty miles of telephone line between Claremont, Spadra and other points in the Pomona Valley.

PAYETTE, IDAHO.—The town council has granted a franchise to Ruben E. Shaw and associates to establish a telephone system.

PRESTON, IDAHO.—Articles of incorporation of the Oneida Telephone Company, with headquarters at Preston, have been filed at Boise.

PAYETTE, IDAHO.—The Payette Valley Telephone Company has filed incorporation papers. The company, which is incorporated for $40,000, will build a telephone system in New Plymouth, Idaho.

METAMORA, ILL.—The Metamora Telephone Company has increased its capital stock from $280 to $12,000.

ROCKFORD, ILL.—The Winnebago County Telephone Company has increased its capital stock from $5,000 to $25,000.

CARLYLE, ILL.—Geo. Johnpeter, of Posey, has been granted a franchise to build a telephone line between Bartelso and Carlyle.

CHICAGO, ILL.—The Woodlawn Park Telephone Company is asking for a franchise in Woodlawn. The council committee has recommended its passage.

BLOOMINGTON, IND.—The Stouts Creek Telephone Company has been incorporated by Samuel Hunter, John A. Parks and Joseph World.

INDIANAPOLIS, IND.—The Farmers' Accommodation Telephone Company, of Greene township, Hancock County, has been incorporated.

WATERLOO, IND.—An independent telephone company has asked for a franchise to operate a telephone exchange and toll lines in this city.

BICKNELL, IND.—The Bicknell Telephone Company has incorporated with a capital stock of $6,000. J. H. Barr is president and John S. Hoover, secretary.

CARLISLE, IND.—The Carlisle Co-operative Telephone Company has incorporated. The capital is $10,000. John Wipps and Charles Griffin are directors.

GREENFIELD, IND.—The Star Line Telephone Company, of Hancock County, and the Banner Telephone Company, of Greenfield, have been incorporated.

INDIANAPOLIS, IND.—The Amboy Home Telephone Company has been incorporated with a capital stock of $5,000, by W. H. Miller, W. H. Houch, Robert Ridgeway, E. F. Cox and John Stancomb.

GARRETT, IND.—The Garrett Telephone Company has been incorporated with a capital stock of $15,000, by John B. Mager, S. B. McCullough, James M. Ritter, W. H. Coffinsberry and H. W. Montz.

DEER CREEK, IND.—A. A. Cook is at the head of a co-operative telephone company that is to establish an exchange in this village. He has already eighty subscribers, and the equipment is to be purchased soon.

INDIANAPOLIS, IND.—The Landesville Rural Telephone Company, of Grant and Huntington Counties, has been incorporated with a capital stock of $4,200, by Henry Wine, Rude Freeman, Simon Clevenger and Wade Robinson.

ORANGE, IND.—The Orange Mutual Telephone Company, capitalized at $3,500, has been incorporated. It will build a line in Fayette County. The incorporators are W. F. Schrontz, W. P. Sipe, W. R. Conaway, George A. Looney and J. E. McKee.

RICHMOND, IND.—The Richmond Home Telephone Company's business has so far exceeded expectations that the capacity of the plant is found wholly insufficient. Eighteen hundred telephones are in use, and the plant will be increased, so as to give service to nearly as many more subscribers.

NEW CASTLE, IND.—The Sulphur Springs Co-operative Telephone Company has been incorporated. It is composed of 12 separate systems in Jefferson, Fall Creek and Harrison townships. The central station will be at Sulphur Springs. The directors are Strod Hayes, Rufus Mann, David F. Hoover, Henry Fadely, Joseph Williams, J. Huffman, Asa Maddy, John McSherley and George Fleming.

INDIANAPOLIS, IND.—The directors of the New Telephone Company have elected officers as follows: S. P. Sheerin, president and general manager; Louis Holweg, vice-president, and H. B. Sale, secretary. The annual report shows that the company had on the first day of March, 6,716 telephones, which is an increase of 1,781 during the year. The gross receipts for the year were $180,471, being an increase over the previous year of nearly $40,000.

DES MOINES, IA.—The Iowa Telephone Company plans to lay down a large amount of conduit during the present season.

COUNCIL BLUFFS, IA.—The Western Iowa Independent Telephone, Telegraph & Terminal Company has been incorporated with a capital stock of $40,000.

GRANBY, MASS.—The Granby Telephone & Telegraph Company has been incorporated with a capital stock of $1,200. Mr. Willard A. Taylor is president, and Richard E. Dickson, treasurer.

FAYETTE, MO.—A. F. Davis, president of the Fayette Telephone Exchange, has bought the Glasgow Telephone Exchange from Wicks & Peters for $9,000. This gives the Fayette Telephone Company full control of all the independent lines in Howard County.

ALBANY, N. Y.—The New York and Long Island Telephone Company (to operate in Kings, Queens, Nassau and Suffolk counties), has been incorporated; capital, $100,000. Directors: W. H. Bennett, G. L. Deneo and B. P. Tabbot, New York.

ALBANY, N. Y.—The West Chazy & Sciota Telephone Company has been incorporated to build a line between West Chazy and Sciota. The capital is $,00 and the directors are W. McGaulley, W. E. Clough and F. N. Swift, of West Chazy.

SPRAY, N. C.—The International Telephone Company, of Spray, has been chartered with $125,000 authorized capital. The company has the right to construct telephone lines and to build an interurban electric railway.

TROY, OHIO.—Council of Pleasant Hill has granted to the Covington Telephone Company a franchise for a local exchange.

COLERAIN, OHIO.—The Colerain Telephone Company has increased its capital stock to $10,000, and will make improvements. D. A. Bevis is president.

STEUBENVILLE, OHIO.—The Farmers' Independent Telephone Company, of Smithfield, will build a line through New Alexandria to Mingo Junction.

STEUBENVILLE, OHIO.—The Scroggsfield Telephone Company has completed a line to Carrollton and now gives service in seven towns in this county.

WESTWOOD, OHIO.—The City & Suburban Telephone Association (Bell) will build a branch exchange at Westwood to supply the surrounding villages at rates now prevailing in Cincinnati.

BUCYRUS, OHIO.—The Bucyrus Telephone Company is planning to improve its exchange and is investigating the merits of several leading makes of switchboards before making a selection.

ATTICA, OHIO.—The Farmers' Mutual Telephone Company has been organized for the purpose of constructing telephone systems in Seneca, Huron and Wyandotte counties. J. W. Walker is president and J. Zellers, secretary.

MARYSVILLE, OHIO.—The Marysville Telephone Cnmpany will be incorporated and a re-organization of the present telephone system owned by N. E. Liggitt will be effected. A number of improvements and extensions will be made.

MARIETTA, OHIO.—The Muskingum Valley Telephone Company has decided to make a number of improvements. Exchanges will be built at Beverley and Lowell and lines will be built to McConnelsville by way of Stockwell, Coal Run and Lowell.

VAN WERT, OHIO.—The Van Wert Telephone Company is planning to make important improvements. A mile of cable will be strung in the city and an addition to the switchboard will be installed. A line will be built to Shanesville to connect a large number of farmers.

NEW BENTON, OHIO.—A company is being organized to build telephone lines throughout Deerfield, Berlin Center and Diamond, and the promoters are figuring on supplies. The system will be connected with the lines of the United States Telephone Company. Dr. E. Miller is the chief promotor.

TOLEDO, OHIO.—At the recent annual meeting of the Toledo Home Telephone Company all the present directors were re-elected, with the exception of General C. M. Spitzer, whose place was filled by Clarence Brown. A proposition to spend $30,000 in laying new cable and extending the switchboard was favorably acted upon.

TONKAWA, OKLA.—The Farmers' Mutual Telephone Company has been organized at Owens to build a system between Tonkawa and Billings, a distance of 21 miles.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company now has 11,000 telephones connected. During the year connections have been established with Oil City, Pa., Warren and Wellsville, Ohio, and many other important points.

TITUSVILLE, PA.—The Petroleum Telephone Company, operating lines touching Oil City, Franklin, Titusville and other places, has, it is reported, passed into the hands of a receiver. The company was started two years ago in competition with the Bell Company.

PHILADELPHIA, PA.—The Keystone Telephone Company will build a trunk line between Philadelphia and Morrisville, to connect with the Interstate Telephone Company, of Trenton. The company also intends to rebuild its line between Trenton and Camden, thus providing another route to Philadelphia.

CRESSON, PA.—The Cambria County Telegraph & Telephone Company will expend during the Spring $25,000 in improvements to its system. New lines will be built to Altoona giving direct and independent connections with the lines of the Central Telephone Company and through them with Harrisburg, Philadelphia and Pittsburg.

SALT LAKE CITY, UTAH.—The Bell Telephone Company in this city intends to place all the telephone wires in the business section of the city under ground this year.

MARTINSBURG, W. VA.—A controlling interest in the Berkeley Springs Telephone Company has been bought by John J. Hetzel, who represents a syndicate. The company will extend its lines throughout Morgan County and reach outside points through the system of the Winchester Telephone Company.

PARK FALLS, WIS.—The Park Falls Telephone Company has been granted a franchise for a local and long-distance telephone system in and between Park Falls, Phillips and Mellen.

FORT WILLIAM, ONT.—The Municipal Telephone Exchange was destroyed by fire recently, entailing a loss of $6,000. The property was fully insured. A new exchange will be built at once.

MONTREAL, QUE.—A deal has been completed by which the Merchants' Telephone Company, of Montreal, has passed under the control of a New York syndicate. Mr. Arthur Johns, of New York, represented the syndicate in the deal. The total common stock of this company amounts to $61,000, and in addition to this, there is a bond issue of about $60,000, secured on first mortgage and paying eight per cent. interest. No dividend has been paid on the common stock.

ELECTRIC LIGHT AND POWER.

COEUR D' ALENE, IDAHO.—The Cable Milling Company will construct an electric light plant and water works, at a cost of $40,000. It will probably be ready for bids in 30 days. Mr. B. O. Graham is secretary.

KEWANEE, ILL.—It is stated that the Kewanee Light & Power Company will install a plant, at a cost of about $40,000.

EVANSTON, ILL.—The Evanston Yaryan Company has been ordered by the court to pay $260,989.45, the interest on its outstanding bonds. In default of payment the plant is ordered sold by Master in Chancery Elting.

PAXTON, ILL.—The Paxton Light, Heat & Power Company has been incorporated, with a capital of $150,000, to deal in light and power. Incorporators: J. B. Richardson, H. Walter Bond and Gerald A. Griffin.

RANTOUL, ILL.—The Rantoul Water, Light & Power Company, of Rantoul, has been incorporated, with a capital of $2,500, to erect and maintain water works, heat, light and power plants. Incorporators: Geo. P. Heckel, Thos. J. Roth and John D. Neal.

WINONA, IND.—Contracts have been let for the construction of a new electric light and heating and pumping plant here, to cost $125,000.

ANDERSON, IND.—It is stated that the Union Traction Company, of Indiana, contemplates going into the electric light business and will soon apply for franchises along its line.

RICHMOND, IND.—The city council has refused the proposition of capitalists to purchase the municipal electric lighting plant and has ordered electrical equipments for immediate delivery as follows: General Electric Company, $1,430 and $1,320; Monarch Electrical Company, $550; Westinghouse Electric & Mfg. Company (October delivery), $4,100; total value of new machinery ordered, $7,405. The present value of the plant is placed at $166,120. The plant made a better showing for February. The receipts were $950 in excess of the expenses. Heretofore the plant was operated at a loss each month.

HUMESTON, IA.—Jas. L. Humphrey is interested in the construction of an electric light plant here.

COVINGTON, KY.—The Stewart Iron Works Company will equip a large new factory with electric drive throughout.

ELLSWORTH, ME.—The Bar Harbor & Ellsworth Light, Gas & Power Company is stated to have secured options on Union River dam properties. This company will continue the electric lighting in Ellsworth and Bar Harbor and will probably extend to Northeast Harbor and Seal Harbor.

TOLLARD, MASS.—The G. L. Straw Co., of Boston, is reported interested in the construction of a power plant on Farmington River, between Tollard and Sandisfield.

COLD SPRING, MASS.—F. G. Smith and F. D. Gilligan, of New York, N. Y., it is stated, have secured water privileges at Cold Spring on Farmington River and will build a plant for the generation of electricity.

MAYVILLE, MICH.—The citizens have voted to issue $5,000 electric light bonds.

BANGOR, MICH.—The citizens have voted to issue $25,000 electric light and water bonds.

PLYMOUTH, MICH.—It was voted March 9 to issue $12,500 bonds for the construction of an electric light plant. E. Gayde is village clerk.

ALLEGAN, MICH.—It was voted on March 9 to issue $30,000 bonds for the purchase of the electric lighting equipment now rented and improving the water works and water power. C. F. Davison is village clerk.

MORRIS, MINN.—The council is considering the question of establishing a lighting plant.

WINONA, MINN.—The Winona Railway & Light Company will expend about $100,000 in improvements, including the purcahse of motors, an engine, a condenser, new arc lights, etc.

MANKATO, MINN.—Bids are being received for an electric light plant, to cost about $40,000. Separate bids are required for the boilers. J. R. Thompson is city manager.

EXCELSIOR SPRINGS, MO.—W. A. Bell, of Denver, Colo., is reported to have purchased the electric light plant and water works, and will expend about $70,000 in improvements.

MEXICO, MO.—The City Council has been appointed a committee to correspond with manufacturers in regard to having a gas and electric light plant built here, giving a franchise in exchange for street lighting.

VIRGINIA CITY, MONT.—Tbe Bismark-Nugget Gulch Consolidated Mining Company has, it is reported, secured a franchise for an electric light and power plant on Mill Creek.

BENEDICT, NEB.—W. G. Keeler has purchased the electric light plant and will remodel it.

GREENVILLE, N. H.—A committee has been appointed to investigate the question of constructing an electric light plant.

MANCHESTER, N. H.—A committee has been appointed to report on the feasability of a municipal lighting plant. Sam'l J. Lord is city engineer.

MANCHESTER, N. Y.—On March 17 it was voted to construct an electric light plant. A. Dunham is village clerk.

AKRON, N. Y.—It was voted on March 17 to issue $10,000 bonds to establish an electric light plant. E. E. Stratton is village clerk.

FAR ROCKAWAY, L. I., N. Y.—The Queens Borough Electric Light & Power Company has filed plans for a power house to be located on Clinton Street, to cost $25,000.

GREENE, N. Y.—The citizens have voted bonds to the amount of $13,000 for the construction of an electric light plant and $2,500 to purchase the local electric plant, to use until the new plant is completed.

ST. REGIS FALLS, N. Y.—The St. Regis Light & Power Company has been incorporated at Albany with a capital stock of $50,000. The directors are W. T. O'Neil, H. E. O'Neil and W. B. Babcock, of St. Regis Falls.

ROUSE'S POINT, N. Y.—The town of Rouse's Point has lately adopted three-glower Nernst lamps for street lighting, and the completing of the installation was made the occasion for a local demonstration with the usual brass band adjuncts.

ASHEVILLE, N. C.—Ladshaw & Ladshaw, of Spartansburg, S. C., have made a survey of an undeveloped water power on the French Broad River near Asheville, which may be developed electrically.

MURPHY, N. C.—Capt. Alfred Emerson and others will organize the Cherokee Power & Lighting Company to develop the water power of Hiawassee River, near Murphy, and transmit the same to nearby points.

CHARLOTTE, N. C.—B. S. Drake, of the U. S. Geological Survey, bas been detailed to make a survey of certain water courses in South Carolina where he thinks enough power is available to operate every industry in the State.

NEW ROCKFORD, N. D.—The Light, Water & Improvement Company has been formed to put in a lighting plant.

SANDUSKY, OHIO.—The Cedar Point Pleasure Resort Company will install a power plant at Cedar Point.

WESTON, ORE.—The City Council has appointed a committee to investigate the feasibility of obtaining power for an electric light plant from Umatilla River.

EUGENE, ORE.—The Lane County Electric Company has been incorporated, with a capital of $100,000, by D. A. Paine, J. F. Robinson and others. This company absorbs the Eugene Electric Light Company and proposes establishing an electric plant at Springfield to generate electricity to supply light for Springfield and Eugene.

OAKMONT, PA.—The entire plant of the Oakmont & Verona Light, Heat & Power Company was destroyed by fire March 13.

POTTSTOWN, PA.—It is stated that a 300-hp engine and two generators will be added to the equipment of the Pottstown Light & Power Company.

WAYNE, PA.—The Haverford Electric Light Company and the Wayne Electric Light Company, both owned by the United Gas Improvement Company, will be merged and the villages in Lower Merion Township will all soon be lighted by electricity from the Wayne plant, which will be enlarged.

YORK, PA.—The York Haven Electric Power Company's plant, now in course of construction, has a sub-station in Manchester township all ready. Machinery will be installed in a short time. The current will be transmitted from the York Haven plant some time in September when the above-named plant is completed.

PELZER, S. C.—It is rumored that the Pelzer Manufacturing Company may develop a fine water power on Salinda River. An interurban trolley line is also spoken of.

MEMPHIS, TENN.—The Memphis Consolidated Gas and Electric Company has filed an abstract of its charter which provides for a merger of the Memphis Light and Power Company and the Equitable Gas Light Company. The authorized capital is $4,000,000. New York and Chicago capital is interested.

KNOXVILLE, TENN.—A party of English and Eastern capitalists have visited Knoxville in the interests of the proposed Knoxville Power Company, whose purpose is to develop Little Tennessee River, 35 miles from Knoxville, where 20,000 horse power is available. A number of contracts have been signed by Atlanta manufacturesr for electric power.

CALDWELL, TEX.—Wallin & Scott have decided to construct an electric light plant.

JACKSONVILLE, TEX.—The Jacksonville Electric Company, of Jacksonville, has been incorporated with a capital of $20,000. The incorporators are J. D. Gibbs, R. T. Gibbs and J. C. Brashear.

CENTER POINT, TEX.—The Center Point Electric Light, Power & Irrigation Company, of Center Point, has been incorporated; capital, $6,000. Incorporators: H. Nail, Jas. Sellers and Jas. Crotty.

VERNAL, UTAH.—F. M. Benedict, of Salt Lake, Utah, has been granted a franchise to put in an electric light plant at Vernal.

PETERSBURG, VA.—The Virginia Passenger & Power Co., it is stated, has secured the contract for furnishing the city with electric lights of 2,000-cp. for one year at $57 per light per year.

SEATTLE, WASH.—An ordinance has been introduced in Council providing for the issue of $590,000 bonds for a municipal electric light plant.

CEREDO, W. VA.—The Ceredo Water & Light Company has been incorporated with a capital of $20,000. Incorporators: Louis Prichard, W. F. Burns and others, of Ceredo.

SUN PRAIRIE, WIS.—Dr. L. V. Lewis and Prof. Jas. Meville have been appointed to investigate the matter of a municipal electric plant.

MIDLAND, ONT.—The town of Midland has adopted a by-law to take over the electric light system of the town. The sum voted is $20,000, of which $9,000 is for the purchase of the present company's plant, and the balance for extensive improvements and additions to the system. By this step the town completes its ownership of municipal franchises, and with its waterworks and docks will have a very complete municipal outfit.

WINNIPEG, MAN.—The Great Falls Power Company has submitted a proposal to the city to deliver 3000 horse-power of electrical energy in the city on condition that the city grants it a franchise for a period of 15 years. It proposes to charge $50 per horse-power per annum. It is stated that it is the intention of the company to develop ultimately 40,000 horse-power at Great Falls on the Winnipeg River, at an outlay of from $2,000,000 to $7,000,000. Mr. Samuel Insull, of Chicago, is president of the company, the vice-president being Mr. Robert T. Lincoln.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—The Los Angeles Railway Company has awarded the Electric Storage Battery Company, of Philadelphia, a contract for a storage battery installation, involving about $250,000.

SAN MATEO, CAL.—The South San Francisco Railroad & Power Company has been incorporated to build 13½ miles of electric road in South San Francisco and San Mateo, for $100,000. William J. Martin, secretary of the South San Francisco Land Company, is interested.

LOS ANGELES, CAL.—Applications have been presented to the city council by different interests asking for street railway franchises for about twenty miles more of street railway. The Los Angeles Railway Company, the Los Angeles Traction Company and private individuals are the applicants.

LOS ANGELES, CAL.—The Clear Lake Electric Railway and Power Company has incorporated to do business in Lake County and is heavily backed by Los Angeles capital. A road about 40 miles long will be run between Cloverdale and Lakeport, tapping a section of country that has never had a railway. The capital stock is $1,000,000. Dr. W. R. Prather, of this city, is one of the principal stockholders.

DENVER, COLO.—The Denver & Northwestern Railroad, which owns the Denver Tramway, is about to let contracts for building an electric railway to be operated in connection with the Denver Tramway, from Denver to Golden, and from Denver to Boulder. The line to Golden will be about 10 miles, and to Boulder about 22 miles. The formal incorporation of the two new roads will shortly be made.

MERIDEN, CONN.—It is announced that a third-rail electric service will be established between Meriden and Middletown by the New York, New Haven & Hartford Railroad. The Meriden Division, which runs from Waterbury to Middletown, will be electrically equipped between this city and Middletown soon, so it is said, and it is expected a third-rail servce will also be established between Meriden and Waterbury.

NEW HAVEN, CONN.—The most important railroad fight in the recent history of Connecticut is on before the Joint Judiciary Committee of the State Legislature, in regard to the proposed repeal of the present general railroad law. All the railroad interests of the State have been represented at the committee sessions, besides scores of outside interests. The struggle, however, is between the resident steam and trolley interests of the State and the proposed Boston to New York third-rail line parallel to the Consolidated road. Under the present railroad laws the company which plans the third-rail line has the right to condemn land and build its road. Demanding repeal of this law appear representatives of the Consolidated road, the majority of the street railroads, and the Connecticut Lighting and Railway Company, agent of the Philadelphia United Gas Improvement Company. Against it appear the Connecticut representatives of James F. Shaw & Co. and Gay & Co., bankers, of Boston, who are financing the new line; the old Connecticut Western extension people, and the Vermont Central Railroad.

WASHINGTON, D. C.—The President has before him for approval an ordinance granting to the Vandergrift Company, a Philadelphia organization, a right-of-way for an electric railway across the island of Porto Rico. The road will be 80 miles in length and will connect San Juan with Ponce. The plans call for a large power plant which will supply power to manufacturing concerns on the island and act as a feeder for short electric railways along the coast of the island.

ATLANTA, GA.—Application has been made for a charter for the Piedmont Electric Railway Company, which is to build an electric railway to Roswell and from Roswell. The capital stock will be $500,000. The incorporators named are E. S. Brakelton, of Birmington, Ala.; Charles S. Kingsbery, E. C. Akins, T. J. Hightower, C. W. Hunnicutt, John T. Stocks, H. L. Hunter, B. F. Curtis, Charles K. Maddox, F. M. Stocks, Thomas F. Stocks, R. E. Bondurant, J. A. Tiller and John Burnett, of Atlanta.

GALESBURG, ILL.—The Galesburg & Aledo Interurban Railway Company is to be incorporated to build the projected electric railway between Galesburg and Aledo. The officers of the company are: L. W. Sanborn, of Galesburg, president; C. L. Gerould, of Galesburg, secretary and treasurer; J. J. Welsh, of Galesburg, attorney; A. L. Richey, of Galesburg, engineer.

MOLINE, ILL.—The Illinois Electric Railway Company has been incorporated to construct an electric railway to connect Galesburg, Monmouth, Aledo, Moline, Rock Island and Macomb. The amount of the capital stock is $10,000. The incorporators and members of the first board of directors are John S. Brown, I. M. Kirkpatrick and William H. Sexton, of Monmouth, Ill.; Robert P. McGeehan, of Kansas City, Mo., and James E. Gregg, of Colorado.

GREEN CASTLE, IND.—A franchise has been granted to Messrs. Benson & Holstead, of Brazil, to operate an electric railway in this city.

BRAZIL, IND.—Local capitalists have projected an electric railway to connect this city with Cordonia, Benwood, Carbon and Diamond, all mining towns.

LAFAYETTE, IND.—The Fountain and Warren Traction Company, which proposes to build a line from Danville, Ill., through Covington, Ind., to this city, has filed a written acceptance of the franchise granted by the City Council to enter this city.

VINCENNES, IND.—It is said that the proposed interurban electric railway from Vincennes to Jasper, Ind., is to be extended from Jasper to Rockport, Ind., and thence to Owensboro, Ky., and that the Union Trust Company, of New York, will finance the company which will have a capital of $2,000,000.

MARION, IND.—At a recent meeting of the directors of the newly incorporated Northern Indiana Traction Company the following officers were elected: R. E. Breed, Marion, president; B. F. Burk, Marion, vice-president; G. A. H. Shideler, Marion, secretary-treasurer; E. H. Neal, Jonesboro, general agent; H. F. Coleman, New York, general manager; George Breed, Philadelphia, consulting engineer.

FT. WAYNE, IND.—A company has been organized in Philadelphia to buy the Ft. Wayne Traction Company. It is officered as follows: President, George F. McCulloch; vice-president, J. Levering Jones, Philadelphia; second vice-president, James Murdock, Lafayette; secretary, S. R. Fleming, Ft. Wayne; Hugh McGown, Randall Morgan, Charles Murdock and Bayard Henry constitute the board of directors. The price paid is said to be over $1,600,000. The capital of the new company will be $5,000,000, and it is given out that the deal is the forerunner of a combination of the Ft. Wayne & Southwestern Interurban, the Wabash Valley, the Lima and Ft. Wayne and McCulloch-Murdock systems in Indiana.

MACHIAS, ME.—The Lumberman's Electric Railway Company is seeking incorporation. The plan is to connect Machias, Machiasport, East Machias and Jonesboro. E. R. Curtis, E. P. Grimes and S. N. Fahey are interested.

FAIRFIELD, ME.—The Fairfield & Shawmut Railway Company, which has in contemplation the construction of an electric railway from Fairfield to Shawmut, has perfected its organization, electing the following officers: Amos F. Gerald, president; William T. Haines, treasurer; Harvey D. Eaton, clerk; Amos F. Gerald, William T. Haines and George Fred Terry, directors.

WORCESTER, MASS.—The Hartford & Worcester Street Railway Company has been granted its charter. The capital stock authorized is $300,000. The charter permits the company to build a line from Worcester to the Connecticut State line in the town of Wales, a distance of 30 miles.

LEWISTON, MONT.—The Citizens' Electric Company has under consideration a plan to build an electric railway from Lewiston to Kendall. J. L. Bright is president of the company.

LINCOLN, NEB.—The Omaha, Lincoln & Beatrice Railway Company has been incorporated, with a capital stock of $2,000,000, to build an electric railway to connect Omaha, Lincoln and Beatrice. The incorporators of the company are: Elbert C. Hurd, Henry H. Wilson, Elmer W. Brown, William R. Shankland and Charles D. Biggerstaff.

HORNELLSVILLE, N. Y.—The Allegheny Electric Construction Company has been organized, with a capital stock of $150,000, to build an electric railway in Hornellsville, Alfred and Almond.

SALAMANCA, N. Y.—The Ellicottville, Mansfield & East Otto Railway Company has been organized to build an electric railway from Ellicottville to East Otto. The capital stock is $250,000 and the stockholders include Hon. A. B. Fancher, of Salamanca, and John S. Rockwell, of Buffalo.

UTICA, N. Y.—A special meeting of the stockholders of the Utica & Mohawk Valley Railway Company was held April 1, for the purpose of voting on a proposition to increase the capital stock of the company from $3,100,000 to $6,250,000. The increase, it is stated, is for improvements to the system.

ITHACA, N. Y.—The Auburn-Ithaca Railroad Company is about to incorporate. The company is said to have perfected all the preliminary arrangements for building its proposed line between Ithaca and Auburn. The present officers of the company are: Isaac P. Hazard, president; Dexter Wheeler, vice-president; Sherman Collins, secretary; E. B. Mosher, treasurer.

GOSHEN, N. Y.—The Intervale Traction Company, incorporated last summer, has arranged for a survey of its proposed line between Goshen and Newburgh. The officers of the company are: Edward R. Emerson, of New York, president; Hiram B. Odell, of Newburgh, vice-president; W. J. McKay, of Newburgh, secretary; Lewis W. Stotesbury, of New York, treasurer.

FAYETTEVILLE, N. C.—H. L. Clark and others are interested in the securing of a street railway franchise at Fayetteville.

TOLEDO, OHIO.—The Toledo Urban & Interurban Railway Company, capitalized at $100,000, has been incorporated.

CHAMBERSBURG, PA.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company will increase its capital from $120,000 to $300,000.

JOHNSTOWN, PA.—The Johnstown & Scalp Level Street Railway Company, capitalized at $42,000, has been chartered at Harrisburg. The directors are: Joseph Ruth, president; Gernard Nees, Charles J. Hoffman, Jacob Grosch and Conrad Nees.

LANCASTER, PA.—The Tennis Construction Company, of Philadelphia, has been awarded the contract by the Lancaster, Millersvile & York Furnace Railroad Company for the building of the company's new road from Millersville to York Furnace via Pequea.

NASHVILLE, TENN.—The Nashville Railway Company which has been in the hands of a receiver for two years will be sold by order of the courts within 40 days. It is believed that Newmans, banker, of New York and New Orleans, will purchase the property.

AUSTIN, TEX.—The Austin Electric Railway Company has filed an amendment to its charter, increasing its capital from $200,000 to $350,000.

GRANBURY, TEX.—The Granbury & Glenrose Traction Company has been organized to build an electric railway between Granbury and Glenrose. G. W. Landers and D. O. Baker, of Granbury, and G. F. Gaither and T. J. Bryan, of Glenrose, are interested.

TEXARKANA, TEX.—The Texarkana Light & Traction Company has been incorporated, with a capital stock of $200,000. The officers of the company are: E. J. Spencer, president; M. C. Wade, vice-president; W. H. Arnold, secretary; E. K. Smith, treasurer.

GRAFTON, W. VA.—Humphrey Brohard, of Flemington, will apply for a franchise to construct an electric railway through the county.

PARKERSBURG, W. VA.—The Pickens & Addison Railway Company has been incorporated, capital $5,000. Incorporators: E. A. Beckley, R. L. Walkley, of New Haven, Conn.; W. E. Douglas, of Jefferson, Ohio; F. O. Havener, of Parkersburg, W. Va.; J. F. Johnson, of Pickens, W. Va.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company has increased its capital stock from $20,000 to $750,000.

NEW INDUSTRIAL COMPANIES.

THE TWIN MOTOR VEHICLE COMPANY has been organized at Scranton, Pa., to manufacture motor vehicles of all kinds. The capital is $100,000.

THE BALLOU ELECTRO-DEPOSIT COMPANY, with a capital stock of $300,000, has been incorporated in New Jersey by H. V. Vandenberg, W. L. Ballou and Warren Dixon.

THE CHIAPON CONSTRUCTION COMPANY, of Chicago, has been incorporated under the laws of Delaware to operate and maintain telegraph and telephone lines. The capital stock is $100,000.

THE NEW YORK ELECTRIC MAINTENANCE COMPANY has been incorporated with a capital stock of $25,000. The directors are H. D. Davy, Helmuth Moerchen and A. P. Nevin, of New York.

THE BRODE ELECTRIC COMPANY, with principal place of business in Los Angeles, Cal., has incorporated; capital stock, $50,000. Directors: Luther D. Brode, J. F. Conroy, A. W. Brode, S. A. Jackson and W. H. O'Bryan.

THE INDEPENDENT GAS AND ELECTRIC COMPANY, principal place of business Los Angeles, Cal., has been incorporated; capital stock, $200,000. The directors are H. C. Rogers, F. G. Walsh, E. M. Durant, F. M. Porter and M. A. Newkirk.

THE AMERICAN DISTRICT TELEGRAPH COMPANY has been organized in Phoenix, Ariz., with a capital stock of $300,000. The directors are H. E. Bennett, G. R. Johnston, Frank Jaynes, F. H. Lamb and Henry Bostwick, of Arizona.

HEGENER ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000. The incorporators are James F. Beranek, Frank C. Hegener, Jesse F. Litchen, Herbert F. Weeman, Sarah Ann Beranek.

THE ELECTRIC POWER COMPANY has been incorporated at Keosauqua, Ia., with a capital of $10.000, to construct a canal for power purposes and construct and operate power plants. Capt. W. A. Duckworth, president; E. L. McCoid, secretary.

THE COOLEY EPICYCLOIDAL ENGINE COMPANY has been incorporated at Trenton, N. J., with a capital stock of $10,000,000, to manufacture engines. The names of the incorporators are Charles S. Farquhar, Edward A. Pheppen, George F. Taft, D. W. Farquhar, Henry W. Longfellow, John T. Cooley and William C. Gray, all of Boston, and Matthew E. Gately, of Waltham, Mass.

THE COLUMBIA ELECTRIC COMPANY, of Indianapolis, has incorporated with a capital stock of $50,000. The company proposes to manufacture and sell telephones and other electrical appliances and to build, own and operate electrical plants and install machinery, etc. The company's plant and office will be located in Indianapolis. Seymour Mansor, F. N. Martindale, Luther R. Frost are the incorporators.

LEGAL.

ELECTRICAL ASSESSMENTS.—A temporary injunction has been issued restraining the City of Cleveland from increasing largely the assessment on electric railway and lighting companies in that city.

SHOCK THROUGH WATER.—A unique case has just been closed in Los Angeles County, Cal., wherein a verdict of $5,000 damages was awarded to one Lyman Newton. Newton was a watchman in the plant of the United Electric, Gas & Power Company, at Long Beach, Cal. He threw a bucket of water on an incipient fire which was caused by crossing of wires, and claimed that the water formed a conducting column through which he received a shock, thus crippling him for life.

CUTLER-HAMMER RHEOSTAT DECISION.—Judge Kohlsaat, of the United States Circuit Court at Chicago, rendered a decision March 26 in the case of the Cutler-Hammer Manufacturing Company against Hammer et al, sustaining the Blades patent owned by the Cutler-Hammer Manufacturing Company. This patent covers the automatic magnetic release used on hand-operated rheostats, for allowing the rheostat handle to return to "off" position in case the circuit is interrupted. The suit has been bitterly fought for the past three years. The patent had previously been held invalid by Judge Baker, of the United States Circuit Court of Indiana. Judge Kohlsaat refuses to follow Judge Baker's decision, and holds the patent to be valid. The Cutler-Hammer Manufacturing Company was represented by Jones & Addington, of Chicago. The defense was made by the General Incandescent Arc Light Company, represented by Donald M. Carter.

OBITUARY.

MR. JOSEPH KAVANAGH.—The many friends of Mr. Joseph Kavanagh, the genial and popular assistant treasurer of the New York Telephone Company, were grieved to learn of his death on Thursday, March 26, in this city. Mr. Kavanagh had been ailing for some months from pulmonary complaints, but favorable reports of his condition had been received, and it was supposed that he would shortly be able again to take his place among his business associates. He was born in January, 1860. The beginning of Mr. Kavanagh's business career was contemporary with the introduction of the telephone as a factor in commercial life, and it was in the treasurer's office of the Bell Telephone Company, of New York, in the fall of 1879, that he held his first position as clerk. His friendliness and tact, no less than his industry and ability, marked him for promotion, and in 1890 he was made assistant treasurer of The Metropolitan Telephone & Telegraph Co., then operating the Bell telephone patents in this city and vicinity. Upon the dissolution of The Metropolitan Co., in 1896, he was elected to the office of assistant treasurer of its successor, the present New York Telephone Co. He was also treasurer of the North Jersey and East Jersey Telephone & Telegraph companies. While a valued officer of his company and ranking high in the opinion of the foremost men in his business, Mr. Kavanagh was loved by the men over whom he was placed and was served with devoted loyalty. His personality will long be held in affectionate remembrance by all who knew his wholesouled and generous character. His wife and four children survive him. His wife is a daughter of the late Amzi S. Dodd, well known as an organizer in the telephone field. The funeral services were conducted on March 29 at Long Branch, N. J., in the Star of the Sea Church, Father William P. Cantwell officiating. The floral tributes were numerous. A special train from New York took about 300 officers and employees of companies in which Mr. Kavanagh was interested. The honorary pall bearers were Charles F. Cutler, President of the New York Telephone Company. William H. Woolverton, President of the New York Transfer Company. Theodore N. Vail, Director of the American Telephone and Telegraph Company. Joseph P. Davis, Chief Engineer American Bell Telephone Company. William R. Driver, Treasurer American Bell Telephone Company. William H. Baker, Vice-president and General Manager of the Postal Telegraph and Cable Company. Gen. E. P. Meany, Assistant General Manager of the American Telegraph and Telephone Company. U. N. Bethell, First Vice-president and General Manager of the New York Telephone Company. John H. Cahill, Second Vice-president and Secretary of the New York Telephone Company. W. T. Bouchelle, Treasurer of the Empire City Subway Company. Walter Brown, Auditor of the New York Telephone Company. H. C. Vance, Engineer of the Union Subway Company. P. J. Ferrier, Superintendent of the New York Transfer Company. H. G. McCully, Superintendent of the New York and New Jersey Telephone Company. E. A. Gurnee, Cashier of the New York Telephone Company. The pall bearers were W. D. Sloan, E. A. Hussey, F. M. Tuomey J. F. Lane, William Ennis, H. M. Paddock, W. E. Huntington and P. P. Barnes.

MR. A. BALFOUR.—Mr. Alexander Balfour, a prominent business man, dropped dead in his office, in the Drexel Building, Philadelphia, on March 28. He was a director of several local banks, a director of the Keystone Telephone Company, the Union Traction, and a member of the Board of Inspectors of the Eastern Penitentiary. He was seventy years old.

PERSONAL.

JOHN H. DALE.

MR. JOHN H. DALE.—As one reads of the various legislative, financial and other efforts to check and control the trusts, and to restrict combinations of capital on general principles, it is refreshing and inspiring to note prominent examples of individual success which prove that the opportunities for energy, hard work, adherence to sound business ideas and methods are as good as ever and remain unrestricted. One of these instances is Mr. John H. Dale, President of the Dale Company, of New York., who 14 years ago, started his business in a little 10x12 shop costing the magnificent sum of $15 a month. Fourteen years seems but a comparatively short period to create and develop an enterprise now requiring the whole of the new building just occupied. Mr. Dale was almost born into the business, certainly brought up in it. He started with the old United States Illuminating Company as a boy and on his own request, after a year, was transferred to the Construction Department. There doing six years' active service, he received his first knowledge of electric light construction and engineering. Equipped with very little beyond this experience, he started a small shop of his own on Fulton St., for repairing dynamos and looking after the installation of electric lighting plants, and gradually worked into the manufacture of a few specialties in electric light fixtures. Thence he moved in 1892 to a little larger quarters on Cortlandt St., and in 1893 took a partner. After a couple of years differences of opinion resulted in serious dispute and the partner refusing to buy or sell a receivership resulted, although the concern was perfectly solvent at the time. While proceedings were still pending, Mr. Dale, nothing daunted, started a new place of his own in Centre St., and after a few weeks he managed to get back in the old premises and resume business, and though not legally obligated he gradually paid up all of the old debts. In August, 1896, the present Dale Company was organized and started business at 108 Greenwich St., out of receivership. He owned at that time less than two-fifths of the business, but under his administration and efforts the business grew and prospered and he has since acquired and paid for almost all of the capital stock. During the years 1896 and 1898 Mr. Dale traveled all over the continent of Europe, looking for means and avenues to fill the various wants of the trade, and now once a year it remains his practice to make a trip all over the United States to meet personally the customers of the company, to ascertain special wants and requirements managing to keep in touch with the industry. The business of the company is a model of system and organization. Mr. Dale consults with engineers and architects in the matter of the physical improvement of his plant and shuns no expense to have it perfect, as he believes this to be economy in the end. He has employed for years the services of the well-known expert accountant firm of W. F. Weiss, this city, which has organized his system of financial accounting and of cost accounting in manufacturing, so that the cost of production is a matter of absolute scientific analysis, far beyond the ordinary. There are none better posted than Mr. Dale on the various items of expenditure in and about his business and their relations as to cost of goods in the various stages of manufacture, selling expense, general expense and other necessary comparisons and statistics.

MR. SAMUEL INSULL, president of the Chicago Edison Company, has just returned from England where he has been spending the last three months.

JUDGE J. M. THOMAS, the "independent" telephone leader, has just returned to New York from a three months' trip around the Carribean Sea, and has resumed duties at his New York office.

THE DUKE OF MANCHESTER is a candidate for membership in the Automobile Club of America, proposed by Mr. John Jacob Astor and seconded by Mr. James Stillman.

MESSRS. DODGE & DAY, modernizing engineers, of Philadelphia, have been commissioned to report on motor equipment for the Firth-Sterling Steel Company, of Pittsburgh.

MR. HENRY C. ADAMS, JR., formerly with the Phillips Insulated Wire Company, has taken charge of the New York Sales Agency for the Clifton Mfg. Co., of Boston, Mass.

MR. J. C. BARCLAY has been appointed Assistant General Manager of the Western Union Telegraph Company. As the department of electrical engineering is subordinate to this office, its general direction will remain with Mr. Barclay.

MR. E. B. T. LEE, vice-president and general manager of John Martin Company, of San Francisco, is now in the East visiting the home offices of the various large manufacturing companies which that firm represents on the Pacific Coast.

MR. C. L. DE MURALT will return to Europe next week, ending a professional visit of several months. Mr. De Muralt so timed his return to New York to be present at the Institute meeting last Friday, at which he took part in the discussions.

MR. A. J. WURTS is to lecture before the American Philosophical Society, of Philadelphia, on April 2, on the subject of the Nernst lamp, with illustrations of the lighting. There is a report current that special reference will be made to direct current work, but this is not the case.

MR. W. E. MOORE has resigned his position as general superintendent and engineer of the Augusta Railway & Electric Co., and the Gas Light Co., of Augusta, to take effect as soon as his successor can be appointed. He is taking up similar work with the West Pennsylvania Railway & Lighting Co., of Pittsburg.

DR. WALTHER NERNST, the well-known German chemist and physicist, inventor of the Nernst lamp, etc., is due to arrive in New York City about April 3 from Europe. It is understood he will be able to participate in the proceedings of the American Electro-Chemical Society which meets here this month, as already announced.

PROF. A. G. BELL, who is on the board of the Smithsonian Institution, has volunteered to sustain part of the expense involved in bringing from Italy to Washington the remains of Mr. Smithson, the Englishman who endowed the Institution and gave it his name. It is proposed to reinter the remains in the beautiful grounds near the statue of Joseph Henry.

MR. J. P. COPLAND, a special telegraph operator, who was taking De Forest wireless telegraph material to Cape Hatteras, on a schooner, for installation there, was washed overboard in a fierce storm on Saturday last. The crew managed to save him by throwing lines to him, and then worked the schooner into safe waters. Part of the special cargo was carried away by the sea.

MR. LOUIS W. MILLER, superintendent of the Bureau of Police Telegraphs, at Rochester, N. Y., advises us that the fire alarm and police telegraph systems of the city are to be consolidated and a Bureau of Electricity created in the Department of Public Safety. This new bureau will have charge of all electrical construction and installation within the limits of the city. Mr. Miller will have the supervision of the new office.

MR. CHARLES FOSTER.—The State of North Dakota, or rather the Legislature has made an appropriation for a trolley line to be built from the Capitol building to the Northern Pacific Railway Depot in Bismarck, a distance of approximately one mile, and for a lighting plant to be installed in the Capitol building, and has engaged Mr. Charles Foster, electrical and mechanical engineer, Bismarck, N. D., to make estimates, plans, etc., for same and to superintend construction of same when built.

FATHER JOSEPH MURGAS, a Polish priest at Wilkesbarre, Pa., has devised a wireless telegraph system of his own. When asked recently how far he sent messages he replied that he frequently sent them from his home, in North Wilkesbarre, to the Polish Catholic Church in Park Avenue, two miles away. He said he was handicapped in his experiments by lack of funds and proper equipment, and also by the absence of a competant assistant. The most interesting and businesslike part of Father Murgas' experimental station is in his garden, about one hundred feet from his residence. Here a pole fifty feet high is erected for sending wireless messages to the surrounding country.

MR. GEORGE WHITE, who has surrendered the chairmanship of the London United Tramway Company to Mr. Yerkes, has had a career as striking as that of any American millionaire, according to *The London Chronicle*. A Bristol boy, one of a large family, he received a board school education. His first situation was as bookboy in the library of the Bristol Law Society at a weekly wage of five shillings. A solicitor frequenting the library took a fancy to the lad and gave him a berth in his office as runner of errands and copyist of letters. Smartness and ability raised White to a responsible clerkship. His employers were solicitors to the Bristol Tramway Company, and, anxious to retain the position, they put forward their clerk for the vacant secretaryship, and secured his appointment as their nominee. This was Mr. White's opportunity. One of the first to see the superiority of electric traction, he organized in Bristol, in 1895, the first electric tramway under the modern conditions of the Board of Trade. Four years ago, having risen to the chairmanship of the company, he electrified and extended the whole tramway system of Bristol. He has given London its finest electric tramway service, and done the same for other towns, as chairman of the Imperial Tramways Company. The ex-library boy is now a millionaire, though there is nothing in his quiet life at Bristol to disclose the fact.

EDUCATIONAL.

THE WORCESTER POLYTECHNIC ALUMNI ASSOCIATION OF NEW YORK held a well-attended and enthusiastic meeting at the Hotel Albert on Tuesday evening, March 17. The association includes seventy-five graduates of the Institute, the majority of whom hold prominent positions in various engineering and manufacturing concerns in this city. The next meeting will be held at the same hotel on April 28th and all Worcester "grads" in the vicinity are cordially invited to be present.

UNIVERSITY OF MICHIGAN.—An electrical test of the Detroit, Ypsilanti, Ann Arbor, and Jackson electric railway was recently made by some of the students in the engineering department of the University of Michigan. The test was continued over a period of about twenty-one hours, starting at four o'clock one morning and continuing until one o'clock the next morning. Readings were taken every thirty seconds during that time. The test included the central plant at Ypsilanti, and the sub-stations along the road. A test was also made of the mechanical efficiency of the boilers and engines in the central plant.

UNION COLLEGE, N. Y.—The electrical engineering course at Union College, Schenectady, N. Y., has been re-organized under the immediate direction and supervision of Prof. Charles P. Steinmetz, chief electrical expert engineer of the General Electric Company. The conditions for an electrical engineering school are unusually favorable, due to the old and well-established reputation of the College in engineering education, and the proximity and friendly disposition of the General Electric Company, whose works the student is afforded chances to see and familiarize himself with apparatus and receive information. The complete course will be published shortly in the University catalogue. It may be sufficient here to say that it will give a thorough grounding in the fundamental principles and their application to all branches of electrical engineering, such as will enable the graduate rapidly to acquire the practical experience necessary. A post-graduate course in electrical engineering has been established, which will give advanced instructions, comprising many subjects, which, while of fundamental importance in the modern development of electrical engineering, are not generally taught.

Trade Notes.

THE JOHN F. KELLY ENGINEERING COMPANY has secured offices at 149 Broadway for its engineering and contracting business.

CHANGE OF ADDRESS.—The Edison Manufacturing Company has moved its Chicago office from 144 Wabash Ave. to 304 Wabash Ave.

ASSETS OF THE COLUMBIA TELEPHONE COMPANY.—According to a newspaper report, the Williams-Abbott Electric Company, of Cleveland, Ohio, has purchased the assets of the insolvent Columbia Telephone Company, of Ottawa, Ohio.

CROSS OIL FILTERS.—The Cross oil filter, manufactured by the Burt Mfg. Co., Akron, Ohio, will be used at the World's Fair, St. Louis, in the present power plant. This make of filter was also used by the Omaha, Charleston, Paris and Buffalo exhibitions.

MAN'S PLACE.—The remarkable article by Alfred R. Wallace on "Man's Place in the Universe," which has attracted so much attention both in England and this country since its appearance in the March *Fortnightly* is reprinted entire in *The Living Age* for April 4.

THE WARD LEONARD ELEC. CO., of Bronxville, N. Y., in a new bulletin illustrates its latest types of machine and fan speed controllers. The demand for a controller of these types has increased so rapidly that new price lists have been quoted which will be of great interest to the trade.

CATALOGUES WANTED.—The Hendrie & Bolthoff Mfg. & Supply Co., of Denver, Colo., is adding an electrical supply department to its line of mining machinery and supplies. It proposes to carry a large stock of such material, and wishes to receive catalogues, prices, and price lists in the various lines.

THE BROWNING MANUFACTURING COMPANY, of Milwaukee, Wis., has just opened a Chicago office at 1600 Tribune Building, which will be in charge of R. L. Thayer, an electrical engineer who is well known in Chicago. This is another one of the many indications that this company is reaching out in a progressive manner for small motor business.

PEERLESS FANS.—Bulletins A, B, and C, recently issued by the Peerless Electric Company, Warren, Ohio, are devoted to direct current desk fans, direct current ceiling fans and alternating desk fans, respectively. These various types of machines are illustrated and described in the usual manner, all necessary trade information being given in each case.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Western agent for Gutmann wattmeters and Adams-Bagnall arc lamps, writes that its sales on lamps and meters for the past three months have surpassed those of any similar period in or out of season. Both of these factories have enlarged their facilities so that the increased business is promptly taken care of.

CUTLER-HAMMER BULLETINS.—The Cutler-Hammer Mfg. Company, Milwaukee, Wis., has just issued a set of new bulletins illustrating and giving the principal points of its motor starters, controllers, resistance, solenoid-controlled switchboards, etc., etc. These bulletins are intended to be inserted in their proper places in the "perpetual catalogue" issued by the company.

ELBLIGHT.—The Elblight Company of America has received the unanimous approval of the Electrical Committee of the National Board of Fire Underwriters. The rules governing the use of the material will shortly appear. The Elblight system has recently undergone successfully the trial of lighting one of the tunnels of the Pennsylvania Railroad, where it has been on test since August last.

INSURANCE AND ELBLIGHT.—Mr. Russell Spaulding, president of the Elblight Company of America, informs us that he has been advised by Mr. C. M. Goddard, secretary, that the Elblight system has received the unanimous approval of the Electrical Committee of the National Board of Fire Underwriters, and that rules to gover nits use will now form part of the National Code. This action should act very beneficially in extending the popularity and use of the system in question.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., has issued a unique booklet telling all about its facilities for the production of its incandescent lamps, and calling attention to the principal points of its products. In it attention is directed to the fact that the Columbia type of lamp gives more light in the useful direction than the oval type, but does not consume any more current.

DIAMOND SPECIAL COMMUTATOR COMPOUND is not a grease but a combination of chemicals that act as a lubricant which stops sparking, puts a hard glossy finish on the commutator, prevents excessive wear of both commutator and brushes, and increases the conductivity of brushes by removing dirt and keeping a clean contact. The Central Electric Company, of Chicago, carries a large stock of this compound.

WESTINGHOUSE FAN MOTORS.—Alternating and direct current fan motors of the swivel and trunnion type form the subject of an artistic pamphlet just issued by the Westinghouse Electric & Mfg Co. The fan is well illustrated, complete and in detail, and well executed half tone views show the fan in operation in the dining-room of a large hotel and in a buffet, smoking and library car, etc Tables give the size and prices and other facts about the two types of motors.

AUTOMATIC TELEPHONE SWITCHBOARDS.—The Clark Automatic Telephone Switchboard Company, Providence, R. I., has issued a pamphlet illustrating and describing its telephone apparatus. One of the many interesting illustrations shows a view of an automatic switchboard with a capacity for 72 subscribers. The pamphlet contains copies of various letters from individuals and concerns using the system, and these show that the apparatus is giving great satisfaction in practical operation.

FUEL OIL ENGINES.—A late design of a fuel oil engine is the Ostergren internal combustion engine manufactured by the Fuel Oil Company, 60 Wall Street, New York. This engine is designed for street cars, railway trains, yachts, stationary machinery, etc., and is built in sizes from 1 to 1,000 horse-power and upward. The chief advantages claimed for the engine are lightness and compactness and economy in the use of fuel oil, the cost for operation, it is stated, being two cents or less per horse-power per day.

TUERK ELECTRIC FANS.—The Hunter Fan & Motor Company, Fulton, N. Y., has just issued a neatly gotten-up pamphlet on its ceiling fans for alternating current. The various styles of these fans are illustrated in tinted views, and on one page is an illustration showing the various parts of the fan, numbered to facilitate ordering by mail or telegraph. A price list and a code forms part of the contents. The Eastern agents for this firm are E. B. Latham & Co., 39 Vesey Street, New York.

INTERIOR CONDUIT.—The Sprague Electric Company has just issued a new catalogue of interior conduit—iron armored, brass armored, unarmored and flexible metallic; armored cables; conduit fittings; boxes; elbows; couplings; special tools, etc. The catalogue contains 124 pages and illustrates the different styles of conduit and accessories, for the development of which this company has made an enviable reputation. A comprehensive telegraph code is provided and the entire subject is thoroughly indexed.

THE CHICAGO FUSE WIRE & MFG. CO. makes a specialty of fuse wire and strip for telephone fuses, instrument fuses, and in fact anything requiring a very low fusing point. These fine wires are made with the same degree of accuracy which has always been maintained for all this company's product, and they have sufficient tensile strength to be handled without difficulty. The company says it is in a position to take care of orders whether regular or special, and in large or small amounts, and makes shipment promptly either from its Chicago, New York or Buffalo houses.

MACHINE SHOP OUTFIT.—In a 56-page pamphlet just issued by the Garvin Machine Company, Spring & Varick Sts., New York, a very complete line of illustrations is shown of machines for a modern machine shop outfit. It comprises milling machines, lathes, cutters, tool grinders, drill presses, shapers, etc., etc. Each illustration, of which there are many, is accompanied by a brief description of the machine so represented. The Garvin Company has also issued three separate catalogues on the subjects of universal milling machines, plain milling machines and universal screw machines.

DE LAVAL STEAM TURBINES.—The De Laval Steam Turbine Company of New York, has issued a handsome pamphlet describing and illustrating its steam turbines and turbine machinery. The steam turbine is briefly discussed from the technical standpoint, this being followed by a brief history of its development. Various curves are given showing the performance of the turbines. A section devoted to a description of the construction of the turbine machinery is very complete and artistically illustrated. The pamphlet is a very complete exposition of the whole subject, and will be very valuable for reference.

TOLOR CONDUIT BOXES.—The three principal features of the Tolor system of conduit boxes are as follows: 1st. The "knockout" feature which is primarily the foundation for a perfect system of conduit boxes. 2nd. Any combination of outlets for ½ and ¾ inch pipe is possible. Cast receptacle boxes are universal and all different style covers fit all style bases. 3rd. The absolute completeness of the Tolor system, in that no condition exists in which this system of boxes cannot be applied. The Electric Appliance Company, Chicago, has just issued a most complete catalogue of conduit and conduit fittings. A copy of this catalogue will be mailed upon application.

MACHINE AND FAN SPEED CONTROLLERS.—A bulletin has been issued by the Ward-Leonard Elec. Co., of Bronxville, N. Y., covering its latest types of machine and fan speed controllers. It is stated that a special feature of these controllers is that after starting the motor, the speed can be increased or decreased with one hand. The old trouble of having to hold down the armature of the no-voltage release device with one hand, while cutting in resistance with the other hand, has been done away with. This feature, together with the independent overload circuit breaker device shown in the cuts in this bulletin, makes these controllers absolutely fool-proof.

DEERE & COMPANY, of Moline, Ill., have, at the end of a seven months' trial of the lamp of the Nernst Lamp Co., of Pittsburg, displaced their arc and incandescent lights, as rapidly as is consistent with shop practice. The large machine shop of this company, completed last July, is lighted by multiple glower Nernst lamps, giving greater satisfaction than the former system of local unit lighting. It is the intention to light the entire establishment with Nernst lamps. Another Deere interest, the Velie Carriage Company, of Moline, Ill., was led by observing the above trial to install in its plant a complete Nernst system, using a hundred lamps of the three and six-glower types.

DUNCAN INTEGRATING WATT-METER.—This instrument, which is manufactured by the Duncan Electric Mfg. Co., Lafayette, Ind., is designed for direct current lighting and power service, and embodies many of the most modern ideas peculiar to its type. It is designed to meet every requirement of those whose duty it is in the central station to test, install and inspect meters, so that their work may be facilitated, and assist in keeping the operating expense of the meter department at a minimum. In a bulletin recently issued by the company, the line of electricity meters manufactured by the company is comprehensively described and the various types and styles of instruments clearly illustrated.

TRANSFORMERS.—Bulletins Nos. 9114 and 9115 of the General Electric Company have for subjects: "Some Facts Regarding Type H Transformers" and "Transformer Economy," respectively. Considerable space is devoted to the discussion of various points in the design and construction of transformers from the central station standpoint, and particular attention is called to the improvements in the operating efficiencies of Type H transformers that have been made within the last three years. The heating guarantee on this type low-frequency transformers remains as formerly—not exceeding 45° C. rise at the end of an eight-hour run at full load—which is well within the limits recommended by the American Institute of Electrical Engineers. This temperature, moreover, is measured by increase of resistance method.

THE GORDON BATTERY.—The Gordon cell has now been on the market for several years and has established a high reputation for efficiency and general reliability. The Gordon Battery Company, New York, has just issued a very neat booklet on the subject of its cells, which will be found very useful to all interested in this method of generating electric current. To meet the requirements of the present day, a battery must needs be almost universal in its application, and it is claimed that the Gordon cell fulfills all of the requirements for closed circuit work, while it is equally efficient for open circuits. It has low internal resistance, high electromotive force and long life, and is, besides, clean and little affected by temperature changes. The pamphlet gives some information regarding primary batteries in general, and contains illustrations and prices of the various sizes and types of the Gordon cell, besides the line of Gordon supplies. The company will be glad to send a copy of this pamphlet to any one interested.

MARCONI SYSTEM IN NEW YORK CITY.—It is stated that arrangements have been made by the International Mercantile Marine Company for an installation of the Marconi system at a station on the American Line pier, North River, at the foot of Fulton Street, to enable communicaion with ships compelled by fog to lie at anchor off Sandy Hook and in the lower bay. Sometimes ships are held this way for hours and days, and during such periods are practically isolated. The station on the American Line pier will be complete in every detail. On top of the dock shed will be erected a pole 120 feet high. The sending and receiving apparatus will be located at the end of the pier. Besides allowing captains of incoming steamers to report from the lower bay, the station will permit the giving of instructions to outgoing vessels at the same point. The use of the new station will not be restricted to vessels of the International Mercantile Marine Company, but will be available to all steamers equipped with the Marconi system apparatus.

DICKEY-SUTTON CARBON CO.—This concern, which is incorporated under the laws of Ohio, has an admirable new plant on the line of the Hocking Valley Railroad Company in the suburbs of Lancaster, Ohio. The company has begun business with the production of arc lighting carbons, but is also taking up the manufacture of carbons for electrolytic work, battery work, etc., as well as brushes for dynamos and motors. It will also give attention to carbon specialties for which there is a growing demand. Not alone is the plant equipped with all the latest appliances, inventions and improvements that relate to the carbon art, but it has the advantage of excellent raw material and also has the benefit of natural gas for its ovens. The equipment was installed under the direction of Mr. Edmund Dickey, well known as a master and expert in the field. He is also general manager and vice-president. The other officers are Mr. H. M. Sutton, president; Mr. U. S Colby, secretary; Mr. S. S. Wilson, assistant secretary; Mr. R. R. Dickey, superintendent.

THE WILLYOUNG & GIBSON COMPANY, which we referred to in one of our recent issues as having been incorporated for the purpose of taking over the instrument business of Elmer G Willyoung, has just completed its removal to new quarters in the Steeple Building, No. 40 West 13th Street, New York City. The ground floor of this building has been rented by the company for a term of years, and has been very handsomely and completely fitted up as a high-class instrument shop. A considerable amount of new machinery has been installed, including precision lathes, automatic screw machines, milling machines, etc., and every facility has been secured for the doing of the high-class work for which Mr. Willyoung has always been known. The test room particularly has been very carefully looked after and is a separate department which has been very carefully fitted up with the necessary standards and calibrating apparatus; this part of the work is in charge of Mr. W. M. Comstock, for some years past a member of the teaching faculty at Columbia University. Altogether about 6,000 square feet of space is occupied, and with the increased facilities the company expects to expand its already considerable business. Besides its line of routine apparatus, special attention will be devoted to new problems of measurement and their solution for inventors and scientists. A thoroughly competent designing staff is placed at the disposal of those wanting such facilities. The company invites visitors and correspondence at the new address.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 24, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

12,103. TELEPHONIC APPARATUS, C. G. Burke, Brooklyn, N. Y. App. filed February 3, 1903. (See page 562.)

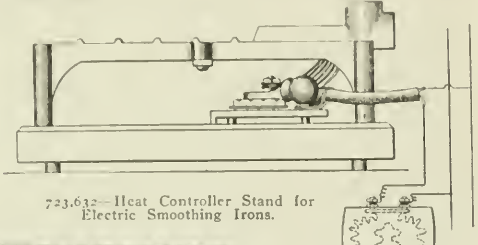
723,253. TELEGRAPH KEY; W. E. Duncan, Macon, Ga. App. filed Nov. 11, 1902. The key lever is of spring metal in one piece with the base.

723,259. ELECTRIC SIGNALING DEVICE; W. Fraser, New London, Conn. App. filed Aug. 12, 1902. A therapeutic device.

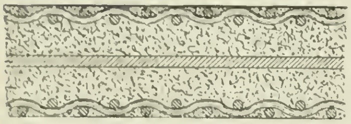
723,261. AUTOMATIC RELEASE DEVICE FOR RHEOSTATS AND HEATERS; C. E. Freeman, Chicago, Ill. App. filed Dec. 12, 1901. The movable core of a magnet is a pin which enters a notch in the lever of the rheostat to normally hold it in place.

723,309. TELEPHONE ATTACHMENT; J. P. Riedinger, Oberlin, Ohio. App. filed September 13, 1902. (See page 562.)

723,320. ELECTRIC BURGLAR ALARM; S. Schwarzschild, Rochester, N. Y. App. filed Sept. 3, 1901. The burglar alarm traverses a subscriber's telephone circuit and operates the annunciator at central office as if it were a call. Central operator, getting no response, surmises that it is a burglar alarm and notifies the police.



723,632—Heat Controller Stand for Electric Smoothing Irons.



723,326—Armored Element for Electric Batteries.

723,321. ELECTRIC DISPLAY SIGN; F. M. Sheridan and E. Behrendt, New York, N. Y. App. filed May 6, 1902. A perforated contact plate is adapted to be fitted over pins forming the terminals of the sign lamps, the perforations on the plate being arranged in the form of a letter.

723,326. ARMORED ELEMENT FOR ELECTRIC BATTERIES; E. A. Sperry, Cleveland, Ohio. App. filed May 25, 1901. A stiff fabric is incorporated with the active material near the surface to form a retaining envelope or armor.

723,327. STORAGE BATTERY; E. A. Sperry, Cleveland, Ohio. App. filed Aug. 12, 1901. A composition consisting of finely divided metallic lead moistened with a mixture of a neutral liquid and ammonium hydroxid.

723,328. STORAGE BATTERY; E. A. Sperry, Cleveland, Ohio. App. filed Aug. 12, 1901. A composition consisting of active material, ammonium sulphate and a catalytic agent.

723,360. TROLLEY REVERSER; F. H. Burnham, Essex, Mass. App. filed March 10, 1902. A retrieving device to prevent the trolley from rising when it leaves the wire.

723,362. PROCESS OF CONCENTRATING ORES; H. F. Campbell, Melrose, Mass. App. filed Aug. 16, 1902. The ores are heated to render certain portions paramagnetic and are then passed through a magnetic field of a strength inversely proportional to the degree of exposure to heat.

723,363. PROCESS OF CONCENTRATING ORE; H. F. Campbell, Melrose, Mass. App. filed Feb. 18, 1903. A modification of the preceding process.

723,369. APPARATUS FOR MEASURING ELECTRICAL RESISTANCES; R. W. Conant, Cambridge, Mass. App. filed Sept. 29, 1902. A testing set especially designed to measure the resistance of rail joints.

723,385. TROLLEY WHEEL; N. T. Hazen, Newburyport, Mass. App. filed Feb. 5, 1902. Details of a device for preventing the trolley from leaving the wire.

723,398. ART OF OPERATING ELECTROLYTIC CELLS; E. A. Le Sueur, Sault Ste Marie, Canada. App. filed April 24, 1901. (See page 562.)

723,441. MEANS FOR OPERATING THE POINTS OF OVERHEAD WIRES ON ELECTRIC RAILWAYS; H. Collins and C. W. Collins, Manchester, Eng. App. filed June 9, 1902. A switch in the overhead trolley wire can be moved by the motorman through mechanical devices extending from the track to the overhead structure.

723,440. ELECTRODE FOR STORAGE BATTERIES; T. A. Edison, Llewellyn Park, N. J. App. filed Nov. 28, 1902. Active material is deposited in a pocket in the plate which pocket has concaved surfaces.

723,450. REVERSIBLE GALVANIC BATTERY; T. A. Edison, Llewellyn Park, N. J. App. filed November 28, 1902. (See Current News and Notes.)

723,451. STORAGE BATTERY; J. B. Entz, Philadelphia, Pa. App. filed Aug. 28, 1900. The end plates have an integral hook, the hill of which presses against the outer wall of the cell to hold the plate in position.

723,471. HOLDER FOR TELEPHONE RECEIVERS; S. Konigstein, San Francisco, Cal. App. filed December 19, 1901. (See page 562.)

723,478. BURGLAR ALARM; G. W. Mills, Elizabeth, N. J. App. filed April 15, 1902. A small casing containing a battery and an electric bell is placed behind the door; the opening of the door moves a push button on the casing and sets the bell in operation.

723,510. EDISON SCREW SWITCH HOLDER FOR INCANDESCENT LAMPS; O. Zielinski, Berlin, Germany. App. filed May 17, 1902. Details.

723,592. ELECTRIC RAILWAY; H. Edwards, Boston, Mass. App. filed June 16, 1902. Switching apparatus for a sectional rail system.

723,607. SECTIONAL ELECTRICAL SWITCHBOARD; T. W. Jardine, Englewood, N. J. App. filed Aug. 8, 1902. The switchboard is built up of sections, each of which carry in a fuse and switch corresponding to branch circuits. Any number of sections may be placed together and interconnected.

723,631. METHOD OF HEATING MATERIAL; E. G. Acheson, Stamford Township, Can. App. filed September 26, 1902. (See page 562.)

723,632. HEAT CONTROLLER STAND FOR ELECTRIC SMOOTHING IRONS; J. I. Ayer, Malden, Mass. App. filed Jan. 9, 1902. The resistance ordinarily thrown into circuit to replace the iron when the latter is out of use, is applied to the stand which is thereby heated and the heat utilized to keep the idle iron at high temperature.

723,633. HEAT CONTROLLER STAND FOR ELECTRIC SMOOTHING IRONS; J. I. Ayer, Malden, Mass. App. filed Jan. 6, 1902. A modification of the preceding patent.

723,634. ELECTRIC SOLDERING IRON STAND; J. I. Ayer, Cambridgeport, Mass. App. filed Nov. 13, 1902. A further modification involving control of the circuits by the weight of the tool on the stand.

723,635. ADJUSTABLE SUPPORT FOR TELEPHONE-RECEIVERS; F. J. Becker, Hamilton, Ohio. App. filed August 8, 1901. (See page 562.)

723,643. ELECTRIC FURNACE; C. S. Bradley, New York, N. Y. App. filed June 19, 1900. (See page 562.)

723,646. TROLLEY; H. H. Bryant, Allegheny, and J. B. McGaw, Pittsburg, Pa. App. filed Nov. 26, 1902. Details

723,690. SWITCH FOR ELECTRIC RAILWAYS; G. W. Linder, Baltimore, Md. App. filed Oct. 28, 1901. Details of a trolley wire switch.

723,717. ELECTRIC CONDUCTOR; J. D. Nicholson, Pittsburg, Pa. App. filed August 17, 1900. (See Current News and Notes.)

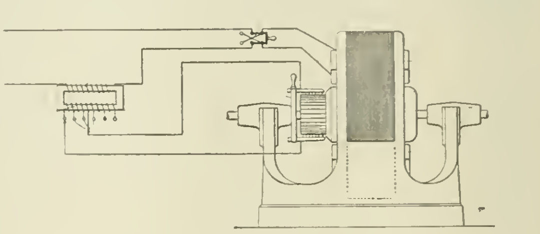
723,727. CAR OR VEHICLE PROPULSION; P. Pfeil, Chicago, Ill. App. filed Oct. 14, 1902. An arrangement for utilizing the momentum of a car when running down hill or coming to a stop to store current for lighting purposes.

723,732. ELECTRIC SWITCH; C. W. Rogers, Newmarket, N. H. App. filed Jan. 15, 1902. A cross bar having a contact at each end is forced downward to close the circuit by means of a centrally located rotating cam.

723,742. TELEPHONE-RECEIVER SUPPORT; D. W. Shick, Chicago, Ill. App. filed October 21, 1901. (See page 562.)

723,766. ELECTRIC HEADLIGHT LAMP; H. P. Wellman, Ashland, Ky. App. filed June 4, 1902. The magnet coil, arc inclosure, clutch, etc., are compactly arranged and capable of being easily removed from the lamp casing.

723,786. ALTERNATING CURRENT MOTOR; A. W. Schramm, Philadelphia, Pa. App. filed July 26, 1902. The field coils are in series with the primary winding of a transformer and the supply circuit, the secondary winding of the transformer is in a closed circuit with the armature and a reversing switch is arranged to change the connections of the secondary winding.



723,786—Alternating Current Motor.

723,788. RESISTANCE BOX; S. S. Wales, Munhall, Pa. App. filed Nov. 29, 1902. Details of a structure wherin a series of separate grids are assembled into panels.

723,791. CONNECTOR FOR ACCUMULATOR PLATES; G. A. Washburn, Cleveland, O. App. filed July 28, 1902. The connectors are cross pieces having openings to receive the lugs of the plates and adapted to rest upon the upper edges of the cells.

723,797. ELECTRIC THERMAL THERAPEUTIC BLANKET; W. W. Williams, Springfield, Ohio. App. filed Nov. 3, 1902. A switch is adapted to cut in different portions of the heating resistance which extends throughout the structure of the blanket thereby making it possible to heat particular portions of the body desired.

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CONTENTS.

Editorial 597
Some Difficulties in Long Distance Transmission 600
New York Meeting of the American Electrochemical Society 600
Six Niagara Power Installations Underway. A Million Horse-Power to be Developed at Niagara Falls. By Frank C. Perkins 601
Manufacture of Electrical Conductors in Russia 605
Electrically Operated Irrigation Plant in Utah 606
Effect of Grounding the Neutral on an Alternating Current System 606
Cable Code Vocabulary 607
Sheet Steel for Static Transformers. By Walter S. Moody 608
The Curtis Steam Turbine 609
De Forest Wireless Telegraph System. By A. Frederick Collins 613
Quick Work After the Helena Fire 615
Electrolysis of Water 616
Accurate Measurements ot Heavy Currents. By P. Letheule 616
The Construction of Aerial Telephone Lines—IX. By Arthur V. Abbott, C. E. 617
Recent Electrochemical Developments. By Clinton Paul Townsend 618
Sylvanus Thompson on Gilbert 618
Current News and Notes 619
LETTER TO THE EDITORS:
  Stress on Frames of Alternating Current Generators. By P. J. Frenell 620
Digest of Current Electrical Literature 621
New Books 625
McElroy System of Railway Car Lighting 626
Cooley Cycloidal Engine 628
Railway Brake Air Compressor 629
The Protection of Polyphase Motors 630
Cabinet Work for Electrical Purposes 631
Oil Cups and Oil-Hole Covers 631
New Cable Clip 631
News of the Week 632

THE MUNICIPAL OWNERSHIP QUESTION.

In spite of the attempt to stir up public opinion in favor of the plan for a municipal electric light plant, we are very glad to note that the people of New York exhibit no enthusiasm on the subject, and that the newspapers most influential as exponents of intelligent public sentiment oppose the scheme and frown upon it. There have been "popular" meetings in support of the measure, it is true, but none that have any claim or right to be regarded as representative of anything but the socialistic spirit which pervades a certain portion of the population here as everywhere else, and that would have every man on the pay roll of the State or the municipality in a vast series of paternalised institutions. We can but express our regret to see members of the Merchants' Association consorting with that element because bills for lighting are said to be too high. If we were to propose running an opposition on municipal lines to the businesses that some of those gentlemen are engaged in, it would be a fierce howl of protest that went up from them. It is wonderful what short memories some people in New York have. Less than ten years ago this city saw in one of its sections—Gravesend, Long Island—one of the most disgraceful and disastrous attempts at a municipal plant the country has ever known. At that place Mr. Kane, a celebrated politician, invested over $120,000 of the public money in a municipal lighting plant. We doubt if it ever ran a light; but we do know that only seven or eight years ago it was a perfect wreck before it had got into operation and was sold out under the hammer for $30,000. Thus was lost over $90,000 of money raised by bonds and taxation to put into a municipal electric light plant in what is now part of Greater New York; and yet with such an example staring them in the face, the Merchants' Association wants to get some more of the same thing on an infinitely larger scale.

Beyond the injudicious or malevolent stirring up of prejudice and ill will against corporations, there is an extraordinary recklessness in this affair in the use of figures intended to prove that the city is being cheated by the present rates for arc lights. Commissioner Monroe had prepared a list of towns and cities with alleged all night, every night, 2,000-cp arc lamps, with the rates. This list the Merchants' Association has reprinted, and made its own, and issued under the title: "The Lighting Monopoly of New York City and Its Exactions." Now this list is the most deceptive, specious and plausible thing of the kind we have encountered lately, and we are sorry to note that the *New York Times* in opposing the measure, is so misled as to accept the list as valid. It is a hollow fraud. There is nothing in it to show the local conditions, or whether the circuits are overhead or underground. There is not a word as to the length of the lighting contracts, a most vital consideration. There is nothing as to the number of lights. There is nothing as to use of water power or steam. There is no data as to the cost of fuel or expense of its delivery or restrictions as to its nature. There are no data as to the cost of water. In fact an absolute absence prevails of any data that would bring the figures to an equality of conditions; and even as they stand many of them look very suspicious. Moreover, they have been boosted up with instances like Detroit, to whose inaccurate municipal plant bookkeeping we paid our respects some weeks ago, showing irrefutably the gross underestimates of actual cost, depreciation, etc. Another vaunted example is Chicago, whose claim of $53.51 "total cost" per light has been pointed to triumphantly. We have the Chicago report before us and regard it as one of the most dishonest documents ever submitted to an unsuspecting public. Aside from a complete want of information as to the real cost of the plant—something which its founder, J. P Barrett, said no man could ever find out—the report omits any charge or allowance for depreciation, taxes, rent, water, sinking fund, insurance, furniture and other little things! The number of lights in operation is variously stated, and every blessed one of them is rated as burning every single hour of the schedule! Not a word of outage, interruption, low candle power, or other offset for which local companies are mulcted, is to be detected in this marvelous report.

As we have said before, we hold no brief for the lighting companies in New York, and are perfectly willing to allow that they are over capitalized. Watering stock is an economic offence for which we have no condonation to offer, in any branch of industry, and it carries its own punishment. But it has little to do with this question, for the public electric lighting is barely 5 per cent. of the New York Edison business, and hence the dividend item could swell the total cost very slightly. The main point is that on a precarious year-to-year contract, subject to just such onslaughts as this under consideration, the company has to instal, maintain and operate a most costly plant, for which it would otherwise have no direct or immediate use. New York is hiring its arc lights on the most unfavorable kind of a retail plan, and yet Mr. Monroe holds it an outrage if the city has to pay a retail price. It is obvious that long contracts and a larger service would do a great deal to bring down the price per lamp and to keep it down. That is much better to secure than to fly to the other alternative of a city plant with all its political and technical perils. Besides, we object to the assumption that an opposition company could not be found or started to give the required arc service, although the arc lighting organizations within the New York Edison system show practically nothing but deficits, we believe, since the wires were put underground.

LOW RATES AND WATER POWER PLANTS.

When a plant deriving its power from a large newly-developed water power begins to distribute electric energy to a community, there is always a temptation on the part of the management of the plant to make rates so low that after a few years come regrets that higher prices had not been initiated. We refer more especially to the class of plants where the company owning the power also does the local distributing to the various customers. Where the power company and the distribution company are separate, the problem is an entirely different one. Usually when a large water power is developed, there is immediately thrown on the market a much greater amount of electric power than the actual demand justifies. If, as is often the case, the water power takes the place of a steam plant, there is likely to be a reduction of rates all along the line, and special inducements are held out to users of large motors maintaining independent steam plants. As soon as the water power project is ready for business, the manager of the light and power company immediately begins to solicit the various steam users in his community to take electric power. Just at this point, the manager is likely to pass through one of the most trying periods in the history of his project. The various small factories have their steam plants already installed, and their owners very likely think that they produce power much more cheaply than they actually do. They are at first very much disinclined to abandon their steam equipment and put in an electric motor involving an additional investment of capital. The great majority of these power users are very slow about taking the new power. The manager of the water power plant sees a large investment lying idle and quantities of water going to waste. In nine cases out of ten, he will become desperate to increase his load faster and begin to lower rates in order to get his plant loaded. When once the ball has started rolling, he begins to take on customers rapidly and wakes up some fine day to find his plant fully loaded and too much of his load taken on at a price which represents little or no profit.

The moral is to scrutinize long time contracts taken at rates which may turn out to be too low to permit of a profit. "But," says the manager whose plant is still without a load, "I cannot afford to have my plant lying idle day after day, waiting for these people to apply for electric power." This is quite true, but it must be remembered that in spite of all that has been said to the contrary, business methods and engineering methods are largely influenced by the force of custom, and at times can almost be called fads. When once a number of power users in a community get started to take electric power, the rest fall in line without solicitation. It is largely a matter of getting the first few started. The policy of the management should, therefore, be that of avoiding "entangling alliances" in the way of losing contracts or of very low rates granted to certain consumers at the outset, which practically govern the price of power to all consumers taken on thereafter. The question is, How can this be done?

Granting at the outset that it is necessary to offer some special inducements to power customers in order to get a load and in order to create a fashion, as it were, for the use of electric power, the advisable thing to do is, of course, to make any concessions that are made in such form that they will be only temporary and will have no influence on the receipts after the first year or two. One way of doing this which suggests itself is to follow out a practice similar to one used by the owners of large office and flat buildings in getting new tenants; that is, to offer power almost free for a short period of time at the beginning of the contract. This would help induce a man to make the investment necessary in electric motors at once, while otherwise he might continue with his engine until the steam plant wore out. On the whole, however, it is a question whether it is necessary to make special concessions even at the outset. A water power plant is a valuable asset, even if the immediate load upon it is not great. As one distinguished engineer put it, "If I had a water power plant and some one would pay the interest on the investment, until such time as it could be utilized, no one could buy it from me." Of course, the rub comes in paying the interest on the investment. Unfortunately, no company has discovered a philanthropist willing to bear this burden until the plant is loaded up to a paying basis, but it certainly is better to run with a light load for two or three years than to load up immediately with power supplied to customers only at a loss. This warning is not needed by those who have been through the experience once.

CODE OF THE GERMAN ELECTROTECHNICAL ASSOCIATION.

A recent number of the *Elektrotechnische Zeitschrift* (February 19) prints the last report of the code committee of the German Electrotechnical Association. It comprises 44 columns of matter, and is very interesting reading. The report goes into many directions that our National Electric Code does not touch, and on the other hand, some of the rules in our national code do not appear to have their counterparts in the German report; but the "must nots" and "forbiddens" are common to both. The report of the "Verband Deutscher Elektrotechniker" sets forth at some length the symbols and letters of reference that plans and engineering drawings should bear, as denoting specific and prescribed features of construction. Thus, a permanently connected incandescent lamp is denoted by a little maltese cross, or multiplication sign, and a lamp with a switch or socket-key, is similarly denoted by such a maltese cross with a wavy line appended to its waist. Arc lamps are shown by a pair of small concentric circles, dynamos by a circle and brushes. Alternators and direct-current machines do not appear to be directly distinguishable in this system; but no doubt the system, as a whole, would enable the reader readily to discriminate in any given case.

It is interesting to see the rule that the neutral conductor of direct-current three-wire systems must be grounded. On the other hand, there are various directions that appear to be at variance with the rules of our National Electric Code. It seems desirable that upon many of these questions, as well as upon many questions of standardization, international agreement and consensus of opinion should be reached. Minor differences of standardization, modes of construction and rules for installation, must inevitably occur in different countries; but it is advantageous for all countries to possess in common an international system of electric rules and standards, so far as it is expedient to unite. This question is one which might properly be considered by an international electrical congress.

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High-Tension Insulation.

The Institute symposium on this important topic for once brought out a deal of valuable discussion. The first paper, that of Mr. Mershon, provoked a debate on the material and insulating value of pins that really added much to our knowledge of the subject. Mr. Mershon started with the principle that the longitudinal section of a pin of uniform strength with varying length is expressed by a simple cubic equation, and the graphical construction shows a gracefully tapering pin in outline suggestive of the Washington monument. Following upon the statical theory is the proposed practical modification for commercial requirements. All pins terminate in an extremity or shank of the same dimensions and form, for all sizes. This is the portion of the pin that is inserted into the insulator. The stem of the pin, or that part which resides between the cross arm and the insulator gap, is tapered in approximate accordance with theory, and varies in length and thickness according to the size of the pin and of the insulator it has to support. The root of the pin, or that part which is inserted in the cross arm, is also variable, in lesser degree, with the general size of pin. These proposed standard pins are of a form readily manufactured and easy to keep in stock.

In the discussion the proposed standard was overhauled pretty thoroughly, and the consensus of opinion was upon the whole favorable. But one thing is evident at the outset, that the number of standard sizes should be kept as small as possible. At the present time pins for high-tension lines are practically all special, for the commercial regular pins are too small for anything but rather light transmission work. Granted that a larger pin is a necessity, it would be an excellent thing if even a single size were sufficiently standardized to be generally available without a long struggle with the maker over the specifications. The weak point of the Mershon pin is in the thread, as was pointed out in the discussion, and in our opinion it would be materially improved by making the threaded portion one and a quarter inches in diameter and three inches long. A "ten-inch" pin thus modified would serve admirably for the great majority of heavy transmission work. It would be amply strong and in particular would stand up better in the thread. The modern heavy high-tension insulators need extra support, particularly in running lines over rough and windy country, and this is best given by a rather thick and stubby pin. If a size like that mentioned could be standardized as a start in the good work, it would prove very convenient.

As to the mooted question of wooden versus iron pins, much interesting information was brought out. It has been shown that wooden pins, particularly at high voltage, and in moist climates, suffer from what has aptly been termed "Digestion." By the very interesting Niagara experiments this has been determined as due to nitric acid formed by the brush discharge from the high-tension lines acting on the moisture of the atmosphere. It is, in short, Mr. Bradley's beautiful process applied on a comprehensive scale just where it is least wanted. It would be very interesting to know at what voltage on the line such action begins to take material effect. We are inclined to think that below 20,000 volts or thereabouts this action is very small, so that in the majority of plants it will not be felt. But at voltages which show powerful brush discharges from the wires it must be looked out for. Treating the pins undoubtedly helps matters somewhat, but treating as ordinarily practised does not strike us as sufficiently thorough.

Knowing the active cause of the digestion, experiments on treatment intended specifically to resist nitrous fumes would be decidedly profitable. It is fairly safe to say that any treatment satisfactory in this respect would be efficient in improving the insulating properties of the pins. But we think the treatment should be applied in a vacuum pan, rather than by mere boiling. Boiling in oil does not saturate the pins properly, as is at once shown by beginning to pump off the air and vapor. And the vacuum treatment is not troublesome, for a big aspirating water pump is amply sufficient to give the necessary vacuum. Supposing the treatment to be efficient it seems to us that a wooden pin may be made to answer admirably even at very high voltages. As between wood and iron, we grant that the former does not add much to the insulation, for that must depend on the insulator itself. But we do not see that anything would be gained by transferring the seat of digestion from the pin to the cross arm, and in the case of a high-potential line that action would certainly take place if an iron pin were used, since the same causes would be steadily at work in the one case as in the other. Moreover, the mechanical strains on the insulator from the use of iron pins are much more severe than in the case of wood, and at best the iron pins are costly. They are indubitably stronger than wooden pins, but the latter are abundantly strong for their purpose if properly designed. We feel, therefore, that the case against wooden pins is hardly made out as yet, and will not be until considerable experience with iron pins has accumulated, particularly in rather damp climates.

The discussion of Mr. Blackwell's paper on insulator testing brought out in this connection the fact that if insulators were to be used with iron pins, they should be tested with the pins in place and not merely by filling the thread cavity with salt water; for insulators that would stand the latter test may quickly break down under the mechanical strains and local action of the former. With respect to the relative merits of glass and porcelain insulators, the usual differences of opinion were in evidence and the general conclusion seemed to confirm what is already pretty well established, that first-class porcelain is mechanically and probably electrically a trifle better than glass, but requires more elaborate testing; while a good article of glass is entirely satisfactory for the vast majority of cases. Altogether, the discussion brought into prominence the fact that the voltages now to be considered seriously are those of 40,000 volts and above, that under this figure it is pretty smooth sailing for the engineer, and that above it lies a debatable ground in which experiments on a large scale are greatly needed.

Some Difficulties in Long Distance Electric Transmission.

In a paper recently read before the Cleveland Electric Club, Mr Paul M Lincoln considered in detail some of the difficulties that have been encountered in the development of long distance electrical power transmission. Referring to high tension in power houses and other interiors, he said it has been customary in the past to place considerable, if not implicit, reliance upon the rubber of a rubber-insulated cable The experience of Mr. Lincoln has been, however, that for such insulation, rubber is not reliable His first experience came at Niagara Falls some years ago. At the time of raising the voltage on the Niagara-Buffalo line from 10,000 to 20,000 volts, a change in arrangements made necessary the rewiring of the transformer station in so far as the high-tension end was concerned. For this purpose there was used a wire covered with a first grade of rubber insulation. A number of tests were made on short sections, and the insulation on none of these tests broke down short of 70,000 volts. An entire reliance was placed on the insulation of the rubber and no particular pains were taken, therefore, with the mountings. These mountings were small clamp porcelains.

Before the job was put into service it was given a test as a whole of 50,000 volts for ten minutes which it stood perfectly. After one week of operating on 20,000 volts, three-phase, two breaks occurred in the rubber insulation. The normal voltage strain on this insulation was only about 13,000 volts, so that there was a factor of safety of at least five. Both the break-downs occurred at the mountings, where in order to get to the ground it was necessary both to puncture the rubber and pass over about one inch of porcelain surface.

It has always been noticed that whenever any conductor is brought near the surface of high-voltage cable, brush discharge of more or less intensity takes place at the surface of the cable. The breaks in the insulation are almost certainly caused by some chemical action on the rubber, caused by this brush discharge. Whether it be ozone or nitric acid or something else that is generated by this brush discharge is not material. The observed fact remains that this brush discharge causes a deterioration of the rubber of the cable more or less rapid, which destroys in time its insulating qualities. In this opinion Mr. Lincoln said he was confirmed not only by many instances in his own experience, but by that of many others as well.

Another instance in which practically the same action occurred was that of a suburban railway, which generated power at a central station and transmitted it at 20,000 volts, three-phase, to a number of sub-stations. The high-tension wiring, both in the central and in the sub-stations, was composed of a good grade of rubber-covered wire, incased in lead. In order to prevent accidents to employees, it was thought best to ground the lead covering of the cables. In this case a brush discharge took place on the insulation of the cable at the point where the lead ended. In less than six months over 100 breaks occurred at various points, but all within three inches of the point where the lead casing of the cable ended. The cure in this case was to remove the lead entirely. Since that has been done very little trouble has been experienced.

A break-down of insulation causing either a ground or short-circuit is injurious, not only in causing an interruption to service at the time, but also in giving rise to electrical surges in the circuit which throw additional strains on the insulation on other parts of the circuit.

Thus, a break-down in one part of the system may cause an overstraining of insulation in a distant part of the same system. With electric waves, the highest potentials will occur at the reflecting points and in an electrical system it is difficult to tell where these reflecting points are going to be. Further, these insulation strains are not confined to the high-tension side of the system. A transformer may act to a certain extent as a condenser, and the sudden discharge of one side of this condenser may transmit to a certain extent electric surges to the other side. In the case mentioned above, for instance, where more than 100 break-downs occurred on rubber-covered cables, at the same these break-downs were occurring on the high-tension side of the circuit, considerable trouble was experienced with the apparatus on the low-tension side. Instruments on the low-tension side seemed to suffer particularly. A number of breaks occurred also in the insulation of some rotary converters. Since the cause of the high-tension break-downs—the lead of the rubber-covered cable—has been removed, practically no trouble has been reported from the low-tension side.

An approved method of doing inside wiring is to mount the wiring on insulators of the same character as would be used if wiring was to be exposed to the weather. The rubber insulator should be retained, but its only function is to protect employees or others in case of a casual contact with the wiring.

It seems probable, however, that the loss of power in brush discharges from the surface of the conductors as well as the disintegrating effect that this brush discharge is likely to have on the metal of the conductor, will place a limit to the increase of voltage. As voltages increase it becomes more and more difficult to insulate. Insulation of the line, however, is not the only thing. The insulation of the transformer and other apparatus attached to the line must also be considered

Lightning is another source of trouble to the transmission superintendent There is present the constant menace that the unusual electrical strains caused by lightning discharges will cause breaks in some part of the system's insulation. Lightning arresters properly designed and properly installed will take care of a great deal of such trouble, but to take away all dangers of break-downs from this source is practically impossible. There is one effect from lightning often overlooked. Lightning storms are usually accompanied by rain which causes the insulators all along the line to become thoroughly wet. A sudden electric strain such as is caused by lightning discharged in the neighborhood, is very apt to go to ground across the film of water on the insulator and down the pole, instead of over the lightning arresters at the ends of the line. In other words, the excess of potential necessary to break down to earth by way of a wet insulator and pole is not far different from that necessary to break over the lightning arrester.

New York Meeting of the American Electrochemical Society.

The following arrangements have been made for visits during the meeting next week in New York of the American Electrochemical Society: For Friday afternoon there are three parties scheduled. Party A will leave the Chemists' Club, 108 West Fifty-fifth Street, at 2 P. M., and arrive at the office of Willyoung & Gibson Company, 40 West Thirteenth Street, about 2.30; leave at 3 P. M., for Crocker-Wheeler Electric Works at Ampere, N. J., taking Christopher Street Ferry at 3.30. arriving at 4.20, and returning at 5.25 train to New York. Party B will leave at 2 P. M., arrive at Sawyer-Man Electric Company's works, 510 West Twenty-third Street, at 2.30; leave at 3.30, arriving at Eimer & Amends (special exhibit), Third Avenue and Eighteenth Street, at 3.45; leave at 4.15, arriving at Cooper Union, Third Avenue and Eighth Street at 4.30. Party C will leave at 2 P. M., arrive at U. S. Electro-Galvanizing Company, 9 Park Avenue, Brooklyn, at 3 P. M.; leave 3.30, and arrive Brooklyn Navy Yard at 4 P. M. Two parties are scheduled for Saturday afternoon, April 18. Party A will leave at 2 P. M., arrive at New York Edison Station, Thirty-eighth Street and East River, at 2.30; leave at 3 P. M., arrive at Manhattan Railway Company power house, Seventy-fourth Street, at 3.30; leave at 4 P. M., arrive at power house of Metropolitan Street Railway Company, Ninety-sixth Street and First Avenue, at 4.15; leave at 4.15 for Columbia College, West 116th Street. Party B will leave at 2 P. M. to inspect the Rapid Transit tunnel at Fifty-ninth Street and Broadway, leaving at 3 P. M. for Columbia College.

On Thursday evening there will be a banquet at the German Liederkranz clubhouse, 111 East Fifty-eighth Street, at which the following gentlemen will be guests: Dr. Walther Nernst, Göttingen, Germany; Mr. T. J. Baker, president of the American Chemical Society; Mr. Charles F. Scott, president of the American Institute of Electrical Engineers; Dr. William McMurtrie, president of the Chemists' Club, New York City; Mr. James M. Dodge, president of the American Society of Mechanical Engineers; Mr. V. Coblentz, president of the New York section of the Society of Chemical Industry; Dr. A. R. Ledoux, president of the American Institute of Mining Engineers; Mr. F. A. Ringler, president of the German Liederkranz; Dr. H. W. Riley, chief chemist of the Agricultural Department, Washington, D. C., and Prof. Samuel Sheldon, president of the New York Electrical Society. A musical programme for the occasion has been arranged by Mr. Carl Schlegel, of the German Liederkranz, assisted by Mrs. Annie Eisen. Ladies will be at the banquet.

Six Niagara Power Installations Under Way—A Million Horse Power to be Developed at Niagara Falls.

By Frank C. Perkins.

SIX great power companies are now installing or preparing to install power plants on the American and Canadian sides of Niagara River, having a total ultimate capacity of over one million horse-power. While a large part of this power will be utilized by manufacturing plants and electrochemical industries in the neighborhood of the Falls as well as transmitted to Buffalo, Toronto and other cities within a radius of 100 miles, it is hard to conceive of a market sufficiently great for so vast amount of power without taking advantage of long-distance electric power transmission. There seems to be little doubt but that Buffalo and the other cities will ultimately obtain power at very low rates, as competition will doubless be severe when all of the large power plants are in operation.

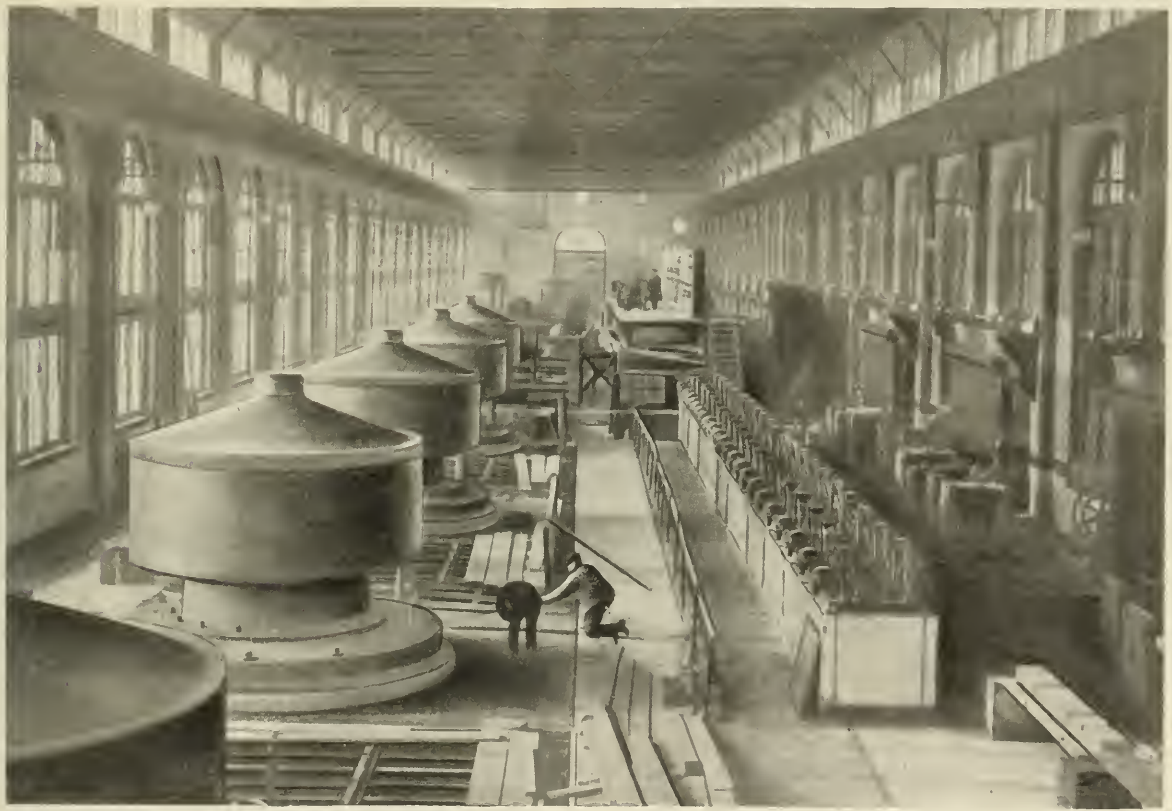

Fig. 1.—Interior of Power House No. 2, Niagara Falls Power Co.

A new electric lighting company has just been incorporated at Albany to operate in Buffalo, and in the towns of Tonawanda, Cheektowaga and West Seneca, Erie County. It is known as the Frontier Electric Lighting Company and has a capital stock of $800,000. It is said to be closely connected with the interests of the Buffalo Gas Company, and among the directors are mentioned Alex. C. Humphreys, Franklin D. Locke, Frederick Strauss, Robert L. Fryer, Stephen Peabody and William Riselay, of Buffalo and New York. That the plans of the new company include the use of a large portion of the new power about to be generated at Niagara Falls can hardly be doubted.

A new power company known as the Toronto Power Company has made application to the Victoria Park Commission for a franchise, and it was approved by that body after which it was referred to the Ontario Cabinet. There is little doubt that the franchise will be granted, which will make three power companies on the Canadian side and three upon the American side of the river. The Toronto company asks for a franchise to build a power house between the sites of the Ontario Power Company and the Canadian Niagara Power Company. From thirty to fifty million dollars capital will be required to carry on these gigantic power developments at Niagara Falls, more than half of which has already been expended or is being expended in present installations.

The power installations below the falls will include those of the Ontario Power Company on the Canadian side, near the Horseshoe Falls, and the Niagara Falls Hydraulic Power & Manufacturing Company below the bridge not far from the Whirlpool Rapids. The president of the Ontario Power Company is John J. Albright, of Buffalo, and this company has a franchise and agreement with the Canadian Commissioners of Victoria Park for the development of power. The 800-ft. dam of this company extends out into the river through seven or eight feet of swift-running water. The power station will be located in the gorge below the falls at the water's edge, and will be continually in the spray from the falls. The penstocks will run through tunnels in the cliff and be fed from supply pipes about 18 ft. in diameter through the park, finally passing down to the turbines in the power house, the site of which is now being excavated below the falls.

In addition to the Toronto Power Company now asking a franchise, the Ontario Power Company is preparing for an ultimate output of 400,000 hp, of which 50,000 hp is under construction. The Canadian Niagara Power Company has its first wheel pit, power house and tunnel well under way, which when completed will have a capacity of 110,000 hp, with a possible enlargement to double this output.

The Ontario Power Company, instead of having a surface canal, will convey its water through large pipes nearly 20 ft. in diameter, covered as they pass through the park and over the bank to a power house in the gorge below the Horseshoe Falls. This company has run a cofferdam out into the Niagara River and down this stream above the Dufferin Islands about 800 ft., thus directing the water during construction, after which it will be restored again to this section.

On the American side the Lower Niagara River Power Company has recently secured from the State of New York a franchise to develop 200,000 hp, and the new power house of the Niagara Falls

Power Company in connection with power house No. 1 will make a total of 105,000 hp, which will be available with the present tunnel, which is 7,000 ft. long, and passes under the City of Niagara Falls.

The present large power canal and the two 11 ft and 8 ft penstocks of the Niagara Falls Hydraulic Power & Manufacturing Company are now supplying water for turbines of from 30,000 to 40,000 hp, and with the enlargements contemplated and now under way, the output will exceed 100,000 hp

The six great power companies, three of which will operate plants on one side and three on the other side of the river, will thus control a million hp of energy in the near future without seriously drawing upon the power which Niagara is estimated to be capable of developing.

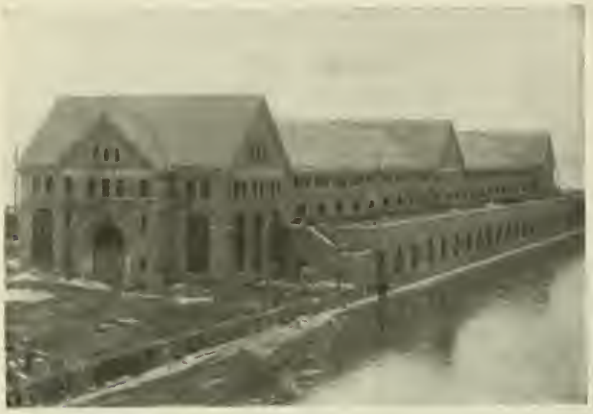

FIG. 2.—POWER HOUSE NO. 2, NIAGARA FALLS POWER CO.

The Niagara Falls Hydraulic Power & Manufacturing Company, whose secretary and treasurer is Mr. A. Schoelkopf, has a grant for 125,000 hp. and the canal through the City of Niagara Falls is being widened and deepened for increasing the capacity of the plant, work being carried on both night and day. Power house No. 1 at the edge of the river below the bank on the American side now has in operation five double discharge turbines of 2,900 hp each, operating at a speed of 250 r.p.m., one of 2,800 hp and four of 2,300 hp each. The three 1,650-hp, double-discharge turbines operate at the same speed as those mentioned above, while a 1,900-hp, double-discharge turbine is in operation at a speed of 300 r.p.m. Two Lombard and two Ellicott governors are used for controlling the speed on four of the turbines.

The electrical generators are all directly connected to the horizontal turbine shafts. Eighteen of these generators are owned by the Pittsburg Reduction Company, and the direct current which is generated at 300 volts is used for reducing aluminum from the ore. Six of these machines are of 560-kw capacity, four are of 1,000-kw and eight of these dynamos have an output of 750 kw.

The three 1,000-kw, direct-current machines supplying current to the Acker Process Company at 325 volts, as well as the two 875-kw, 175-volt machines used by the National Electrolytic Company, are owned by the power company. This is also true of the 200-kw continuous-current dynamo supplying current at 135 volts for the Vermilion Chemical Company.

In addition to the above electrical equipment for electrochemical work, two 560-kw, direct-current, 550-volt generators are used for supplying current for electric railway and power purposes, and one 750-kw alternator generates current at 2,200 volts and 125 cycles and is owned by the Buffalo & Niagara Falls Electric Light & Power Company.

A new power station has been started on the American side of the river near the water's edge in the gorge below the falls by the Niagara Falls Hydraulic Power & Manufacturing Company. This power station will be capable of developing 80,000 hp, or more than double that of the present power plant owned by this company. It is being installed several hundred feet below the present power house, the pit, penstock and interior of which are seen in the accompanying illustrations. The water will be taken from the canal which passes through the city of Niagara Falls. This canal basin will be increased in width to 50 ft. and in length by about 500 ft. toward the north, and it will also be deepened to supply the required amount of water.

As in the present power house No. 1, the penstocks will pass over the cliff and down the face of the high bank to the turbines below, but it is stated that several penstocks will be employed, each serving a single turbine, instead of one penstock serving several comparatively smaller turbines as in the present plant. The turbines are to be of the horizontal type and the units will be of 8,000 hp each, ten being necessary to complete the installation as planned. Mr. Wallace C. Johnson, who is the consulting hydraulic engineer in charge of the work of the Niagara Falls Hydraulic Power & Manufacturing Company, has had a vast amount of experience in this work, having acted in the same capacity in connection with the former installation of this company, as well as the great plant of the Shawinigan Falls Power Company, in Canada.

The penstocks of the Niagara Falls Hydraulic Power & Manufacturing Company, which connect the power canal with the turbines in generating station No. 1 below, are 8 ft. and 11 in. in diameter and were constructed by Struthers, Wells & Co. These two penstocks supply the water for five new turbines built by I. P. Morris & Co., as well as five Jonval-Geyelin turbines and four Leffel turbines. These wheels have capacities up to 3,000 hp each, the total output of the power house being from 35,000 to 40,000 hp.

The effective head of the hydraulic power plant is 216 ft. and the surface canal has only a loss of 2 ft. head, while it is stated that the loss of head in the tunnel of the Niagara Falls Power Company is about 50 ft. The surface power canal supplying this power house below the cliff passes through the City of Niagara Falls and is 4,400 ft. long; its present width is between 250 and 300 ft. near the entrance, narrowing to 100 ft. for half a mile and then again narrowing to about 75 ft. It discharges into a basin about 300 ft. from the edge of the cliff, which is about 400 ft. long and about 75 ft. wide, running parallel with the gorge; as the canal is enlarged this basin may be increased to 100 ft. in width, its depth being from 8 to 14 ft. The water from this basin is used for operating the various turbines along the bank in the various mills as well as for supplying the water to the two 11-ft. and one 8-ft. penstocks of the electric generating power station below the bank.

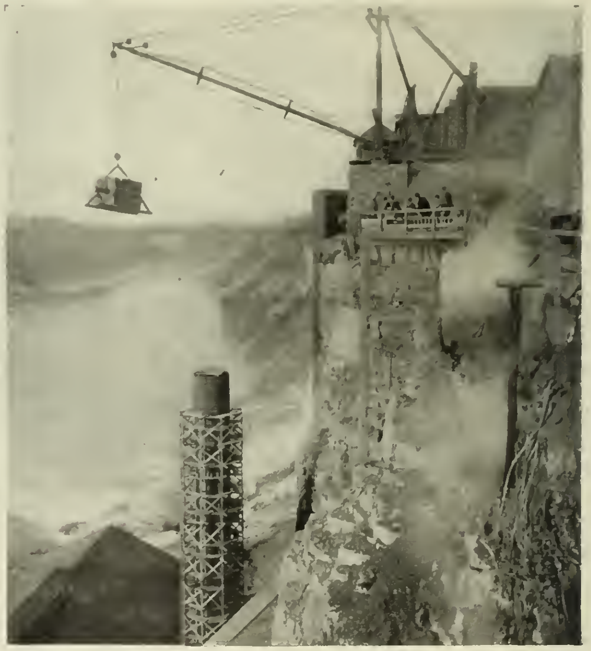

FIG. 3.—PENSTOCK UNDER CONSTRUCTION, NIAGARA FALLS HYDRAULIC POWER & MFG. CO.

The power house of the Niagara Falls Hydraulic Power & Manufacturing Company is constructed of stone and steel. The original 8-ft. penstock was constructed several years ago and supplies water to four Leffel wheels, each having a capacity of 2,250 hp. To three of these turbines are direct-connected, direct-current generators supplying current for the reduction of aluminum at the plant of the Pittsburg Reduction Company on the upper bank. The fourth turbine of this set drives two generators, one of which supplies current for the Lewiston & Youngstown Railway and various power users, and the other operates the Niagara Falls & Lewiston or Great Gorge Railway.

The original power house was increased in size to 120 ft. in length and 100 ft. in width, and five additional turbines of the Jonval-Geyelin type were installed, each of from 2,500 to 3,000 hp. These turbines are fed by the first 11-ft. penstock, which has a capacity of 12,500 hp. It is connected with the forebay by an elliptical bell mouth and is carried out from the cliff horizontally for a distance of about 50 ft. and then drops vertically to the power house a distance of 200 ft.

The penstock varies in thickness from ⅝ in. to 1⅛ in. and an air chamber is provided to act as a cushion preventing severe shocks from the vertical movement of such a great quantity of water. It passes horizontally beneath the power house floor and is connected with a series of five 60-in. hydraulic valves connecting the turbines with the penstocks. The discharge pipes from the turbines project laterally and then downward, connecting with the draft tubes. By means of these draft tubes, which are nearly 23 ft. in diameter, the effective head of the turbines is largely increased and this method has also been adapted in the new power house of the Niagara Falls Power Company, resulting in an output of 55,000 hp in the new power house from the same amount of water which gives 50,000 hp in the old plant using the other style of turbines without the draft tube.

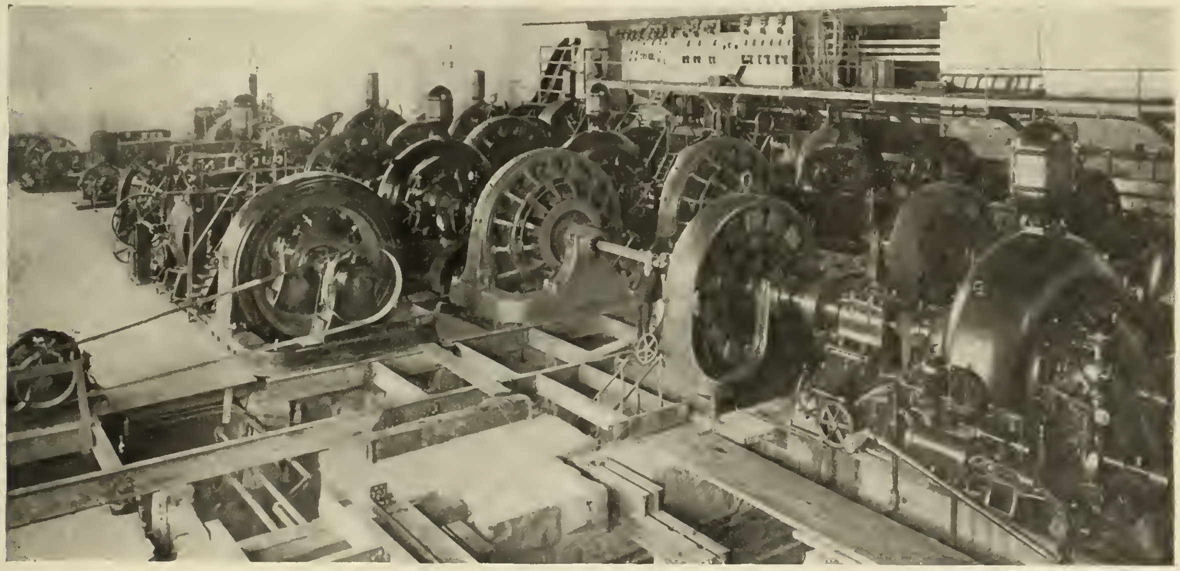

Fig. 4.—Generating Room, Niagara Falls Hydraulic Power & Mfg. Co., Power House No. 1.

The Jonval-Geyelin turbines in the power house below the cliff each weigh nearly five tons; the wheels are made of bronze and are located in the draught tube casing one on each side. There are 34 buckets on the runners with a total area of 140 sq. in., while the guide wheel has 20 runners of about 150 sq. in. total area.

The water for the Niagara Falls Power Company's plant above the falls is taken from the upper river and led to both power houses No. 1 and No. 2, by a canal 250 ft. wide, 12 ft. deep and about 1,700 ft. long, seen in an accompanying view of the new power house. It is of a capacity sufficient for the 105,000 hp to be developed in the two power stations. Power house No. 1 covers a wheel pit 20 ft. wide and 178 ft. deep with a length of more than 400 ft. There are ten penstocks in this wheel pit each about 8 ft. in diameter, supplying water to 10 double Fourneyron turbines built by I. P. Morris & Co. and designed by Faesch & Picard, of Geneva, Switzerland. Each of these turbines delivers 5,000 hp under a head of 136 ft. and a speed of 250 r.p.m. These wheels discharge at full load 430 cubic ft. of water per second, entering between the wheels, about half rising and rushing out through the upper wheel, and the rest passing downwards operates the lower wheel. The water rising to the upper turbine supports a portion of the weight of the shaft and moving parts connected with it, varying according to the position of the gates.

The new turbines installed in power house No. 2 on the opposite side of the canal are somewhat different from those mentioned above, as they are of the internal discharge type utilizing draught tubes and thus increasing the head by about ten per cent. There are, therefore, to be 11 turbines installed in power house No. 2, each of a capacity of 5,000 hp, and to be built by the same manufacturers, I. P. Morris & Co., of Philadelphia. These turbines were designed by Escher, Wyss & Co., of Zurich, Switzerland, who also designed the 10,000-hp turbines for the Canadian Niagara Power Company. The first six governors were built by A. Falkenau, of Philadelphia, and are of the hydraulic oil pressure type built by the Swiss engineers last mentioned.

Each of the 11 units develops 5,000 hp with a turbine speed of 250 r.p.m. The regulation, it is said, will be very close with the new oil-pressure governors, not exceeding 5 per cent., with a load variation of 100 per cent. and much smaller variations for smaller changes in load.

The water from the turbines of both power houses is carried away by a tunnel over 7,000 ft. long passing under the City of Niagara Falls and emptying into the river below the falls at the base of the cliffs near the abutments of the upper arch bridge. The wheel pit of power house No. 2 was constructed by the National Contracting Company. The pit is 18½ ft. wide and about 180 ft. deep and 464 ft. long. The forebay is 40 ft. wide and extends along the length of the building. The new Francis inward discharge turbines for the operation of exciters will operate under a head of 145 ft., and four of these are already in place. The first six turbines in the new power house are directly connected to vertical two-phase external revolving field generators of the same general type as those in power house No. 1 with certain modifications as to ventilation, means for carrying the exciting current to the field coils, and other changes. The remaining five turbines will drive vertical generators having internal revolving fields. At the bottom of the wheel pit a chamber is excavated which is supplied with vertical turbines driving direct-current generators as exciters; these machines also supply current for lighting and operating direct-current motors about the power house. Each of the four exciter turbines operates at a speed of 750 r.p.m., and is controlled by a separate governor. The discharge water from wheel pit No. 2 is carried by a 600-ft. extension of the main tunnel. This tunnel, which has a capacity of 100,000 hp, was recently tested by allowing the full power from station No. 1 to pass through with 10 turbines running and additional water from wheel pit No. 2 sufficient to develop the full power capacity of the tunnel. The test was satisfactory in every way. The discharge water from the two wheel pits attained such a velocity in its flow to the tunnel's mouth below the falls, that it shot across the entire river to the Canadian side of the stream. The tunnel was carefully inspected and found to be in good condition after several years' operation of the power plant No. 1. The hydraulic installation on the Canadian side, being developed by the Canadian Niagara Power Company will utilize the same general scheme as has been so successfully carried out by the Niagara Falls Power Company on the American side. That is, the water will be first led into a canal, carried by penstocks vertically to a depth of nearly 200 ft. and the discharge water carried away from the turbines which will have draught tubes, by a tunnel connecting the wheel pit with the river below the falls.

The new power development of the Canadian Niagara Power Company is well under way and an initial development of five 10,000-hp units will be employed in this plant, the generators supplying a current of 11,000 volts directly from the armature windings. The current designed for transmission to Toronto will be raised to 60,000 volts and transmitted over a line about 90 miles long, which will be constructed probably of bare aluminum cable on account of its comparative lightness, thus requiring fewer poles. The power can be supplied by either the Canadian or the American stations, according to the arrangements of connections between the plants.

The president of the Canadian Niagara Power Company is Mr. W. H. Beatty, Mr. William B. Rankine is vice-president and treasurer, and Mr. A. Monro Grier, K. C., is secretary and solicitor. This company is associated with the Niagara Falls Power Company, whose plant is on the American side. This new Canadian plant will have a feeder forebay 300 ft. long and 280 ft. wide, the depth being 15 ft. at low water. A five span stone arch bridge 60 ft. wide will span this forebay; each arch, which will cover about 50 ft. and be built of steel and concrete, will carry two tracks for the electric railway of the International Railway Company, as well as a highway and sidewalks.

The wheel pit which will contain the penstocks and turbines is to be 570 ft. long and 21 ft. wide, with a total depth of 170 ft. The method adopted for the power development of the Horseshoe Falls by the Canadian Niagara Power Company, is similar to that of the Niagara Falls Power Company on the American side. The forebay supplies the water to a wheel pit nearly 200 ft. deep, which contains the turbines and penstocks, while a tunnel is employed to carry the water away from the turbines as a tail race.

The wheel pit of the first section of the power house constructed will be 270 ft. long, and about three-fourths of the depth has already been reached by the contractors, Dawson & Riley, of St. Catharines, who are also constructing the large forebay. From the north end of the wheel pit a 16-ft. canal 500 ft. long is to be constructed as an ice run, and as several feet fall with be allowed, a good current will result between the mouth and the entrance; gates will regulate the flow from the forebay. Contractor A. C. Douglass is making good headway with the tunnel, shaft and portal, the former being 18 ft. wide and 25 ft. high. This tunnel is nearly half a mile in length and will be lined with brick and concrete, several million brick being employed in this work.

The penstocks in the power plant of the Canadian Niagara Power Company will be a trifle over 10 ft. in diameter and the main shaft, which connects the turbines and generators running vertically in the wheel pit, is to be 40 in. in diameter.

The first installation will consist of five turbines built after designs by Escher, Wyss & Co., of Zurich, Switzerland, each having a capacity of 10,000 hp. under a fall of 158 ft. Eventually this will be increased to 110,000 hp by the addition of six more such turbines. It is stated that the weight of all of the revolving parts will be carried by a water balancing piston, the lower wheel forming another balancing piston. The turbines are estimated to use each 885 cubic feet of water per second. The turbines are to be directly connected to three-phase vertical generators of the internal revolving field type. These machines are being constructed by the General Electric Company and will supply three-phase currents at 11,000 volts and 25 cycles. The turbines will drive the generator fields at a speed of 250 r.p.m., the weight being about 80 tons. The power house is to be equipped with two electrically-driven cranes of 100,000 pounds capacity each.

The power plant of the Canadian Niagara Power Company is located about a third of a mile above the Horseshoe Falls in Victoria Park. This company is closely allied to the Niagara Falls Power Company and its plant is similar in construction to that of this company on the American side, including an intake canal, a discharge tunnel and wheel pits nearly 200 ft. deep.

While the generators on the Canadian side will be of the three-phase type and of 11,000 volts, and those on the American side are two-phase machines supplying current at 2,200 volts, still provision is made for operating the entire system in parallel on both sides of the river.

For the transmission of power to Toronto, which is nearly 90 miles from the power house of the Canadian Niagara Power Company, 60,000 volts will be employed and several hundred cities and small towns will be served by the transmission line through this section of the Province of Ontario.

The 11,000 volt, three phase currents from the power house will be utilized at this voltage for power distribution in and about the Canadian city of Niagara Falls, and the current may also be used on the American side if desired, as the two power houses will be connected by triple conductor cables carried over the Niagara River on the upper arch bridge.

The American two-phase generators and the Canadian three-phase generators will be arranged to be connected in parallel by means of the Scott system of two-phase, three-phase, step-down transformers. By this arrangement the two-phase, 2,200-volt current from the American power plant can be raised to 11,000 volts and changed to a three-phase current at the same time by the step-up transformation and transmitted across to the Canadian plant through triple-conductor cables on the bridge. It can thus be used directly in parallel with the Canadian high-pressure machines when they require assistance for the local distribution, or it can be raised by the step-up transformers to 60,000 volts for helping out on the long-distance transmission line if necessary.

In the same way the Canadian machines may be made to assist on a heavy load on the American side by a reverse transformation, supplying the power users on the American side in parallel with the two-phase machines at 2,200 volts, or raised to 22,000 volts, three-phase for the American transmission lines to Buffalo, Tonawanda or Lockport, if desired.

The Canadian three-phase, 10,000-hp generators are similar in construction to the new generators to be used on the last five units of power house No. 2 on the American side, both having internal revolving fields and external stationary armatures.

The Ontario Power Company will install its plant on the Canadian side below the falls, carrying the water over the bank to the turbines below by a system similar to that of the Niagara Falls Hydraulic Power & Manufacturing Company on the American side.

It may be of interest to note the difference in construction of the electrical apparatus, including the generators, switchboards and other apparatus in these various plants, due largely to the different methods employed in developing the energy by the hydraulic turbines. The owners of the Niagara plants above the falls using the vertical turbines must necessarily employ vertical electrical generators, while those power companies using horizontal shaft turbines below the falls utilize electrical generators very similar to those employed in steam engine practice for large power plants.

An accompanying illustration shows the hydraulic arrangement of the penstocks and horizontal turbines, which are directly connected to both alternating and direct-current machines having horizontal shafts and armatures as installed at the present power house of the Niagara Falls Hydraulic Power & Manufacturing Company.

In the power plant of the Niagara Falls Hydraulic Power & Manufacturing Company, below the falls, the generator supplying current for the Buffalo & Niagara Falls Electric Light & Power Company, which is located in the power house below the cliff on the American side, is a single-phase machine of high frequency. It has a capacity of 700 kw and generates current at 125 cycles and 2,200 volts. This machine is direct-connected to one end of the turbine shaft, which drives it at a speed of 250 r.p.m.

A General Electric 14-pole, direct-current machine is directly driven by the turbine shaft supplying a current of 5,000 amp. at 175 volts, which is used for electrochemical work in the chlorate of potash plant. This machine has a capacity of 875 kw, or about 1,200 hp, and the current is conducted over aluminum cables, a portion of which is bare and the balance well insulated where leakage is liable to occur.

Of the four Leffel turbines supplying 2,250 hp each, three are directly connected to six direct-current multi-polar machines for supplying current to the Pittsburg Reduction Company for use in the electric furnaces for producing aluminum. The current is conducted on aluminum bars up the side of the 11-ft. penstock to the aluminum building on the upper bank.

The fourth Leffel wheel drives two direct-current machines which supply current for various power users as well as to the Lewiston & Youngstown Electric Railway and the Niagara Falls & Lewiston or Great Gorge road. A 200-kw generator of the General Electric, direct-current, shunt-wound type supplies current at 135 volts for use in the manufacture of chromium by the Alloy Smelting Company. This generator is driven by a turbine receiving its water from the 8-ft. penstock.

Of the five Jonval-Geyelin turbines supplied from the 11-ft. penstock and ranging in capacity from 2,300 to 3,000 hp, two are directly connected to 750-kw multi-polar generators supplying current of 3,000 amp. each at 300 volts. The current from these machines is used for the reduction of aluminum by the Pittsburg Reduction Company.

Three 1,000-kw machines are operated by Jonval-Geyelin turbines and deliver current to the plant of the Acker Process Company, and a 5,000-amp. generator supplies current to the National Electrolytic Company. The current generated by the machines driven by the new turbines built by the I. P. Morris Company will be used by various manufacturing concerns, including the Pittsburg Reduction Company, the Acker Process Company and the National Electrolytic Company. These and other electrochemical works will also absorb much of the power of the new station, which is to be built near the Whirlpool Rapids, to take water from the enlarged Schoelkopf power canal.

The power plant below the cliff installed by the Niagara Falls Hydraulic Power & Manufacturing Company, while developing a large amount of power and generating many thousands of kilowatts of energy, is not to a great degree a power transmission generating station. The current is very largely a direct current and utilized in the immediate neighborhood by various factories for motive power and by numerous electrochemical works for their various processes requiring current for electrolytic cells and electric furnaces.

The power transmission plants, strictly speaking, are those above the falls owned by the Niagara Falls Power Company and the Canadian Niagara Power Company. Whether the current generated at the power house below the falls on the Canadian side by the Ontario Power Company or that supplied by the new power house on the American side near the Whirlpool Rapids, will be transmitted to a distance to any considerable amount is as yet unknown. There is no question but that there will be a continual demand in the neighborhood of the City of Niagara Falls for a vast amount of electric power for new electrochemical and other industrial plants during the next decade.

The Niagara Falls Hydraulic Power & Manufacturing Company has recently acquired a large area of land in the north end of the City of Niagara Falls where numerous factories will be constructed, and undoubtedly most of the available power of this company will be utilized in the immediate vicinity of the "Power City."

The power development at Niagara under way is well on towards half a million horse-power and even at the present time about $35,000,000 capital has been raised for this great work. It is stated that the plans of the Ontario Power Company provide for a development finally of 400,000 hp, and the construction of a plant for 50,000 hp is now under way.

The new power company which has entered the field and secured a franchise from the State of New York for the development of 200,000 hp, is said to have an abundance of capital for the work. This company is known as the Lower Niagara River Power Company, and it is stated that the work on this company's installation will soon begin.

Wireless Newspaper on Land.

The Los Angeles (Cal.) *Times* says: "The only daily newspaper in the world publishing sure-enough dispatches transmitted by wireless telegraph had its birth yesterday morning (March 25) at Avalon, Santa Catalina Island. The event is a unique one in the history of journalism and marks the beginning of an epoch in the dissemination of news in isolated places. The name of the infant journal is the *Wireless*, appropriately so called on account of the method by which it receives the news of the busy world. The unique sheet begins its career in the shape of a three-column folio, the exact size of the pages being 11 x 8 in. In this convenient form is crowded, in addition to the local news of Avalon, an epitome of the local and general news appearing simultaneously in the *Los Angeles Times*, thus giving the residents of the island and visitors to its lovely shores a comprehensive synopsis of all the principal news of the world hours before the arrival of the steamer from the mainland with the Los Angeles morning paper."

Manufacture of Electrical Conductors in Russia.

Our Russian contemporary, *Electritcheskij Wiestnik*, of St. Petersburg, in a recent issue comments upon the present situation in Russia with respect to the manufacture there of electrical conductors. The occasion of its comment is a letter forwarded for publication by Messrs. Felton & Guillaume, known also as the Reben Manufacturing Company, of St. Petersburg, which was called forth by some statements made by the American Consul at Odessa, Mr. T. Chinan, criticising the slowness of electrical development in Russia. Referring to the Consul's remarks on the production of electrical conductors and cables, the letter says that the Reben Manufacturing Company and also the Siemens & Halske Company produce conductors and cables of excellent quality, but it is acknowledged that the exportations from abroad are very large.

The editor remarks that the letter does not answer the question, Why, in spite of the good quality of Russian cables, are such large quantities bought abroad? He also incidentally says that the American Consul neglected to mention the Petilchef Works at St. Petersburg and the Koltchugine Works at Moscow, which have quite large outputs. In answer to the question, it might be said that Russian manufacturers do not make all lines of conductors and cables or that they are not able to produce the necessary amount to meet the Russian demand. It is, however, a well-known fact that they do manufacture all forms of conductors and cables and that the capacity of their plants is in excess of the demand. The real difficulty lies in the fact that manufacturers are handicapped by conditions over which they have no control. Copper and other raw materials required are subjected to a heavy taxation which more than offsets the import duty on the manufactured material. This reason, as well as others, causes orders to go to foreign countries, and those given to Russian manufacturers are at figures more apt to result in a loss than a gain. To other adverse conditions should be added the high cost of freight transportation in Russia. In Austria and Germany manufacturers are allowed considerable reduction on carload shipments, and they frequently ship in a roundabout way over longer distances in their own countries in order to shorten the transportation over Russian railroads. On the other hand, the Russian railroads place electric conductors and cables in the high-tariff class of merchandise, and allow no reduction in rates, no matter what may be the quantity shipped.

Still another adverse condition is in connection with the supply of telephone and telegraph conductors. The principal European governments own the telegraph and telephone services, and naturally purchase material required in their own countries. The manufacturers in these countries then sell their surplus to foreign countries at a low figure, sometimes even less than actual average cost to them, in which case, however, they derive an advantage through being able to operate their factories at normal capacity. In Russia where the telephone service is under private ownership, the companies naturally wish to purchase their material at the lowest figure without reference to whether it is made in Russia or abroad. This was recently illustrated in the course pursued by the syndicate which obtained a telephone franchise in St. Petersburg.

The editor considers that the taxation on raw materials, as well as the tariff on manufactured products, should be so regulated as not to close the market to Russian manufacturers, while leaving it open to foreigners. He believes that such a revision may soon be expected. A short time ago a new tariff scheme was proposed, which provides duties much higher for manufactured products, but unfortunately also higher for raw material. That the high quality of Russian material is recognized at home is shown by a large order recently given to the Reben Works for all the conductors to be used in connection with the new telephone exchange at Riga, and for the conductors for the new electric light plant at St. Petersburg.

Third Rail in New York.

It is reported that the Manhattan Elevated in New York may try the hooded third rail in place of the unprotected form. Alderman Downing has presented a resolution to the board asking the Corporation Counsel to draft a law compelling railroad companies to devise a system for the use of covered third rails. The matter was referred to the Committee on Railroads.

Electrically-Operated Irrigation Plant in Utah.

A detailed description appeared in these columns some months ago (October 25, 1902) of a large irrigation plant on the shores of Utah Lake, operated by induction motors. The plant has been in operation now for some months, and from the first day has been of immense benefit to the farming community which it serves. By its means a large beet crop has been saved, and a third alfalfa crop secured. The accompanying illustrations give views of the interior and exterior of the pump house.

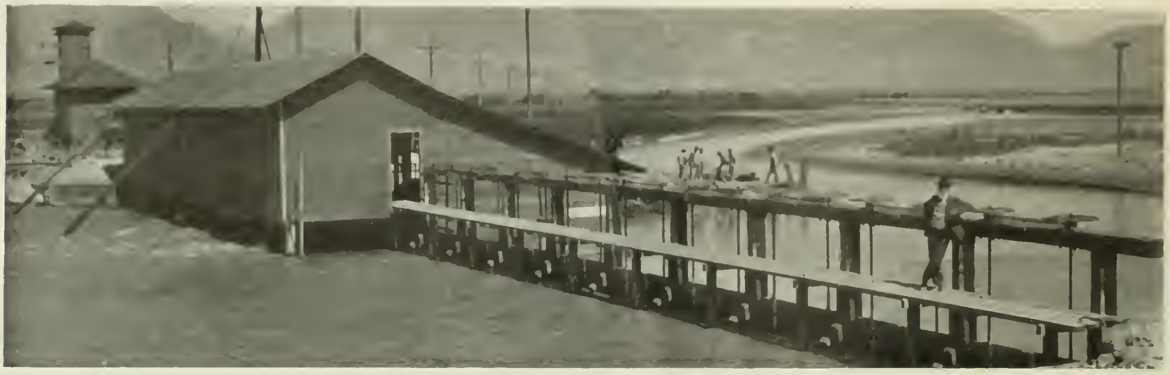
FIG. 1.—GENERAL VIEW OF WATER PUMPING PLANT FOR IRRIGATION.

There are four Byron Jackson centrifugal double suction pumps in use, driven by the same number of Westinghouse induction motors of 100 hp each. The pump, as shown in the illustration is 9 ft. in diameter, with an outlet 48 in. in diameter. The pulleys attached to the pumps make some 200 r.p.m. and each has a diameter of 6 ft.

The pumps are placed on a platform on piles in a channel of the river 300 yards from the lake outlet. The water is forced through a dam constructed across the river, and the pumps raise the river water at their outlet about 3 ft. higher than it is at the intake. Large gates stop the water from flowing back into the lake.

The pumps supply water for about 30,000 acres of land, which would be worthless without them. There are those who express fear that the lake cannot stand the constant drain, and that the water supply will be exhausted; but while it is thought that the fall of the level in the summer may be four, five or possibly six feet, it is claimed by those interested in the scheme that the winter will make up for all the decrease. The lake surface is 375 square miles, and it is claimed that three-fourths of the loss is caused by evaporation and only one-fourth by irrigation; and that by lessening the surface of the water a large percentage will be saved.

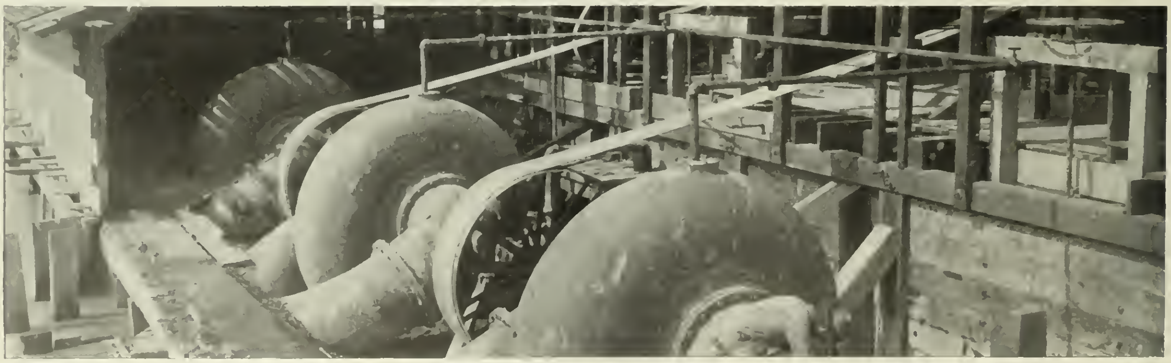
FIG. 2.—VIEW OF PUMPS, UTAH LAKE PUMPING PLANT.

Institution of Electrical Engineers.

Secretary McMillan, of the English Institution of Electrical Engineers, writes that the library and offices or the Institution will be hereafter at 92 Victoria Street, London, S. W., where all communications should now be addressed.

Effect of Grounding the Neutral on an Alternating-Current System.

The Chicago Electrical Association had another very successful dinner at the Albion Café, Pullman Building, Chicago, Friday evening, April 3, over 100 being present. The subject for discussion was: "The Effects Produced by Grounding the Neutral on Alternating-Current Systems." A paper was presented by G. M. Eastman, who has charge of the testing department of the Chicago Edison Company. Mr. Eastman first took up the general mathematical principles involved as laid down in the paper presented by J. D. Nies at a previous meeting of the association and published with some additions by the author in ELECTRICAL WORLD AND ENGINEER of April 12, 1902. This paper has almost become a classic on that subject. Mr. Eastman, after a discussion of the general principles, proceeded to figure out some concrete examples from the overhead and underground lines of the Chicago Edison Company, and showed how much excessive pressure above the normal working voltage might arise in certain cases where the neutral was not grounded; the conclusion being in every case that arises in practice that the neutral of a four-wire, three-phase, alternating-current system should be grounded. The contents of Mr. Eastman's paper will be given more completely in a later issue.

J. D. Nies, in discussing the paper, spoke of Mr. Eastman as having been one of the first champions of the practice of grounding the neutral. While at first sight it would seem dangerous to deliberately place a ground on a high-tension alternating system, thereby producing the full-phase voltage between any one of the wires and the ground, it is now conclusively demonstrated that an accidental ground on an underground system might cause a voltage much in excess of the regular voltage. With the neutral not grounded permanently, an accidental ground on any one of the phase wires, if not inductive, might give rise to a potential 83 per cent. above the normal working voltage. But if the accidental ground were of the swinging kind, such as would draw an arc, and hence be of the nature of an inductive resistance, the rise in voltage due to the ground might be much higher. If the ground were in the primary coils of a transformer, it was possible to get a voltage of four or five times the regular pressure of the system. It was always better to ground the neutral.

President Woodworth spoke of the difficulty at first in convincing some of the authorities in charge of local legislation or of the framing of underwriters' rules, that true safety lay in grounding the neutral; and he pointed to the fact that it had actually been proposed to forbid by law the grounding of the neutral in the City of Chicago.

Mr. D. W. Roper, of St. Louis, was called upon to tell of the practice of the Missouri Edison Company in regard to grounding on alternating-current lines. He said that his company operated only a single-phase, alternating-current system. The various alternators were not operated in parallel, but one side of each alternator was connected to a common bus-bar. This, of course, gave something in the nature of a star-connected multiphase system, as the current of the various alternators occupied various angles with reference to the common bus-bar. This common bus-bar was now connected through a non-inductive resistance to ground. Before this bus-bar was grounded, a lightning arrester discharge between any one of the mains and grounds was likely to cause an excessive potential between the common bus-bar and ground, so that the arrester on this side would discharge, causing a temporary short circuit. A non-inductive resistive in the shape of a barrel of water was connected between the common bus-bar and ground. This resistance amounted to about 20 ohms on the 1,200-volt, single-phase system. After the proper resistance was determined in this way, a permanent non-inductive resistance was installed. This resistance also serves a useful purpose in the operation of a ground detector. A transformer is connected in shunt across the terminals of this resistance. Ordinarily not enough current flows between the common bus-bar and ground to light a lamp in the secondary of this transformer. If a ground should come on the non-grounded side of any one of the feeders, this lamp would be lighted, because of the rise in potential across the terminals of the resistance.

Mr. H. B. Gear told of the practice of the Telluride Power Transmission Company in Utah. This company has about 300 miles of three-phase, 4,000-volt line, much of which is aluminum. The transformers are star-connected and the neutral grounded. An interesting thing about this line is that the lagging current due to the inductive load imposed by the motors does not compensate for the leading current caused by the condenser capacity of the line. The company has two plants about 90 miles apart, in parallel. As illustrating some of the inconveniences of having so large a leading current, Mr. Gear mentioned one incident where, with the ordinary connected load, it was necessary to operate one of the idle generators in the power house as a synchronous motor, to give a lagging current to the line.

Mr. Carl Swartz was called upon to state the practice in Russia and in Caucasia. He said the larger central stations in Moscow and St. Petersburg used delta-connected transformers, one other station was named employing star-connection with grounded neutral.

Mr. G. H. Lukes, superintendent of the North Shore Electric Company, Evanston, Ill., remarked on the St. Louis practice as being economical in cost of switching apparatus. As the voltage of an installation is increased the cost of switching apparatus and switchboard installation increases very rapidly. By using a common bus-bar for one side of the system and grounding that bus-bar, single-pole switches could be used everywhere, and the switching apparatus reduced very much in cost. On pole lines, also, the grounding of one side was an advantage, because the grounded lines could be kept near the pole, leaving the live lines for the outer ends of each cross arm.

Mr. Blanc, responding to a request to give the results of his observations in California on grounding the neutral, said that it was a practice generally endorsed there, both the Standard and Bay County's immense transmission systems being operated with a grounded neutral. One of the first transmission plants in Germany started to operate with star-connected transformers and a grounded neutral; but the government found that this interfered with their grounded-line telephones, and prohibited the practice of grounding.

Mr. Peter Junkersfeld, regarding the practice of omitting the switches in any circuits which are grounded, said that on some of the recent work of the Commonwealth Electric Company on the four-wire, three-phase system, switches had been put on the three outside or phase wires only, leaving the neutral permanently connected to ground without switches. He considered papers along the lines of Mr. Eastman's of great value, by demonstrating that the grounding of the neutral is not only permissible, but absolutely necessary to the greatest safety of operation. When a new practice of this kind is inaugurated it is sometimes claimed that the operating company is adopting the new practice because of some financial benefit it is to derive from it, and that it is a detriment to the general public. Mr. Eastman had shown that it was safer for the public, for the employees of the company and for the apparatus, to have the neutral grounded.

Cable Code Vocabulary.

At the last meeting of the New York Chamber of Commerce, the Committee on Foreign Commerce and the Revenue Laws also presented a short report with reference to the compulsory use of an official cable vocabulary for commercial purposes. It was as follows:

Your Committee on Foreign Commerce and the Revenue Laws beg leave to present the following preamble and resolutions, and to move their adoption:

"*Whereas,* It is reported that an effort will be made at the conference of International Telegraph Lines in London, on May 26, 1903, to put into compulsory use in cable telegraph messages the so-called 'official vocabulary' of cable code ciphers prepared under the direction of the International Telegraphic Bureau; and

"*Whereas,* Such official vocabulary is inadequate for commercial business, and not adapted to existing conditions; and

"*Whereas,* The enforced use of such official vocabulary and the exclusion of cable code systems now in use would entail serious expense, inconvenience and labor upon commerce; therefore, be it

"*Resolved,* That the Chamber of Commerce of the State of New York again enter its protest against the compulsory use of an official vocabulary in cable telegraphy; and be it further

"*Resolved,* That the Committee on Foreign Commerce and the Revenue Laws be instructed to enter into communication with other commercial bodies, both in this country and in other parts of the world, for the purpose of bringing every possible influence to bear to cause a reconsideration of the proposed plan for the compulsory use of the 'official vocabulary' in cable correspondence."

This report was signed by Gustav H. Schwab, Isidor Strauss, S. D. Webb and George F. Vietor.

Wireless Telegraphy Across the English Channel.

The Northern of France Railway Company, it is stated, has decided to install wireless telegraphy on its Dover-Calais cross-channel steamships. A station will be erected at Calais harbor. Some time ago an effort was made to introduce wireless telegraphy on all the packets running between Dover and Calais, but the obstructions of the English postal authorities prevented a receiving station being erected on their side of the Channel. Even now the French mail packets, like the Belgian boats, will be unable to communicate with Dover, however necessary a message may be, as in the case of a break-down similar to that which befell the *Pas de Calais* not long ago. The present English policy, therefore, is "not to talk back."

Cheap Chemical Alcohol.

Advices received by the State Department at Washington from United States Consul Haynes at Rouen, France, throw more light on the new process that has been discovered by which alcohol may be produced by chemical synthesis. It is predicted that the cost of such production can be reduced to less than ten cents a gallon. Thus far the cheapest alcohol produced has cost nearly twenty cents a gallon. At this price Germany produces quantities of alcohol, potatoes being used as the vegetable base. By the French process no vegetable matter is employed. From carburet of calcium—a direct combination of carbon and hydrogen in the electric arc—acetylene is obtained. Sufficient hydrogen then is added to produce ethylene and by combining water with ethylene alcohol is obtained. While the cost of alcohol by the new process has not yet been reduced much below its cost as produced from vegetable matter, it is predicted with confidence by eminent French chemists that in the near future it may be produced by the new process at a cost of about half that which Germany pays to obtain it from potatoes.

Sheet Steel for Static Transformers.

By Walter S. Moody

THOSE who are at all familiar with the subject know in a general way that there has been a great improvement in the efficiency, safety and life of transformers since they were first used commercially. It is doubtful if many fully appreciate how very great the change is or the principal reason that has made the improvement possible. Let us look back for a moment to what must, in electrical history, be considered ancient records to ascertain what the advance has really been.

In order to make the comparison simple we must have data on one size of transformer extensively used through the period covered. If we go back 15 years this necessitates the selection of what to-day seems a very small unit.

The following data apply to 2½-kw transformers. The figures for each period are the average of tests made at that time on several different makes, and in no case represent a single transformer or make of transformer. They are therefore, fairly representative of the average commercial produce of the leading manufacturers of the time.

Time (years back)	15	10	5	Present.
Total losses in watts	190	125	103	92
Full load efficiency	93%	95.5%	96%	96.4%
Temperature rise full load 8 hours. ..	100°C.	80°C.	60°C.	40°C.

During the period covered commercial frequencies have dropped from 125 cycles or higher to 60 cycles. The first two cases above cited are based on transformers designed for the higher frequency. The last two were designed for the lower frequency, but all figures apply to operation at 125 cycles, for uniformity. The question is, how has it been possible, without material change in cost, to so greatly improve transformers that those made now have less than half the losses and temperature rise of those made 15 years ago?

Analysis of the designs does not show any great change in the effectiveness with which material is used. The dimensions of the coils and core and their relative weights were almost as well chosen in the best transformers made ten years ago as in those of to-day.

Much has been learned as to the best insulating material and its most effective use, resulting in transformers being more safely insulated and yet having a much larger percentage of the winding space filled with solid copper. These changes are of comparatively minor importance, however, in their effect on efficiency. Commercial copper has not changed appreciably in its conductivity. Therefore, it does not enter as a factor in the case.

This leaves us nowhere to look for the improvement, but in the iron used to form the magnetic circuit, and it is right here that we do find practically all necessary to account for the transformer of to-day having less than half the losses of those made in the past.

The early manufacturers of electrical apparatus found that different lots of iron varied greatly in hysteratic and eddy losses and that, in general, the former could be reduced by having the iron soft, but why one lot was better or worse than another no one could say.

The art of rolling thin sheet iron was then in a rather elementary state in this country and the extreme variations in the magnetic properties of various lots of iron as received from the mills induced some manufacturers to investigate foreign products. It was found in so doing that a mild sheet steel produced in England for tin plate was much superior in mechanical properties to anything that was then produced in this country, besides being better mechanically.

Extensive use of this material left much to be desired, however. Magnetic variations, while less pronounced than in the American-made iron, were still very great even after the material was re-annealed by the transformer manufacturer. There was no assurance that a mill that gave good material in one shipment would do so in the next. The electrical manufacturer was, therefore, never sure of his finished product and was constantly in search of some mill that would give him better iron. The search much resembled the groping of a blind man, as neither the transformer maker nor the steel manufacturer knew what was necessary to obtain the desired result.

Many are to-day still continuing the hopeless search, but the progressive man appreciates that he could never produce satisfactory electrical apparatus until he had steel that was as definite a substance magnetically as copper and insulating materials are electrically.

Little progress was possible so long as the supply had to be obtained from abroad. The foreign mills were too inaccessible and their management too conservative to admit of the study and changes necessary for advancement. Fortunately, however, the rolling of sheet steel for tin plate and other purposes was undertaken in this country about ten years ago, and all know the rapid progress that was made, resulting in the United States producing practically all its own sheet steel. With this advance in the art of making good sheet steel for mechanical purposes came the opportunity for the electrical engineer and the sheet steel manufacturer to work together towards obtaining the best possible material for magnetic purposes. The problem was not an easy one and required joint study on the part of the electrical engineer, metallurgist and practical sheet steel manager. The gratifying result is that to-day it is possible to cover by detailed specifications every step in the process of the manufacture of magnetic steel so definitely that the carrying out of such instructions will insure a product in which the quality of steel in different transformers does not vary 5 per cent. from an established standard. The writer has before him records of tests on thousands of transformers produced during the last two or three years, the cores of which were built from steel manufactured in different mills, but to the same specifications, in which such uniformity is shown.

It is not within the scope of this article to attempt to explain in detail how this result is obtained. Briefly it may be stated, however, that the chemical composition, the mechanical processes to which the steel is subjected during its manufacture, and last and most important of all, the heat treatment from the beginning to the end of the process, have a direct and important bearing on the product.

The chemical composition need not differ greatly from that of sheet steel rolled for mechanical purposes, and a very considerable latitude in composition is allowable provided the heat treatment is changed to agree with the composition. It evidently is desirable, however, to maintain a uniform practice with reference to heat treatments, and as a slight change in composition necessitates a corresponding change in heat treatment, it follows that once having selected a composition it is desirable to hold to it as closely as the present knowledge of steel manufacture admits. In this respect as well as in the mechanical workings, however, no greater care is necessary than in producing high-grade steel designed to have definite mechanical properties. In the heat treatment, on the other hand, the requirements are much more severe.

It has been a well-established fact for several years that the mechanical properties of steel depend very largely on the arrangement of its molecules. These may be in an amorphous or in various crystaline forms. By studying this structure with the aid of a powerful microscope the metallurgist can with considerable accuracy tell the previous mechanical and heat treatments which produced the structure as shown and in this manner can decide whether the steel is suitable for a given purpose or not.

Similar investigation has more recently demonstrated that much can be learned about the magnetic condition of steel in the same manner. It is found to be a fact that in order to get a steel of a given composition into a definite magnetic condition that it is necessary to control the temperature throughout the various processes of manufacture with far greater exactness than is necessary in obtaining equally satisfactory results with steel desired for mechanical purposes. The method of determining temperature by color, crude even when performed by an expert, must give way to some of the various forms of pyrometer capable of accurately measuring within five to ten degrees temperaturs between 700 and 1,000° C.

Furnaces must be used in which perfect control of the heat is possible and in which uniform distribution of heat throughout the furnace is assured. The design of furnace must be such that the pyrometer used can take not only the temperature at one point, but at many points so that any failure of the furnace to maintain uniform temperature may be promptly and accurately known.

In other words, the structure of steel can only be put in that condition in which it has the lowest coefficient of hysteresis by the aid of a furnace whose temperature is under more perfect control than has heretofore ever been possible except it may be in laboratory experiments. Especially is this true if the steel is to remain in this condition permanently when subjected to the moderate increase of temperature usual in transformers; that is, if freedom from so-called "aging" is to be assured.

Apparently there is reason to hope for still further reduction in the hysteresis coefficient, although present results are probably approaching the limit. Such improvements as may still be accomplished will in the opinion of the writer be the result of still greater uniformity in composition and more perfect control of high temperatures than has so far been practicable.

The Curtis Steam Turbine.*

THE development which this paper describes is based upon the original theories and inventions of Mr. C. G. Curtis, of New York, whose ideas were first made the subject of patent application about 1895. Since that time these inventions have been the subject of experimental investigation at Schenectady under the direction of Mr. Curtis and of the General Electric Company's engineers; the object of these experiments being to establish data and laws which would form a basis for the correct design of commercial apparatus. The difficulties of such an investigation are very great. All new facts must be established by the test of different machines or parts which are difficult and expensive to produce. About two years ago the results of these experiments gave us data which showed great commercial possibilities, and since that time work has gone on on a large scale in the production of commercial machines. The contracts for these machines now aggregate 230,000 hp in turbine-driven electric generating units, the largest size so far built being 7,500 hp. Thus a great industry has been brought into existence in a very short time, and since the work has all been done in one place and by a few persons very little information concerning it has reached the public. This paper is the first printed matter which has appeared on the subject.

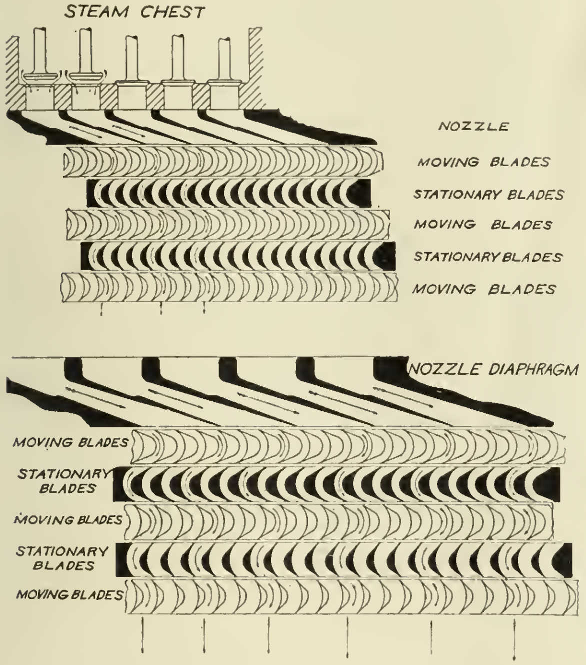

FIG. 1.—DIAGRAM OF NOZZLES AND BUCKETS.

The reason for this immense demand and production without publicity and in so short a time, is that the improvements effected are radical in economy, simplicity and efficiency of action.

All improvements in prime movers are of great importance to the engineering world. The steam turbine is destined to effect the first really great improvement since the days of Watt, and the forms of Curtis turbine here described make the first great stride in advance of other steam engines.

Every efficient steam engine must provide means by which a fair proportion of the expansive force of steam can be converted into useful work. In the engines of James Watt and his successors this result is accomplished in various degrees by the application of pressure from the steam to moving pistons. In steam turbines the expansive force imparts motion to the steam itself, and this motion is given up to a revolving part by impacts of the moving steam upon it.

The idea of the steam turbine is quite simple, and is similar to that of the water turbine or impulse wheel. The practical difficulty which has heretofore prevented the development of good steam turbines, lies in the very high velocity which steam can impart to itself in expansion, and the difficulty in efficiently transferring this motion to wheels at speeds practicable for construction or practical use. Steam expanding from 150 lbs. gauge pressure per square inch into the atmosphere is capable of imparting to itself a speed of 2,950 ft. per second, and if it is expanded from 150 lbs. gauge pressure into a 28-in. vacuum it can attain a velocity of 4,010 ft. per second. The spouting velocity of water discharged from a nozzle with 100 ft. head, is 80 ft. per second. These figures illustrate the very radical difference of condition between water turbines and steam turbines. In both water and steam turbines the theoretical condition of maximum economy exists when the jet of fluid moves with a velocity equal to about twice that of the vane against which it acts. In water wheels this relation is easily established under all conditions, while with steam the total power produces a velocity so high that the materials available for simple wheels and vanes are not capable of sustaining a proper speed relation to it under practicable conditions.

Before the appearance of the Curtis turbine two practical methods of accomplishing fair economy had been devised, namely, the turbines of Carl De Laval, of Sweden, and of Hon. Charles Algernon Parsons, of England, both of whom were brought out more than fifteen years ago.

In the De Laval turbine, the total power of the steam is devoted to the production of velocity in an expanding nozzle which produces velocity very efficiently. The jet so produced is delivered against a set of vanes on a single wheel which, by an ingenious construction and method of suspension is adapted to operation at a very high peripheral velocity. The very high rotative speed which this construction entails is made available for dynamo driving by very perfectly made spiral-cut gears which effect a ten-to-one speed reduction. The peripheral velocity of the wheel in the largest De Laval turbines is about 1,200 ft. per second, while the velocity which energy can impart to steam is over 4,000 ft. per second. Thus the wheel falls far short of the theoretically economical speed.

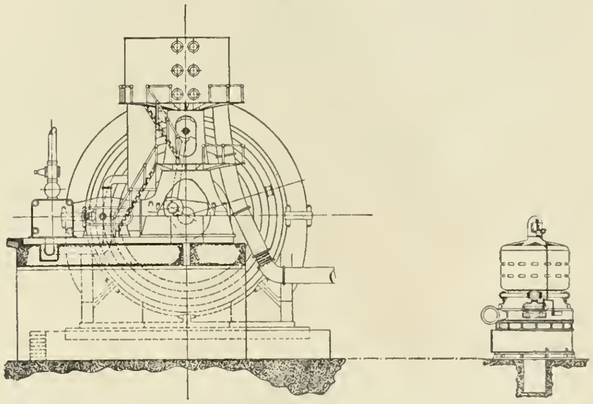

FIG. 2.—COMPARATIVE SIZES OF 5,000-KW CORLISS ENGINE AND 5,000-KW CURTIS TURBINE.

In the Parsons turbine the steam is carried in an axial direction through the space provided between a succession of internal revolving cylinders and external stationary cylinders which enclose them. Both the internal and the external cylindrical surfaces are covered by many successive circles of vanes so arranged that the steam has to pass alternately through rows of moving and stationary vanes. In passing through this turbine the steam never acquires a speed which approaches the velocity which it attains in the De Laval nozzle; but instead, moves along alternately, acquiring velocity by expansion, and partially giving it up by impact with the moving vanes.

Both of these turbines have attained some success, but neither, as thus far developed, affords sufficient advantage over the steam engine to cause any very rapid or radical change in engineering conditions.

The important disadvantages of the De Laval type are, that it is limited by the imperfections of high-speed gearing, that its efficiency is not particularly high, and that the design is not conveniently applicable to large sizes. The Parsons type is principally limited by the multiplicity and weight of its parts, and the high cost of construction.

The Curtis turbine retains some of the features of its predecessors, but introduces new ideas which make possible a much lower speed, less weight, fewer and simpler parts, higher economy, less cost, and other important advantages.

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* A paper read by L. R. Emmet before the American Philosophical Society, Philadelphia, April 2.

The general arrangement of a turbine generating unit of this type is shown by the drawings which accompany this paper. Its functions may be briefly described as follows, and are illustrated by the accompanying cut.

Velocity is imparted to the steam in an expanding nozzle so designed as to efficiently convert nearly all the expansive force, between the pressure limits used, into velocity in the steam itself. After leaving the nozzle, the steam passes successively through two or more lines of vanes on the moving element, which are placed alternately with reversed vanes on the stationary element. In passing successively through these moving and stationary elements, the velocity acquired in the nozzle is fractionally abstracted, and largely given up to the moving element. Thus the steam is first thrown against the first set of vanes of the moving element, and then rebounds alternately from moving to stationary vanes until it is brought nearly to rest. By this means a high steam velocity is made to efficiently impart motion to a comparatively slowly moving element. The nozzle is generally made up of many sections adjacent to each other, so that the steam passes to the wheels in a broad belt when all nozzle sections are in flow.

This process of expansion in nozzle and subsequent abstraction of velocity by successive impacts with wheel vanes is generally repeated two or more times, the devices for each repetition being generally designated as a stage. There may be various numbers of stages and various numbers of lines of moving vanes in each stage. The number of stages and the number of lines of vanes in a stage are governed by the degree of expansion, the peripheral velocity which is desirable or practicable, and by various conditions of mechanical expediency.

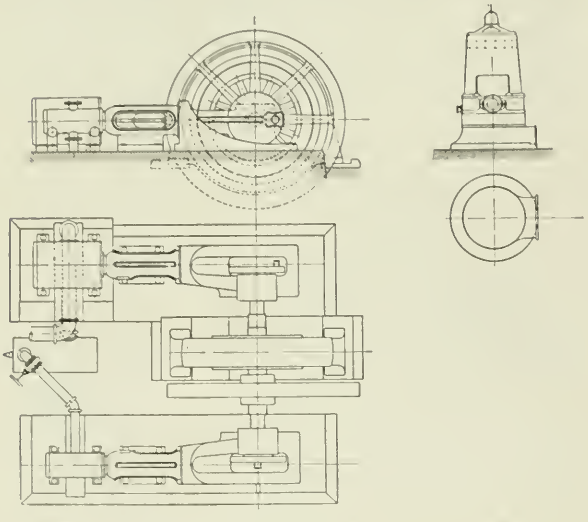


FIG. 3.—COMPARISON OF 500-KW CROSS-COMPOUND ENGINE AND 500-KW CURTIS TURBINE.

Generally speaking, lower peripheral speeds entail more stages, more lines of vanes per stage, or both. Our general practice is to so divide up the steam expansion that all stages handle about equal parts of the total power of the steam.

The losses and leakages of the earlier stages take the form of more heat or more steam for the later stages, and are thus in part regained. Much water of expansion, which might occasion loss by re-evaporation, is drained out of each stage into that which succeeds it.

The governing is effected by successive closing of nozzles and consequent narrowing of the active steam belt. The cut shows part of the nozzle open and part closed; the arrows showing space filled by live steam. In the process of governing, the nozzles of the later stages may or may not be opened and closed so as to maintain an adjustment proportional to that of the first stage, which is always the primary source of governing. Some improvement of light load economy may be effected by maintaining a relative adjustment of all nozzles; but in many cases the practical difference in economy is not great, and automatic adjustment of nozzle opening in later stages is dispensed with in the interest of simplicity. In some machines an approximate adjustment is maintained by valves in later stages, which open additional nozzles in response to increase of pressure behind them. These are used as much for limiting the pressures in stage chambers as for maintaining the light load economy.

The principle of the Curtis steam turbine is susceptible of application to a variety of purposes. Within the scope of this paper I intend to give only a general idea concerning existing designs for its application to electric generators. Its development, even for this purpose, is very recent, and will doubtless be subject to important future improvements. In its present state, however, it embodies many important advantages, as has already been stated. The most important of these advantages is the high steam economy which it affords under average conditions of service. This economy is shown by the accompanying curves, which are derived from actual tests of the first commercial machine of this type which was completed. This machine drives a dynamo of 600-kw capacity. The curves give its performance at a speed of 1,500 r.p.m., which is a safe and practical speed for commercial operation, and which corresponds to a peripheral velocity of about 420 ft. per second. The results, with superheat, given in these curves are not derived actually from tests of this turbine, but are plotted from data obtained on smaller turbines. They correspond to the results obtained on turbines of other types, and are undoubtedly reliable.

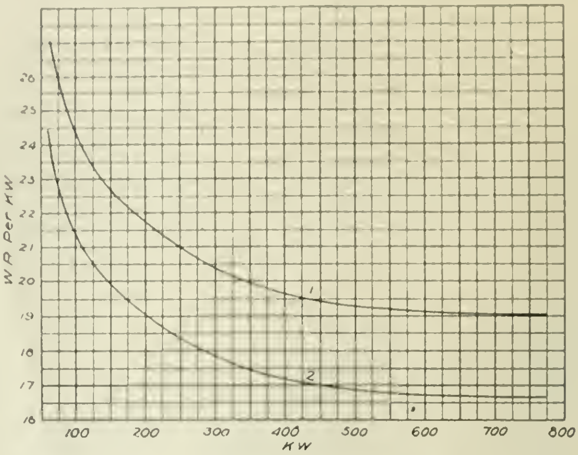


FIG. 4.—CURVES OF WATER CONSUMPTION OF 600-KW CURTIS TURBINE.

Fig. 4 shows the steam consumption of this machine in pounds per kilowatt-hour output at various loads and under the conditions stated, the lower curve giving the steam consumption at various loads with 150° superheat.

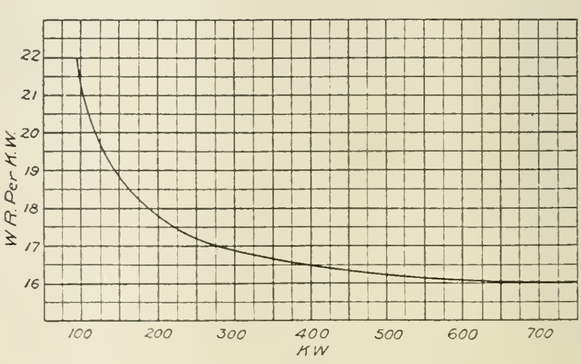
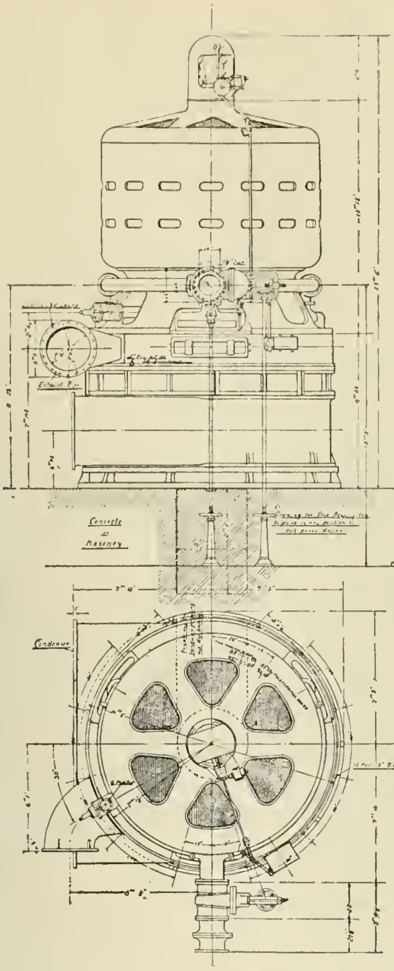


FIG. 5.—CURVE OF WATER CONSUMPTION OF 600-KW CURTIS TURBINE.

Fig. 5 shows the results which could be obtained from this turbine if it were operated with high pressure and a high degree of superheat, these conditions of operation being perfectly practical with the machine, while with steam engines the use of such high temperatures would with ordinary constructions be prohibitive.

The results shown by these curves are better than any heretofore produced by steam turbines of any make or size, and are very much



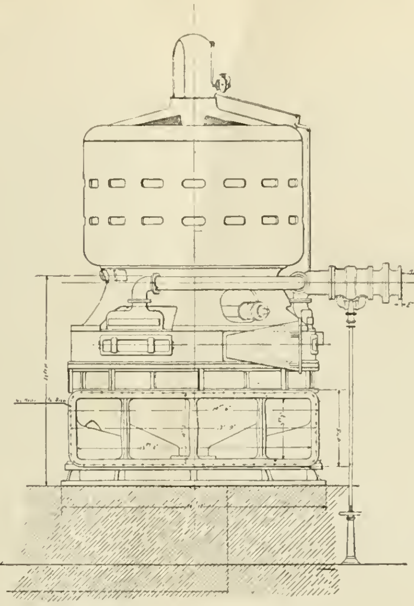


FIG. 6.—PLAN AND ELEVATION OF 5,000-KW CURTIS TURBINE WITH GENERATOR.

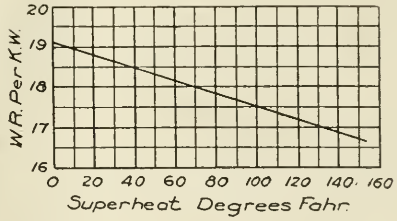


FIG. 11.—CURVE OF WATER CONSUMPTION OF 600-KW CURTIS TURBINE.

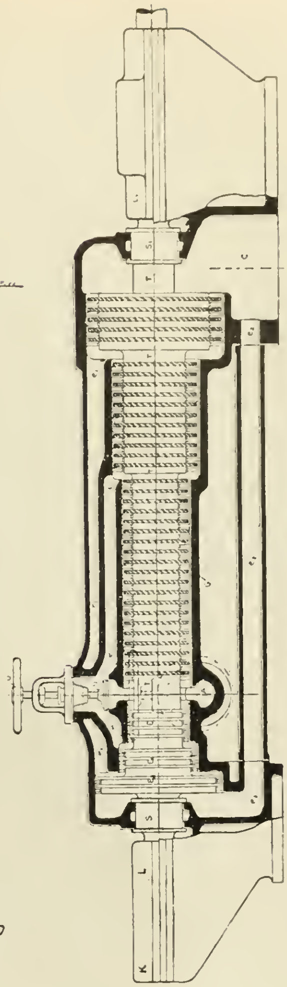
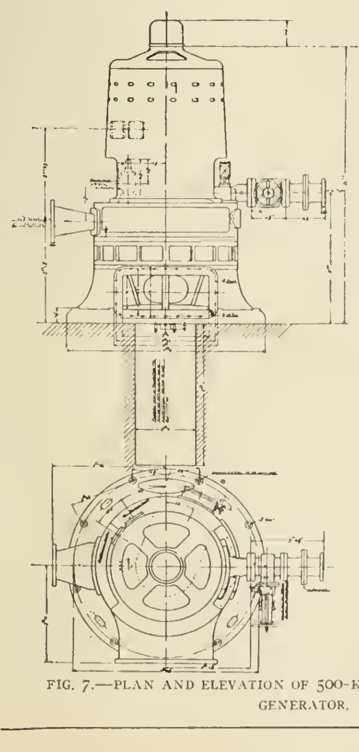


FIG. 8.—CROSS-SECTION OF PARSONS TURBINE WITHOUT GENERATOR.



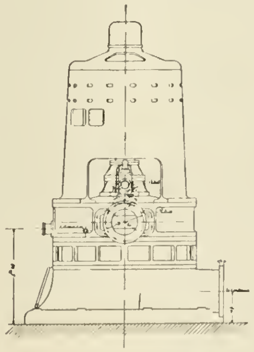


FIG. 7.—PLAN AND ELEVATION OF 500-KW CURTIS TURBINE WITH GENERATOR.

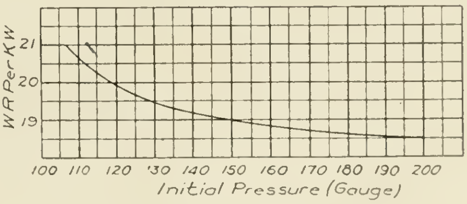


FIG. 10.—CURVE OF WATER CONSUMPTION OF 600-KW CURTIS TURBINE.

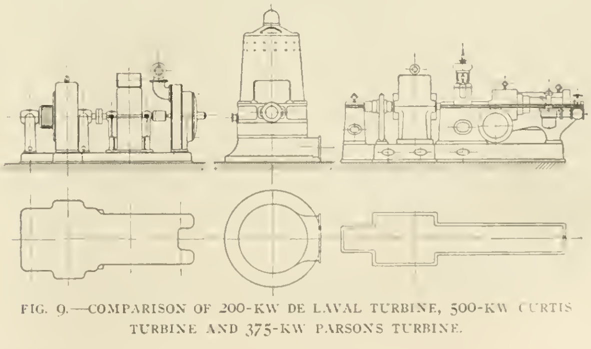


FIG. 9.—COMPARISON OF 200-KW DE LAVAL TURBINE, 500-KW CURTIS TURBINE AND 375-KW PARSONS TURBINE.

THE CURTIS STEAM TURBINE.

better than those obtainable from the types of steam engines generally applied to the production of electricity.

It should be noted that these curves show a very high efficiency at light loads, as compared with results obtainable from steam engines, and that the efficiency does not fall off at overload as it must necessarily do with all engines which operate economically under normal full load conditions. This light load and overload economy is an important feature of the Curtis turbine, and arises from the fact that the functioning of its working parts is virtually the same under all conditions of load.

Figs. 10, 11 and 12 show the effect upon steam consumption of changes in the steam pressure, the degrees of superheat and in the vacuum. It will be observed that the superheat and vacuum curves are straight lines so inclined as to indicate a great advantage by the use of all degrees of superheat and also an immense advantage in the use of very high vacuum. The most important reason why the Curtis turbine so greatly surpasses the steam engine in economy is that it is adapted to use effectively the highest possible degrees of expansion, while in the steam engine it is practically impossible to provide for high degrees of expansion. As the exhaust pressure approaches a perfect vacuum, the volume naturally increases at a rapid rate—the volume of steam with a 29-in. vacuum being double that with a 28-in. vacuum. To handle high degrees of expansion, it would, therefore, be necessary to make cylinders of steam engines very large, and this increase of size and weight of parts fixes a practical limit which cannot be passed without excessive cost and complication. In the turbine, the highest degrees of steam expansion are easily provided for, and consequently a much larger proportion of the total work in steam can be utilized by turbines than by steam engines.

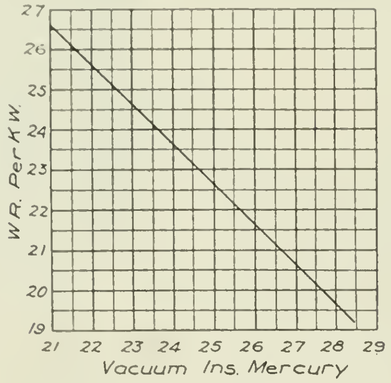


FIG. 12.—CURVE OF WATER CONSUMPTION OF 600-KW CURTIS TURBINE.

There are other conditions in the Curtis turbine which make high degrees of vacuum more easily attainable than they are under ordinary conditions. The machine is so constructed that leakage of air into the vacuum chamber is easily rendered impossible. The leakage of air into condensing engines is considerable, and is generally not checked owing to the small value of improved vacuum to an engine.

With turbines of the type here described, no oil comes into contact with the steam, and, consequently, condensed water can be taken from surface condensers and returned to boilers. The use of surface condensers under such conditions renders unnecessary the introduction of air either in feed or circulating water, and consequently makes possible a very high vacuum with small air-pumping apparatus.

The results shown by these curves are obtained from a machine of 600-kw capacity, and are naturally inferior to results which are expected from the very large units which are now being built. It is hoped that very soon after the reading of this paper a 5,000-kw unit, which is now complete, will be put into operation in Chicago. This machine is expected to give considerably better steam economies than are shown by the accompanying curves, and will be superior particularly in the matter of light-load performance. The variation of efficiency in this machine from half load to 50 per cent. overload, will not exceed 3 per cent.

The external appearance and dimensions of this 5,000-kw unit are shown by one of the drawings which accompany this paper, and another drawing shows this unit compared with an engine-driven generating unit of similar capacity. Each unit is shown as complete with prime mover and generator, one being the machine for Chicago, above mentioned; the other, one of the units which are operating in the Manhattan Railway Company's power station at New York. The comparison sufficiently illustrates the improvement which the turbine has introduced. The respective weights of these complete units, exclusive of foundation, are in the ratio of 1:8, and the saving in foundations alone is a very important item. Other drawings which accompany this paper show a 500-kw unit recently installed at Newport, and also a comparison drawn to the same scale between this 500-kw unit and a cross-compound engine unit of equal capacity designed to operate at 100 r.p.m. The contrast here is even more striking.

If the extreme simplicity of the Curtis turbine is considered in combination with these figures and comparisons, it is easy to appreciate that a very great engineering advance has been accomplished. It has been conservatively estimated that engine units, like those in the Manhattan Company's station, can be replaced by turbines like that in Chicago, and that the cost of such replacement can be paid for by saving in operating expenses in three years.

Whenever an improvement has been effected in prime movers, the influence upon engineering and business conditions has been very marked. When the release cut-off principle was introduced by Corliss, a certain improvement in engine economy was effected, and although this improvement was accompanied by no diminution in cost, the change resulted in a very great activity in engine building, and the renewal of most of the large mill engines in the country. It is, therefore, safe to predict that the influence of the steam turbine will be of radical importance. The steam turbine is, on account of its high speed, particularly adapted to the driving of electric generators, and its introduction will consequently stimulate the use of electricity rather than other power transmitters.

In the past the most economical use of steam has been confined to the most expensive and elaborate plants, while in the future it will be within the reach of all where condensing water is available.

◆

Paris Gas Interests.

It was announced some time ago in the daily newspapers that possibly Mr. A. N. Brady and others might take an interest in the Paris gas plants. A cable dispatch from Paris of April 4 says: "The project of American capitalists to purchase the Paris gas franchise has played a considerable part in a bitter political controversy before the Municipal Council, aroused by the question of extending the franchise. Several newspapers have asserted that one of the leading companies seeking the franchise is American, and the *Matin* said Rockefeller interests controlled four-fifths of its capital. This brought out a sharp letter of denial, which the *Matin* published yesterday, from several leading French capitalists interested in the company. After referring to the report that the Rockefellers control the concern, the letter says: "Our project is not American, but is French. Its organization will be French and its administration exclusively French. The letter further denies the report that some of the religious orders own part of the company's stock."

◆

Yarrow on Submarine Craft.

Mr. Yarrow, head of the shipbuilding firm, before the British Institute of Naval Architects last week came out strongly against the recent naval policy of France, Great Britain and the United States in building submarines. He said that he has no belief whatever in the submarine boat, either for offensive or for defensive purposes. He does not consider that anything practical will ever result from the experiments which all maritime nations are making in this direction. Submarines, if entirely successful or otherwise, would be of use only against stationary vessels. For the purpose of attacking vessels in motion they could not be guided, he maintains, with sufficient accuracy and knowledge to be relied upon, while even if they could, at least as much has been accomplished already by torpedo boats, with far less risk and cost.

De Forest Wireless Telegraph System.

By A. Frederick Collins.

For some time much effort has been directed toward producing a receiving apparatus which would eliminate the coherer and provide in turn a swifter, surer means for indicating electromagnetic waves. The coherer, as is well known, retards the flow of a local current until the filings are drawn into closer proximity with each other by the action of electric oscillations set up in the resonator circuit by the received electric waves when the resistance is lowered from thousands to tens of ohms and permitting the local current to flow through the circuit.

In the ordinary silver filings coherer the resistance remains at its minimum value long after the last oscillation of the current, and in order to restore the local circuit to its normally high resistance it is necessary to decohere the filings either by electro-mechanical or purely mechanical means. A coherer of this type actuating a relay and a Morse printing register requires a definite period of time between the instant the first train of waves are impressed upon the resonator system of which it is a part and the reception of the second train of waves. This is due largely to the lag occasioned by the restoration of the filings to their normal state by mechanical means and the high time constant of the relay.

Another untoward effect produced by the ordinary coherer is due to the dual circuits required to operate a Morse register, and a fourth difficulty is caused by the sparks which occur between the filings, which process sets up oscillations emitting miniature trains of electric waves, and unless exceeding care is exercised will be registered as a Morse character on the tape.

Dr. Lee De Forest has invented, in conjunction with Mr. E. H. Smythe, a responding device for receiving, transmitting and indicating electromagnetic waves, in which the electric oscillation builds up resistance in the responder, as the De Forest-Smythe wave detector is termed, instead of decreasing it as in the filings coherer, and yet the responder is not an anti-coherer, but is based fundamentally upon the laws governing electrolysis as produced by high-frequency currents. The resistance of the circuit, including the responder and the means of indication, is uniformly increased and is proportionate to the energy of the received electric waves, the resistance being decreased again by the action of a local circuit. The action and reaction of the responder, according to investigations of the inventors, is that the responsive device normally maintains a number of conducting paths, and these paths are interrupted by the oscillations set up by the received electric waves in the resonator system, which increases the resistance of the responder; but when the high-frequency currents cease the local direct current reconnects the conducting paths instantaneously and the normally low resistance is re-established.

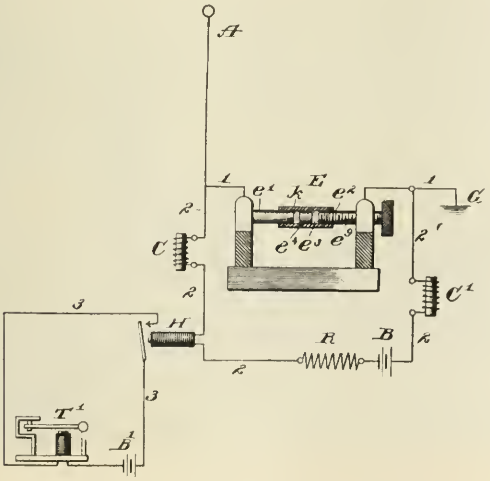


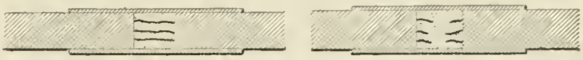
FIG. 1.—DIAGRAM OF DE FOREST-SMYTHE RESPONDER.

By this method it is claimed that an instantaneous and automatic return is secured of the normal conditions of the detector after each series of oscillations are indicated and without any auxiliary apparatus for tapping back, thereby providing a detector of exceptional rapidity, certainty of action and suitability for long-distance work—in short, fulfilling to a nicety the most rigid requirements imposed upon a detector in actual work.

The De Forest-Smythe responder is shown diagrammatically in Fig. 1, and is connected with the resonator system and local circuit exactly as is a coherer or other wave-detecting device. *A* represents the aerial receiving conductor or antennæ, *G* the earthed terminal or grounded wire, and *E* the responder; the responder comprises electrodes or conductor plugs, e^1, e^2, forced in a glass or other insulating tube, *K*; the space or pocket, e^3, is filled with a special compound or medium which will be fully described below.

The local battery, *B*, provides current for actuating an indicator of any suitable type, but in actual practice takes the form of a telephone receiver; the local circuit includes the responder, a battery and choke coils, *C*, C^1, in oppositely disposed arms of the circuit as shown, and a resistance, *R*, usually made variable to provide a current suitable for the varying resistance of the responder.

The action of this responder is essentially of an electrolytic nature, for it was discovered by the inventors that when two metallic electrodes are slightly separated and included in series with a source of current and a suitable medium is interposed between their opposed surfaces, minute metallic particles are detached from the anode and thence carried across the gap separating the electrodes to the cathode, where they build up bridges which extend toward and soon reach the anode, thus bridging the gap. In Fig. 2 is shown schematically the metallic thread deposited by electrolysis of local current; and in Fig. 3 the disruption of the thread on the passage of an oscillating current.



FIGS. 2 AND 3.—DE FOREST-SMYTHE RESPONDER, BEFORE AND AFTER DISRUPTION.

It is evident that as long as electrolysis takes place the connecting metallic thread or bridge continues between the electrodes of the responder, which opens a practically free passage for the current derived from a cell; but the effect of high-frequency oscillations such as are set up by impinging electric waves is to instantly disrupt or break down the metallic threads formed by the local current when the resistance is increased by several thousand ohms.

The process involved in making and breaking these conducting threads is accomplished practically instantaneous, and if the responder is connected with a telephone receiver the increasing and decreasing resistance of the circuit is manifested audibly.

Originally water was employed in the gap between the electrodes, which was sufficiently sensitive to indicate the electric oscillations, but it was neither accurate nor permanent. By means of the microscope it was ascertained that when water was used between the electrodes of the detector a direct current from a battery deposits particles of metal from the anode and deposits them on the cathode; and if the process is continued for some time, the particles continue to be deposited until a minute thread is formed connecting the electrodes, as shown schematically in Fig. 2, and when this takes place feeble electric oscillations such as are produced by the received electric waves are unable to disrupt the metallic thread and the detector is said to be "clogged."

To eliminate this undesirable effect and to increase and maintain the sensitiveness of the detector, a great number of different substances was interposed between the electrodes and exhaustive tests conducted in order to ascertain a suitable medium. Viscous liquids, including glycerine and heavy oils, viscous semi-solids, such as vaseline powders, sulphur, oxides of lead and mixtures of PhO with glycerine and collodion and gelatine were employed, as well as manganese dioxide and potassium chlorate. It was found that when these media were used they limited the number of threads or bridges built up by the local current and concentrated the action of the electric oscillations to and upon these threads. The effect of the oscillating current on the deposited metallic threads segregates and precipitates it quite gently instead of violently disrupting it, such an action being represented in Fig. 3; when instantly this operation of the oscillations cease the process of building up takes place.

The microscopical analysis made showed that when the oscillatory current is superimposed upon the local direct current, minute bubbles of gas are liberated at the cathode and along the deposited particles forming the deposited metallic thread; the investigations also showed that the segregation of the particles forming the thread is directly due to this sudden generation of gas, and that the action is "largely one of disruptive electrolysis in a film of electrolytic liquid interposed between each metallic particle and its neighbor."

To fulfill the theory thus evolved it is necessary to introduce some suitable electrically decomposable medium, such as water with the supporting medium in which the particles forming the thread are suspended. In practice commercial glycerine is used and fulfills the above requirements nicely, since water exists in commercial glycerine as an impurity.

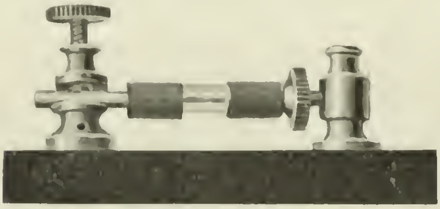


FIG. 4.—GENERAL VIEW OF RESPONDER.

The investigation also indicates that the gas liberated is hydrogen, and the oxygen set free effects a combination with the metal of the anode, or in the case where glycerine is employed as the sustaining medium, "the chemical activity of the nascent oxygen may be sufficient to cause it to abstract hydrogen from the glycerine to form water."

The inventors in their patent state they have obtained the best results with the oxides of lead and that these substances act as a depolarizer as well as a sustaining medium. The gas arising from the electrolytic processes referred to above may be absorbed by substances such as finely divided sulphur, which are interposed between the electrodes.

The terminal conductor plugs or electrodes employed in the responder are about an eighth of an inch in diameter and separated one-sixteenth of an inch. The oppositely disposed surfaces may be either smooth or roughened. A screw adjustment is provided for determining accurately the sensibility of the responder.

The complete detector is shown in Fig. 1, and consists of an insulating tube, *K*, of glass or ebonite, an auxiliary electrode, e^4, being forced between the electrodes, e^1, e^2 proper. In the spaces or pockets is the sensitive medium, composed of rather coarse filings and oxide of lead in equal proportions by bulk and made into a paste by the addition of glycerine or vaseline with a trace of water or alcohol. The local circuit should have a small value, preferably one-tenth to one milli-ampere, or when two cells are inserted in the circuit a resistance of 12,000 to 15,000 ohms is necessary to obtain the proper relative values. A photographic reproduction of the responder is given in Fig. 4.

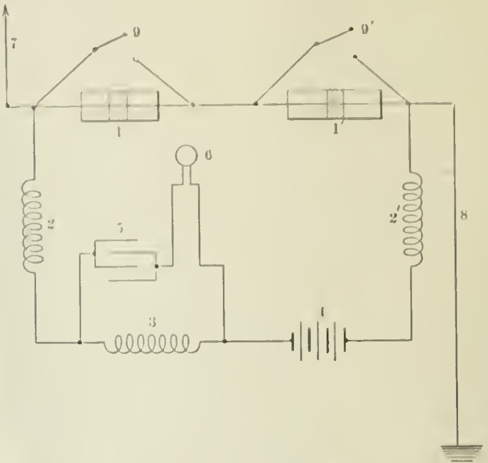


FIG. 5.—DIAGRAM OF WIRELESS TELEGRAPH RECEIVER.

In practice two electric wave responders are usually connected in series as shown in Fig. 5, and included in the circuit are two choke coils, 2, 2', a resistance of 5,000 ohms, 3, and a three-cell battery, 4; with tre resistance in circuit is a condenser, 5, and a head telephone, 6. The complete receiver is illustrated in Fig. 6. The transmitter employed in this system is shown in Fig. 7; it consists of an alternating-current generator, which energizes the primary coil of an oil transformer with a 500-volt current which is stepped up to 20,000 volts in the secondary coil; this in turn charges a battery of Leyden jar condensers to its maximum capacity, when it discharges through an air-gap setting up oscillations of great intensity in the oscillator circuits. The generator is driven by a gasoline engine except where a current is otherwise available, when a motor is connected direct to the alternator, the former operating on a 110 or 220-volt direct-current circuit.

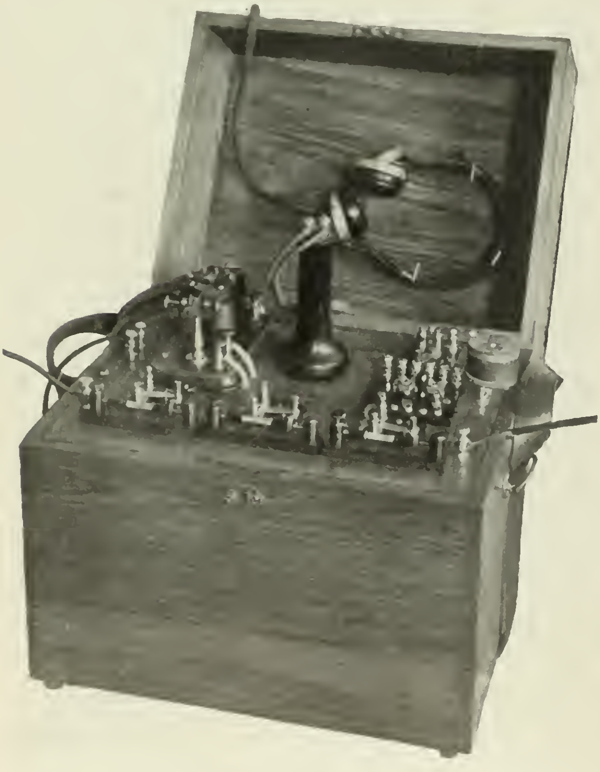


FIG. 6.—GENERAL VIEW OF RECEIVER.

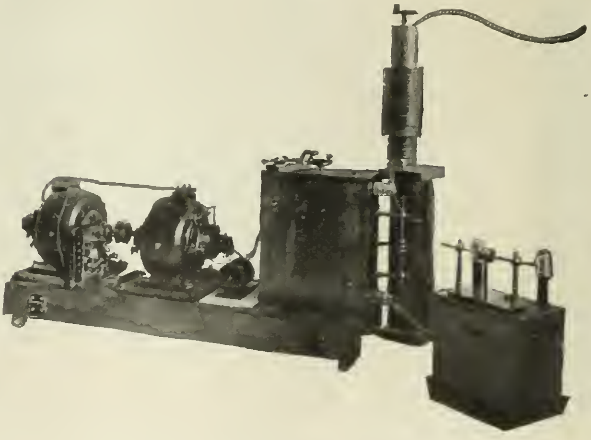


FIG. 7.—GENERAL VIEW OF TRANSMITTER.

Quick Work After the Helena Fire.

Last October the power plant of the Helena Light & Traction Company, of Helena, Mont., was almost entirely destroyed by fire. Through the courtesy of Superintendent R. A. Wilson, some particulars are here given as to the remarkably quick work which Mr. Wilson and his staff performed in getting the plant into service again.

At this station steam power was abandoned several years ago, and the company has been getting all of its power over an 11,000-volt transmission line from the plant of the Missouri River Power Company at Canon Ferry, 18 miles distant, on the Missouri River. The Helena Light & Traction Company supplies practically all the electric lighting and power work in the City of Helena, as well as the street railway service. The number of lights installed is about two per capita of population, which is an unusually high percentage for a city of the size of Helena. As the company supplies so much electric lighting, and practically all the power in the city, the interruption of the service was a great calamity to the community. At the time of the fire it was thought by many that it would be weeks before service could be resumed, as the station was apparently a total wreck. As a matter of fact, it was just fifty hours from the time of the fire that Superintendent Wilson began to give electric lighting service; and in a few hours more the street railway service was resumed.

The station which was burned was an old steam power plant which had been converted into a sub-station at the time that water power was first transmitted to the city. The fire started at a short circuit, where the 11,000-volt line entered the building. It is believed to have been caused by some tarpaulin which fell across the lines. The destruction of the plant was so rapid that the chief engineer, after telephoning the alarm, could not secure his coat, which was hanging near the switchboard, and which contained a large sum of money.

Fig. 1 shows the interior of the temporary transformer room, which is now doing service. Mr. Wilson does not consider the wiring as a standard of excellence, to be copied; but it served to give power and light to the people of Helena within fifty hours after the breakdown.

The exterior of the old station, the stone wall of which is still standing, and the temporary shed in the foreground, which is at present serving as a station, is shown in Fig. 2. In getting this temporary plant into operation, some feats were performed which are not down in the text-books on electrical construction. For example, some of the high-tension cable was manufactured by pulling wires out of the ruins and covering them with ordinary rubber hose. Some of these cables can be seen in the foreground in Fig. 1. Many of the switches were taken out of the ruins and made serviceable by the use of a file. In the fifty hours that elapsed between the burning of the building and the resumption of service, a temporary shed was erected, transformers were hauled 18 miles over the mountains from the water power plant at Canon Ferry, and all the wires strung. The service wires for the City of Helena stretched directly over the ruins, making a tangle which had to be straightened out, and adding considerably to the work of resuming service.

The "railway department" of the temporary plant is shown in Fig. 3. Induction motors which were taken from the ruins were belted to some direct-current dynamos secured in neighboring towns. It is a striking testimonial to the indestructibility of the induction motor that these motors were simply pulled out of the ruins, dried out and had their terminals and leads renewed before being put into service.

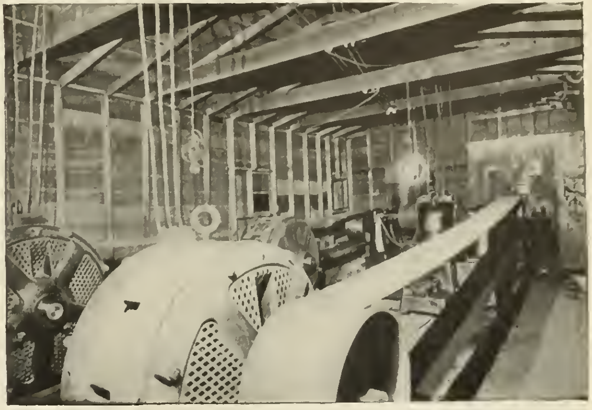


FIG. 3.—RAILWAY PLANT IN TEMPORARY STATION.

The fire was even more instructive as regards the performance of the oil-filled transformers. Some constant-current transformers which went through the fire were used immediately afterwards, after being dried out and having the oil renewed, and some small repairs made on such of the insulation as was reached by the heat. The oil protected most of the coils. Some of the larger high-tension transformers were located over a pit on the wooden floor, and the fire burned out the floor, tipping them over into this pit. Of course, the oil which was thus dumped into the pit made a tremendously hot fire. It was believed, however, that if all the transformers in the station had been on a solid foundation, with covers on tight, and with water-cooling system outside of the oil, they would have survived the fire without injury.

Plans have been prepared for a handsome sub-station to take the place of the one destroyed, which will be made one of the most completely equipped distributing stations to be found in the United States.

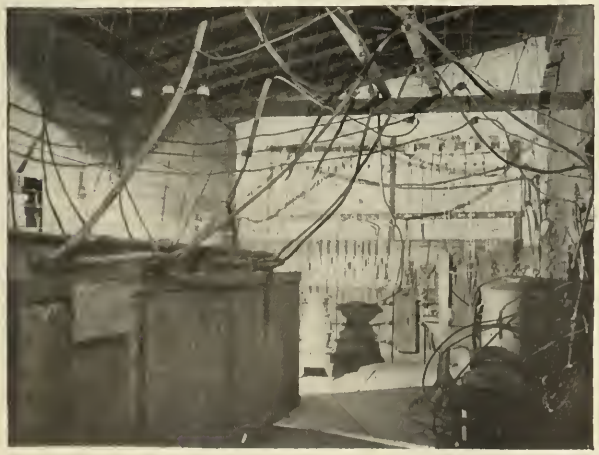


FIG. 1.—TEMPORARY TRANSFORMER ROOM.

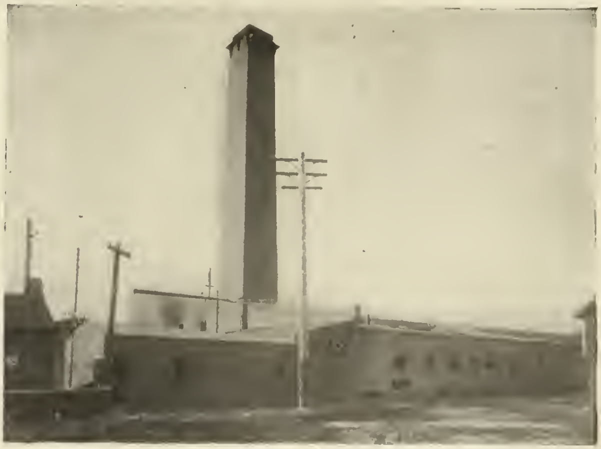


FIG. 2.—TEMPORARY STATION.

Electrolysis of Water.

In an article in the March number of the *Journal of Physical Chemistry*, Prof. W. R. Whitney discusses the continual electrolysis of water at voltages below the so-called decomposition value, on the basis of the application of the Nernst formula for e.m.f. of polarization. Dr Bigelow has repeated the early experiments of Helmholtz in which water, in closed vessels, is shown continually to conduct the current when the potential difference across the cell is only one volt. For visible decomposition, about 1.7 volt is necessary, and this is approximately the value calculated by the erroneous process of considering the heat of the chemical reaction to be exactly equal to the electrical energy obtained from the reaction when generating a current, or equal to the electrical energy necessary to bring about the decomposition of water into its component gaseous products at atmospheric pressure.

The recent advances in electrochemical knowledge lead to the conclusion that whenever an e.m.f. is applied to a pair of electrodes in an electrolyte, if its value is too small for visible electrolysis, there immediately occurs at least such an amount of real electrolysis as is capable of changing the poles into electrodes whose characteristic e.m.f. is equal and opposite to the impressed e.m.f. The earliest experiments on polarization point to this as a fact.

In the case, then, of an aqueous solution, the electrodes at one volt impressed e.m.f. are so charged with oxygen and hydrogen that they are to be considered as gas electrodes of low gas concentration or pressure. No reason appears for not accepting this conception as representing a condition to be expected. The gases could escape as bubbles only when the concentration had at least reached that value at which a gas pressure equal to that upon the liquid was reached, i. e., the atmospheric pressure. Helmholtz certainly recognized this principle when he drew the conclusion that with gas electrodes the e.m.f. should be different for each different pressure of the gas. This he then expressed in the form,

$$A - A_1 = C \log p/p_1.$$

If these electrodes represent the gases at low pressure these gases should certainly dissolve in the water and tend to reach a condition of saturation corresponding to the above concentration. In an open vessel this might never be attained, owing to the continual escape of the gases into the air, where their partial pressures are low. As it is well known also that these gases when dissolved in the electrolyte are capable of depolarizing the electrodes, especially the hydrogen and the oxygen electrode, a current at very low voltages seems a necessary result. It should depend largely on diffusion and convection, as the actually studied current very evidently does.

Considered from the point of view of energetics, there is also no transgression of a law. A molecule of water certainly could not be decomposed by an expenditure of less total energy than would be generated in its formation, nor is such an assumption necessary to the case in hand.

In the decomposition of water by the current in general, electrical energy and heat are both absorbed, but the quantitative relation between the two varies with the conditions. Moreover, at a given temperature it varies with the pressure so that at low pressures less elecrical energy should be necessary than at high, although the total energy should be the same in all cases. The total energy-difference between the water and its gases will be the same at a given temperature for all concentrations because of the constancy of the value of the product of pressure and volume for these gases, but the difference in free energy will depend upon the perssure and volume of the gases, for the greater the volume the less the free energy they contain. The electrical energy obtainable from these gases under ideal conditions is a measure of the free energy they contain. At great attenuations this would become very small, though the heat of reaction would be the same as before; conversely the decomposition of water into these attenuated gases requires the application of but little work.

The quantity factor of the electrical energy necessary to decompose the water is the constant of Faraday's law, but the intensity factor by which this must be multiplied to give the energy necessary, is the e.m.f. of polarization. This, in accord with the Helmholtz-Nernst conceptions, is a function of the concentration of the active electrodes. This has been shown to be the case with cadmium and zinc amalgams, and it is natural to assume that it applies to the case of gas electrodes.

Dr Bigelow's experiments really support this view. For example, the minimum current reached in his various cells when corrected for size and resistance of electrolyte is practically a constant whatever precautions were taken to previously remove gases from the electrolyte. In fact in the single case where he could have observed the actual production of gas at low pressure above the electrolyte he apparently did so, but attributed it to a leakage of air. It seems most probable that a low rate of electrolysis existed in each of the several experiments described, that this started without the introduction of dissolved gases and probably reached a condition of equilibrium in which the diffusion of one dissolved gas to the other electrode in both cases caused continual depolarization. In such a case there should also have been some gas pressure above the electrolyte and this while not demonstrated, was really indicated by the experiments.

It would seem a radical step to adopt the theory of Dr. Bigelow that simple dissolved gases conduct the current and the facts hardly warrant it. To build upon this theory the additional theoretical structure involving the mysterious corpuscles of Thomson would be still more dangerous. If all the phenomena of this particular subject seem on careful investigation to be in accord with our present theories it is simply fortunate.

•

Accurate Measurements of Heavy Currents.

By P. Letheule.

The Laboratoire Central d'Electricité has been carrying out experiments on accurate measurements of very high and very low intensity currents, the results of which are embodied in a paper read at the February meeting of the Société Internationale d'Electriciens by Prof. Janet. These experiments, which were performed under his supervision by M. Iliovici, refer to alternating currents of more than 1,000 amp, the measurement of which is rendered difficult by the awkward nature and large size of the conductors.

The methods in general use for accurately measuring high intensity currents are the shunt method and the Kelvin kiloampere balance method. This latter shows a systematic difference which exceeds 2 to 3/1000 amp in continuous current, and 4 to 5/1000 in alternating current when the frequency varies from 25 to 60 cycles, probably due to Foucault currents in the conductors of the Kelvin balance.

The transformer method was shown to be equal in accuracy to the preceding ones, though not limited, as are the latter, by the intensity of the currents measured. Certain conditions, nevertheless, have to be conformed to, which will be dealt with later.

The transformer consists of an iron ring provided with two windings, the respective numbers of turns being n_1, n_2. With corresponding currents, I_1, I_2, and when no self-induction takes place between the two windings, we have the simple equation, $n_1 I_1 + n_2 I_2 = O$.

In practice, however, the primary and secondary circuits do not conform to the ideal conditions, the secondary being in part composed of an ammeter, the primary winding of which is far from uniform by reason of the large section and bulky nature of the conductors. Magnetic leakage, therefore, takes place between the windings. The magnetic permeability also varies, and other disturbing influences are due to Foucault currents and hysteresis loss in the core of the ring.

For the sake of analysis, M. Janet at first neglects hysteresis and Foucault currents. The leakage taking place between the windings is accounted for by adding to the effect of uniform winding, the effects of additional inductance, l, in the primary circuit and inductance and resistance, $l_2 r_2$ in the secondary circuit (containing the ammeter).

Now, considering the hysteresis and Foucault currents, these can easily be derived from the respective losses in watts due thereto,

$$\begin{aligned} W_H &= I_1' \times U_1 \\ W_F &= I_1'' \times U_1 \end{aligned} \qquad (U_1 \text{ being the primary e.m.f.}),$$

and added geometrically to the primary current, I_1, determined at first, $I_1 = (I_1 + I_1' + I_1'')$. I_1' and I_1'' being almost completely energetic, the arithmetical addition of the terms will be sufficient in practice and will give a value slightly superior to the current to be measured.

From the reasoning above outlined, we find that the ratio, $\frac{n_1 I_1}{n_2 I_2} = y$ departs from unity, and accurate calculation of its value has given the formula:

$$y = \sqrt{1 + \frac{R^2}{16 \pi^2 w^2 n_2^2} \left(\frac{r_2}{n_2}\right)^2} \qquad (1)$$

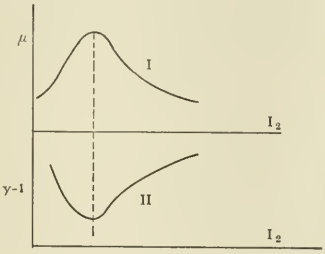
This result, which is remarkable in that the value of y is independent of r_1 and l_1, and only varies with the reluctance, R, the frequency, w, the number of secondary turns, n_2, resistance of winding, r_2, including the reading ammeter ($r_2 = r'_2 + r''_2$).

Fixing the frequency, w, it is interesting to note how y varies with I, which can be determined by means of the formula (1) and the following formula (2):

$$\phi_{\max} = \frac{r_2 I_2 \sqrt{2}}{n_2 W} \qquad (2)$$

y is related to reluctance R or inversely to permeability, μ by the formula (1). μ is related to ϕ by the curve of permeability (upper curve I of the accompanying figure).

Both formula and curve, I, therefore, permit the elimination of R and ϕ, or μ and ϕ, and to draw the curve relating y to I_2, or $y - 1$ to I_2, curve I I.
and 100 ($y - 1$) as ordinates, show the influence of a change in frequency; decreasing $y - 1$, it results from above formulas and experiments that r_2 should be made as small as possible. Experiments with different ammeters have shown that greater accuracy is obtained with the least resistance in ammeter circuit.



MEASUREMENTS OF HEAVY CURRENTS.

Now investigating the hysteresis current, I', Mr. Iliovici found that it was no longer dependent upon the primary constants of the main current, I, under the following conditions:

Connecting n_1 primary turns all in series or in multiple changes, I_1, proportionally as seen from formula (1); it also changes I_1' in the same ratio, as proved by experiment and calculation.

Calculation, in fact, gives for I_1':

$$I' = \frac{W}{U_1} \qquad (3)$$

$$U_1^2 = \frac{A r_1^2 + B l_1^2 + C n_1^2 l_1 + D n_1^2 r_1 + E n_1^4}{F n_1^2} \qquad (4)$$

A, B, C, D, E, F being functions of I_2.

The formula (4) shows that putting in series n_1 turns first connected in multiple is equivalent to multiplying the numerator by n_1^4; the denominator by n_1^2 and the result by n_1^2; U is multiplied by n_1 and I is divided by n_1.

The geometric sum, $I_1 + I_1' + I_1''$, is, therefore, modified in the same proportions as the separate turns; that is, all divided by n_1, and resultant ampere-turns $n_1 (I_1 + I_1' + I_1'') =$ constant.

Experiments made before the Institute by Mr. Janet prove the constancy of the resultant ampere-turns.

The ring used was made of 39 iron sheets, 0.066 cm in thickness. The external diameter was $D_1 = 15$ cm, and the internal diameter of ring $D_2 = 13$ cm. There were 250 secondary turns and 15 primary turns.

The same readings are made when the primary turns are all connected in multiple and carry 750 amp, or all in series (15) with 50 amp. Practical use can be made of such rings with one primary turn carrying as many amperes as needed. The accuracy, varying from 1 to 4/1000 in the most unfavorable cases, is fully equal to the requirements of the standardizing laboratories.

The Construction of Aerial Telephone Lines—IX.

By Arthur V. Abbott, C. E.

JOINT USE OF LINES BY TELEPHONE AND ELECTRIC LIGHT COMPANIES.

It often happens that telephone and light companies must carry their circuits along the same highways, and in many cases streets are so occupied as to compel the joint use of poles by both companies, for frequently municipal authorities enforce such a partnership. Both companies, naturally, have grave objections to allow any other circuits upon their poles, and probably wisely use every means to delay and retard such joint occupancy as long as practical. That there are some vital objections cannot be gainsaid; but with proper precautions and restrictions, it is untrue to say that such occupancy is not feasible.

There are two objections that the telephone company may argue to such joint pole line construction. If the wires of the electric light company are placed above those of the telephone circuits, a broken light wire may fall upon the telephone circuits and do much injury by burning off the existing circuits, or injuring apparatus at the sub-stations and in the central office, and by frightening or even killing the employees of the telephone company or possibly its subscribers.

If the wires of the electric light company are placed below those of the telephone company, the linemen employed by the telephone company must crawl through the lighting circuits whenever any pole is visited, and, consequently, are exposed to extreme hazard shock. From the lighting company's standpoint, two objections also exist. If the telephone wires are below the lighting circuits, electric light linemen must crawl through the telephone wires. This is a performance which is not attended with any danger, as far as shocks from the telephone plant are concerned, but the presence of the telephone wires certainly retards work of the linemen and causes it to be more expensive. If the electric light wires are placed below the telephone circuits, a broken telephone wire may drop upon the electric light circuits, and injure the lighting company by opening its circuit-breakers, and otherwise putting its circuits out of commission. All of these objections are real and valid, and should be given due weight when an endeavor is made to enforce the use of joint lines. But when all is said and done it is possible for both companies to occupy a joint line; but, if compelled to do so by municipal authorities, companies should be exempted from suits for damages due to the presence of each other's wires, so long as both companies protect their circuits in the best-known manner. Where joint lines are used, it is usually customary to place the electric light wires above the telephone circuits, and allow a space of not less than six feet between the lowest electric light cross arm and the highest of the telephone circuits. A notable and good example of this form of construction may be seen on Euclid Avenue in Cleveland, where the lines of both the electric light and telephone companies occupy one side of the street, set upon 55 and 60-foot pole lines for some miles.

WIRE.

The best conducting material for open wire lines has always been a point of discussion. Early telephone circuits were invariably made of iron, but its rapid rusting, its objectionable resistance and more objectionable magnetic qualities have caused it to be discarded by all excepting those who are doing an inferior class of work. Extended experience points to the use of .080 B. & S. copper for all lines under from ten to twenty miles, .104 copper for toll and long-distance lines of magnitude, while .165 copper has been used by the transcontinental systems. It is doubtful, however, whether such large wire would be employed in the future. Iron wire, doubtless, has a place in the construction of telephone line where business to be transacted is relatively of minor importance; where distances covered are small, and where the line load is light, it is necessary to use the most economical form of a construction. For local work, under such circumstances, the use of iron wire is presumably preferable, but much false impression exists as to the economy of iron wire. It is argued that, as iron wire costs 3½ cents per pound, and copper wire 15 cents, about four-fifths of the cost may be saved by the employment of iron wire, but this is obviously fallacious; for the cost of the line is not only that of the wire, but of the poles, cross arms, pins, braces, insulators and labor of erection, so that the wire itself forms but a small fraction, or about two-fifths of the total cost of the line. It, therefore, a saving of four-fifths is made upon two-fifths of the cost, the actual saving is but eight twenty-fifths of the total cost of the pole line, and there are few instances where this economy is worth the decreased life and the poorer service rendered by the iron wire line.

There have been many attempts to construct some other form of wire, which would be preferable for telephonic purposes. A number of alloys, chiefly combinations of aluminum and copper in the aluminum bronzes, have been tried. These wires possess considerable greater strength than hard-drawn copper, but are always burdened with two or three times the resistance. For drop wires, alley lines, and other distributing purposes, wire of this description has a value, and its use in this direction is likely to increase, but it seems to be limited to such special locations. In times past many attempts have been made to form what is termed a bi-metallic wire or center of steel, surrounded by a coating of copper, upon the theory that the steel would contribute the necessary strength and the copper the desired conductivity. Theoretically all this is true, but practically the increased cost of manufacture does not enable such wires to show economy over regular hard-drawn copper, and from no other standpoint is their use desirable. Prior to the application of hard drawing to the manufacture of wire, the use of iron was almost a necessity, as ordinary annealed copper could not be made of sufficient strength to support itself over the proper spans under a snow load. But when Mr. Doolittle showed how greater tensile strength of copper could be increased by the process of passing it through a die, without subsequently annealing, the fate of iron wire was sealed, as the increased tensile strength thus secured to the copper made it capable of sustaining itself under all ordinary conditions of span and load. In using hard-drawn copper, however, it must not be forgotten that the value of the material lies in the surface skin, and that nothing should be done which in any way interferes with its integrity. Thus all tools or hard objects must be kept away from the surface of hard copper wire. It must under no circumstances be nicked or scratched, or bent at a sharp angle. Anything which disturbs its surface vitally injures its cohesive power. Any form of annealing will perform the same result, and, consequently, no soldering must be done upon hard-drawn wire, but all joints must be made with clamps—McIntire's, or by some other mechanical method.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

EXTRACTION OF SUGAR.

The endosmotic method of Dr. Schwerin for extracting sugar solutions from comminuting beet roots or cane was described and illustrated in these columns, Vol. XXXVIII, page 942; and more recently (Vol. LXI, page 365) a modified apparatus for this and analogous purposes has been described. The current patent issue contains a further modification of the earlier process, this modification being applicable solely to the extraction of sugar. According to the earlier method the cane or beet chips to be extracted were packed between a cathode of wire-gauze and a diaphragm of filter-cloth, an anode being placed in water in a compartment beyond the diaphragm. This anode was of zinc or aluminum, these metals being capable of uniting with the acids of the normal juices to form insoluble compounds, thereby eliminating them.

In a construction of this kind the albuminoids which form a normal constituent of the juices are dissolved in the alkaline liquor at the cathode, and unless afterward removed by separate treatment will correspondingly reduce the purity of the sugar. This is said to be overcome in the present case by interposing between the cathode and the comminuted sugar-bearing material a layer of bone-black, preferably retained between filter-cloths. To facilitate retention of this layer a horizontal position of the apparatus is adopted. By interposing the bone-black in the path of solution moving toward the cathode the albuminoids are removed before they have an opportunity of dissolving in the cathode solution.

An independent improvement consists in substituting for the costly anodes of zinc and aluminum, plates of iron, and precipitating the organic acids by magnesium oxide, calcium carbonate, or other suitable compound held in suspension in the water of the anode compartment.

DENTAL MUFFLE.

These muffles as heretofore constructed have comprised a casing, generally of porcelain, in the inner walls of which platinum resistance wires were embedded, or in the latter models these wires have been bedded in separable plates with which the muffle walls are lined. The close bedding of the wires, as formerly practiced, has also been abandoned, on account of their liability to part under the expansion and contraction of the plates, and instead they have been merely passed through grooves or perforations of ample size.

A further step, in direct line with earlier progress, is represented in the furnace recently patented by Robert Winter, of Berlin. According to this construction the resistance wires are carried in tubes of porcelain which are loosely supported in horizontal grooves in opposite interior faces of the muffle, and evenly spaced by means of projections on their sides. The result is a further reduction in the size of the heating units, with correspondingly lessened liability to fracture under the necessarily violent temperature changes to which they are subject in use.

DEPOSITION OF GOLD.

Mr. E. D. Kendall, of New York, seeks to simplify the plating of gold by providing a solid composition which by mere solution in water will yield a suitable electrolyte; that is to say, the electrolyte from which gold will be deposited as the result of secondary action. The composition described is prepared by adding to a strong solution of trichloride of gold a slight excess of potassium hydroxide, followed by a considerable quantity of potassium ferrocyanide. The whole is then evaporated to dryness upon a water bath, grounds and preserved in air-tight packages.

Mr. Kendall also patents a composition designed for silvering brass, copper or other base metal by simple contact. This powder consists of silver chloride, one part; sodium thiosulphate, four parts, and a siliceous powder such as infusorial earth, four parts; and is applied directly to the carefully cleaned article to be silvered by means of a wet cloth.

Sylvanus Thompson on Gilbert.

The Royal Geographical Society has recently been making an exhibition in London of Elizabethan relics to signalize the tercentenary of the death of the great Queen. Among the objects exhibited there was very appropriately a unique collection illustrating the life and works of Dr. William Gilbert, one of Queen Elizabeth's Physicians-in-Ordinary, who has been called the "father of modern electrical science." This collection was formed by Prof. Sylvanus P. Thompson, who, as is well known, has made a special study of everything relating to Dr. Gilbert, and whose superb translation of the "De Magnete" was recently issued, a few copies being secured by fortunate subscribers on this side of the Atlantic at a price far below their present and future value.

In a speech at the Royal Geographical Society's meeting on March 23 in connection with the Elizabethan tercentenary, Prof. Thompson said of Dr. Gilbert: "By his magnificent generalization from the small-scale models to the globe itself, supported from point to point by experimental researches, he created the science of terrestrial magnetism. If from the imperfection of the data at his disposal he fell into sundry errors of detail, he yet founded the method of philosophizing by which those errors were in due time corrected. And if for nothing else than his masterly vindication of scientific methods, and his rescue of the subject of magnetism from the pedantry and charlatanry into which in the preceding ages it had lapsed, his memory must be held in high honor.

"To the names of the men who made great the age of Queen Elizabeth, who added lustre to the England over which she ruled, and made it famous in foreign discovery, in seacraft, in literature, in poetry, and in drama, must be joined that of the man who equally added lustre in science, Dr. William Gilbert. Alas! that of the personality of so great a man so little should be known."

National Electric Light Association.

Mr. C. O. Baker, Jr., master of transportation of the National Electric Light Association, states that the Central Passenger Association has granted a special rate of a fare and a third, on the certificate plan, from all points in its territory to Chicago and return, for delegates attending the twenty-sixth convention of the National Electric Light Association, to be held in Chicago May 26, 27, 28, 1903. A preliminary list of 125 questions has already been tabulated by Mr. Hartman, editor of the Question Box for the twenty-sixth convention, from questions already received from members. New questions are coming in daily, and this feature of the programme will contribute greatly to the interest and importance of the meeting. Many of the questions relate to subjects that have never before been brought up for discussion at the conventions, and they are sure to elicit valuable information.

CURRENT NEWS AND NOTES.

STUDYING EARTHQUAKES.—At the invitation of the German Government a conference with the object of founding an international seismic association will be held at Strasburg from July 24 to July 28.

WIRELESS TELEGRAPHY ON TRAINS.—The recent tests of wireless telegraphy between moving trains and stations on the military railway near Berlin, according to a despatch from that city, have been successful. It is stated that telegrams were exchanged without any difficulty. The Braun system is used.

WIRELESS PRESS NEWS is now a feature of the *London Times.* A wireless press association is, it is rumored, being quietly organized to embrace the United States and Canada. Thirty operators are to be stationed at the Glace Bay and South Wellsfleet stations of the Marconi system to receive and transmit messages. The organization is not yet completed, but is to be ready for service by the time that perfect communication is established both ways across the Atlantic. The service is also to be exchanged, it is said, with that of a similar organization in England.

A LONG KENTUCKY ROAD.—The Ohio Valley Traction Company has applied to the General Council at Louisville, Ky., for a right of way into the heart of the city. The company, which will be organized by ex-Congressman A. S. Berry, of Covington, is being backed by Eastern capitalists. The line will connect Cincinnati and Louisville, which are 110 miles apart, and two of the largest cities in the West. It will cost $3,000,000, and will have all the privileges of a trunk railroad line. It will open up a rich farming and mineral country. The construction of the road will be begun within the next few weeks.

GERMAN WIRELESS TELEGRAPHY.—It is stated from Berlin by special cable dispatch that the Allgemeine Electricitäts-Gesellschaft has received orders for twenty-five sets of Arco-Slaby wireless telegraph apparatus from the United States Navy Department. Another cable dispatch states that the German military authorities have successfully experimented with wireless telegraphy along the line of the military railroad between Berlin and Zossen, eighteen miles, for several weeks past, and continuous communication has been maintained between moving trains and the signal stations.

COLUMBIA'S NEW PROFESSORS.—The trustees of Columbia University have decided to fill the vacancy caused by the death of Prof. Ogden N. Rood by creating three new offices in physics. A new professorship in experimental physics is to be filled by the appointment of Prof. Ernest F. Nichols of Dartmouth College, and a new professor in mechanical physics by the appointment of Dr. Albert P. Wills of Bryn Mawr. The third new appointee will be Bergen Davis, tutor in physics, who is now studying under Prof. Thomson at Cambridge University as the Tyndall Fellow of Columbia.

A JOURNALISTIC "FREAK."—It is stated that German competitive enterprise is about to take another and original form. A journal devoted to electrical subjects is soon to be printed in Berlin in the English language, and circulated wherever the British flag flies, the object being to set forth the superiority of German electricians as compared with all comers. One of the curious features of the undertaking is that this new Anglo-German industrial publication is to be backed by one of the great German electrical manufacturing companies. An English technical journalist has been secured to edit the new paper.

BIG TRUNK TROLLEY SYSTEM.—It is understood that the Appleyard electric railway syndicate, which has been operating extensively in Southern Ohio, has planned an immense trunk line trolley system, giving a through line from Cincinnati to Cleveland by way of Columbus, and from Cincinnati to Toledo by way of Dayton and Springfield. This line, it is stated, when completed, will enter Cleveland by the way of Akron, and the Northern Ohio Traction Company will be part of the system. Some of the work still remains to be done between Cincinnati and Hamilton, but is now under construction. There is also a connection being made between Newark and Zanesville.

A MODERN LAKE STEAMER.—The steamer "City of South Haven," which was recently launched at Toledo, O., will be fitted out with a number of electrical features. She will be equipped with a complete telephone system, connecting each stateroom, and the exchange on board will be provided with a trunk line which will be connected with the local telephone systems at Chicago and South Haven when the steamer makes her landings there, thus enabling passengers to communicate with all parts of the cities without leaving their staterooms. The vessel, it is stated, will also be equipped with Marconi wireless telegraph apparatus and a daily newspaper will be published on board during the excursion season.

EGYPTIANIZED CLAY.—Mr. E. G. Acheson has recently been conducting some interesting work with clay earth, and has obtained a product called "Egyptianized Clay." This is obtained by a very simple treatment with tannins or similar extracts of vegetable matter whereby the clay is rendered very much higher in tensile strength, more dense, and the shrinkage is materialy reduced. To obtain this same effect was probably the real object of the use of straw by the Egyptians. This having occurred to Mr. Acheson, he extracted the soluble matters from the straw, throwing away the fibre, and by treating the clay with these soluble constituents obtained the above mentioned results. The tensile strength was increased as much as 350 per cent. in the sun-dried article.

BRITISH MUNICIPAL OWNERSHIP.—The government returns of the municipal plants operated in England, of all kinds, are not particularly encouraging. The average annual income for the 299 municipal undertakings amounted in the aggregate to rather more than $65,000,000, from which must be deducted $41,000,000 for working and other expenses. The apparent balance is about $24,000,000, from which again must be deducted nearly $15,000,000 for interest on money loaned, and nearly a million dollars for depreciation. If a further sum of $6,300,000 be subtracted for repayments of principal, there is a net profit of considerably less than $2,000,000. On further examination, this profit dwindles so seriously that it ought really to be a deficit. The amount invested in electrical current supply is $62,500,000.

STEEL CASTINGS IN IRELAND.—Mr. W. W. Touvelle, U. S. Consul at Belfast, Ireland, writes the State Department as follows: From recent investigations that I have made, and from numerous inquiries received from different firms in this city, I am satisfied that a good market is open to American manufacturers who can supply steel castings of high permeability for electrical works. Castings of magnetic steel, for field magnets of electric motors and dynamos, and magnetic steel or iron sheet stampings, of high permeability and low hysteresis, for armature cores, are mentioned. L. B. Mollan & Co., Alexander Street West, Falls Road, electrical and mechanical engineers and contractors, and Millin & Co., Ultonia Works, 59 Victoria Street, are desirous that their names may be brought to the attention of steel manufacturers of the United States, as they are large users of the castings described.

CHICAGO LIGHTING.—According to statements in the *New York Herald* as to prices paid by city employees in Chicago for the privilege of holding their jobs under the existing regime, linemen in the electrical department have to pay out $5, while lamp trimmers are also assessed $5. This goes into what is graphically called the "slush fund."

MASSENA PLANT.—A serious break occurred last week in the canal of the Massena plant. The bank which held the water of Froe Bay in check became undermined and gradually began to give way, causing an alarming leakage. A large number of men and teams, after working several days dumping tons of stone and other material into the opening, succeeded in stopping the leakage and danger is now considered past. It is stated that the damage will be heavy.

GERMAN ELECTRICAL COMBINATION.—A cable dispatch from Berlin of April 7 says: The arrangements for the combination of the Allgemeine Elektrizitat and the Union Elektrizitat Companies have been completed. Each concern will keep separate accounts, but will pool their profits, which will be apportioned according to the ratio of their respective capitals, the former company receiving fifteen-nineteenths and the latter four nineteenths. The combination will become operative on July 1, and will continue for thirty five years.

ALUMINUM-COPPER CONDUCTOR.—A patent issued March 24 to J. D. Nicholson describes a conductor having a copper core enclosed with aluminum. It is stated that a wire can be readily drawn from a compound ingot composed of the two metals, the core being of copper and the shell of aluminum. In coupling such wires the difficulty ordinarily found in soldering aluminum is not serious, as the copper part of the conductor can be readily soldered without raising the resistance of the joint. The claim is for a compound electrical conductor composed of a core and a shell of different materials drawn into wire, one metal being aluminum and the other copper.

OPERATING MOTORS IN DUST-LADEN ATMOSPHERES.—A patent granted March 31 to Thomas A. Edison describes means for operating electric motors in atmospheres which are heavily charged with dust, as in cement-grinding establishments, flour mills, etc. The invention consists in enclosing the entire motor in a casing consisting of a light framework covered with textile material, such as ordinary gunny cloth, the walls being double. Where the motor shaft passes through the casing a packed bearing is provided to exclude dust at that point. A fan is arranged within an opening in the casing to cause an outward draft from the same, a shield being so arranged at this opening as to prevent the inward flow of air around the fan, which would carry dust within the casing.

CHICAGO ELECTION.—Mr. Carter Harrison has been elected Mayor of Chicago for the fourth time, but by the smallest plurality in the series. The chief issue in the campaign was the traction question, both candidates favoring ultimate municipal ownership of the street railways. Mr. Graeme Stewart, the Republican candidate, advocated an immediate improvement of conditions, making the best terms possible with the companies. Mr. Harrison recommended a delay until the city had obtained what it desired from the companies after the election. Mayor Harrison said: "I regard the present election as less of a personal victory for myself than as a victory for municipal ownership and for the referendum—a victory which should lead to the development of public national as well as municipal utilities."

MASSACHUSETTS MUNICIPALISM.—The Massachusetts Gas & Electric Commission has recently made its annual report. During the fiscal year ended with June, 1902, the municipally owned electric plants of Massachusetts had a gross income from all sources of $157,390.35. Their gross operating expenses were $218,696.39. To this must be added interest on bonds, $39,395.55; depreciation, $55,729.29; losses, $447.36. The sum of these items, added to the net loss on operating account of $61,306.04, would indicate that the cost of municipal electric lighting over and above the charge made for it, was $155,032.34. Of sixty-three Massachusetts companies engaged in electric lighting, thirty-eight paid dividends and twenty-five did not.

INVENTORS AND THE NEW INDUSTRIAL SITUATION.—Mr S. T Dodd, the well known electrical engineer, in a recent lecture on the development of the electric railway said that in gathering his notes on the subject the question has forced itself on his mind as to whether under modern conditions of business the same work would ever have been done, and whether if we had the same or a similar problem before us to-day, we would be able to solve it as the inventors of 20 years ago solved the street railway problem. Since that time business interests have been associated into the vast organizations of the so called trusts, and, as a necessary concomitant, men have more and more associated themselves into labor unions. It is unquestionable that the natural effect of large organizations of either capital or labor is to reduce its members more and more to the level of machines and to specialize and narrow the work and efforts of each individual along certain lines while doing the work of the organization at the expense of the personality of the individual. He considers it absolutely certain that such men as Sidney Short, Thomas Edison and Leo Daft were not working for any thirty million-dollar corporation. The query arises, if they had been, would they have been allowed to spend their time on the various apparently hair-brained ideas out of which has developed our electric railways? In particular, would they have exerted their efforts if they had known that their ideas were to be absorbed by the corporation and included under that general term of patents and good will, which disappears when the corporation is merged in a new organization? The labor unions of those days did not hold the position which they do to-day. The query arises, if they had would these men have been able to hire assistants who were machinists, carpenters, plumbers, painters and electricians combined. It is perfectly certain that these men were working for themselves and because they knew that the developments they made would be known by their names and would lay the foundations of their own possible fortunes. Mr. Dodd asks, Is such a condition of things possible to-day? Or, are modern conditions wiping out from among us the American inventor? If so, are they not also removing one of the most potent factors and incentives to advances in American mechanics, American engineering and American civilization?

LETTER TO THE EDITORS.

Stress on Frames of Alternating Current Generators.

To the Editors of Electrical World and Engineer:

SIRS:—I have read in your issue of February 14, 1903, the letter of Mr. A. Hansson, commenting on my article in the issue of January 24, 1903, having the above title. In this he says: "The author has neglected torque in the inner circumference of the core * * * the force due to this torque in the example given would be about 10,000 lbs."

It does not make any difference what the figures of this torque are, because it does not enter in the stress in the sections of the frame where the maximum stresses are to be found. It is the moment of this force we have to deal with, not the force itself. The bending moment of the said force for the two sections in a vertical plane through the shaft is zero. This is the reason why the force is neglected in the article, and it seems to be a pretty good reason.

The object of my article was to interest the designing electrical engineer in the stress problem. There is a wide field in America for this kind of work. Because material is cheap there in comparison with the cost of labor, saving in material has hitherto been a question of secondary importance. But while saving in labor, why not at the same time economize in material and consequently get the highest results? An article written with this object must not be too theoretical, because in the latter case it would probably not be read by the practical engineer, who is apt to prefer examples showing the application of theory. If any designer has received practical benefit from my article, I am very well satisfied.

The letter refers to an article in the *Elektrotechnische Zeitschrift* by Mr. Hans Linsenmann. This is a theoretical article relating to the deflection of frames, and as such is a very good one. Mr. Hansson does not appear, however, to have understood either this or my own article. They relate to subjects just as different as are the ideas of deflection and stress. Mr. Linsenmann in an example gets as a result from six pages of theory a maximum deflection, at the top of a 1,200-kw generator, 13 ft. 9 in. in diameter, of .012 in.

This small deflection is of very little importance, for in designing a machine a difference of air-gap of 1-16 or .0626 in. is allowable. The author has said not a word about frame stress, which is the main thing for the designer.

"The frames of large machines must be calculated in relation to the air space; that is, the deflection must be calculated just as in the case of a shaft, and the frame dimensioned accordingly." This is another error, the calculation of a shaft and a frame having nothing to do with each other. In the case of a shaft for electrical machines, under normal conditions deflection is a serious matter and the stress of less importance; while in the case of a frame, just the opposite is true, as I have stated above.

The structural frames of Siemens & Halske may be a commercial success in Germany where labor is cheap, but I doubt if this would apply in America on account of the high cost there of labor. There undoubtedly the cast frame of iron or steel will continue to be preferred.

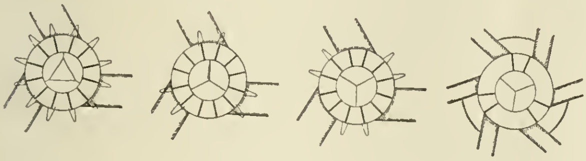
P. J. Frenell.

Berlin, Germany.

DIGEST
OF
Current Electrical Literature.

Dynamos, Motors and Transformers.

Heyland Machines Without Closed Connections Between the Segments.—Heyland.—An illustrated description of a recent improvement made in his machines. Fig. 1 represents the original arrangement for a compensated three-phase machine; the connections between the different segments are represented by fine lines. These connections between the segments offer practical difficulties, especially in multipolar machines, as the calculation gives in many cases large values for the resistance of these connections which, therefore, must be made long and of small cross-section, so that they cannot be easily placed on the commutator. It is, however, possible to omit some of these connections if care is taken that the breadth of the interrupted segments is smaller than the breadth of the brushes. This improvement is shown in Figs. 2 and 3, where some of the connections between the segments are left out; Fig. 2 shows the main position in which some connections between the segments are open; Fig. 3 shows the moment of commutation in which the segments between which there are no connections, are bridged over by the brushes. It is even possible to omit all connections between the segments; this is shown in Fig. 4, where each brush is divided into two brushes connected together by a resistance; the distance between the brushes is so chosen that at the moment of commutation the point of interruption is bridged over by the brushes. This arrangement has the advantage that it is easy to regulate the resistance properly. He gives some formulas showing that by this arrangement the shunt losses can be made as small as desired.—*Elek. Zeit.*, March 19.



Figs. 1, 2, 3 and 4.—Heyland Machines.

Reference.

Small Motors.—Kimball.—An illustrated article on the historical development of the small electric motor.—*Eng. Mag.*, April.

Lights and Lighting.

Pressure in the Mercury Arc.—Stark and Reich.—An account of experiments in which they determined the pressure in the mercury arc by attaching a manometer tube direct to the mercury vessels. They find that if the mercury arc plays in a tube without a condensing vessel, the vapor pressure rises rapidly in the first two minutes. When the glass tube has grown so hot that small mercury droplets evaporate inside, the pressure rises rapidly from 2 mm to 10 mm. At the same time the current decreases and the difference of potential of the electrodes increases. If, on the other hand, the tube is provided with a condensing attachment then, on closing the circuit, the vapor pressure increases during the first few minutes to some 5 mm, and remains steady after that. The condensing vapor, as it enters the condensing vessel, glows with a reddish color, and shows the same spectrum lines as the arc, except that the less refrangible lines are accentuated. The condensing vapor is, therefore, cooler, but still hot enough to glow. As the difference of pressure between the arc and the condensing vessel increases, the condensing vapor contracts more and more into a sheaf, and finally becomes a cylindrical pencil. While it is still a divergent sheaf it shows a kind of stratification.—*Phys. Zeit.*, March 1; abstracted in Lond. *Elec.*, March 20.

New System of Electric Illumination.—An editorial note on the "Linolite" system which consists of a "line o' light," produced by a series of straight tubular lamps carried in a semi-cylindrical reflector. The lamps are each 9 in. long, with straight filaments—except in the case of some with a single curl at the center—and one contact plate at each end. They are held in spring holders of simple construction and in concealed brass terminals, highly plated, in the type used for theatre, shop and all internal lighting. The leads are carried in the beading at either side of the reflecting trough, and are looped into the spring contacts; for 100 to 120 volts the lamps are all in parallel, while for higher pressures they are arranged two in series. The reflector measures about 2¼ in. deep and can be made in any desired length; the lamps can also be made of any candle-power, the power absorbed being about 3.75 watts per candle. The light is distributed uniformly over an angle of 180° and gives a brilliant effect when seen directly; it is, however, preferable in applications such as shop window lighting, for which the system is especially suitable, to direct the light from the spectator toward the goods exhibited, so as to avoid glare. The reflectors are made either of nickelled copper or polished aluminum.—Lond. *Elec.*, March 20.

Power.

Electric Shop Drive.—A full report of a recent discussion before the Eng. Club of St. Louis. Layman outlined the various methods of electric shop drive. There are two general systems, the group and individual tool system; the former may be termed a compromise between the old and the best of the new. In its best adaptions, group drive is so arranged as to have various classes of machine tools subdivided into groups of from 6 to 10 tools, each group being operated by a single motor. Where variable-speed service of tools is necessary, the individual motor system is the ideal one. The disadvantage of alternating-current motors is the lack of a satisfactory speed control. With alternating current, shop lighting from the same mains which feed the motors, is possible and commercial, while with the prevailing methods for variable-speed, direct-current motor drive the shop lighting system is practically entirely independent of the motor service system. With the aid of diagrams he discussed at some length the rheostatic control and the multivoltage systems. Cooper discussed the subject of speed variation at great length and pointed out that a really perfect speed-changing device is still missing; in conclusion he indicated the following rules to be used in determining relative sizes of motors for constant horse-power application: the total range of speed, using both variable voltage and field regulation, will be as the square of the range of voltages; change of horse-power will be directly proportional to change of voltage in armature, field being constant, the change of horse-power by change of field strength will be inversely proportional to the change in speed, the voltage on armature remaining constant; the relative size of the motor as referred to the maximum speed will be directly proportional to its speed variation when using variable voltages; the relative size of the motor as referred to the maximum speed will be as the square of the speed variation when using field regulation. While Layman made a strong argument for constant-speed, direct current motors and mechanical means between motor and tool for speed variation, Schwedtmann thinks that the most satisfactory system for the greater percentage of shop work is to use multiple voltage, direct-current motors or motors in which variation of speed is obtained by changing without the use of resistance the voltage across the armature or field. He finally described some methods for speed variation in alternating current systems. Ganz & Co. are running their whole shop with two speed, alternating current motors; the motors are their standard two or three phase machines; wires from two generators furnishing 50 and 25 cycles respectively are taken to each motor; on the higher frequency the motor runs without transformer; on the low frequency a transformer is inserted, reducing the voltage to a point where the best efficiency and magnetic density is obtained in the motor; this system offers all the advantages of a two circuit, multiple-voltage control system. At the shops of the Oerlikon Company the same results are obtained in a different way; only one set of wires from one generator is taken to the alternating-current motors which have short-circuited armatures and two sets of field winding, one with double the number of poles of the other; nearly the whole Oerlikon shop is driven with this system. Schwedtmann thinks that a combination of the two systems of Ganz and Oerlikon would give all the advantages of the best multiple-voltage control system.—*Jour. Eng. Soc.*, January.

REFERENCE.

Water Power in South Africa.—FOSE.—An illustrated article on the Victoria Falls of the Zambesi River, with some remarks on their possible electrical development.—*Cassier's Mag.*, April.

TRACTION.

Northern Ohio Interurban Lines.—A description of the formation of an electric trunk system of which the Columbus, Dayton & Marion Railway is the nucleus. The system is now being rapidly extended in several directions, and it is proposed eventually to furnish through routes between Cleveland, Toledo, Columbus and other Ohio cities. The principal towns served by the system have a population aggregating 168,750. Excellent terminal facilities are secured at Columbus, Delaware, Marion, Clintonville and Stratford, and in most of these towns an arrangement has been made for operating over the tracks of the local company and taking part of the local traffic. A private right of way has been secured for most of the system and where necessary the roadbed and overhead work has been entirely reconstructed to bring it up to modern standards for high-speed interurban work. There are very few curves except in the cities, and none of them are over 4°. and there are very few cuts or fills along the line. The present owners have put in some very good bridges and trestle work, examples of which are illustrated. A feature of the transmission system is the pole line with which great care has been taken owing to the fact that the transmission is at 33,000 volts. Absolutely no iron is used at the top of the pole except the through bolt which holds the cross arm; the details of construction are shown. The present power plant is a temporary installation which will be supplanted by modern equipment as soon as the lines which are now under construction are completed. The company is also building several sub-stations, which will eventually be operated from the Marion power station.—*St. R'y Jour.*, March 21.

Interurban Electric Railways.—GONZENBACH.—A second article on engineering preliminaries for an interurban electric railway. The writer treats particularly of the location and acquirement of the right of way for railways of this character, the construction of the roadway and track, the selection of rolling stock and equipment, and the provisions required for safe operation. The size and weight of the track rail and the characteristics of the contact rail as well as the conductivity of both are discussed in detail. The writer discourages the use of the highway for the reason that numerous stops are necessary and this precludes the possibility of attaining high schedule speed; moreover, the highways as a rule do not mark the most direct routes between the points desired to be reached. The necessity for good construction of roadbed and the adoption of a type of track construction that will meet all the requirements of the service are emphasized; at the same time the writer points out that there is a marked tendency to use much heavier rail than is absolutely necessary and that considerable saving may be effected, without decreasing the value of the property, by a careful investigation of the absolute requirements of the equipment to be used. Special attention is called to the fact that there are no reciprocating parts on an electric car, and consequently there is none of the hammering to test the strength of the rail, as in the case of steam railroads employing locomotives. Attention is also directed to the fact that the heaviest electric cars in use to day are much lighter than the ordinary steam locomotive, and that the present weight is not liable to be increased materially for ordinary interurban service. *St. R'y Jour.*, March 14.

REFERENCES.

Brooklyn.—An article on some interesting work on the Brooklyn Elevated. Where one elevated line in Brooklyn crosses another there was so little clearance that the motor cars could not be equipped with trolley poles. The third rail is used on the elevated, but trolley poles were needed after the cars have left the elevated structure in the suburbs and run on the surface. Up to the present, trolley poles have been carried on the trail cars, but the structure has been raised so that they can now be carried on the motor cars. The method of raising the structure is described.—*St. R'y Jour.*, March 21.

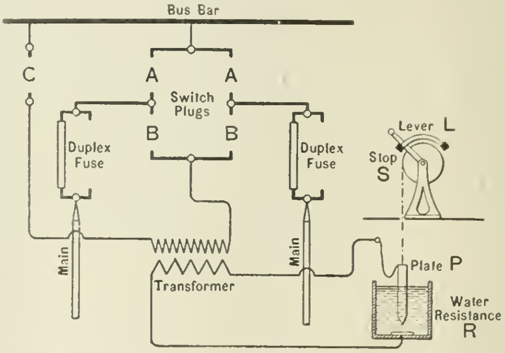
Electric Railway Bridges.—WATSON.—An illustrated paper on the construction of bridges for interurban electric railways.—*Jour. Ass. Eng. Soc.*, January.

Storage Batteries for Sub-Stations.—An article in which the writer refers to an editorial in a former issue on "Storage Batteries in Sub-Stations," and states that he does not believe that the use of batteries in sub-stations will reduce the amount of other machinery required in the same proportion as stated in that issue.—*St. R'y Jour.*, March 21.

Station Operation in Dublin.—An article in which detailed figures are given on the operation of a station in Dublin, in which the cost per kilowatt-hour is 0.7624 cents.—*St. R'y Jour.*, March 14.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging and Discharging High-Tension Cables.—PARTRIDGE, ORTON, NORTHCOTE, GARRARD.—Several other communications on this subject which has been discussed for some time in the correspondence columns of Lond. *Elec.*, as noticed in the Digest. Partridge considers that some sort of apparatus is essential for this purpose, but not in the shape of lightning arresters or spark gaps, but some arrangement which prevents the rise taking place. In Deptford he used the following device which has worked perfectly; it has been in daily use for the last ten years, and there was never a rise in pressure on the mains, although they are put on and taken off every day in the year. It is shown in the adjoining diagram. To charge a main switch, the switch-plug, *C*, is first closed, which connects one pole of the transformer to the bus-bar. The switch plug, *B*, of whichever main is to be charged is then inserted. The plate, *P*, connected to the low-tension side of the transformer, is then lowered into the liquid resistance, *R*, by means of the lever, *L*. When this is lowered to the correct position which is marked by a stop, *S*, the plug, *A*, is put in, which short-circuits the apparatus, and plugs *B* and *C* are then removed. When a main is taken off, the lever, *L*, is put over to its stop, *S*, and the plugs, *B* and *C*, are put in. The plug, *A*, is then removed and the lever, *L*, pulled over to the other side, which gradually discharges the main. The time taken to connect up the entire apparatus and either charge or discharge a main is about half a minute.—Lond. *Elec.*, March 6. Orton emphasizes the damage which will occur to transformers, motors, etc., connected directly to the high-tension mains when sudden surgings of current and corresponding rises in e.m.f. occur, due to a short circuit, a bad synchronism of an incoming machine, etc. The static interruption of Thomas (Westing-



CHARGING AND DISCHARGING HIGH-TENSION CABLES.

house Company) is referred to as an actual protection, also when the mains are being connected or disconnected. To protect the cables themselves, either spark-gaps or a water-charging resistance can be used; he prefers suitably designed spark-gaps. Northcote points out that pressure rise in cables depends on several things, and their relative properties, namely capacity, resistance, frequency and self-induction.—Lond. *Elec.*, March 13. Garrard defends the use of water resistances. He agrees that only such an arrangement should be used which prevents the rising taking place, and not one which should safeguard the system after the rise has occurred. He thinks that with any arrangement, such as that of Partridge, in which transformer is combined with the cable to be charged, is liable with certain combinations of capacity and self-induction, to do more harm than good, and that the only method in which it is impossible for a bad effect to result is the use of a non-inductive resistance. He says the mechanical difficulties in the construction of water resistances are very small; with good china insulators one can insulate everything and no difficulty has been experienced in this direction.—Lond. *Elec.*, March 20.

Insulation Tests of Networks and the Earthing of the Middle Wire.—An editorial calling attention to the great importance of constant tests of the insulation resistance of a network. Reference is made to a recent paper by Taylor in which he describes a method; some older ones are also mentioned. The actual value of the insulation resistance of a network may be calculated by momentarily removing the earth connections on the middle wire and connecting an ammeter or voltmeter successively between the two of the bus-bars and earth. A second method is to connect an ammeter in series with a resistance (or high-resistance ammeter) between the middle wire and earth, and shunt it with an equal resistance, the insulation of the network being again calculable from these two readings. This latter test does not necessitate an additional ammeter to that ordinarily connected between the middle wire and earth if this instrument has a sufficiently long range or is provided with appropriate shunts. Russell has indicated a modification of these methods. The method of earthing the middle wire is then discussed. Direct earthing is not to be recommended in any case, and the most advisable plan appears to be to earth the middle wire bus-bar at the station through the ammeter referred to above and a fuse, the fuse being shunted by a resistance capable of carrying a fairly heavy current. If an earth develops on one of the outer mains the fuse blows, and the resistance is placed in circuit and saves the otherwise inevitable "short." Some electricians prefer to place a resistance premanently in series, with the ammeter between the middle wire and earth, but it is thought to be preferable to omit this. The object of the earth connection is to maintain the voltage between one of the outers and earth at its normal value, whatever may be the fault resistances of the mains. But if the middle wire earth connection has a resistance comparable with the normal fault resistance of the mains, the potential of one of the outers above earth may be considerably higher than the voltage of the supply, and there will be danger both from possible shock and leakage. Concerning the question of fuses on the middle wire it is thought that solid links should be employed throughout for the middle wire connections, whether in the streets or house-wiring. The elimination of all fuses and switches from the middle wire is a safeguard as well as a simplification.—Lond. *Elec.*, March 13.

Synchronizer Effect.—Callis.—A brief description of a curious effect observed in synchronizing the two-phase alternators recently installed at Sheffield. The synchronizers used with the 100 frequency machines are fitted with both lamp and Evershed voltmeter, connected to the same terminals, for indicating the phase. When paralleling a machine with one already running on load, it was noticed that when nearly in synchronism, a slight difference of phase displacement of the incoming machine either ahead or behind actual synchronism, produces a very marked difference in the behavior of the lamp and voltmeter, although both are fed from the same terminals. If the incoming alternator is slightly behind in phase, "as shown by the phantom poles, produced by the arc lamp slowly traveling backwards," the voltmeter needle commences to show the phase an appreciable time before the lamp filament is even red hot. If, on the other hand, the machine is ahead in phase by the same amount, the lamp attains quite a glow before the voltmeter needle commences to move. When in synchronism, both lamp and voltmeter read apparently together. In the actual paralleling of the alternators, the best results have been attained when the incoming machine is slightly ahead in phase, the switches being closed when the lamp shows full brilliancy. He says the matter cannot be explained on the general ground that the voltmeters are, to a certain extent, inductive, while the lamp is not.—Lond. *Elec. Rev.*, March 6.

Distribution Losses in Electric Supply Systems.—Constable and Fawcett.—The first part of a paper read before the (Brit.) Inst. Elec. Eng. Few central station engineers expect to get paid for more than 75 per cent. of the energy they generate; about 5 per cent. are used in the station itself for lighting and other purposes, and the remaining 20 per cent. are wasted. The authors discuss how this 20 per cent. waste is made up and whether it is possible to reduce this loss; the figures given by the authors refer to the Croydon electricity works. They first discuss the switchboard losses which in the Croydon station with a maximum output of only 1,250 kw, amount per year to 10,000 units. They then deal with the cable losses which are the most important and can be least easily reduced. They consist of three components; first, the Joulean heat loss in the dielectric, which is very small; second, the Joulean heat loss in the conductors, which is of greatest importance, and lends itself to fairly accurate calculation; third, the losses due to what may be called dielectric hysteresis. The Croyden cables consist of 25 miles 2,000-volt feeders, 50 miles 400 and 200-volt distributors, and 30 miles are cables; the total Joulean heat loss in the same is per year 150,600 units. The paper is to be continued.—Lond. *Elec.*, March 13.

Storage Battery Charging with Synchronous Converters.—Karapetoff.—A communication referring to the recent observation of Banti, who had found that the direct current given out by a single-phase synchronous converter, was decidedly pulsating, while charging a storage battery, and the same was almost steady, while at work on an ohmic resistance. Banti suggested as an explanation that the storage cells act like electrolytic condensers, producing a greater difference of phase between the current and the voltage of the charging current. The present author points out that a single-phase synchronous converter must always give some little pulsating direct e.m.f., because its armature reaction is a pulsating one; therefore, the field, being a little fluctuating, produces a pulsating e.m.f. on the direct-current side; small fluctuations of the e.m.f. may produce in special cases great pulsations of the current, no capacity or self-induction being necessary. The fluctuations in the case of a battery are large on account of its counter e.m.f. and its small resistance, as he shows by a simple calculation. No such pulsations can take place in two or three-phase converters, the armature reaction there being constant; the reaction consists in this case of a fixed reaction of the direct-current and a rotating one, produced by polyphase currents; the field of this last reaction rotates synchronously relative to the armature, but in the opposite direction, so that it is immovable in space, and thus produces a constant demagnetization of the field magnets. Concerning Banti's observation that self-induction diminishes the pulsations of the current while charging the battery, he shows how the lessening effect of a choking coil may be calculated. He finally suggests the following experiment to see whether his explanation is correct; if it is correct there should be a pulsating current when in Banti's experiment a direct-current, shunt motor is substituted for the battery.—Lond. *Elec.*, March 6.

Wires, Wiring and Conduits.

Earthed Metallic Sheathing for Cables.—Mavor.—A communication in which he emphasizes that the enclosing of the conductors in a continuous metallic sheathing connected to earth makes all the difference between absolute safety and imminent risk, but safety depends entirely upon the perfect continuity of the earthed sheathing, and unless the provision and maintenance of such continuity can be absolutely assured, the sheathing is not only no safeguard, but becomes in itself a source of acute danger both to shock and fire. It is easy to make regulations as to frequent testing of the earthing of the cable sheathings and switch and fuse box casing, but very difficult to enforce them, especially in mines. He thinks the only means of absolutely compelling maintenance of the required continuity of the metallic sheathing is the use of concentric cable with the uninsulated outer conductor connected to earth, and all switches, fuses and such apparatus enclosed in cast-iron boxes forming a portion of the earthed outer conductor. Prejudices exist against the use of an uninsulated conductor, but as applied to mining purposes they are unsupported by valid arguments.—Lond. *Elec.*, March 13.

Fire Hazard.—Devereux.—A paper read before the Engineers' Club of Philadelphia on some electric fire hazards. He distinguishes the three following causes: a short circuit, a leak, and the contact of inflammable materials with electrically heated parts. These three causes are discussed and illustrated by examples from practice. Safety can be obtained only by the proper methods of construction, using only high-grade material. The fire hazard should always be carefully considered in an electric installation. "While the operation of electrical apparatus is burdened with many dangers under some conditions the reverse may be said when the equipment is installed by skilled wiremen guided by experienced engineers and the National Electric Code carefully applied; and it is essential, when alternations or repairs are necessary, that, as a continual safeguard, due notifications be given to the local Board of Fire Underwriters. Under these conditions electricity is as safe as any source of power and the safest source of light known to mankind."—*Proc. Eng. Club Phila.*, January.

Electro-Physics and Magnetism.

Charge of Gaseous Ions.—J. J. Thomson.—An account of a series of experiments made to determine the charge on a gaseous ion. The method devised in 1898 by him for this purpose and carried out by Wilson by means of the condensation-cloud device, assumes that the sudden expansion of the air leads to the condensation of water vapor which takes place on all the ions, both positive and negative. Subsequent experiments have, however, shown that when the rates of expansion does not exceed 1.31, only the negative ions are caught. The number of ions present is measured by determining the current carried by ions moving with a known velocity; this gives the produce of the number of ions by the ionic charge. Owing to the error mentioned above, the number of ions comes out about half its real value, and therefore the charge comes to twice its real value; he has, therefore, carried out experiments at various expansion ratios, and found that when the ratio exceeds 4 to 3, all the ions are brought down by the condensing vapor, and a further expansion does not add to the number precipitated. The charge of the gaseous ion is 0.00000000034 electrostatic units. The number of molecules in 1 cc of gas under standard conditions is 3.6 multiplied by the 19th power of 10.—*Phil. Mag.*, March; abstracted in Lond. *Elec.*, March 13.

Magnetic Detector of Electric Waves.—Tissot.—A description of a magnetic detector, somewhat like Marconi's instrument, used in conjunction with a bolometer capable of measuring the thermal energy received by the antenna. He found that the detector action is a hysteresis effect and that the cores giving the best effect are those consisting of a material whose cycle of magnetization embrace a large surface. He has constructed two detectors which have a sensitiveness equal to that of the coherer. In one of them the core is fixed and finely laminated, and bears 50 or 60 turns of fine wire. A small coil of several hundred turns of the same wire is placed at the center of the first turn and joined to the telephone. The variable field is produced by the rotation of a magnet. In another form which recalls a Gramme ring, rotational hysteresis is brought into play.—*Comptes Rendus*, February 9; abstracted in Lond. *Elec.*, March 13.

REFERENCES.

Electromagnetism.—Stine.—The first part of a paper on the contributions of H. F. E. Lenz to the science of electromagnetism.—*Jour. Frank. Inst.*, April.

Barlow's Wheel.—Carvallo.—A description of an experiment for lecture purposes, in which he drives a Barlow wheel by means of a single thermo-couple and thus transforms heat into mechanical energy.—*Jour. de Phys.*, February; abstracted in Lond. *Elec.*, February 27.

Terrestrial Magnetism.—The December issue contains a paper by Bauer on the results of international magnetic observations made during the total solar eclipse of May 18, 1900, including results obtained during previous total solar eclipses; a paper by Ferr on records of earthquakes on quickly driven magnetographs; an article on magnetic observations on land by the Austrian Navy between 1896 and 1901; and a portrait of Benjamin Franklin.—*Terr. Mag.*, December.

Electro-Chemistry and Batteries.

Aluminum Valves.—Nodon.—An account of some researches on the internal resistance of electrolytic valves and their effect upon alternating discharges and telephone currents. When an aluminum anode is placed in a concentrated solution of neutral ammonium phosphates, the capacity of the valve may reach 1 farad per square centimeter of aluminum; this has the effect of considerably reducing the e.m.f. of the currents rectified. The apparent specific resistance of the liquid when the valves are open, is many times as high as the true specific resistance of the electrolyte. There is no oxide visible under the microscope while a current passes; but the aluminum always appears porous. A telephone current can be measured by rectifying it and using a direct-current galvanometer. Wehnelt interrupter phenomena may be obtained with an aluminum valve in an alternating-current circuit containing an induction coil provided with a very light trembler having a period identical with that of the current rectified.—*Comptes Rendus*, February 16; abstracted in Lond. *Elec.*, March 6.

REFERENCES.

Electrolytic Galvanometer.—Heilbrun.—An illustrated article in which he describes some lecture room experiments for demonstrating that when a galvanic cell sends current through an external circuit, the current also flows through the electrolyte of the cell, a fact which he thinks is often doubted by laymen. He uses the magnetic effect of a coil consisting of a glass tube wound in many windings and filled with the electrolyte, and forming the only connection between the anode and the cathode compartments.—*Zeit. f. Electrochemie*, February 5.

Aluminum.—Pitival.—The first part of an article of the present conditions of the metallurgy of aluminum, with special references to a recent article of J. W. Richards.—*Jour. de L'Elec.*, February 15.

Aluminum.—Sperry.—An illustrated article on the use of aluminum in the rubber industry for making moulds.—*Metal. Ind.* (formerly *Alumin. World*), February.

Telegraphy, Telephony and Signals.

Core Ratio.—Young.—The conclusion of his article on the ratio of resistance to capacity in long submarine cables. He discusses the best resistance of the battery for a given maximum pressure; while in automatic curb transmission direct to line, the lower the battery resistance the better, with condenser-curb sending it has a certain "best value," which is defined as follows: the best value of the battery resistance in condenser sending is the limit to which its resistance can be raised conjointly with the e.m.f., without exceeding a given maximum stress, beyond which limit the gain in amplitude of the wave is neutralized by the loss of sharpness of form. The best resistance of the receiver in direct working, varies directly as the square root of the CR per microfarad of the line for a given signalling speed. With condensers in circuit at one or both ends, the law is less simple; the higher the speed of sending the less the best resistance of the receiver; the higher the condenser capacity, the less the best resistance of the receiver. The most obvious application of the principle of resistances per microfarad, as well as the most elegant proof of the law of inverse square roots, consists in the condenser bridge or "double block" duplex system. Here the balance of the potentials on the opposite sides of the bridge depends on the equality of the pair of pressure waves, alike in amplitude and phase. Those who have to duplex long cables are well aware how a slight difference between the two waves in either respect, whether retardation of phase by too much resistance, or excess of amplitude by too much capacity, operates to upset the balance. The recorder in the cross-circuit indicates principally differences between the mean ordinates of the waves, but if rapid it will often respond first to inequalities in their maximum. In the most perfect adjustment one wave must be an exact copy of the other in the peak of maximum pressure as well as in the mean, the well-known "jar" being the indication of want of coincidence in the wave crests. What is conclusively proved, however, by observation is that a working balance, or effective equality between the pair of pressure waves, is only produced when the bridge condensers are adjusted inversely as the square roots of the CR's per microfarad of the cable and artificial line respectively.—Lond. *Elec.*, March 13.

Loaded Lines in Telephonic Transmission.—Campbell.—A mathematical investigation of the effect of inserting self-induction coils on long telephone lines as in Pupin's system, and an account of some experiments. He worked with a cable circuit 46 miles in length, partly artificial, containing 100 equally-spaced inductance coils. The initial loss due to the loading was found to be equivalent to the introduction of 9 miles of standard cable, but on account of the greatly reduced attenuation, the loaded line is better than the unloaded line for all distances greater than 15 miles. In the author's arrangement, the distance over which transmission could be obtained was nearly trebled by the loading, and the quality was improved in addition. At the transmitting end a person talked in a steady, monotonous manner, and at the receiving end a person could switch instantly from the loaded line to the artificial cable standard, to compare the clearness of transmission over the two. The comparison gave the equivalents of the two circuits for commercial service. The author admits that much further experimental work remains to be done.—*Phil. Mag.*, March; abstracted in Lond. *Elec.* March 13.

MISCELLANEOUS.

REFERENCE.

Biographical.—HAWKINS.—An article on "Nikola Tesla, his work and unfulfilled promises."—*Elec. Age.*, February.

New Books.

DIE KUNSTLICHEN KOHLEN. Fur Elektrotechnische und Elektrochemische zwecke, ihre Herstellung und Prüfung. By Dr. Julius Zellner. Berlin: Julius Springer. 295 pages, 102 illustrations. Price, 9.20 marks.

Hitherto the literature of carbons for technical purposes, aside from isolated papers appearing in technical journals from time to time, has consisted of Pritchard's "The Manufacture of Electric Light Carbons" (London, 1890), and Jehl's "The Manufacture of Carbons for Electric Lighting and Other Purposes" (London, 1899). The volume before the reviewer is, then, the first exhaustive presentation by a German scientist of the results of researches conducted with characteristic German thoroughness and extending over a period of more than seven years. The subject matter of the book may be sub-classified severally as (1) the raw material, as found in the natural state and as artificially produced; (2) the actual construction of the carbons from this raw material, and (3) the testing, preliminarily of the raw material, finally of the finished product.

An important feature of the work is that exact descriptions and details of processes are given. The author, a professor of chemistry, has availed himself of the experience of his colleagues with regard to mechanical and technical aspects of the work, inevitably related to the subject in hand, but lying outside the peculiar province of chemical investigation. The result is that the writer is not compelled to veil his ignorance of allied topics by loose and inaccurate statements. In a word, the book is thoroughly German. The numerous illustrations distinguish themselves for showing at a glance and clearly-cut, the essential features of the devices described in the text.

ELECTRICITY AS APPLIED TO MINING. By A. Lupton, G. D. Aspinall Parr and H. Perkins. New York: D. Van Nostrand Co., 280 pages, 171 illustrations. Price, $3.50.

This is a volume which appeals to the mining engineer, and is a manual that furnishes him with instructions for such electric installations as are particularly designed for various mining processes.

The first two chapters are devoted to such an exposition of electrical theory as will enable the mechanical engineer easily to comprehend the principles involved in the construction of dynamos and motors. The matter is very condensed, but on the whole presented in an exhaustive, clear and readable form, much more so than is common to elementary descriptions of the principles of electrodynamics. Chapters III and IV are occupied with a comparison between water power, steam power and gas engines, rather from the economic than from the mechanical standpoint. There are a number of tests upon plants, showing efficiency and cost of operation, which form a valuable feature.

Chapters V and VI take up the distribution of electrical energy theoretically, in the first place showing the method of designing and calculating circuits in common use, and subsequently from the construction standpoint, describing conduits, cables and line building in general. Chapters IX to XIV, inclusive, about half of the volume, are taken up with the description of the various forms of mining machinery which are driven by electricity, together with the methods of installation and operation. The last two chapters deal with a comparison of electricity with other forms of the transmission of power, and the dangers to be guarded against in the use of electricity in mining. The volume is thoroughly up to date, and the tabular matter bears the appearance of unusual care, while in style the book will address itself to the engineering mind.

BOOKS RECEIVED.

ELEKTRISCHE STRASSENBAHNEN. By Johannas Zacharias. Vienna: A. Hartleben. 240 pages, 128 illustrations. Price, 5 marks.

STEAM POWER PLANTS: Their Construction and Design. By Henry C. Meyer, Jr., M. E. New York: McGraw Publishing Company. 160 pages, 65 illustrations, 16 plates. Price, $2.00.

DIE HERSTELLUNG VON METALLGEGENSTANDEN UND DIE ELEKTROGRAVURE. By Dr. W. Pfanhauser. Halle: Wilhelm Knapp. Price, 7 marks.

EINRICHTUNGEN VON ELEKTROLYTISCHEN LABORATORIEN. By H. Nissenson. Halle: Wilhelm Knapp. 51 pages, 32 illustrations. Price, 2.40 marks.

KALENDER FUR ELEKTROCHEMIKER. Sowie Technische Chemiker und Physiker, 1903. By D. A. Neuberger. 583 pages. Beilage zum Kalender fur Elektrochemiker sowie technische Chemiker und Physiker. 448 pages. Berlin: M. Krayn. Price, 4 marks.

STORAGE BATTERY ENGINEERING. A Practical Treatise for Engineers. By Lamar Lyndon, B. E., M. E. New York: McGraw Publishing Company. 382 pages, 178 illustrations and 4 plates. Price, $3.00.

INFORTUNI SUL LAVORI. Mezzi Tecnici per Prevenirli. Manuali Hoepli. By E. Magrini. Milan: Ulrico Hoepli. 215 pages, 258 illustrations. Price, 3 lire.

CONDUCTORS FOR ELECTRICAL DISTRIBUTIONS. Their Materials and Manufacture. By F. A. C. Perrine, A. M., D. C. New York: D. Van Nostrand Company. 287 pages, illustrated, with 5 charts in cover pocket. Price, $3.50.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

AMERICAN ORDER OF STEAM ENGINEERS. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Wm. J. Davis, Ithaca, N. Y.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ENGINE BUILDERS' ASSOCIATION. F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION Secretary, E. M. Coleman, Louisville, Ky.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Iowa.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ASSOCIATION OF MANUFACTURERS. Secretary, Marshall Cushing, 170 Broadway, New York. Annual convention, New Orleans, La., April 14, 15 and 16, 1903.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

New York Electrical Society, Secretary G. H. Guy, 104 Liberty Street, New York.

Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

McElroy System of Railway Car Lighting.

At the meeting last month of the Boston branch of the A. I. E. E., Mr. James F. McElroy described his system of train car lighting as developed by the Consolidated Car-Heating Company, of Albany. This system of lighting cars may be called a modified constant-potential system, and employs an axle-driven dynamo which is capable of operation by motion in either direction. Fig. 1 presents a view of the dynamo. The dynamo rests, at one end, upon bearings on the car axle, whilst it is supported by easy-riding springs under the dynamo body, the springs resting upon curved supporting bars attached at one end over the car axle bearings, at the other end swinging from pendulum supports to a cross-bar which rests upon the truck frame. The dynamo is, therefore, free to move with the car axle. The curved bar supports facilitate the removal of the axle and wheels, when that is necessary, by dropping down out of the truck frame in the usual manner. They also make it easy to open the dynamo as shown in Fig. 2 without, in any way, releasing the dynamo from its supports. The dynamo is driven by means of gear and pinion in a manner somewhat similar to that employed on motors of trolley cars. A wrought-iron gear case incloses the gear and pinion and is made dust-proof with leather packing.

All doors admitting to parts of the dynamo requiring inspection as well as the doors for supplying oil and waste to the axle bearings close upon leather or felt packing and are held firmly to place by strong spring latches of flat steel. All doors are in this way made dust-proof. The compartment containing the reversing switch is shown at the left and in advance of the armature bearing. This switch is operated by the armature shaft and reverses the connections of the armature to the mains. A door easily accessible admits to this chamber for purposes of inspection.

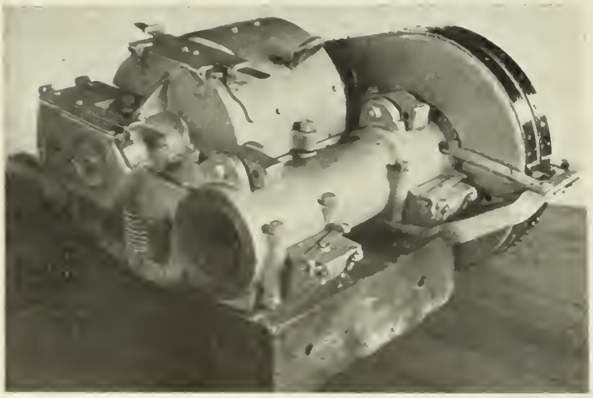


FIG. 1.—VIEW OF DYNAMO (CLOSED.)

A storage battery is employed for supplying the lamps during stops. The battery receives its charge at all times when the dynamo is in operation and the battery is below the point of full charge. The flow of current to the storage battery and the generation of current by the dynamo are regulated, through the widest variations of speed, by means of the regulator shown in Fig. 3. In this regulator a motor, through worm and gear connections, operates a rheostat which is connected in series with the dynamo fields. The motor is controlled by a compound solenoid and plunger, the plunger being connected with an arm carrying carbon contacts by which the current is directed through the motor for changing its direction of motion.

To insure the workings of the regulator under all conditions, it is necessary that the motor should be wound for large torque and low speed and be capable of operating at a voltage as low as the lowest voltage ever carried upon a battery. It is also necessary that the changes in position of the rheostat should be made at a rate not greater than the rate at which the corresponding changes will take place in the field magnets of the dynamo, otherwise the phenomenon of racing will cause a disturbance in the lights. To prevent racing a centrifugal governor is used, by means of which the circuit through the motor is completed between two stationary rings which surround the motor shaft. Contact is made between these two rings by means of weighted arms which, on the starting of the motor, immediately throw out and break the circuit. The result is that the governor gives to the motor a fixed rate of motion and this rate of motion is not increased or decreased within the limits of voltage at which the motor operates. The centrifugal governor is mounted above the motor and within the perforated hood at the top of the regulator.

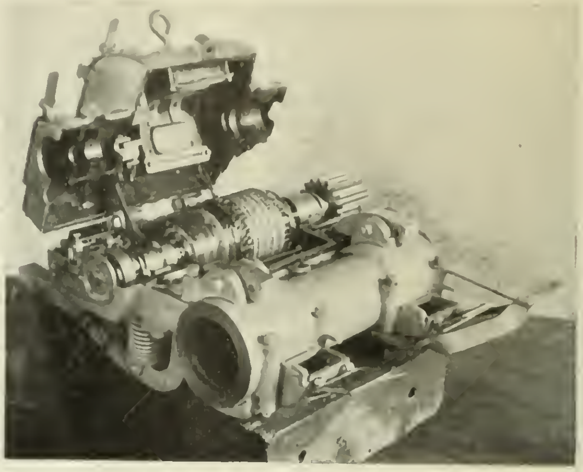


FIG. 2.—VIEW OF DYNAMO (OPEN.)

In the construction of this regulator the compound solenoid is placed inside an iron envelope which receives its support from the metal framework to which all of the working parts of the regulator are attached. The iron envelope increases the pull of the solenoid more than double by furnishing a magnetic covering through which the magnetic flux is conducted back outside of the coil. At the ends the iron envelope is kept back from the plunger a distance of nearly three-eighths of an inch to prevent the envelope from creating a side pull upon the iron plunger. Longitudinal ribs are cast on the iron casing for the purpose of furnishing a path in the direction of the magnetic flux and at the same time for increasing the surface of the iron casing to permit of the ready escape of heat that may be generated in the solenoid. The enlarged pull upon the plunger, due to the improved path for the magnetic flux and the fact that the regulation is effected both by means of change of voltage and change of current to the battery, renders the apparatus very sensitive and positive in its action.

The switch for disconnecting the dynamo from the storage battery is operated by the motor which drives the rheostat. The return of the rheostat to the home position when the field resistance is all out opens the switch and disconnects the dynamo. In starting the dynamo, when the dynamo voltage equals the lamp voltage, the first motion of the rheostat closes the switch and connects the dynamo and storage battery together. A further rise of voltage causes the lamp resistance to be inserted step by step between the battery and lamps and the battery begins to receive its charge.

The lamp resistance is shown more clearly in diagram of connections in Fig. 4. The sections of this resistance are inserted as the voltage of the dynamo rises, causing motion of the rheostat arm from its home position. The proper fall in voltage from that required for the storage battery to the lamp voltage is thus secured. The lamp voltage is that which the storage battery is capable of maintaining when the dynamo is not in operation. As the lamps are divided into two circuits, each circuit has its own lamp resistance, which is inserted step by step by the rheostat arm.

Vestibule lamps are provided so as to give an abundance of light upon the steps and in the vestibules of a car when the train comes to a standstill. These lamps are preferably connected across the cut-out switch separating the dynamo from the storage battery. The current for the vestibule lamps, therefore, flows from the storage battery through the dynamo and lamps in series. These lamps are lighted solely by the difference of the e.m.f. of the dynamo and storage battery. They are, therefore, lighted automatically when the speed of the train drops below twelve miles per hour and come to full intensity at very slow speeds and during stops. As these lamps do not draw upon the lighting apparatus during long runs, they can be made of ample intensity to furnish an abundance of light over the steps of a car at the time when the steps are in use, and at the same time do not draw upon the lighting apparatus at times when the lights in the vestibules are not needed.

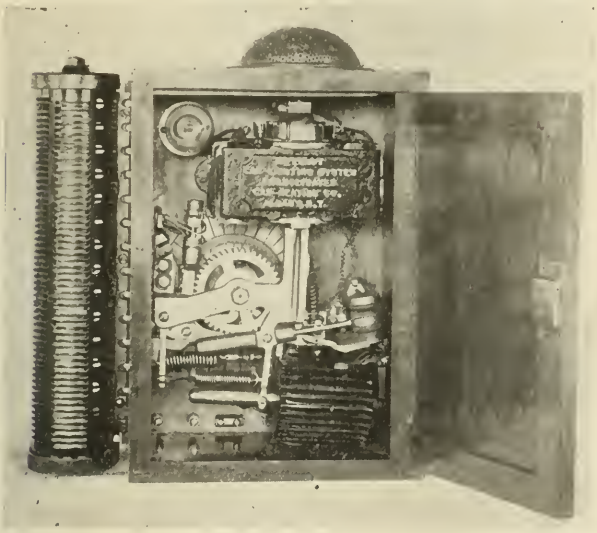


FIG. 3.—VIEW OF REGULATOR.

The motor of this regulator performs a series of operations in a prearranged order. In the act of stopping a train the rheostat moves to its home position and cuts out the resistance in series with the field coils of the dynamo. As it approaches the home position it cuts out the lamp resistance and automatically changes the tension of the regulator spring to change the adjustment of the regulator from the voltage of the dynamo when charging the battery to the voltage of the lamps. When the dynamo voltage reaches the lamp voltage, the motor opens the switch between the motor and storage battery. A further movement of the motor opens up its own circuit so that when the car is at a standstill there is no circuit through any part of the regulator or dynamo through which the current of the storage battery is wasted. However, all parts of the regulator are then in proper position so that when the dynamo current picks up and excites the solenoid, the effect upon the plunger is to first re-establish the circuit through the motor which is done at the carbon contacts; second, it closes the circuit between the dynamo and storage battery and then third, a further rise of voltage of the dynamo causes the regulator to insert resistance in series with the lamps and in series with the field coils of the dynamo.

In this regulator no motion of any of its parts takes place except when necessary to meet some change in the condition of the lighting system. When the train is running at a constant speed, the regulator is motionless. When speed increases a slight motion takes place just sufficient to introduce the proper resistance in series with the dynamo fields to maintain the voltage constant. In this way there is the smallest wear of moving parts and the least possible care is required to keep the mechanism in order.

As has been stated above, the regulator is controlled by a compound solenoid. By reference to Fig. 4 it will be seen that the compound solenoid is made up of two coils, one a large shunt-wound coil connected between the dynamo mains, and the other a small series coil which is connected between the main and the storage battery. These two coils act in conjunction when the dynamo is supplying current to the storage battery, and are opposed to each other when the storage battery is giving out current. The compound solenoid draws the plunger against the tension of a spring. A motion of the motor always takes place when the pull of either the solenoid or the spring predominates and causes the carbon contacts to close the circuit through the motor. The total of the effects of the two coils upon the plunger is equivalent to the tension upon the resisting spring.

It is evident that when the storage battery is nearly depleted, the rush of the charging current into the battery through the series coil will cause the series coil to increase its pull upon the plunger and hence reduce the voltage at the terminals of the shunt coil. In this way the excessive flow of current into the depleted battery is prevented. However, as the charging operation proceeds and the counter e.m.f. of the battery increases, the decreased flow through the series coil to the battery will decrease the magnetic effects of the series coil and the voltage at the terminals of the shunt coil will correspondingly increase. As the counter e.m.f. of the battery continues to increase, the decrease in the flow to the battery will slowly but gradually cause a rise in the voltage on the mains. When the battery begins to gas and the voltage of the battery rises abruptly the shunt coil will assume almost the entire control over the regulator and the current through the series coil to the battery will reduce to not over 5 to 10 per cent. of the original charging rate, this being deemed just sufficient to cause the battery to slowly gas and replace battery losses or leakages. In this condition the apparatus may be used on a car having a daylight run and with practically no load upon the dynamo after the battery has become fully charged. It is also used, without readjustment, upon cars operated wholly at night with all lights in use. With this simple device the charging of the storage battery is made automatic and by proportioning the number of ampere-turns of the series and the shunt coil, the charging rate may be made to follow any formula that the battery maker may prescribe. It will also be seen that with this method of regulation we avoid the dangers of both the shunt and the series methods of regulating the charge to the storage battery.

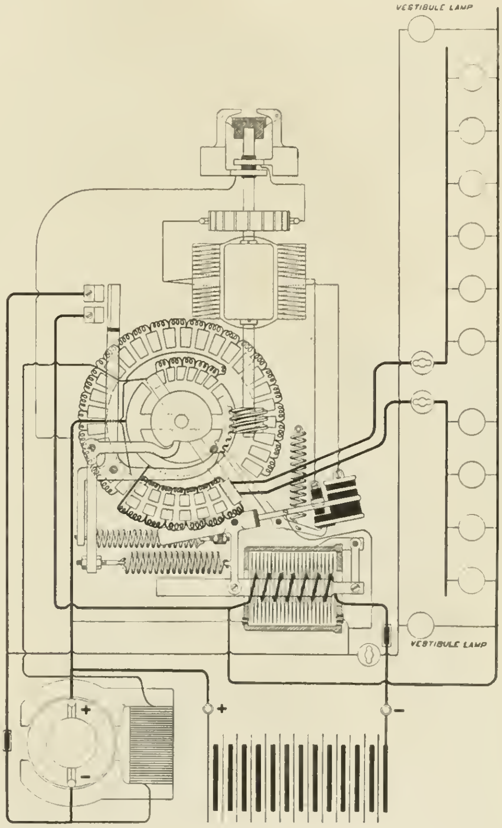


FIG. 4.—DIAGRAM OF WIRING WITH REGULATOR.

Cooley Cycloidal Engine.

If the path of a point is developed by simultaneous circular motions about parallel non-coincident axes, this path may have any one of the shapes that lie between the circle and the straight line. By the application of this principle to steam engines and machine tools, the Cooley Cycloidal Engine Company, of Boston, Mass., is producing some notable results. In a small machine built to illustrate the principle in question, a revolving table with a circular sheet of paper attached is located beneath a revolving spindle with three markers. The axes of the revolving table and the spindle are parallel and may be made coincident or not as desired. By means of this little machine the circle, the square, the triangle, the straight line, and an infinite number of intermediate shapes are described on the paper held by the revolving table.

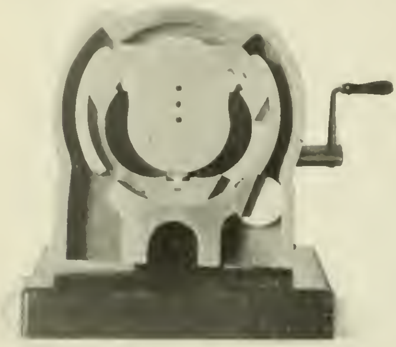


FIG. 1.—SECTION OF ENGINE.

In the application of this principle to a lathe, both the work and the cutter revolve about parallel, but non-coincident axes. Two simple circular motions thus combined make it possible to turn a bar of square, triangular or polygonal shape, and to have corresponding holes. A desirable application of the ability to turn and bore square might be found in the case of armature shafts, spiders and couplings where a square fit would be much superior to a round fit with a key.

As applied in the design of a steam engine, the foregoing principle results in the production of a prime mover with simple rotating parts, a practically unlimited range of speed, and great power in terms of bulk and weight. In general outline, this type of engine is a cylinder that tapers to a bearing at each end for the central working shaft. In speed these engines are said to be only limited by the strength of their parts, and they may be operated at any rate of revolution between that of the fastest steam turbine and that of a slow reciprocating engine. The engine is entirely destitute of reciprocating parts. As to allowable steam pressure, it is said that these engines are subject to only such limitations as apply to the ordinary types. While the Cooley engine is workable through a range of speed which includes those of all other types, the power of any particular size varies directly with its rate of revolution and approximately as the steam pressure employed.

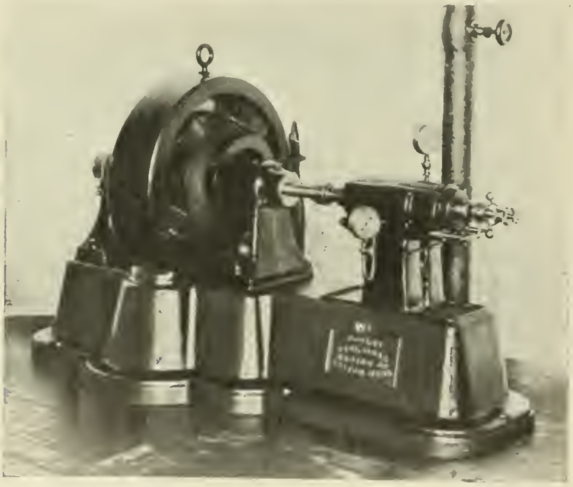


FIG. 2.—10-HP ENGINE AND 6-KW DYNAMO.

Illustrating the small bulk and weight of these engines per unit of capacity, it may be said that the size rated at 10 hp with 200 pounds of steam pressure when operating at 2,000 r.p.m., has a weight of 70 pounds and measures approximately 6 in. in diameter by 14 in. long. If the speed of this machine is reduced to 1,000 r.p.m., it yields 5 hp with 200 pounds steam pressure. Compared with that of a dynamo having equal capacity, the bulk of one of these engines is very small, as may be noted in the case of a four-pole, 6-kw, 950-r.p.m. dynamo, direct-connected to an engine in the testing room of the Cooley Compnay. The speed of these engines is regulated by either automatic or throttling governor, as desired, and in order to operate the same engine at widely different speeds, it is only necessary to change the governor. A striking feature of the engine is the ease with which it can be reversed in its direction of rotation by the simple turn of a lever when operating at very high speeds.

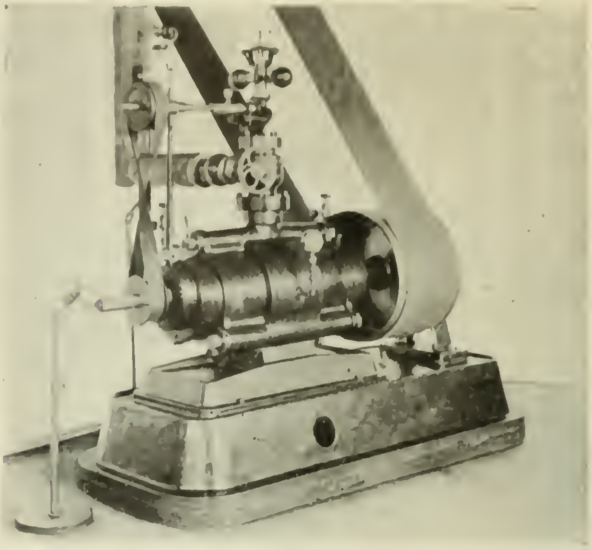


FIG. 3.—70-HP ENGINE.

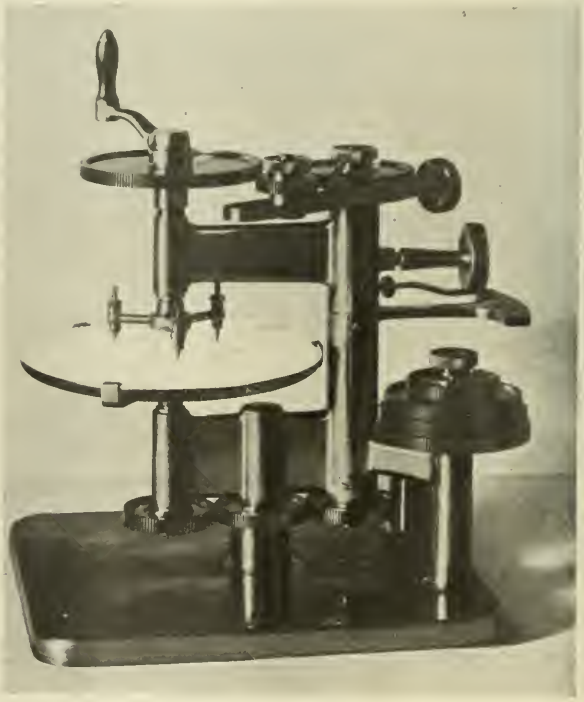


FIG. 4.—MACHINE TO ILLUSTRATE PRINCIPLE OF COOLEY INVENTIONS.

For the highly important matter of efficiency tests on its engines the Cooley Company has made unusually elaborate and complete provisions in its shops at Allston, a suburb of Boston. These facilities are placed at the disposal of those who may wish to test the engines with a view to their use. In the testing room are several iron plates on which engines can be operated, three dynamos ranging from 6 to 70-kw capacity, a large bank of lamps with a convenient arrangement of switches, and an equipment of volt and ampere meters. Beneath the testing room and in other parts of the basement there are a steam boiler devoted to testing purposes, a Worthington condenser, with pump, and the necessary piping to deliver the engine exhaust to a pair of tanks mounted on large Fairbanks scales. The completeness of all this equipment for the execution of economy tests on engines is seldom equalled outside of technical schools. An interesting piece of apparatus for exhibition purposes comprises a 10-hp engine mounted to drive a propeller wheel in a large tank of water with a glass side. Prof. Edw. F. Miller, of the Massachusetts Institute of Technology, has made a number of tests of engines for the Cooley Company at its shops. In one of these tests, lasting from 5.06 to 6.36 P. M., on March 4, 1903, a nominal 10-hp engine direct-connected to a 6-kw dynamo was concerned. According to the report of this test, the boiler pressure varied between 162 and 174 pounds, and the vacuum in the condenser varied from 12 to 23.8 pounds per square inch.

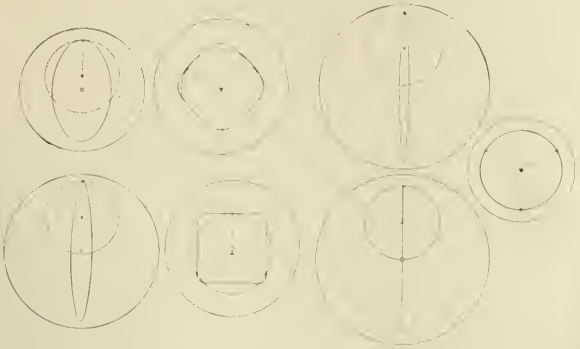


FIG. 5.—FIGURES TRACED BY ILLUSTRATING MACHINE.

The average brake horse-power delivered by the engine to the dynamo during the test was 10.5, and the steam consumed by the engine per horse-power-hour was 42.8 pounds. In another test, extending from 4.42 to 5.42 P. M., on February 28, 1903, an engine rated at 70 hp, with 200 pounds steam pressure, was operated on a partial load consisting of shafting and a dynamo supplying lamps. During this test the boiler pressure ranged between 86 and 145 pounds and the vacuum in the condenser connected with the engine was as low as 14 and as high as 20 pounds per square inch. The average rate of work delivered by the engine during the hour of operation was 19.6 hp and the weight of steam consumed per horse-power-hour was 33.4 pounds. It is fair to presume that this 70-hp engine would show better economy at nearly full load. Both of the foregoing tests were made on simple engines without jackets, and there is no doubt that insulating jackets and compounding would lower the rate of steam consumption.

The Cooley Company is building an engine of 150 hp for the Massachusetts Institute of Technology, and has also under way an engine for locomotive use that will yield 600 hp when used simple and a much greater capacity when compounded. A few engines are built by the Cooley Company for purposes of exhibition and testing, but the main business of the company is the sale of rights to apply its inventions to engines, machine tools, and for other purposes. In the shops of the company are a number of machine tools fitted with its devices for turning and boring special shapes, and these tools, together with the complete plant for engine testing, are open to any one who wishes to investigate the merits of the apparatus.

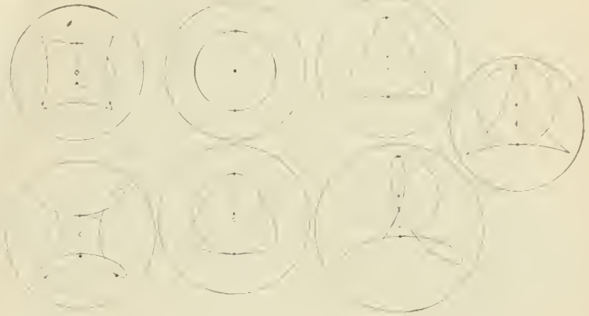


FIG. 6.—FIGURES TRACED BY ILLUSTRATING MACHINE.

The matter here presented has been obtained through the courtesy of Mr. John F. Cooley, manager of the company. The characteristics of the above prime mover are such that dynamo builders and users will watch its future development with no little interest.

Railway Brake Air Compressors.

The accompanying illustrations refer to the General Electric system of railway car air braking. The compressor consists of two main parts—the motor end and the compressor end. The motor is similar in design to the General Electric box frame type of railway motors. The unsplit magnet frame has frame heads at each end which support the armature shaft bearings. At the compressor end, horizontal single-acting tandem cylinders are cast as a part of the frame head. The armature shaft bearing at this end is specially large in diameter, and the crank pin formed at the end of the shaft is located just inside the bearing diameter. By removing the four bolts which fasten the combined frame head and cylinders to the magnet frame, and taking off the retaining washer at the end of the crank pin, the compressor can be separated from the motor. On the removal of the compressor the armature can be taken from the magnet frame.

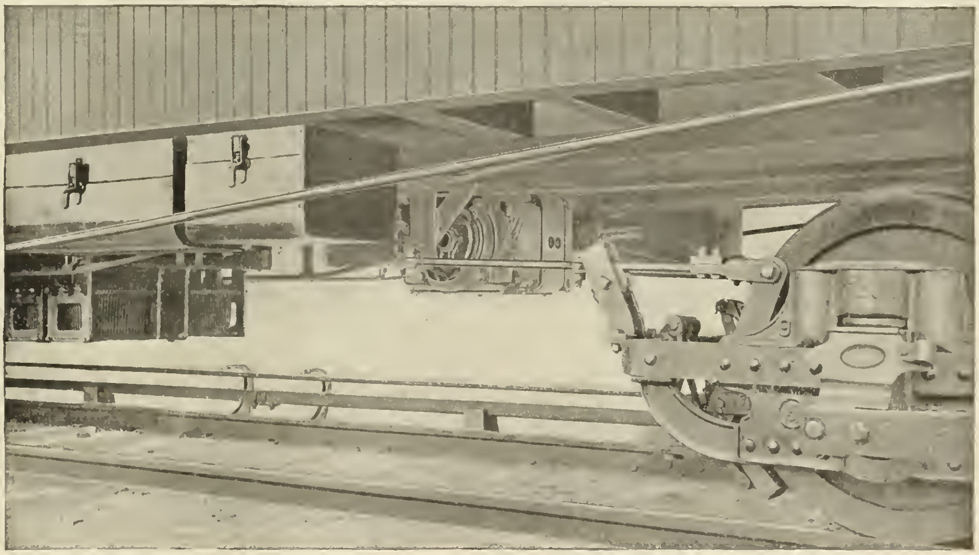


Fig. 1.—Air Compressor Mounted on a Car.

Working in the tandem cylinders is a single double-ended piston actuated by a single connecting rod, which connects the crank pin to a wrist pin located at one end just back of the piston head. By removing one of the cylinder heads, the piston can be drawn out.

The magnet frame is cast steel, unsplit, and cubical in shape with well rounded corners and inwardly projecting poles. There are a number of openings fitted with malleable iron covers which permit of easy inspection and access to the commutator and brush holders With covers on, the motor is completely enclosed Under service conditions which will permit of it, the covers can be left off for ventilation if desired.

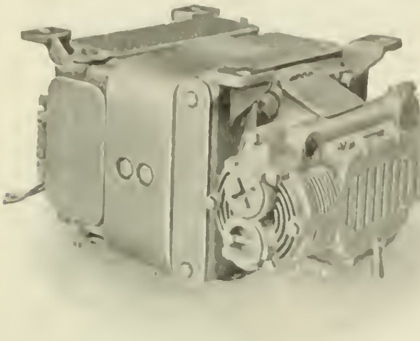


FIG. 2.—AIR COMPRESSOR—COMPRESSOR END.

There are large openings in the ends of the frame through which the armature can be easily put in place. The openings are filled with the frame heads which support the armature crank shaft bearings. As stated above, lugs or feet for supporting the outfit are cast on the frame.

The frame heads project well within the armature, this construction permitting long and liberal bearings, without sacrificing the compactness of the compressor. At the commutator end of the motor, the frame head is accurately bored to receive a sleeve bearing lining. A large well, fitted with a spring-hinged cover, is cored in the head to receive oil to lubricate the bearing.

The frame head at the compressor end is cast in a single piece with the compressor cylinders. The head carries a large lining for the shaft bearing and has provisions for lubrication similar to that on the commutator end.

The two compressor cylinders are cast in a single piece with the compressor end frame head which carries the shaft bearing and oil well. The exterior of the cylinders is well ribbed to radiate the heat generated during compression, and the interior surfaces are accurately bored in alignment. The extension of the casting between the cylinders forms an enclosed chamber hollowed at the bottom to receive a quantity of oil for the lubrication of the cylinders and the connecting rod bearings. The parts may be inspected through an opening in the front which is provided with a hinged cover.

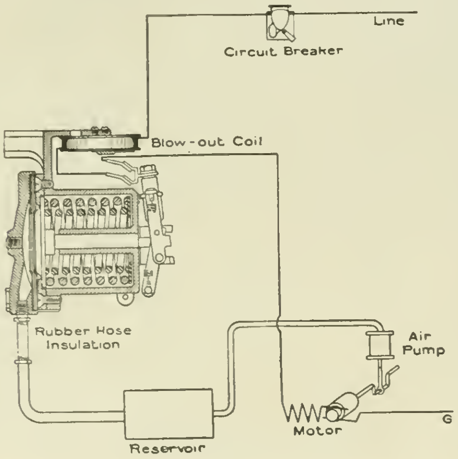


FIG. 3.—CONNECTIONS OF AIR COMPRESSOR GOVERNOR.

Each cylinder head contains two bored chambers which contain the valves. A large plug screwed against a copper gasket closes each chamber and allows easy removal of the valves. Liberal passages are cored in the casting around the outlet valve, connection being made with an air passage between the cylinders.

The trunk piston consists of a single casting with a head at each end, and hollowed in the central portion, leaving strong ribbed sections. Within the space between the heads, the connecting rod and crank pin play, forming a very compact construction. The wrist pin on which the connecting rod pivots is located just back of one of the piston heads. The pistons are accurately turned and grooved for cast iron packing rings with lapped joints. This design insures accurate machining and perfect alignment.

The valves are composed of small, light disks, playing noiselessly, with small clearances and minimum leakage. They operate on accurately machined seats within a steel casing. There are no springs or complicated parts to deteriorate under the high temperature of compression. The inlet and outlet valves are the same in general design, the seats being merely reversed in position.

Aside from the contact between the pistons and the cylinders, there are but four bearings—two armature shaft bearings and two connecting rod bearings. The shaft bearings consist of brass sleeve linings, cut away on the sides to allow oily waste in the oil wells to press directly against the shaft. The slow speed of the armature and the liberal dimensions of the parts insure a long life for the bearings. Oil deflectors on the shaft prevent oil from getting into the interior of the motor. The overflow is caught in channels leading to suitable drip cups cored in the castings beneath the bearings.

An effective method of lubricating the cylinders and connecting rod bearings is furnished by a finger, fastened to the end of the crank pin, which in rotating through the oil at the bottom of the compressor chamber distributes it over the bearing surfaces.

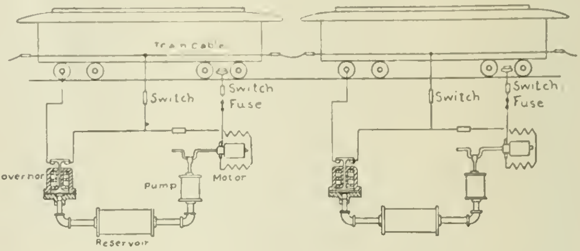


FIG. 4.—CONNECTIONS OF AIR COMPRESSORS ON TRAIN OF CARS.

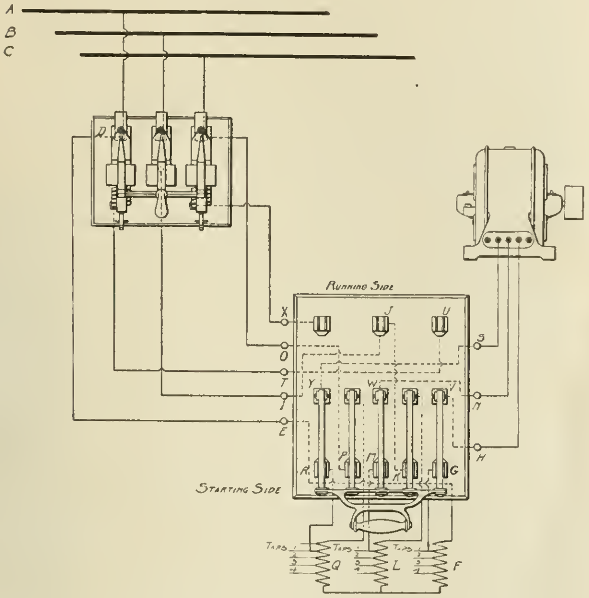
Fig. 2 is a view of a compressor from the compressor end and Fig. 1 shows a compressor mounted on a car. Fig. 3 shows the connections of an air compressor governor and Fig. 4 the car and train connections.

The Protection of Polyphase Motors.

A new type of I-T-E circuit breaker has been designed by the Cutter Company for use in connection with polyphase motors. Polyphase motors are, for the most part, so admirably built, and their ability to withstand heavy overloads is so well known, as to very frequently lead to their being carelessly started and otherwise unduly abused. While this may not result in immediate injury to the motor, it causes excessive disturbance in the voltage of the circuit, undue waste of energy, and may result, sooner or later, in serious injury to the machinery operated by the motor—always an item of much greater cost than that of the motor itself.

The heavy starting current required by many types of polyphase motors has heretofore constituted a serious objection to the use of "Overload" circuit breakers for their protection. This difficulty is overcome by making the connections as shown in the accompanying diagram between the auto-converter and the circuit breaker, so that the latter will be included in the circuit of the motor only when the switch of the auto-converter is in the running position. When the circuit-breaker is connected in this manner, it will not be acted upon by the currents which pass while the switch is in the starting position; but should the switch be thrown into the running position at once, or before the motor has come up to speed, the circuit breaker will open upon the resulting overload, as it also will in case the motor is unduly loaded.

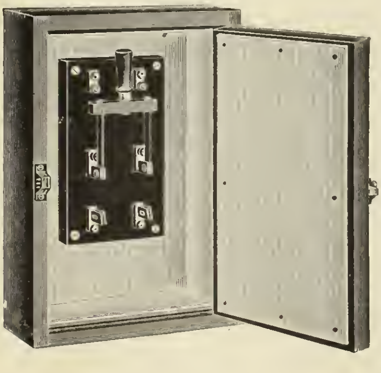
Another source of danger to polyphase motors is the accidental severance of but one phase of the circuit, due, in most cases, to the blowing of an irresponsible fuse, either at the motor or somewhere in the circuit supplying it. Where this occurs when the motor is running, the latter will, unless very lightly loaded, come to a standstill, and if not promptly disconnected is liable to injury. With this point in mind, the insuffiency of fuse protection for polyphase motors at once becomes obvious, and the necessity is plainly seen for a device which insures the opening of all phases simultaneously when the circuit of any one phase is interrupted.



CONNECTIONS OF CIRCUIT-BREAKER FOR POLYPHASE MOTORS.

Cabinet Work for Electrical Purposes.

E. J. Noblett & Co., of Chicago, are catering to the electrical trade in the matter of cable terminal boxes, service switch boxes, cross arms, pins and brackets; in fact, all kinds of high-grade woodwork. This concern makes nothing but the box part of the cable and service boxes, the contents of the box being left to the choice of the user. It furnishes the highest grade of work on these classes of boxes. It already numbers among its customers some of the largest electric lighting and telephone companies. Its boxes for containing electric light service switches and fuses are asbestos-lined, made according to underwriters' specifications and approved by them. Cable terminal boxes are made of 1⅛-in. finished lumber, all joints tongued, grooved and white-leaded. They are painted with two coats of asbestos paint inside and two coats of white lead outside.

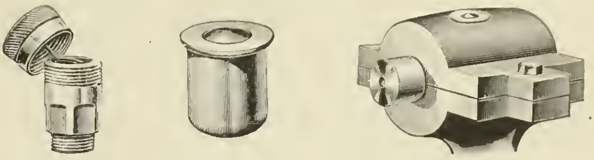


SERVICE SWITCH BOX.

As power transmission at high voltage has recently become an important part of electrical industry, this company is now prepared to turn out pins for high-voltage insulators of as great length as any electrical engineer will care to specify, automatic machinery having been introduced to produce pins up to 30 in. in length. Many of the larger central station and transmission companies will no doubt be glad to know of a wood-working establishment which makes a specialty of this class of work and sells direct to the consuming companies.

Oil Cups and Oil Hole Covers.

The accompanying illustrations represent the Bennett toggled-top oil cup and the Bennett self-closing oil-hole cover, which are manufactured by the Bay State Stamping Company, Worcester, Mass. The oil cup cover, when unscrewed, lies at one side, as shown, thus giving plenty of room for the insertion of the spout of the oil can. The cover, therefore, cannot be lost, and when it is screwed home the cup is rendered oil-tight. This cup is also made without thread and packing in the cover for use on common bearings where an oil-tight cup is not necessary.



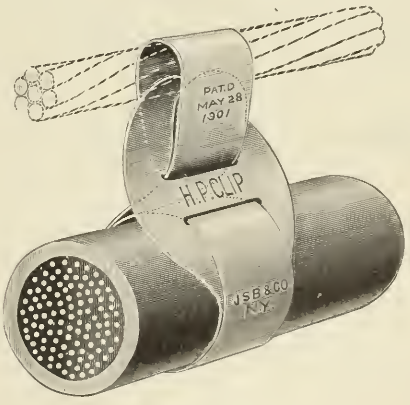
FIGS. 1, 2 AND 3.—OIL CUP AND OIL HOLE COVERS.

The self-closing oil-hole cover can be applied by drilling the oil hole a proper size and forcing the oiler in. The oil is inserted by pressing the oil can spout upon a valve which closes by a spring when the can is removed. The cover projects a trifle above the surface, thus rendering it convenient to keep clean. It is made in three pieces, a case valve and spring, the valve being made with projecting arms to guide it centrally and allow the oil to pass. The advatages claimed for this cover are economy in cost and application, convenience and neatness in using, while by reason of its simplicity of construction there is nothing to get out of order.

Fig. 1 shows the oil cup; Fig. 2, the oil hole cover, and Fig. 3 a cover in place on a bearing.

A New Cable Clip.

The "H-P" cable clip, which is now being manufactured by Messrs. James S. Barron & Co., of 200-206 West Broadway, New York, is made of one piece of zinc and is, therefore, rustless and has no parts to become detached and lost. It is a simple device and easily put on. To apply the hanger, the circular enlargement is held against the cable with the left hand while the free end is wound around and passed through the slot. It is then wound around again, put through the upper slot and carried over the suspension wire, after which it is bent and hooked into the upper slot.



CABLE CLIP.

The cut shows the hanger gripping the cable. These hangers are made in all lengths from 10½ in. up, the widths being the same in all lengths.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET. Time money was offered with comparative freedom and there was a fair demand. The closing rates were 5¼ @5½% for 30 to 60 days; 5@5½ for three, four, five and six months. The stock market was irregular and showed a somewhat firmer tone than was indicated in the report of the previous week. Little or no public buying was, however, aroused by the tendency of the prices to improve in the early part of the week. A severe drive was made at Western Union on Wednesday, based on allegations that effective competition from the wireless telegraph organization may be expected in a short time. The industrials were on the whole relatively steady. The United States Steel shares were rather neglected, and the very favorable accounts about current earnings had liltle effect on account of the indisposition which is shown to trade in the securities on an active scale. Brooklyn Rapid Transit was rather steady early in the week and developed decided strength on Friday. Indeed, this was the only stock in the traction and electrical lists that showed a gain at the end of the week. It dropped to 64½, but rallied and closed at 67½, this being a net gain of 2¼ points. Metropolitan Street Railway showed considerable weakness and closed at very near the lowest point of the week, the last quotation being 133⅜. At no time did it go beyond 136⅜. The closing figure represents a loss of 1⅜ points. In the electric list both General Electric and Westinghouse showed marked declines, the former losing 4¼ points and the latter 11 points. General Electric closed at 186, being 2 points above the lowest figure of the week and 3½ under the highest. Westinghouse closed at the lowest point—196. As the result of the attacks upon Western Union that stock reached the low level of 84, but at the close had gained 1 point, representing a net loss of 2⅜. American Telegraph & Telephone closed at the lowest figure of the week—81¼, being a loss of ¾ of a point. In Boston values were lower and the market conditions somewhat unsettled. Copper shares showed weakness in sympathy with like conditions in New York, although it did not cause a great deal of liquidation. Following are the closing quotations at New York, of April 7.

NEW YORK.

	Mar. 31.	Apr. 7		Mar. 31.	Apr. 7
American Tel. & Cable	81	81¼	General Electric	188	185
American Tel. & Tel	†159	155	Hudson River Tel	..	..
American Dist. Tel	32	..	Metropolitan St. Ry	135¾	133⅛
Brooklyn Rapid Transit	66	67¾	N. E. Elec. Veh. Trns	⅛	..
Commercial Cable	..	..	N. Y. & N. J. Tel	165	
Electric Boat	23	23	N. Y. E. V. T. Co	8¾	..
Electric Boat pfd	37	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1½	1½	Western Union Tel	87⅜	85½
Electric Vehicle	8⅝	12¼	Westinghouse com	198	194½
Electric Vehicle pfd	13	16	Westinghouse pfd	198	194

BOSTON.

	Mar. 31.	Apr. 7		Mar. 31.	Apr. 7
American Tel. & Tel	158½	154	Western Tel. & Tel. pfd	97½	97*
Cumberland Telephone	..	..	Mexican Telephone	2⅛	2
Edison Elec. Illum	..	265	New England Telephone	139*	135
General Electric	189½	186	Westinghouse	100	98
Western Tel. & Tel	21	20	Westinghouse pfd	100	98

PHILADELPHIA.

	Mar. 31.	Apr 7		Mar. 31.	Apr 7
American Railways	50¼	..	Phila. Traction	97	97¼
Elec. Storage Battery	77†	77*	Phila. Electric	6¾	7
Elec. Storage Battery pfd	.	77*	Pa. Electric Vehicle	..	..
Elec. Co. of America	9	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Mar. 31.	Apr. 7‡		Mar. 31.	Apr. 7‡
Central Union Tel	..	..	National Carbon pfd	98½	..
Chicago Edison	..	.	Northwest Elev. com	..	..
Chicago City Ry	212	..	Union Traction	9	..
Chicago Tel. Co	..	..	Union Traction pfd	..	..
National Carbon	24⅝	..			

*Asked. †Ex Dividend. ‡Election.

NEW YORK TRANSPORTATION.—At the annual meeting of the New York Transportation Co. the following directors were elected: Henry Sanderson, G. H. Day, G. Herbert Condict, G. W. Wesley, W. H. Palmer, Jr., Harry Payne Whitney, Philip T. Dodge, Wm. K. Ryan, Frank T. Strachan. Messrs. Day and Dodge succeed H. L. Zabriski and James E. Hayes. Some stockholders present showed considerable dissatisfaction because the company issued no financial statement and an effort was made to lay the motion to proceed with the election of directors, on the table, but it was lost upon a stock vote. President Sanderson said that the electric automobile business during the current year showed a substantial growth and the earnings are showing a satisfactory increase, the profits during the winter months being very gratifying. After the annual meeting the minority stockholders met and adopted the following resolutions: "As stockholders of the New York Transportation Co., representing several thousand shares of its stock, we enter our earnest protest against the conduct of the annual meeting of the stockholders and the refusal of the president of the company, Henry Sanderson, to permit the free discussion of motions or to enter reasonable inquiries of the stockholders to permit them to examine the by-laws of the company, or to give them any information in regard to the conduct or conditions. We denounce the manner in which the stockholders were refused a hearing and in which they were overridden by the authority of the chair and by the stifling of debate."

NEW JERSEY LIGHT AND TRACTION DEAL.—Reports from Newark, N. J., are to the effect that negotiations are pending for the formation of a large holding company to take over all the North Jersey trolley companies, together with the New Jersey electric light and gas companies. The Prudential Insurance Company, of Newark, the Equitable Life Assurance Society, of New York, the United Gas and Improvement Company, of Philadelphia, are said to be allied with the Fidelity Trust Company, of Newark, which concern has for some time been negotiating for the control of the trolley lines. If the deal becomes a reality, the merger will include the following companies: North Jersey Street Railway Company, capital, $15,000,000; Jersey City, Hoboken and Paterson Railway Company, capital $20,000,000; Orange and Passaic Valley Street Railway Company, capital $1,000,000; Gas and Electric Company, of Bergen County, authorized capital, $2,000,000; Paterson and Passaic Gas and Electric Company, authorized capital, $5,000,000; Essex and Hudson Gas Company, capital, $6,500,000; Hudson County Gas Company, capital, $10,500,000; Gas Light Company of New Brunswick, capital, $400,000 stock, $500,000 bonds; Central Electric Company, capital, $750,000 bonds, $750,000 stock; Shore Electric Company, capital, $76,000; Consolidated Gas Company of New Jersey, capital, $1,000,000, bonds, $971,000; United Electric Company of New Jersey, Capital, $20,000,000, bonds, $16,239,500. This corporation takes in twenty-one corporations doing business in Essex, Hudson, Bergen, Union and Morris Counties. South Jersey Gas, Electric and Traction Company, capital, $6,000,000, bonds, $6,000,000; Elizabeth, Plainfield and Central New Jersey Railway Company, capital, $3,000,000, bonds, $1,500,000.

MARCONI FINANCES.—The annual meeting of the Marconi Wireless Telegraph Company of America will be held April 20 at 15 Exchange Place, Jersey City. No stock can be voted on which has been transferred within 20 days next preceding this election. The balance sheet as of January 31 is as follows:

Assets:	
Patent rights	$5,286,494
Cost of stations and experimental work	139,939
Stock of apparatus on hand	31,244
Accounts receivable	18,382
Cash at bank and in hand	15,432
Furniture and fixtures	1,204
Treasury stock	700,000
Organization expenses	35,468
Total	$6,228,166
Liabilities:	
Capital stock issued	$6,190,000
Accounts payable	38,166
Total	$6,228,166

About May 1 Mr. Marconi will return to America and an attempt will be made to establish constant and uninterrupted communication between this country and England. On the same date, May 1, the Porto Rican government will open proposals for a wireless service in Porto Rico. The Marconi Company expects that it will secure the contract for this service.

STANLEY ELECTRIC.—The new officers of the Stanley Electric Mfg. Company, of Pittsfield, Mass., elected at the recent meeting of the board of directors are as follows: President, W. Murray Crane, Pittsfield, Mass. 1st vice-president, Dr. F. A. C. Perrine, Pittsfield, Mass. 2nd vice-president, M. D. Barr, New York, N. Y. 3d vice-president, S. N. Hamill, New York, N. Y. Treasurer, W. W. Gamwell, Pittsfield, Mass. asst. treasurer, R. S. Murray, Pittsfield, Mass. secretary, W. S. Westover, New York, N. Y.; asst. secretary, A. G. Davis, New York, N. Y.

CURTIS TURBINE CO.—According to Wall Street authorities, the General Electric Co. will organize a company to take over the Curtis turbine, but there will be no rights for stockholders in connection with the matter. Mr. C. Curtis, the inventor, will probably be given a 4% preferred stock issue of $1,000,000 for his patents, and his services will be retained by the company. All the common stock will be held by the General Electric Co.

WESTERN UNION WEAKNESS is without much apparent explanation, except the doubt whether the business can yield profit enough to cover repairs and reconstruction without calling for new capital. Just now a good deal of the system is being renovated. Wireless competition does not yet cut much figure. The rumor that financial backing has been secured for a new company to erect poles and wires and enter into active competition with Western Union and Postal Telegraph between New York and Chicago is discredited by officials of both the Western Union and Postal Telegraph Companies.

CENTRAL UNION TELEPHONE.—Advices from Chicago state that the directors of the Chicago and the Central Union Telephone Cos. have decided upon the successor to Mr. John I. Sabin, formerly president of both companies and will announce the names in a short time. It is understood that each company has chosen a separate president as it is believed that the companies can be better managed with a distinctive head officer over each. The Central Union stock is very dull, notwithstanding that the capital stock was recently cut in half. At that time it had a market value of $40 per share, and after the reduction there were a few scattering sales at 75 and 80. The stockholders refused to take much of the new treasury stock at par, the American Telephone & Telegraph Co. being the main subscriber. The promises of a 5% dividend were not fulfilled and the question of future financeering of the company is quite problematical. As already announced in these columns Mr. Sabin has returned to the Pacific coast and will give his exclusive attention to the management of the Pacific coast Bell telephone companies in which he has a large personal interest.

Commercial Intelligence.

THE WEEK IN TRADE.—The industries, particularly in iron, steel and lumber, are active all over the country. The Spring crop of strikes is equal to the average, though most of them have appeared a trifle earlier, particularly in the building trades. The activity in lumber is a notable feature just now, the only complaint being that deliveries are not sufficient to meet current demand. Retail trade is expanding, favored by spring-like weather; and jobbers report reorders from retailers increasing while collections show some improvement. Southern trade advices are better. In the central West the demand from jobbers has improved, notably at Chicago and St. Louis. Better rates have helped retailers and collections show some improvement. Pressure of foreign iron at the Eastern seaboard market is the reason assigned for the cut of $1 per ton in Southern foundry grades and for the sympathetic weakening of 50c. per ton for other kinds of pig iron at Eastern markets. A large business is reported at the concessions, however. In finished iron, only favorable reports are noted. Transportation has improved. Coke is in better supply, iron furnaces and mills being better able than ever to supply current demand, and quotations continue firm. The business failures for the week ending April 2, according to the Bradstreet compilation, numbered 145 against 175 the week previous, and 176 in the corresponding week of last year. *Bradstreet's* reports of failures show the smallest number of embarrassments in the first quarter for twenty years past, and the smallest number of liabilities in sixteen years. Export trade continues excellent, particularly in cotton and corn and the fiscal year's total will probably equal the best previously recorded, taking exports as a whole. Gross railway earnings returns to date indicate a gain of 14% for March over the same month last year, and are by that percentage the best ever recorded for that month. The copper market was very quiet and consumers are well supplied for the near future. On the other hand, sellers, it is stated, have very little copper for sale for the present and little for delivery during the next few months. March exports are figured by the Metal Exchange at 12,840 gross tons as compared with 20,012 gross tons during the same period last year. The total exports for the first quarter are 32,254 tons and 49,490 tons, respectively, a decline of 17,236 gross tons.

POWER HOUSE AND RAILWAY EQUIPMENT FOR YOKOHAMA.—The Yokohama Electric Tramway Company, which is to build a six-mile road from Yokohama to Kanagawa, has placed a contract for power house apparatus and railway equipments with the Japanese house of Takata & Co. The contract calls for two Westinghouse 150-kw, 500-550-volt, direct-current engine-type generators with a standard Westinghouse railway switchboard, also 22 Westinghouse double-motors, 25-hp. arranged for electric braking. The equipments are to be arranged for a double-trolley system. The Takata contract also calls for 22 Brill trucks. Takata & Co. are also to furnish two 10-in. Blake automatic relief valves. The International Steam Pump concern will also ship two Knowles feed pumps and receivers to be used in feeding the water condensation from the steam pipes and steam jackets of the engines direct to Babcock & Wilcox boilers. Two 5-in. Cochrane steam separators supplied through F. E. Idell, 26 Cortlandt Street, and two 30 (nominal)-hp patent vertical feed water heaters made by the Wheeler Condenser & Engineering Company, 120 Liberty Street, New York, have also been specified. The car bodies will be built in Japan. The equipment will be shipped during June and July. The Yokohama system will be entirely arranged for double trolley, this method being required by the Japanese officials in the large cities especially, ground return being prohibited.

EQUIPMENT FOR BIG CANAL DOVER (OHIO) LOCOMOTIVE PLANT.—The Standard Motive Power Company, Consolidated Exchange Building, 60 Broadway, has just determined on the letting of an important contract for the construction and equipment of its plant, to be built at Canal Dover, Ohio. The Pittsburg (Pa.) Engineering Company have secured the contract. The plant proposes to manufacture locomotives, transform existing locomotives, construct street and interurban motor cars and build automobiles under the Dodge system. In the completion of the first sections it will mean an estimated expenditure of $1,000,000. Electrical equipment will be utilized very extensively in the building of the locomotives, etc. The Whiting Foundry & Machine Company, of Harvey, Ill., New York offices, Taylor Building, 39-41 Cortlandt Street, will build the electric traveling cranes.

ENGINES FOR YOKOHAMA TRACTION PLANT.—McIntosh, Seymour & Co., Havemeyer Building, 26 Cortlandt Street, have been awarded the contract for the engines to be installed in the power station of the Yokohama Electric Tramway Company. There will be two center-crank, horizontal-tandem compound-condensing piston valve, operating at 200 r.p.m., direct-connected to Westinghouse generators. The rated load of these engines is 230 indicated hp for each machine. The steam pressure will be 125 pounds. The engine contract was secured by the American Trading Company, New York, which purchases considerable electrical equipment, etc., for the Far East.

MEXICAN ELECTRIC RAILWAY PROJECT.—The construction of an electric railway is projected between a point near Cordoba, on the Vera Cruz & Pacific Railroad, and Tierra Blanca, on the same Mexican road. The line will be about 75 miles in length. Andrew Mackenzie, president of the San Rafael & Xico Railway, is interested in the project. He is now in Canada making arrangements for the construction of the system. Power is to be derived from a hydraulic plant on the Rio Blanco. The concession for the water power was recently secured by a company in which F. P. Hoeck, of F. P. Hoeck & Co., 1a San Francisco No. 12, Mexico City, is the head.

EQUIPMENT FOR UNITED STATES FORTIFICATIONS.—The United States Corps of Engineers, at Fort McKinley, Portland, Me., have requisitioned for the installation of three 130-hp Westinghouse cross-compound engines, to be direct-connected to General Electric generators. The equipment will be utilized for general power and lighting purposes. A similar installation will be made at Fort Levett, Portland, Me.

GENERAL ELECTRIC ARC LIGHTING SYSTEM FOR CHINA.—The commission house of Fearon, Daniel & Co., of China, 90-96 Wall Street, has awarded a contract to the General Electric Company for a complete arc lighting system at Shanghai. The contract requisitions for 160 series inclosed arc lamps, two 50-light transformers, the same number of 25-light transformers, four switchboards, etc.

MEXICAN WATER POWER SCHEME.—W. W. Graham, Rafael Gonzalez Platt and Manuel Macotela, all of Mexico City, are after a franchise for the purpose of utilizing the waters of the River Grande in the district of Temascaltepec, State of Mexico, to generate electricity. In the application made to the Mexican authorities it is proposed to use 10,000 litres per second.

NEW PERUVIAN LIGHTING PLANT.—An electric lighting plant is to be constructed at Piedra Leco, Peru. The order for the engine has been taken by J. K. Robinson, of Iquique, acting on behalf of Westinghouse, Church, Kerr & Co. It will be of 460-hp capacity, compound-condensing and of direct-connected type.

GENERAL SUPPLIES FOR JAPAN.—Francis A. Cundill, 90-96 Wall Street, New York, who represents the interests of the British electrical engineering and contracting firm of J. F. Healing & Co., Yokohama, has just secured a substantial contract for general electrical supplies.

TELEPHONE WIRE FOR JAPAN.—The Hazard Manufacturing Company, of 50 Dey Street, New York, has secured a contract for telephone wire for shipment to Japan. The contract came through Francis A. Cundill, 90-96 Wall Street.

ROYAL ELECTRIC CO., of Peoria, Ill., has just received from the Black Hills Electric Light Co., of Deadwood, S. D., a third order for alternating current generators.

GROWTH OF EXPORTS.—The growth in the exportation of manufactures from the United States and their distribution to countries and grand divisions are discussed in much detail in a monograph prepared by the Treasury Bureau of Statistics, for publication in the April Summary of Commerce & Finance. It shows the exportations of manufactures in each year from 1790 to the present time and their distribution country by country, and article by article in each year from 1892 to 1902. The exportation of manufactures has grown from $1,243,547 in 1790 to $17,580,456 in 1850, $102,856,015 in 1880, $151,102,370 in 1890, and $403,641,401 in 1902. In 1790, manufactures formed 6.15% of the total domestic exports; in 1850 13.03%; in 1880, 12.48%; in 1890, 17.87%, and in 1902, 29.77%. This shows that the exports of manufactures are increasing much more rapidly than those of other great classes of the exports. This growth in the exportation of manufactures is especially marked in the period since 1895. In that year, 1895, the total exports of manufactures were $183,595,743, having gained 81 million dollars in the 15 years between 1880 and 1895. In the 8 years from 1895 to 1903 the increase was 220 millions. Thus in the 8 years since 1895, the increase in the exportation of manufactures has been nearly three times as much as in the 15 years immediately prior to 1895. The statements of distribution of the manufactures exported also show some striking and interesting facts. They show, for example, that practically one-half of the manufactures exported from the United States go to Europe, and that the exportation of manufactures to Europe has grown from 76 millions in 1892 to 107 million dollars in 1902. To North America other than the United States, our exports of manufactures have grown from 33 millions in 1892 to 100 millions in 1902.

WESTINGHOUSE FOREIGN CONTRACTS.—The Westinghouse interests have secured within the past few days several fair-sized contracts for engines, both steam and gas, generators and other equipment to be installed in Mexican, South American and Australian plants. Among the Mexican contracts in hand is one for a 300-hp compound engine for direct-connection to an alternating-current generator ordered through G. & O. Braniff, Mexico City, on behalf of the Negociacion Minera Promontorio. The Braniff people have also sent in an order for five small engines for shipment to Salina Cruz in connection with the harbor construction work now being undertaken at that Mexican port by the British contracting firm of S. Pearson & Son, Limited, which is building the National Tehuantepec Railway. The Montezuma Lead Company, another Mexican concern, has ordered two 100-hp Westinghouse compound engines for belting to generators. One generator is already installed and the other will be built by the C. & C. Electric Company, 143 Liberty Street. T. F. Witherbee, superintendent of extensive iron mines at Durango, has ordered a small Westinghouse compound engine to be belted to a generator for lighting purposes. J. K. Robinson, of Iquique, who represents the Westinghouse interests on the west coast of South America, has sent in orders for several small engines to be belted to generators for general power work. The Australian electrical engineering and contracting firm of Noyes Brothers, Sydney and Melbourne, has ordered a 200-hp compound engine to be direct-connected to an alternating-current generator.

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, of Boston, reports that the demand is good for its high-grade water wheel governors. It has recently closed orders for different types with the Cascade Electric Co., of Berlin, for 1 governor; Redlands Elec. Light & Power Co., of California, 1 governor; Brattleboro Gas Light Company, Brattleboro, Vt., 1 governor; Ware Shoals Mfg. Co., Laurens, S. C., 2 governors and 4 hydraulically balanced relief valves; Nasonville Woolen Co., Nasonville, R. I., 1 governor; Athens Elec. Rwy Co., Athens, Ga., 1 governor; Ludlow Mfg. Associates, Ludlow, Mass., 1 governor; Sebasticook Power Co., Sebasticook, Me., 3 governors; Niagara Falls Power Co., Niagara Falls, N. Y., 1 governor; Lynchburg Water Power Co., Lynchburg, Va., 4 governors and 4 electric speed controllers; Public Works Co., Bangor, Me., 2 governors with electric speed controllers; Zanesville Electric Lt. & Pr. Co., Zanesville, O., 2 governors with electric speed controllers; Canadian Elec. Lt. Co., Levis, Que., 1 governor; Victor M. Braschi & Bro., City of Mexico, 1 governor; Sacramento Electric, Gas & Rwy. Co., 1 governor and electric speed controller; Valley Counties Power Co., of California, 2 governors with electric speed controllers. Also some governors ordered through dealers for destinations unknown.

THE MACKAY ENGINEERING COMPANY report that they have closed the contract for a large equipment for Conron Brothers, provision dealers, Fourteenth Street and Tenth Avenue, New York. The outfit includes one 100-kw and one 75-kw Akron generator, each direct-connected to a Reeves vertical compound engine, two 1,000-hp boiler feed pumps, two 200-ton brine pumps and one 600-gallon deep well pump, as well as a number of motors for driving air compressors. They also report a large demand for the National underwriter fire pumps, for which they are eastern agents. The company are just installing two 150-kw Akron generators, direct-connected to a 500-hp cross-compound Williams vertical engine in the Navy Yard, New York.

THE STROMBERG CARLSON TELEPHONE MFG. CO. has recently sold switchboards to the following companies: Rossville Home Tel. Co., Rossville, Ind.; West Va. Western Tel. Co., Parkersburg, W. Va.; Winchester Tel. Co., Winchester, Ind.; S. S. Hooks, Gilmore, Ill.; J. W. Corwin, Dahlgren, Ill.; Newport Tel. Co., Newport, Tenn., E. P. Phillips, Lakenan, Mo.; Zenith City Tel. Co., Duluth, Minn.; O. I. Miller, Woodburn, Oregon. It has also recently sold telephones and material to the Farmers' Telephone Co., at Windsor, Ill., Green Valley Tel. Co., Green Valley, Ill., and the London Mills Tel. Co., London Mills, Ill. The factory is now turning out 1,200 telephones a day.

SOME WESTINGHOUSE GAS ENGINE ORDERS.—The Franklin Electric Company, Franklin, Pa., has placed a contract with Westinghouse, Church, Kerr & Co. for five gas engines, to be operated on natural gas belted to generators of 125-hp each, for lighting work. Two Westinghouse gas engines of similar capacity, and to be operated on natural gas and for lighting use, have also been ordered for the plant of the Indianapolis Water Company, of Indianapolis, Ind. These engines will be direct-connected to 80-kw, 250-volt Westinghouse generators. A switchboard has also been requisitioned.

BIDS INVITED.—The Department of Education of the Borough of Manhattan, New York City, is inviting bids on April 13 for wiring and installing electric light and electric bell fixtures in a new public school building in the Borough of the Bronx; also for installing a central-energy telephone system in the Morris High School in the Borough of the Bronx. Bids are also called for for a telephone system in the new High School of Commerce on 65th Street and Amsterdam Ave., Manhattan. Mr. C. B. J. Snyder is Superintendent of School Buildings.

WORTHINGTON PUMP ABROAD.—A cable dispatch from London of April 6 says: Samuel Untermyer, of New York, will tomorrow incorporate the Worthington Pump Company, Limited, with a capital of $4,500,000, consisting of $2,000,000 in 5 per cent. bonds and $2,500,000 in shares. The company acquires the European business of the Worthington and Blake Companies, in addition to others. Two factories will be erected, one in Germany and the other in Russia. The directorate will be jointly American and English.

EXTENSION OF JAMESTOWN (N. Y.) STREET RAILWAY.—The Jamestown (N. Y.) Street Railway Company is to extend its plant and is now letting contracts for considerable equipment through its president, Mr. W. Brodhead. The Westinghouse interests have secured the contract for the engines and generators. There will be three cross-compound condensing engines of 460-hp capacity each. They will be direct-connected to alternating-current generators of 250-kw each.

BALL ENGINE ORDERS.—The Central Connellsville Coke Co., New Salem, Fayette Co., Pa., is installing an electric plant. The engine will be furnished by the Ball Engine Co., Erie, Pa. The Excelsior Springs Elec. Light Co., which is building a new plant at Excelsior Springs, Mo., has purchased two 135-hp tandem compound engines from the Ball Engine Co. The engines will be direct connected to General Electric generators.

GAS ENGINES FOR GREECE.—Westinghouse, Church, Kerr & Co. have just been allotted an order for gas engines by D. P. Zacharias, of Athens, for installation in an electric lighting plant in the Grecian capital. There will be two Westinghouse gas engines, of 63-hp each, 3-cylinder producer gas type, belted to generators. The engines will be operated under the system of D. R. Wood & Co., of Philadelphia, Pa.

THE STANLEY ELECTRIC MFG. COMPANY has sold to the Indianapolis, Columbus and Southern Railway Company the following apparatus; Forty-eight railway motors, one 500-kw revolving field generator, one 300-kw rotary converter, three 110-kw and three 150-kw transformers, and the necessary switchboard apparatus.

WELLMAN-SEAVER-MORGAN.—News comes from Cleveland of the merger of the Wellman-Seaver-Morgan Engineering Company, of Cleveland, and the Webster-Camp & Lane Company, of Akron, under the name of the Wellman-Seaver-Morgan Company, and with a combined capital of $3,000,000.

WIRE OUTPUT.—An official of the American Steel and Wire Company is quoted as saying that the output of the mills for the quarter ended with March was by far the largest ever known, exceeding the corresponding period last year by fully 20 per cent.

IRON CITY ENG. CO., of Pittsburg, Pa., has been awarded the contract for the entire electrical work to be installed in the Stoneleigh Court, Washington, D. C.

General News.

THE TELEPHONE.

AZUSA, CAL.—Application has been made to the local Board of Trustees by the Home Telephone Company, of Covina, for a telephone franchise in this city.

LOS ANGELES, CAL.—The Long Beach Telegraph & Telephone Company has incorporated, with a capital stock of $50,000, of which amount $10,000 has been subscribed. The directors are Charles L. Zahn, W. M. Eason, J. C. Brainard, W. L. Porterville and Don C. Porter.

RICO, COL.—The Colorado Telephone Company has asked for a franchise in this city.

DERBY, CONN.—Eight girls employed in the Southern New England telephone exchange in this city struck, on March 30, because the management, thinking that seven hours was too long for them to work without having an hour in which to rest, decided to change the working time into two shifts of four hours each, paying them for the extra hour. The girls preferred to work seven hours straight without a rest and when the management insisted on having its way they quit.

ATLANTA, GA.—The Atlanta Telephone and Telegraph Company has been incorporated at Wilmington, Del., to construct telegraph and telephone lines in Atlanta, Ga.; capital, $400,000.

AUGUSTA, ILL.—The Augusta Mutual Telephone Company has organized with George Catlin as president.

STRAWN, ILL.—The Strawn Telephone Company has been incorporated with a capital stock of $1,500 by Reis C. Gullberg, Joseph Duntz and J. W. Kirkham.

PEORIA, ILL.—The Northern Middlebrook Telephone Company, with a capital stock of $600, has been incorporated and will build a line from Laura to Princeville.

GREENFIELD, IND.—The Shady Grove Telephone Company has incorporated to establish an exchange in the Shady Grove School house and extend lines throughout Hancock County. Jasper M. Burch, J. F. Stultz, W. H. Foster and W. W. Piles are directors.

NEW RICHMOND, IND.—The New Richmond Co-operative Telephone Company has incorporated to build an exchange in New Richmond and lines in Montgomery and Tippecanoe counties. The capital stock is $12,000. M. L. Claypool, O. W. Mason, Edgar Waltz and Wm. Graves are directors.

CRAWFORDSVILLE, IND.—The Crawfordsville Co-operative Telephone Company has decided to make an effort to get a complete trunk line system in Montgomery County. To this end a committee was appointed to confer with the co-operative companies elsewhere in the county, and if possible to make arrangements whereby all lines will merge and the county be supplied with a complete system.

ELKHART, IND.—The Home Telephone Company, which is putting in a 2,400-line multiple switchboard at a cost of $24,000, announced an advance of 25 cents per month in the rent of each telephone beginning April 1. It anticipated that at least one hundred subscribers would give notice of withdrawal of patronage, but only two have filed such notice. The company has nearly 900 subscribers and the new rate is $2.25 and $1.25 for business houses and residences respectively.

WABASH, IND.—The Home Telephone Company, of this city, has issued $15,000 worth of 5 per cent. bonds for the payment of floating indebtedness incurred in building extensions and in making improvements to the local plant and toll lines. The company will this Spring build a complete system of rural telephones in the country around Wabash. It has already 300 applications for telephones from farmers. Trunk lines will be run out on the principal roads, and party lines will be built therefrom to farm houses. In some of the prosperous small towns independent switchboards will be installed.

SHEFFIELD, IA.—At a recent special election a telephone franchise was granted to the People's Mutual Telephone Company, of Latimer. A new exchange will be established at once.

DES MOINES, IA.—The Stratford Telephone Company, of Hamilton County, has filed articles of incorporation, the capital stock being $1,500. Mr. Edward Peterson is president and Fred Reugnitz, secretary.

NEWPORT, KY.—The Fitzsimmons Telephone Manufacturing Company, of Cincinnati has applied for a franchise to install a telephone system in Newport.

BALTIMORE, MD.—The Peninsula Long-Distance Telephone Company has been incorporated in Maryland for the purpose of establishing an extensive telephone service in various counties on the Eastern Shore. The company will have a capital of $100,000. The main line is to be built from Elkton to Crisfield, Md., from Middletown to Dover, Del., and to Cape Charles City, Va. Branch lines will be constructed to take in all the principal points as far as Rehoboth, Del. The Peninsula Company's main line will connect with the Maryland telephone system at Elkton. The names of the incorporators are Stanley Baker, David E. Evans, Harry Welles Rush and Joshua Clayton.

GRAND RAPIDS, MICH.—The Citizen's Telephone Company, it is stated, will expend between $15,000 and $20,000 in extending its system.

LANSING, MICH.—The following-named independent telephone companies were incorporated recently: Henrietta Telephone Company, Henrietta, capital $5,000; Monroe County Telephone Company, Monroe, capital $15,000; Hillsdale Telephone Company, Pittsfield, $15,000.

AUSTIN, MINN.—The Interstate Telegraph & Telephone Company, which was recently incorporated here with a capital stock of $60,000, will be ready to begin operations about April 10. The affairs of the company will be conducted by a board of directors, as follows: James Keenan, John L. Gulden, Seymour Johnson, Thomas A. Revord and Charles A. Sterling.

MISSOULA, MONT.—The Bell Telephone Company will put in local exchanges at Lo Lo, Florence, Stevensville, Victor and Hamilton. These towns will connect with all the large fruit farms in the Bitter Root Valley.

CHOUTEAU, MONT.—The Montana Telephone Company, with headquarters here, has been organized to build telephone lines in Teton County. It is the intention of the company to absorb all small lines, besides building new ones.

BEAVER CROSSING, NEB.—The Beaver Crossing Telephone Company has been incorporated with a capital of $5,000. The incorporators are Dr. C. W. Doty, J. H. Ritche, Henry Gake and others.

LOVELOCK, NEV.—Dr. Asher, of this place, is interesting a number of citizens in a proposition to build a telephone line from here to a number of nearby towns.

BROOKFIELD, N. Y.—The Brookfield Telephone Company, of Brookfield, Madison County, has been incorporated; capital, $1,000. Directors: J. F. Keith, B. M. York and B. L. Spooner, of Brookfield.

MIDDLETOWN, N. Y.—The Orange County Telephone Company has decided to extend its system so as to connect with the Farmers' Telephone Company, of Sussex, N. J., the Highland Telephone Company and the Port Jervis Telephone Company, besides making other extensions.

NEW YORK, N. Y.—The New York and New Jersey Telephone Company is building a new telephone exchange on Grant Street, near Flatbush Avenue, Brooklyn, to relieve the congestion of telephone work in the eastern section of Brooklyn. The new building will be three stories high and will cost about $40,000.

BEAUFORT, N. C.—The Beaufort Telephone Company, capital $2,000, has been incorporated by N. W. Taylor and others.

GREENSBORO, N. C.—The Bell Telephone Company is soliciting subscriptions for a local system at Greensboro, which will probably precipitate a fight with the already existing company in this town.

HENDRUM, N. D.—The Hendrum Telephone Company, with a capital stock of $5,000, has been organized, Mr. V. H. Moffatt being president.

CARROLLTON, OHIO.—The Kilgore Telephone Company is building a line between Kilgore and Amsterdam.

HARPERSFIELD, OHIO.—The Harpersfield Telephone Company is installing a large number of rural telephones.

URBANA, OHIO.—The Urbana Telephone Company has secured a new site and is preparing to erect a new exchange building.

PORT CLINTON, OHIO.—The Port Clinton Telephone Company is laying a new cable across Portage River to Put-In-Bay Island.

DRESDEN, OHIO.—The Zanesville Telephone & Telegraph Company is extending its lines through Madison township and a large number of farmers' lines are being installed.

SMITHFIELD, OHIO.—The Farmers' Independent Telephone Company has been incorporated; capital $10,000. Incorporators: M. B. Cole, J. M. Copeland, A. H. Kreager, Frederick Scott.

JEWETT, OHIO.—The Connotton Valley Telephone Company, of this place, has been incorporated with a capital stock of $2,000. The names of the incorporators are G. O. Fleming, J. W. Harding, George H. Collins, R. H. Benedict, Isaac Stewart.

CINCINNATI, OHIO.—The Druggists' Association, of Cincinnati, is having a controversy with the City & Suburban Telegraph Association (Bell) relative to rates at pay stations in drug stores. The druggists demand 10 per cent. on $50 worth of business, 15 per cent. on $75, 20 per cent. on $100, 25 per cent. on $125, and to have free calls to wholesale houses. The terms proposed by the company are considerably lower and the druggists threaten to join hands with the projected independent company.

GUTHRIE, OKLA.—A territorial charter has been granted to the Oklahoma Southern Telephone Company, the capital stock being $15,000. The company will construct and operate a system in the counties of Cleveland and Pottawatomie and in the Creek, Seminole and Chickasaw nations. The incorporators are W. A. Jennings, Graham Brunham and R. C. Willard.

ABBEVILLE, S. C.—The Abbeville Telephone Company has recently entered into a sub-license agreement with the Southern Bell Telephone Company, the former agreeing to use only fixtures manufactured by the Bell Company.

WAKONDA, S. D.—The Wakonda Telephone Company has been formed to establish a local system.

CANTON, S. D.—The farmers throughout Lincoln County are enthusiastic over the telephone idea. They are organizing country exchanges and will build private lines connecting with city exchanges.

GREENVILLE, TENN.—A meeting of representatives of about forty independent telephones lines was held recently in Greenville to consider the matter of combining, a result which will probably be consummated.

DENTON, TEX.—The Independent Telephone Company has been granted a franchise by the council in this city.

PIEDMONT, W. VA.—The Piedmont & Keyser Telephone Company is making extensive improvements to its system and will extend its line from Barnum to Blaine and Elk Garden.

RONCEVERTE, W. VA.—A new telephone company has been formed here to build an independent line from this place to Elkins, connecting with the Virginia system at Barstow. S. W. Payne and E. N. Arbogast, of Marlington, are at the head of the enterprise.

GLEN-BROCKLY, WIS.—The West Wisconsin Telephone Company, with headquarters in this place, has been incorporated with a capital stock of $5,000, by D. H. Syme and C. J. Augustin.

MANITOWOC, WIS.—The Manitowoc & Western Telephone Company has elected officers as follows: President, Dr. R. S. O Connell, of Cato; vice-president, J. E. Schultz, of Reedsville; secretary, J. P. Watt, of Maple Grove; treasurer, W. N. Killen, of Cato, and business manager, George Wittman, of Whitelaw. The company will make several extensions during the year.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—Local press reports state that the Mutual Electric Company will construct a new power plant on Folsom and Spear Sts.

LOS ANGELES, CAL.—The Independent Gas & Electric Company, of Los Angeles, has been incorporated, with a capital of $200,000. Incorporators: E. H. Durant and M. A. Newkirk, of Los Angeles.

WHITEWATER, COLO.—Haskell & Schwalbach, of Grand Junction, have prepared plans for a power dam to be constructed at Whitewater.

ATLANTA, GA.—The Westinghouse Electric & Mfg. Company is now making the machinery for the big power plant to be erected on the Chattahoochee River near Atlanta. Geo. Baum is consulting engineer.

ATLANTA, GA.—Local press reports state that two bids, one from J. F. Lester and the other from the Georgia Railway & Electric Company were received by Council March 23. Mr. Lester's bid provided for the construction of a $450,000 electric light plant. By yearly payments in fifteen years the city is to own this plant. The Georgia Railway & Electric Company agreed to furnish lights under contract as follows: 1 year arc lights at $110 each; incandescents $49.75; 3 years $82.50 and $33.75 and 7 years $79.50 and $21.75.

QUINCY, ILL.—The stockholders of the new Independent Light & Power Company have organized and elected a board of directors who met and elected officers as follows: J. W. Cassidy, president; Thomas D. Gardner, vice-president; C. E. Mead, secretary; J. J. Bragg, treasurer.

NOBLESVILLE, IND.—The City Council has granted a franchise to Thos. Griffin to construct an electric light plant.

GREENSBURG, IND.—A. R. Thompson & Co., of Chicago, Ill., contemplate constructing an electric light plant here.

SOUTH BEND, IND.—Electric power furnished by the St. Joseph river dam is now being used in this city, the connections having been established on March 26.

GREENSBURG, IND.—A. R. Thompson & Co., of Chicago, have applied for a franchise to construct and operate an electric light, heat and power plant in this city. It is thought the franchise will be granted.

WASHINGTON, IND.—The municipal electric lighting plant of this city is regarded as a financial success. The report of the trustees for the past year shows that the receipts were $91,640.43 and the expenses, bonds and interest, were $61,395.43, leaving a net profit to the city of $30,245, which is claimed to be ten per cent. on the $100,000 investment.

ELKHART, IND.—A franchise for the privilege of selling electric light and power in this city has been granted to the National Manufacturing Company. The company will erect a big power plant at Bristol, ten miles above, on the St. Joseph river, where a good water dam and power will be constructed. Power and light will be furnished other cities in northern Indiana and Michigan.

INDIANAPOLIS, IND.—The ten-year contract to be let for lighting this city is attracting many inquirers. It is reported that an Eastern syndicate, some of whom are interested in the local gas plant, will bid on the contract with a view of building a new electric lighting plant here. A five-year contract was made a few days ago with the Indianapolis Light & Power Company to furnish light and power to run the pumps, the cascades and the elevator in the soldiers' monument at $5,000 a year, also a contract with the Jenney Electric Company to furnish two 60-hp motors at $1,730.

NOBLESVILLE, IND.—The City Council has granted to Thomas Griffin a franchise to put in an electric plant here. Mr. Griffin proposes to locate his power plant four miles north on White river and construct a sixteen-foot dam to furnish 1800 horse-power required. The local company now furnishing lights has asked the council for an increase in the price of lights from $70 to $85 a year, stating that unless granted the lighting will be discontinued as the plant is being operated at a loss of $600 to $700 per month. The city will enjoin the company from leaving the city in darkness before the Griffin plant is completed.

CALEDONIA, IA.—The citizens have voted to construct an electric light plant to cost about $8,000.

CLINTON, LA.—The Town Council has granted the Clinton Electric Light & Ice Company a franchise to establish an electric light and ice plant.

MADISON, ME.—A committee has been appointed to investigate the question of constructing an electric light plant. T. F. Manter is city clerk.

RIVER ROUGE, MICH.—The Council has appointed a committee to investigate the question of constructing an electric light plant.

BUHL, MINN.—The citizens have voted to construct an electric light plant.

FAIRFAX, MINN.—The citizens have voted to issue $20,000 bonds for an electric light plant and city hall.

MANKATO, MINN.—On March 20 the Court issued an order restraining the city from selling $40,000 bonds for pumping station and lighting plant. The order is made returnable on April 6.

WINONA, MINN.—The Winona Railway & Light Co. has decided to expend about $100,000 in improvements, which will include the rebuilding of the present lighting and power plant.

VICKSBURG, MISS.—The Vicksburg Sanitarium will install a small electric light and heating plant. H. M. Street, of Vicksburg, is interested.

JACKSON, MISS.—The directors of the Jackson Light Company will soon let contracts for the construction of its plant. This company was recently incorporated with a capital of $25,000.

YAZOO CITY, MISS.—The Supreme Court has reversed the decision of Chancellor Conn in the injunction suit which restrained this city from issuing $75,000 bonds for constructing water works, an electric light plant and a sewerage system. This means the construction of the system.

ST. JOSEPH, MO.—It is proposed to issue $200,000 bonds this summer, to be used in extending the capacity of the city electric light plant.

PLATTSMOUTH, NEB.—The City Council has granted Chas. C. Parmele a franchise for an electric light, gas and heat plant.

JERSEY CITY, N. J.—The Century Light, Heat & Power Company has been incorporated here with a capital of $125,000.

TRENTON, N. J.—The Empire Light, Heat & Power Company has been incorporated with a capital of $125,000, by Ward W. Packard, George P. Fort and Thomas W. E. Middleton.

BROCKTON, N. Y.—The citizens have voted to construct an electric light plant, at a cost of about $10,000.

ROCHESTER, N. Y.—Bray & Albaugh, of Rochester, have secured the contract for building a storage dam across Oak Orchard Creek ravine for A. L. Levett, which is to develop 3,000 horse-power for electric transmission.

LIDGERWOOD, N. D.—Ralph Maxwell has petitioned for a franchise for an electric light plant.

COOPERSTOWN, N. D.—W. F. Ballard and Frank J. Hecker are stated to have secured a franchise for an electric light plant.

ALBANY, N. Y.—The Corporate Electric Company has been incorporated here to manufactore electrictiy for light, heat and power purposes in Garden City, Long Island, and in the five boroughs of New York City. The capital is $300,000, and the directors are Harold S. Recknagel, Harold C. Vaughan and Walter L. Worrall, of New York City; C. C. Freeman and Henry C. Eldert, of Brooklyn. The People's Illuminating Company was also incorporated to supply electricity in Manhattan and Bronx Boroughs of New York City. The capital is $25,000, and the directors are C. C. Freeman and H. C. Eldert, Brooklyn; and W. L. Worrall, of New York City.

SHERODSVILLE, OHIO.—A franchise for an electric light plant has been granted to C. C. Bolen and A. H. Snively.

COLUMBUS, OHIO.—Bids will be received April 13 by John A. Connor, Clerk of the Board of Public Works, for erecting a municipal electric light plant.

MARIETTA, OHIO.—The council has placed contracts with the Ft. Wayne Electric Works and the Warren Electric Company for equipment for the new lighting plant. The city will erect electric arches on the main streets.

MARIETTA, OHIO.—A number of leading local merchants are forming a mutual company to erect a lighting plant to supply power and light to stockholders. It is probable the company will incorporate with $100,000 capital stock.

CINCINNATI, OHIO.—The directors of the Cincinnati Gas & Electric Company have decided to increase the capital of the company $1,000.000. The new stock will be sold by the company as the money is needed to pay for extensions and improvements.

NORTH YAMHILL, ORE.—F. L. Trullinger writes that bids will be received in June for an electric power plant, to cost about $15,000.

MIFFLINBURG, PA.—The Council is reported to have voted to construct a $10,000 electric light plant.

TUNKHANNOCK, PA.—The Tunkhannock Electric Light Company is stated to have purchased property on Tunkhannock Creek and the work of constructing a power plant will begin about July 1st.

NORTH EAST, PA.—The North East Electric Light & Power Company has been incorporated with a capital of $10,000. The incorporators are Henry Watts, of Buffalo, N. Y., and C. C. Hill, of North East.

ALTOONA, PA.—A new electric power plant installed at the Altoona machine shops of the Pennsylvania Railroad is now in operation. It includes three dynamos representing 1200 horse-power and furnishes light for the machine shops and railroad yard.

LANCASTER, PA.—The Edison Electric Illuminating Company has secured a contract for lighting the streets of this city with 300 arc lights at $93.50 per light. Last year the company charged $85 per light. There was no competition this year. The company claims that the increased cost is due to the high price of coal.

ROCK HILL, S. C.—The Rock Hill Light & Power Company has been permitted to increase its capital stock from $50,000 to $150,000. G. F. Reynolds is interested.

RAPID CITY, S. D.—Frank M. Lockhart and W. H. Chambers have secured a franchise for an electric light plant.

NORFOLK, VA.—The Economist Lighting Company has been granted a charter here. The capital is to be from $1,000,000 to $20,000,000. The officers are Samuel B. Lawrence, of New York, president; Alfred T. Davisson, of New York, vice-president; Henry C. Everdell, of New York, secretary, and John B. Summerfield, of New York, treasurer. These, with James W. Wilcox, of Norfolk, are the directors.

FOND DU LAC, WIS.—The Village Board of North Fond du Lac has decided to issue bonds for a municipal lighting plant.

STEVENS POINT, WIS.—It is reported that the Stevens Point Lighting Company will construct a water power plant. U. Mainland, of Oshkosh, is reported interested.

BURLINGTON, WIS.—The Burlington Electric Light & Power Company has been incorporated, with a capital of $50,000, by Leonard J. Smith and Clarence E. Partee.

MARINETTE, WIS.—The Isaac Stephenson Co., of Wells, Mich., is reported to have received plans from C. B. Pride, of Appleton, for a power plant to be built at Chandler Falls, on Escanaba River. The cost of the dam is estimated at $30,000, and of the complete electric plant and transmission line to Wells and Escanaba at $200,000.

WINNIPEG, MAN.—The City Engineer has been authorized to report on the approximate cost of machinery, etc., necessary to supply electricity for light and power by means of both steam and water power.

THE ELECTRIC RAILWAY.

LITTLE ROCK, ARK.—The Little Rock Railway & Electric Company has been incorporated as the successor of the Little Rock Traction & Electric Company, and the Little Rock Edison Electric Light & Power Company, both of which were recently purchased by Isidore Newman & Son, of New York and New Orleans. The corporators and directors of the new company are D. H. Cantrell, president; J. F. Loughborough, vice-president, and H. T. Bunn, secretary. The capital stock of the company is $2,250,000, divided into $750,000 preferred and $150,000 common stock.

BRIDGEPORT, CONN.—The Connecticut Railway & Lighting Company has awarded the H. Wales Lines Company, of Meriden, the contract for building an addition to the company's power house on Seaview Avenue. A new direct-connected unit is to be installed in the addition.

WILMINGTON, DEL.—The Morton Traction Company, of Wilmington, Del., capitalized at $100,000, has been incorporated by Elzy B. Van Atta, of New York City; Frank A. Field, Samuel S. Morton, of York, Pa.; David H. Lincoln, of Marion, Ohio.

WALLACE, IDAHO.—Plans are being discussed for the construction of an electric railway to connect Wardner, Wallace, Burke and Mullan. Elmer Hughes, of Missoula, is said to be interested.

ROCK FALLS, ILL.—The Dixon, Rock Falls & Southwestern Electric Railway Company has been incorporated, with a capital stock of $50,000. The incorporators and first board of directors are O. E. Maxson, A. S. Goodell, A. J. McNeill, R. L. Leitch and H. L. Sheldon, of Rock Falls, Ill.

PRINCETON, ILL.—The City Council has granted a franchise to the Illinois Valley Traction Company to operate its service in Princeton. It is expected a line now being built from Galesburg to Kewanee will be extended to Princeton, which, with one connecting link between Marseilles and Joliet, will make a continuous electric railway from Galesburg to Chicago, a distance of 160 miles.

INDIANAPOLIS, IND.—The incorporators of the Indianapolis, Green Castle & Western Traction Company have elected Frank M. Fauvre, president, and J. W. Chipman, secretary.

ANDERSON, IND.—The plans for the addition to the power house of the Union Traction Company at North Anderson are completed. Work on the building will soon be commenced.

INDIANAPOLIS, IND.—The Toledo & Chicago Interurban Railway Company has filed articles of incorporation with $500,000 capital stock. J. E. Rove, of Auburn, will furnish desired information.

LAGRANGE, IND. The St. Joseph Valley Traction Company has filed articles of incorporation with a capital stock of $200,000. Directors: Rollin Ellison, M. V. Bilger, Jas. A. Roper, F. S. Fish, W. B. Pratt and others.

COLUMBUS, IND.—The Indiana Central Electric Railway Company has incorporated to build and operate a line from this city to West Baden and French Lick Springs. The initial capital stock is $20,000. Directors: John B. Burrell, John F. Stout, of Paoli; John Stratton, of Campbellsburg; H. C. Johnson and W. H. Shields, of Rockport.

INDIANAPOLIS, IND.—The Indiana Western Railway Company has incorporated with a capital stock of $1,000,000. The company proposes to build and operate street lines in, and connect the following cities with interurban lines: South Bend, New Carlisle, Laporte and Michigan City. The directors are D. D. Bates, H. F. Wurzer, John M. Brown, Eugene Miller and Wm. Stower, all of South Bend.

ANDERSON, IND.—The Union Traction Company, of Indiana, contemplates going into the electric lighting business, and will soon make an offer to various cities along its lines. The company is increasng its power house capacity here from 6,000 to 12,400 horse-power. Two-thirds of this will be required to operate its lines; the remainder will be sold. The company already has a number of sub-stations and will build more.

NEW ORLEANS, LA.—Northern capitalists are considering the question of building an electric railway in the Lake Pontchartrain District. J. F. O'Shaughnessy, of New York; S. H. Chisholm, of Cleveland; A. P. Bradstreet, of Waterbury, Conn., and U. Goodwin Reed, of Boston, are interested.

GRAND RAPIDS, MICH.—The Grand Rapids, Grand Haven & Muskegon Electric Railway will be extended to Highland Park.

DETROIT, MICH.—The Toledo & Monroe Railway has been sold to the Detroit, Monroe & Toledo Short Line Railway, a new corporation with a stock of $2,000,000. The road will be completed from Monroe to Detroit this spring. Present officers are Matthew Slush, president; C. A. Black, vice-president; Elisha Flinn, secretary; C. R. Hannan, treasurer.

WINONA, MINN.—The Winona Railway & Light Company contemplates spending about $100,000 in improvements. A steam turbine and a new condenser are to be installed in the power house, and new motors, new arc lights and other apparatus are to be purchased.

ST. LOUIS, MO.—The contract for the new power house to be built for the Terminal Railroad Association at 358-363 South Eighteenth Street, has been let to G. A. Fuller & Co. for $60,000.

KANSAS CITY, MO.—The Metropolitan Street Railway Company has taken out a permit for its new power house at Second and Grand Avenues. The building, exclusive of the excavation and equipment, will cost $300,000.

HAMSTEAD, N. H. A charter for the Hamstead & Haverhill Street Railway has been granted by the Legislature. Among those interested are Isaac Randall, James W. Sanborn, Arthur M. Emerson, George R. Bennette, George Palmer, William A. Emerson, of Hamstead.

SYRACUSE, N. Y.—It is reported that the deal by which the Syracuse Rapid Transit Company absorbed the Syracuse, Lakeside & Baldwinsville Railway has been closed in New York and that $643,000 was paid for the road.

COLUMBUS, OHIO.—The leading lines of the Appleyard system are to be equipped with the block signal system of the United States Block Signal Company, of Boston.

UPPER SANDUSKY, OHIO.—Dr. J. D. Johnson and R. R. Dunham are promoting a railway system to radiate from Upper Sandusky and connecting Bucyrus, Marion, Corey, Tiffin and Sandusky.

MARIETTA, OHIO.—The Marietta, Woodsfield & Barnesville Electric Railway Company has been organized with R. Merydith, president; W. E. Daker, vice-president; T. M. Ripley, secretary; W. M. Hart, treasurer.

COLUMBUS, OHIO.—The Columbus, Bellefontaine & Northwestern Electric Railway Company has been incorporated, with $10,000 capital stock, by D. E. Sullivan, H. C. Grose, George Riddle, F. D. Sullivan and Charles F. Galloway.

CINCINNATI, OHIO.—The Cincinnati, Milford & Loveland Traction Company has closed a contract with the Falk Company, of Milwaukee, for the construction of 33½ miles of road from Cincinnati to Loveland. The power house will be erected at Milford.

MANSFIELD, OHIO.—The Citizen's Electric Railway, Light & Power Company which controls the local lighting plant and street railway system, as well as the Shelby-Mansfield line is to be succeeded by the Mansfield Railway, Light & Power Company. New capital has been interested in the company and the capital stock is increased to $1,000,000. Plans are being made to extend the interurban line.

MANSFIELD, OHIO.—The Capital City Traction Company has been incorporated, with $10,000 capital stock, under Ohio laws to build an electric railway system at Olympia, Washington. The officers are J. B. Weddell, Mansfield, president; J. B. Beckett, Cincinnati, vice-president; E. B. Connor, Coshocton, O., secretary, and A. S. Caton, Olympia, Wash., treasurer. The promoters are endeavoring to establish an Ohio colony near Olympia.

EL RENO, OKLA.—The City Council has granted S. F. Roberts and H. R. Canon, of El Reno, and John A. Bell and H. H. Carson, of Nashville, Tenn., a fifty-year franchise for the construction of an electric railway and electric light system here.

CONNELLSVILLE, PA.—The Mount Pleasant, Pleasant Unity & Baggagley Street Railway Company, has been chartered with a capital stock of $100,000. Construction work will be commenced shortly. W. C. Crow is president of the company.

PIERRE, S. D.—Articles of incorporation have been filed for the Black Hills & Spearfish Valley Electric Railway Company, at Spearfish, with a capital of $2,500,000. The directors are Hiram Dotson, Milton C. Conners, Frank Welch, Edward Granfield, Daniel J. Toomey, John D. Kingsley, John M. Caldwell, of Spearfish.

STAUNTON, VA.—The City Council has agreed to permit the City Street Car Company to operate its lines only five months during the year. The company stopped running cars eighteen months ago, contending that winter travel did not pay.

ST. MARYS, W. VA.—The Williamstown & Moundsville Railway Company has secured a 50-year franchise to build its line through the county. The company will also furnish light and power.

NEW INDUSTRIAL COMPANIES.

THE AUTOMOBILE COMPANY, of New Jersey, capital $100,000, has been incorporated by Harry H. Picking, Gardner W. Kimball and Charles A. Greene.

THE EQUITABLE X-RAY COMPANY, of Brooklyn, N. Y., has been incorporated with a capital of $2,000. Directors: E. E. Bennett, W. F. Bennett and W. D. Farrington, of Brooklyn.

THE MANVILLE COVERING COMPANY, with a capital of $150,000, has been incorporated by Harry Hill, Marmaduke Tilden, Jacob B. Merseles, Alexander Morrison, Jr., and Joseph V. Clark.

THE BALTIMORE ENGINEERING COMPANY, of New York, has been incorporated with a capital stock of $10,000. The incorporators are Louis S. Hubbard, G. E. Relyea and John A. Djerk.

THE GENERAL AUTOMOBILE AND MANUFACTURING COMPANY has been incorporated at Delaware, Ohio, with a capital stock of $125,000. Mr. M. L. Thompson, of Cleveland, is agent.

THE ELECTRIC CABLE JOINT AND APPLIANCE COMPANY, of New York City, has been incorporated, capital $100,000. Directors: W. M. Murphy, F. H. Wilmott and H. M. Randall, of New York City.

THE MOBILE RAPID TRANSIT COMPANY, of Irvington, N. Y., has been incorporated with a capital of $100,000. Directors: John Walker, Sr., John Brisben Walker and David S. Walker, Irvington.

THE FIELD CONDUIT CONTRACTING COMPANY, of New York, has been incorporated with a capital of $15,000. Directors: J. E. Clark, Jr., and G. B. Smith, New York; W. A. Cullen, Newark, N. J.

THE TELEPHINE COMPANY OF AMERICA has been incorporated at Washington, D. C., to manufacture, among other things, antiseptic attachments for telephone mouthpieces. The incorporators are O. H. Savage, J. T. Richards and E. L. Squire.

THE AMERICAN COMPOUND BEARING COMPANY has been incorporated in New Jersey to manufacture bearings for machinery. The capital stock is $125,000 and the incorporators are Osborne Congleton, Henry C. Wilson, Henry F. West, Kenneth K. McLaren and James C. Campbell.

THE FRONTIER ELECTRIC LIGHTING COMPANY, of Buffalo, has been formed by Buffalo Gas Company interests with a capital stock of $800,000. The directors are Alexander C. Humphries, Frederick Strauss and Stephen Peabody, New York; Howard L. Clark, Providence, R. I., Franklin D. Locke, Buffalo.

PERSONAL.

PROF A. J. WOOD

PROF A. J. WOOD The trustees of Delaware College, Newark, Del., have just awarded Prof Wood several thousand dollars to enable him to give the electrical and mechanical departments an equipment that will be up to date and enable the studies to be conducted with greater efficiency. Prof Wood is a son of the late Prof. De Volson Wood, so well known for his work at the Stevens Institute of Technology He was born at Roseville, N. J., in 1874, graduated from the Hoonton High School, and from Stevens in 1896 with the degree of mechanical engineer. In 1897 he attended lectures on advanced mechanics at Columbia University, and until 1900 was on the editorial staff of the "Railroad Gazette." During this period he gave special attention to matters connected with electric traction; as well as acceleration of trains and gas engine design. His investigations on hydraulic rams, printed in the "Stevens Institute Indicator," also embodied a large amount of original work. Before going to Newark, Del., Prof Wood was an instructor in mechanical engineering at the Worcester Polytechnic Institute for about one and one-half years, and he has also acted as consulting engineer in regard to a number of enterprises. Since 1899, Prof. Wood has been a member of the council of the Society for the Promotion of Engineering Education. In 1898 he was elected to the American Society of Mechanical Engineers, and in 1899 he joined the American Institute of Electrical Engineers. Prof. Wood has done a variety of original work on electrical apparatus, and is now laying out broad plans for the useful development of the department under his care, so that his students may not only be well grounded, but undertake the foremost branches of electrical engineering. In connection with such work, the students have recently formed an engineering society, and Prof. Wood has already been able to attract to Newark for its benefit a number of well-known popular lecturers in the engineering field; giving the society considerable prestige and stimulus.

MR. T. A. EDISON has returned to his home in Orange, N. J., from his plantation in Florida, where he always spends a part of the winter.

MR. W. D. SARGENT, vice-president and general manager of the New York & New Jersey Telephone Company, has returned home to Brooklyn, N. Y., from his wedding trip in the far South.

MR. ARCHIE KELLY, A. M. I. E. E., a member of the consulting electrical engineering firm of Lester Taylor, Kelly & Hide, of Liverpool, is now visiting the United States and making a tour of inspection as far west as Chicago.

MR. JOHN R. GEARY, of the General Electric Company, has gone to Japan with a view to representing permanently the interests of that company in the Mikado's Empire. Mr. Geary will make his headquarters at Yokohama.

MR. I. STERNFELD, of G. & O. Braniff, Mexico City, representing the Westinghouse electrical interests in the Southern Republic is now in New York. He is making his headquarters at the offices of the Westinghouse Company.

MR. HUGH L. COOPER, an engineer, of Montreal, has gone to Mexico where he will take up his work as resident engineer of the Mexican Light & Power Company. Mr. F. S. Pearson, vice-president of the company accompanied him.

MR. E. R. KNOWLES, C. E., is consulting electrical engineer for the new plant which the American Type Founders Company is putting up at Communipaw, N. J., and which will include a great many machines run by separate motors.

MR. J. SHAW, of the power and mining department of the British Thomson-Houston Co., Ltd., at Rugby, England, arrived here by the *Umbria* last week, and will spend some weeks in looking up General Electric methods and installations.

MR. RALPH D. MERSHON, the consulting electrical engineer, who has lately been closely engaged on power plant and transmission work at Montreal, Can., expects to sail from New York to England on April 10, to be gone until the middle of May.

MR. H. J. DOUDS, who up to the beginning of the year was manager of the supply department of the General Electric Company at Cincinnati, Ohio, has since that time been connected with the engineering firm of J. G. White & Co., in New York City.

MR. E. S. MACKIN, of the American contracting firm of Mackin and Dillon, is now in New York, regarding the Monterey electric traction project, in the realization of which there is expected to be some delay. Mr. Mackin is a guest at the Van Rensselaer Hotel.

MR. H. C. PATTERSON has opened an office at 17 State Street, New York, as an electrical, mechanical and hydraulic engineer. Mr. Patterson's experience dates back to 1881 with the old T-H Edison companies and latterly he was with the General Electric Company.

MR. ERNEST F. SMITH, assistant to the chief operating engineer of the Chicago Edison and the Commonwealth Electric Companies, has been elected vice-president and general manager of the St. Joseph Boat Manufacturing Company, St. Joseph, Mich. Mr. Smith will retain his present position with the Edison and Commonwealth companies.

MR. A. W. McLIMONT, some time president of the Federal Electric Company, 141 Broadway, New York, and who more recently acted as chief engineer in connection with the Monterey, Mexico, electric traction project, sailed this week for Peru for the purpose of superintending the construction of the proposed Lima-Chorillos electric road.

MR J. B. D'HOMERGUE, manager of the "Keystone Hair Insulator" department, of the H. W. Johns-Manville Co., sailed on March 30 for England, where he will make an exhaustive and comprehensive investigation of the trade for asbestos and sound-deadening materials in that country. Upon his return, about May, he will be permanently located in New York.

MR. A. K. T. BULKLEY, of Bulkley & Bowden, Johannesburg and Durban, South Africa, is now in the United States for the purpose of placing some substantial orders for electrical equipment, machine tools, etc. He is in the West, but will return next week While in New York he will make his headquarters at the offices at 116 Broad Street, of the export firm of Cadenas & Co.

MR. B. A. BEHREND, Chief Engineer of the Bullock Electric & Mfg. Company, on his recent visit to California, delivered two lectures to the electrical students of Stanford University on "Design of Alternating Current Machines." Mr. Baum, of the Electrical Department is arranging for a series of lectures to be given by practical men of recognized standing in the profession.

MR. J. K. ROBINSON, Iquique, Chili, who represents the Westinghouse interests on the west coast of South America, is due to arrive in New York April 21, en route for London, where he will go regarding some important contracts pending for electrical equipment, etc., in Chili and Peru. On his return from the other side, he is expected to place some heavy orders before sailing for South America.

MR. CHARLES J. GLIDDEN, the well known telephone manager, who has of late been making some remarkably long automobile tours in this country and Europe, is to spend this summer in Scandinavia, and proposes to push his auto to within 2½ degrees of the Arctic circle, in Norway, and starting from England. The total distance, including local steam travel, will be 4,406 miles, and the time scheduled 45 days.

MR. F. P. FISH.—President Fish of the American Telegraph & Telephone Company has returned to Boston from an inspection of some of the important exchanges of the local telephone companies. During the past six months he has visited some of the larger exchanges east of the Mississippi River with a view of forming an opinion on the extensive construction required in the territory of the sub-companies during the coming summer.

MR. F. G. BAUM, of the Electrical Department of Stanford University has accepted the position of assistant electrical engineer to the chief engineer, Mr. L. M. Hancock, of the California Gas & Electric Corporation. Under Mr. Hancock, Mr. Baum will have general charge of the electrical engineering and operation of the system. For the present Mr. Baum is continuing his classes at the University, giving his spare time to the work of the corporation.

MR. FERDINAND W. PECK, who was commissioner general of the display made by the United States at the Paris Exposition of 1900, and Dr. Lee De Forest, the scientific director of the De Forest Wireless Telegraph Company, visited the administration Building at the St. Louis Exposition on April 3. The De Forest Company will make an exhibit in the Electricity Department and may give demonstrations of the practical use of wireless telegraphy on the grounds during the Exposition.

MR. V. C. GILPIN, who was formerly New York agent for the Cutter Electric Mfg. Company and two years with the Supply Dealers' Association as supervisor, joined the forces of the De Veau Telephone Mfg. Company a few months ago. He has just returned to New York after a long and successful trip in behalf of the De Veau specialties, and has very interesting stories to tell as to telephonic development in the Middle and Western States. He considers the telephone industry one of the most progressive in the electrical field at the present time.

MR. ANDREW CARNEGIE has begged to be allowed to pay all bills incurred by students of Cornell University on account of sickness during the recent typhoid epidemic at Ithaca in all cases where the students or their parents will permit it. It is Mr. Carnegie's desire to place each student who has been ill in precisely the same pecuniary condition as that which he occupied at the outbreak of the epidemic. The gift is applicable to all sick students, those who withdrew from the university as well as those who remained at Ithaca. Mr. Carnegie has also offered to aid in ensuring a pure water supply hereafter.

MR. J. B. ORR, one of the resident partners at Rio Janeiro of the electrical engineering and contracting firm of James Mitchell & Company, of Rio Janeiro, Brazil, which concern represents the interests of the General Electric Company, the Pelton Water Wheel Company, Babcock & Wilcox Company and other prominent American concerns, is now visiting the United States. At time of writing he was in the West, but he is expected to be in New York early next week. It is anticipated that he will place some substantial contracts for various electrical equipments, etc., before he returns to Brazil next month. While in New York he may be found in the Brazilian department of the American Trading Company, Broad Exchange Building.

PROF. A. A. ATKINSON.—In a recent personal note, D. Van Nostrand Company in their monthly bulletin say: Prof. A. A. Atkinson, of the "Ohio University," should not be confounded with the late Mr. Philip Atkinson, of Chicago. The latter was the author of three works of merit in "Electrical Science," namely: "Elements of Electric Lighting," "Elements of Dynamic Electricity and Magnetism," "Power Transmitted by Electricity and Its Application by the Electric Motor, including Electric Railway Construction," and "Elements of Static Electricity," all of which are standard works and have had a large sale. The former is the author of a more recent work, entitled, "Electrical and Magnetic Calculations for the Use of Electrical Engineers and Artisans, Teachers, Students and all Others Interested in the Theory and Application."

MR. F. A. LA ROCHE.—Considerable interest and curiosity was aroused in electrical circles this week by the action of Mr. F. A. La Roche, the well-known electrical manufacturer and automobilist, in appearing in the Jefferson Market police court, of New York City, as complainant against John St. Clair, a private detective, who he said had been shadowing him. Mr. La Roche is a witness for the defense in the patent suit case of the Weston Electric Instrument Company against the Empire Electrical Instrument Company, which is pending in the United States Circuit Court. Mr. La Roche said that he has been constantly shadowed for two months. St. Clair, he said, followed him on a bicycle when he went out in his automobile and he or some other sleuth was always on guard before his factory or at his home, 140 West Fifteenth Street. Magistrate Barlow held St. Clair in $300 bonds for examination.

MR. WILLIAM C. ANDREWS, for the past two years associate editor of the *Street Railway Journal*, has accepted the position of Eastern representative of E. P. Roberts & Co., consulting engineers, Cleveland. The increasing Eastern business of this company has made it advisable to open a New York office, of which he will have charge. Mr. Andrews is a graduate of Columbia University, School of Mines, receiving the degree of electrical engineer in 1895. After a year in Europe, he spent another year with the Royal Electric Company, of Montreal, in the lighting and manufacturing departments. In 1897 he entered the post-graduate course at Cornell University, but left in the early spring of 1898 to become assistant in physics at Columbia University where he remained until 1900. He then became connected with the McGraw Publishing Company in the editorial department of Electrical World and Engineer and was lately associate editor of the *Street Railway Journal*, which position he held until recently.

MR. S. T. DODD.—In the S. K. C. club rooms at Pittsfield, Mass., Mr. S. T. Dodd, engineer of the street railway department of the Stanley Electric Mfg. Co., gave, last week, an exceedingly interesting lecture on the development of street railway apparatus. This was particularly interesting to Berkshire shire people on account of one of the first railway motors having been invented and made by Mr. Stephen D. Field, of Stockbridge. It was named "The Judge," in honor of the uncle of the inventor, Chief Justice Field, and was operated in Chicago in 1883. Mr. Dodd illustrated his lecture with lantern slides, together with anecdotes and personal reminiscences of men and events in connection with the development of street railway apparatus, and pointed out the improvements made from time to time on this apparatus. The S. K. C. club has arranged for lectures covering the next two or three months, and as the subjects are of interest to employees, they are having quite a large attendance. The evening's entertainment was considerably enhanced by the S. K. C. orchestra of 33 pieces. This orchestra is one of the leading features of the entertainments which the club has organized.

OBITUARY.

MR. L. T. LAWTON.—We regret to note that Lyman T. Lawton, widely known as an electrical inventor, died at Meriden, Conn., on April 3, aged fifty-five years. He was formerly President of the Automatic Lighting Company and the Connecticut Telephone and Electric Company.

LEGAL.

SUIT TO RECOVER A NICKEL.—Dr. Elmer Prescott, in his suit against the Chicago Telephone Company to recover a nickel which he alleged he had dropped into a telephone, and for which he received no service, was awarded judgment for five cents by Justice Blume on March 30. The company appealed the case to a higher court.

CHICAGO TELEPHONE RATE CASES.—Hundreds of lawsuits are to be brought at once against the Chicago Telephone Company to recover money claimed to have been collected by the company in excess of the rate authorized by city ordinance. The complainants have organized the Chicago Telephone Adjustment Company, which will attend to the litigation for its members. William B. Judd is president of the company. Eighteen suits have already been started. These actions are the consequence of the proceedings brought by the Illinois Manufacturers' Association to compel the telephone company to reduce its annual charge to the $125 specified by ordinance. Judge Tuley found that the company had no right to charge the tolls in force, which ran up to $175 and more in many cases.

Trade Notes.

BUFFALO FORGE COMPANY, of Buffalo, N. Y., has removed its Pittsburgh office to 607 House Building, corner Smithfield and Water Streets, where it will be continued in charge of Mr. H. D. Wilson, M. E.

THE UNITED ELECTRIC HEATING COMPANY, which has been carrying on business at 260 Randolph Street, Detroit, Mich., as manufacturer of electric heating devices, has incorporated under the old name.

ARMOUR & COMPANY are making tests at the Union Stock Yards, Chicago, of the Nernst lamp, manufactured by the Nernst Lamp Company, of Pittsburg, preparatory, it is understood, to an extensive installation of this lamp in their offices and works.

C. F. SPLITDORF, 17 Vandewater St., New York, has recently been compelled to increase his factory by taking an extra floor. This has been made necessary by the constantly increasing demand for his well-known spark coils for X-ray, wireless telegraphy and gas engine ignition. This business was established in 1858.

LOWE & LEVERIDGE, general electrical supplies, New York City, have taken a lease of the entire building at 183 Greenwich Street, from May 1. This will give them a great deal more space for all departments of their business, and they are ready to take on one or two more suitable agencies for outside electrical manufacturers.

PLATINUM.—The well-known firm of J. Bishop & Co., refiners and dealers in platinum and manufacturers of platinum wire, have recently removed from Sugartown to Malvern, Pa., where they are permanently located, and are in possession of increased facilities. This firm was established in 1842, and is said to be the oldest of its kind in this country.

THE ELECTRIC CONTRACT COMPANY has removed from 53 Maiden Lane, New York, to 202 and 204 Centre Street, where it has a thoroughly equipped new factory. This move was made necessary by the steady increase of its business in the various lines of electric novelties, flashlights and other specialties. Mr. Charles P. Skinner, vice-president, says it will now be able to fill all orders promptly and in any quantity.

CLEATS.—James S. Barron & Co., 200 West Broadway, New York, are making a specialty of porcelain and wood office cleats for the use of telephone companies. Some of these cleats are illustrated in a sheet just issued by the firm. Among those illustrated are small double grooved cleats; porcelain single grooved cleats and backing, fancy and plain single grooved cleats, Circular Loom cleats and cross-arm connecting cleats. The dimensions and prices of these cleats are given.

CRANDALL PACKING.—On account of its constantly increasing business, the Crandall Packing Co. has found it necessary to have larger quarters in which to conduct the volume of trade emanating from its New York office. It has leased commodious offices at No. 123 Liberty St., where its salesroom will be located. Mr. S. M. Hildreth, local manager, will be very glad to welcome its numerous customers at the new location and explain the various packings, which should be interesting to all users of steam goods.

THE ENGINEERING AGENCY, Monadnock Block, Chicago, received applications in one day last week for 67 high-grade technical men; one company asking for 25 blast furnace draftsmen at $125 to $150 a month and another company for 30 structural draftsmen at $125 a month. The Agency has vacancies on its books for over 200 competent men, including instructors in shop work for technical colleges, teacher for manual training school, assistant editor for technical journal, chemists, engineers of all kinds, shop superintendents, draftsmen, etc.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., opened an office in the National Life Building, Chicago, on April 1st. The large number of alternating-current circuits and plants in the Chicago district have helped to increase the demand for Nernst lamps beyond the point where a local office can be dispensed with. A stock sufficiently large to supply the trade and consumers promptly will be carried. The rapidly increasing popularity of this lamp promises to be an important factor in the illuminating field, as is evidenced by the number of large contracts recently placed for its installation in important buildings and manufacturing plants.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 31, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

723,804. STORAGE BATTERY; J. M. Allen, St. Louis, Mo. App. filed July 21, 1902. The electrodes are in the form of rectangular boxes which are designed to prevent buckling.

723,817. ELECTRIC CURRENT CONTROLLER; L. Bradley, Milwaukee, Wis. App. filed Nov. 11, 1901. The invention consists of means for gradually applying pressure to a stack of resistance disks.

723,836. INDUCTION APPARATUS; P. F. Cowing, New York, N. Y. App. filed Oct. 24, 1902. The primary of an induction coil and one-half of the core are mounted on the under side of a table or board, while the secondary winding and other half of the core, together with a lamp and fixture in circuit with the secondary, is adapted to be placed against the top—or front of the table or board. By altering the angular position of the two coils with respect to each other, the induced current to the lamp is controlled.

723,840. CONTROLLING SWITCH SYSTEM; A. L. De Leeuw, Hamilton, Ohio. App. filed Oct. 13, 1902. To cause electro-magnetic clutches to release promptly, a reversed polarity is sent through the coil an instant before the release is desired.

723,845. ALARM AND ANNUNCIATOR; R. J. Dodd, Cottage Place, Va. App. filed April 16, 1902. The inside of an electric bell-gong is provided with a reflecting surface and a lamp which is lighted when the gong rings.

723,866. ELECTRIC SWITCH; G. W. Hart, West Hartford, Conn. App. filed July 19, 1902. The front plate of a plug socket is provided with a shutter which is automatically opened to admit the plug and closed when the plug is removed.

723,928. ELECTRO ENDOSMOTIC PROCESS OF EXTRACTING SUGAR; B. Schwerin, Berlin, Germany. App. filed Nov. 15, 1901. Consists in causing the albuminous matter to separate out at the negative electrode and in converting the acid accumulating in the beginning of the process in the water at the positive electrode into indissoluble and innocuous compounds. (See page 618.)

723,982. TILE OR CONDUIT FOR ELECTRIC CONDUCTORS; R. W. Lyle, Perth Amboy, N. J. App. filed July 1, 1902. Details of a key for connecting the sections of the tile together.

723,989. POLE SHOE FOR DYNAMO ELECTRIC MACHINES; A. Churchward, Chicago, Ill. App. filed Aug. 23, 1901. The shoe which is applied to cores having interrupted pole faces, is also discontinuous or interrupted.

724,012. PROCESS OF MAKING ELECTRIC ACCUMULATOR PLATES; J. J. H. Hunte, Charlton, Eng. App. filed April 15, 1902. In order to shorten the process of forming the plates, they are subjected to the action of chlorine and oxygen in a specific way.

724,041. AUTOMOBILE VEHICLE; H. Lemp, Lynn, Mass. App. filed April 25, 1900. Separate motors are applied to independent drive wheels, each motor having a series field winding which is connected to the other through a bridging connection; a series multiple controller is used.

724,060. TRANSFORMING SYSTEM; N. Thomas, Jr., London, Ohio. App. filed Nov. 25, 1901. A transforming system comprising two oppositely disposed induction coils, a source of electricity to which the primaries of the coils are connected mutually in multiple and individually in series, the secondaries being connected through independent transmitting circuits to a common working circuit, and a vibrator connected in the primary circuit and adapted to alternately make and break the circuits through the primaries of the coils.

724,069. ELECTRIC FURNACE; R. Winter, Berlin, Germany. App. filed Aug. 7, 1901. Tubes of refractory material containing the heating resistance are arranged as a lining on the inner walls of the furnace.

724,071. ELECTRIC ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed Jan. 18, 1902. A horizontally pivoted frame carries a coarse wire coil at one end and a fine wire coil at the other, stationary armatures co-operate with these coils and clutch operating devices are connected with the frame.

724,072. ALTERNATING CURRENT ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed March 12, 1902. A modification of the preceding patent.

724,073. ALTERNATING CURRENT REGULATOR; T. E. Adams, Cleveland, Ohio. App. filed March 26, 1902. The current is regulated by the counter electromotive force of self-induction caused by the automatic lifting of a coil to more or less cover an iron core.

724,089. MEANS FOR OPERATING MOTORS IN DUST LADEN ATMOSPHERES; T. A. Edison, Llewellyn Park, N. J. App. filed January 9, 1903. (See Current News and Notes.)

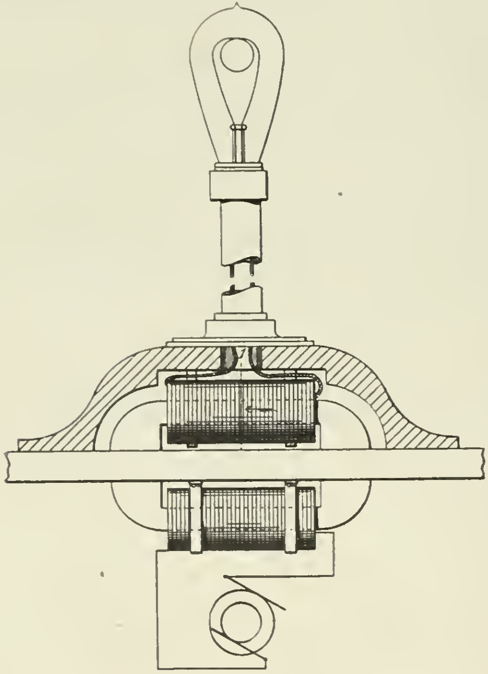
724,099. TROLLEY WHEEL; J. Henger, North Amherst, Ohio. App. filed June 30, 1902. Details.

724,102. ELECTRIC FLASHER AND CIRCUIT THEREFOR; H. C. Horstmann, Chicago, Ill. App. filed March 28, 1902. The object is to provide a simple mechanism to operate and control a number of circuits through which the current is flashed at intervals, in a manner to avoid sparking.

724,107. COMPOSITION OF MATTER FOR ELECTROLYTIC DEPOSITION; E. D. Kendall, New York, N. Y. filed Sept. 17, 1902. A solid compound consisting of a suitable aurate and a suitable ferrocyanide which by mere solution in water furnishes an electrolyte available for the deposition of gold.

724,144. ATTACHMENT FOR ELECTRIC GENERATORS; E. A. Terpening, Geneseo, Ill. App. filed Jan. 10, 1903. A commutator attachment capable of a wide range of adjustment to enable it to be used with generators of various dimensions.

724,186. ELECTRICAL APPARATUS FOR THERAPEUTICAL WORK; H. Jackson, Newton, Mass. App. filed Jan. 22, 1903. An apparatus for producing ultra-violet rays for Finsen treatments.



723,836.—Induction Apparatus.

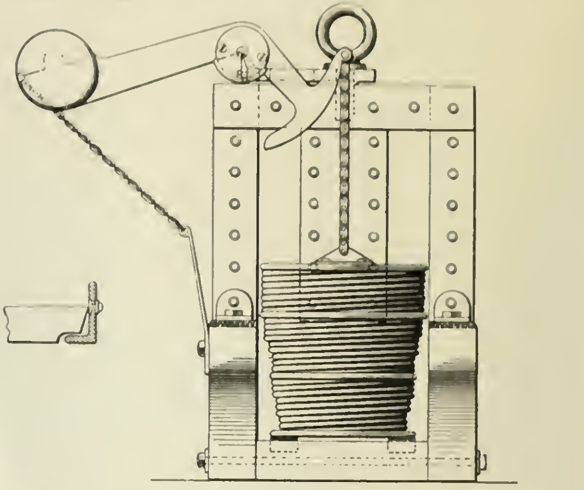
724,191. CELL FOR ELECTROLYTIC BLEACHING PLANT; L. E. Lander, Warren, N. H. App. filed Sept. 22, 1902. The cell is of iron and protected from attack by the chlorine gas by a covering of asbestos.

724,228. ELECTRIC CIRCUIT BREAKER; J. J. Wood, Fort Wayne, Ind. App. filed May 8, 1901. The arc is blown out by the gases which it generates.

724,229. ELECTRIC ARC LAMP; J. J. Wood, Fort Wayne, Ind. App. filed April 23, 1902. An arc lamp having its feed controlling magnetic element proportioned to render the lamp self-compensating for temperature changes.

724,274. SIGNALING APPARATUS; R. A. Fessenden, Detroit, Mich. App. filed Nov. 19, 1900. A signal constructed to operate progressively and of necessity requiring to be reset to its initial position after each operation; it is useful especially on ships.

724,287. MANUFACTURE OF ELECTRODES; Jean Jacques Heilmann, of Paris, France. App. filed September 6, 1900. A mechanism for manufacturing storage battery plates of the class comprising a central core and a coating of active material. The machine automatically coats the core for the proper length with active material and automatically cuts off the same in predetermined lengths.



724,073.—Alternating Current Regulator.

724,329. INSULATOR; R. H. Polk, Birmingham, Ala. App. filed June 17, 1902. An insulator having specially formed notches by which the wire can approach it at any angle and still be securely held.

724,339. LIGHTNING ARRESTER; H. M. Shaw, Newark, N. J. App. filed Sept. 20, 1901. Alternate plates of carbon and mica are inserted between the serrated terminals.

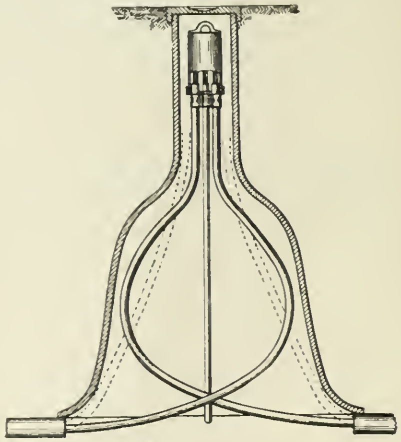
724,351. INSULATED STRAIN; L. Steinberger, Brooklyn, N. Y. App. filed Aug. 25, 1902. Details.

724,361. CUT OUT; O. B. Williams, Whitewater, Wis. App. filed Oct. 22, 1902. Details.

724,366. ELECTRIC ARC LAMP; J. J. Wood, Fort Wayne, Ind. App. filed March 19, 1902. Improvements in the various features of the lamp.

724,367. ELECTRICAL TRACTION TOWAGE; S. W. Wood, New York, N. Y. App. filed June 25, 1902. Three rails placed one above the other along the canal bank are traversed by motor driven carriages.

724,368. ELECTRICAL TOWAGE ON CANALS; S. W. Wood, New York, N. Y. App. filed June 25, 1902. A modification of the preceding system in which the middle rail carries the current, while the upper and lower rails are the return conductors for two lines of carriages.



724,383.—Junction Box.

724,383. JUNCTION BOX; R. S. Donaldson, Cleveland, Ohio. App. filed June 4, 1900. The box is for underground heavy cables and has an enlargement at its base permitting the cable to make a gentle sweep in entering the box.

724,387. METHOD OF PRODUCING STORAGE BATTERY PLATES; W. Gardiner, Chicago, Ill. App. filed Dec. 13, 1900. A process of oxidizing lead plates consisting in passing a current from the plates through an electrolyte containing three acids, one of which is a good solvent of lead, another a poor solvent of lead, and the third an organic acid.

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CONTENTS.

Editorial 641
Professor Walther Nernst 644
Aluminum Litigation 644
Chicago Meeting of the A. I. E. E. on High Tension Lines 644
Vancouver Transmission Plant. By Wyatt H. Allen 645
St. Louis Exposition Congresses 648
The Development of the Electron Idea. By W. Kaufmann 648
Effect of High Potential Discharge on Mica Insulation. By John Harden 651
Parallel Operation of Direct-Connected Alternators. By P. C. Oscanyan 652
Annual Convention of the Iowa Electrical Association 652
Discussion of New York Municipal Plant Scheme 654
Recent Electrochemical Developments. By Clinton Paul Townsend 656
New Telephone Patents 657
Summer School for Artisans 658
Individual Plan of Charging for Current at Cleveland, Ohio. By Samuel Scovil 658
Third Rail Methods in Brooklyn 659
Automatic Motor Starter Litigation 660
Sale of Ries Patents Unratified by the Court 660
Current News and Notes 660
LETTERS TO THE EDITORS:
  Fuel Consumption in Central Stations. By Hartley Le Huray Smith 661
  The Proposed New York State Electrical Laboratory. By Nicholas F. Brady, Vice-President 662
  Electric Traction on the Swedish Private Railroads. By Arvid Westerberg 662
"Water Pail" Electric Lighting. By Joseph B. Hall 662
Digest of Current Electrical Literature 663
New Books 667
Turbine *vs.* Reciprocating Engine Generators. By David Hall 668
Westinghouse Turbo-Generators 668
Photometer Attachment 670
Exhibits at the Iowa Electrical Association Meeting 670
Electric Process for Water Purification 670
News of the Week 671

THE IOWA ELECTRICAL ASSOCIATION.

We doubt whether any of the State electric light associations has a larger membership in proportion to the number of central station companies in the State than has the Iowa Electrical Association. We doubt also if there is any from which the members obtain more real practical benefit than from the Iowa Association. This body has pursued its work with very little ostentation for three years, and has proved already of great practical value to its members. The general lines of work most valuable have been the collection of comparative data of various kinds from various members. This is to be carried still further and will necessitate the keeping of more accurate records of all branches of central station performance in the future. The members of the association realize that a convention to be of any value must get down to something besides glittering generalities, and even though the facts and figures exchanged on the convention floor may be somewhat crude, they have a value; and are a stepping stone to greater refinements in practice. In no State has the advance in small central station administration been greater the past ten years than in Iowa; and Iowa is pre-eminently a State of small stations.

THE MUNICIPAL PLANT AGITATION.

Elsewhere in this issue will be found part of the address made by Mr. Bowers at Albany before the legislative committee against the proposed Monroe municipal electric lighting plant for New York City. It is a sober statement of incontestable facts, and explains in part, although by no means as fully as it could, why lighting, like many other things in New York, is more expensive than in some other much smaller places. Alongside this data, the phonographic yawp of the Merchants' Association about the "exactions of the lighting monopoly" becomes more ridiculous than ever. The prices charged by the city for replacing a granite pavement are a case in point; or those levied by it for asphalt work. The city has the audacity to take $8 for the first yard of granite and $4 for the second, from the lighting companies, when the work can be done reasonably for $2.50, while the asphalt "gouge" is in the same monstrous proportion. On top of that come further exactions for inspectors. And yet the Merchants' Association, under whose very eyes this goes on, prates about the cheapness with which the city can do its own work! It is impossible not to marvel at this manner of "merchant," and wonder how any of them ever escape the bankruptcy into which they would plunge the city by municipal plant extravagance.

Nor does this scope and plan stop at mere city supply. As we intimated at the outset of the agitation, general sale of current to everybody is contemplated, involving a plant of enormous capacity in direct competition with those already established. At a meeting in Cooper Union last week, ex-Senator John Ford said: "Why do the gas and electric companies combat the proposed change to municipal lighting, when they claim that but 4 per cent. of their business is composed of municipal lighting? It is because they know that municipal lighting will be a success, and that it will not be long before the municipal plant will not only be able to furnish light to the public institutions, but to private concerns and to householders. And they know that this will lead to the municipal ownership of all public utilities in this city." This is exactly what we contended was the ultimate aim; and if the public does not want to see such a plan of municipal operation of electric light plants, street railways, gas works, abattoirs, ferryboats, bakeries, icehouses, coalyards, milk walls, and other enterprises, it had better call a halt on this propaganda now than later. Meantime we would advise the citizens of New York to be very distrustful of the alleged evidence laid before it by the agitating officials and the Merchants' Association, for the most casual examination of the data thus far brought forward by them in support of a municipal lighting plant shows it to be utterly unreliable and untrustworthy—as usual. Besides, we should like some of the municipal agitators to explain the little incident at Gravesend, L. I., where the municipal authorities of that New York suburb spent $120,000 of public money on an electric lighting plant, and so milked or mismanaged it that without ever giving service it had to be sold under the hammer for a bare $30,000. If that instance is not enough to turn any healthy stomach, we can quote a few more showing how fearful the economic results may be with unreflecting or dishonest movements of this kind.

Electrolysis of Water.

It has long been known that although a certain fairly definite e.m.f. was necessary to electrolyze water (somewhat lower than 2 volts) in order to produce any considerable quantity of the constituent gases, yet at pressures materially lower than the critical, a feeble electric current passes through the water, accompanied by polarization, but without any perceptible decomposition and generation of gas. Considerable interest attaches to this phenomenon, because it has been adduced in support of various theories of electrolysis otherwise mutually inconsistent. In our issue of last week a reprint of a paper on the subject by Prof. W. R. Whitney appeared. The essential fact is, however, as pointed out by Prof. Whitney, that the e.m.f. at which electrolysis of water takes place is such as conforms with thermodynamic theory after various corrections have been applied. It takes a certain amount of electric pressure to expend energy on the electrolyzing current sufficient to effect the molecular decomposition and expand the gases against gravitational forces. If a lower voltage could effect this decomposition, an explanation would have to be sought for the delivery of the energy of constituent gases or we would be confronted with an apparent failure in the law of conservation of energy.

The fact that a very feeble decomposition—a sort of microscopic decomposition of water—does occur below the critical voltage, is not a matter of great importance from the standpoint of energetics. The total quantity of energy to be accounted for in the phenomenon is very trivial, and in a physical organization so complex as an electrolytic bath of water including a pair of metallic electrodes, with the vast molecular activities in normal play, the little stock of energy necessary for maintaining the observed polarization current might be borrowed from any one of a variety of stocks, without creating any local evidences of theft that would attract attention, or be readily susceptible of measurement.

The Development of the Electron Idea.

A very noteworthy summary of the electron theory up to date, from the German standpoint, appears, by translation, in this number on page 648. Dr. Kaufmann traces the history of the development of the electron idea. The roots of the idea go back about twenty-five years. The growth of the stem has taken place within the last ten years, and now we have a flourishing plant, and a large literature on the subject. Broadly speaking, the latest theory accounts for inertia, suggests a cause for gravitation, explains the leading phenomena of the spectra of hot gases, and co-ordinates hypothetically a host of minor phenomena that seem at first sight to have no discernible mutual relationship.

The salient discovery is the recent one that the electric charge of a gramme of hydrogen matter is about ten millions of c.g.s. magnetic units, as connected with the phenomena of gaseous discharge, while in electrolysis, the apparent electric charge of a hydrogen gramme is only about ten thousand c.g.s. magnetic units. This unit is the quantity of electricity theoretically charged in a one microfarad condenser under an e.m.f. of ten millions of volts, so that a gramme of hydrogen, or equivalent gramme of other matter, contains an enormous amount of electricity stowed away unobtrusively in its molecules. The inductance of this electricity when set in motion is sufficiently great to account for the mechanical inertia of the mass to which it belongs. If the electrostatic attraction of unlike charges be assumed to be somewhat greater than the repulsion of like charges, then, according to Dr. Kaufmann, gravitation may be explained, only he does not state how he arrives at this result. A not inapt comparison of sizes is offered in the rough ratio that an electron is to a bacillus or bacterion, as is a bacterion to the world at large.

Assuming that experimental tests continue to verify the electronic hypothesis, the discovery of the existence of these infinitesimally small quantities of matter, will remain a monument to the power of scientific research. And finally the process of conduction in metals is referred to ionic meandering just as it is in gases or in electrolytes, except that the ionic ranges and courses are very different in these different cases. The existing inference seems to be that without ions there is no conduction of electricity. We still possess, however, electrostatic induction through space as a process unpre-empted by electrons.

Operation of the Induction Coil.

A paper by Mr. Giovanni Giorgi, recently read before the Italian Electrotechnical Association, deals with the subject of induction coil building. The treatment is theoretical, but with a keen eye towards practical possibilities. There are a number of points of interest in this paper. One is a gem of a graphical method of representing correlated quantities by the aid of inclined cartesian axes, as distinguished from the ordinary perpendicular axes of ordinates and abscissas. The plan of attack is by the suppression and elimination of the secondary winding, whereby attention is concentrated upon the phenomena of the primary circuit. The type of coil which the deductions of the paper favor is a sort of shell transformer, with a narrow air-gap. In fact, the magnetic circuit of the apparatus, as sketched, has two gaps, one inside the coils, and the other outside. The iron core occupies about 80 per cent of the entire volume. Moreover, of the winding space, about three-quarters is given to the secondary coil, and one-quarter to the primary. The air-gap is recommended as being made adjustable. The form here recommended for a Ruhmkorff coil is, therefore, materially different from the classical form, and approaches much closer to a type of alternating-current transformer.

There is no doubt that the reinforcement of the iron core in an induction coil increases the stock of energy associated with a given current strength, and, therefore, potentially available for throwing into the spark-gap, or external circuit, on discharge. The only question is whether the sluggishness of electric action associated with so large a relative volume of iron core, even in a very finely laminated condition, may not more than absorb the advantage of the greater initial stock of energy, by unduly limiting the rate of magnetic collapse, and, therefore, the magnitude of induced secondary e.m.f. Experience in the past with induction coils for high potentials has hitherto established the empirical principle of limiting the quantity of iron core in the spark-coil. The Tesla-Thomson coil, which produces, perhaps, the greatest magnitude of e.m.f. at present attainable, is noteworthy in this respect, because it has no iron core, and the introduction of any iron core within it seems to act prejudicially. Nevertheless, if a preponderance of iron in an induction coil can be made to effect an improvement, the electrotechnical arts will certainly welcome the old Ruhmkorff coil in its new suit of armor.

The paper contains reference to the "weber" as a unit of magnetic flux, in the practical system of ohms, volts and amperes. Thus interpreted, a change rate of flux of one weber-per-second induces one volt per linked-turn. This extension of magnetic units into the practical system is unfortunate, because it tends to make us measure our Ruhmkorff coils, and dynamos, in earth-quadrants as units of length, instead of in centimetres. Moreover, the already authorized magnetic unit of flux, the maxwell, in the C. G. S. system, is in fairly extended use in this country.

AMERICAN ELECTROCHEMICAL SOCIETY.

The programme for the meeting this week in New York of the American Electrochemical Society is of surprising excellence, considering the youth of the body and the absence until its formation of any solidarity in this country among the workers in this branch of electrical and chemical application. Aside, however, from the reading and discussion of papers, the social features of the meetings of the society, which are wisely being given prominence, are of the greatest use. The membership of the society is principally composed of men who have rallied to the youthful industry from diverse walks of life, and the social occasions furnish the opportunity for becoming acquainted and aid in building up that *esprit du corps* so necessary to the well being of professional bodies. The present meeting promises to be more than ordinarily successful in this respect, each evening providing a programme of social entertainment. The arrangements for the banquet on Thursday have been particularly well laid, and with Dr. Nernst as guest of honor and with the presidents of the leading professional bodies of the United States as guests, the occasion will not only add prestige to the society but set an admirable precedent which the older professional bodies will probably not find it well to ignore.

THE VANCOUVER POWER PLANT.

In these days of large and long transmissions it takes something more than ordinary in the way of engineering to cause the slightest general interest. A mere new transmission of 15 or 20 miles at 15,000 or 20,000 volts is deemed hardly worthy of a stick-full in the daily press. But there are some peculiarities in the case of the new Vancouver plant, described elsewhere in this issue, that are worth more than a passing notice. In the first place, the hydraulic arrangements are very unusual. With two lakes as the source of water, the projectors of this plant have tunnelled two and a half miles through a mountain more than 4,000 ft. high in order to use the lakes conjointly and to discharge the larger one through the smaller. A glance at the map shows the very unusual character of this hydraulic procedure better than words can describe it. We wish that our correspondent had given the facts and figures that led to the adoption of so extraordinary a plan. In itself it is tremendously expensive, and must have exceedingly good reasons as an excuse for existence. Ordinary sound practice would dictate merely the electrical union of the powers, particularly as about 8 per cent. of the total head is lost in their combination. Of course, the gradient of the Coquitlam River and the topography about the outlet of the lake may be such as to prevent utilizing its head effectively, but a two and-a-half-mile rock tunnel will pay for a prodigious lot of piping, and it would be most instructive to learn the details that prompted so unusual and drastic a measure as a long rock tunnel. Incidentally, a main power house on the west side of the mountain involves a 2,800-ft. cable span over navigable water, a thing not to be recommended save under severe compulsion.

In the proposed station we find several features of exceptional interest. One in particular is the combination of needle valve and deflecting nozzle in the regulation of the water wheels. The impact wheel has done such sterling service in electrical power transmission plants that it seems almost ungrateful to criticize it, but really the control usually adopted—the deflecting nozzle—is quite the most wasteful device that it has yet entered the mind of man to conceive. Of course, regulation at the end of a long pipe line at nearly 400 ft. head is no joke, but neither is the loss of water, and it is quite certain that the scheme of regulation needs revision. We shall be greatly interested to see how the needle valve answers the purpose in this instance, although the main regulation seems to be still left to the deflecting nozzle. In the past, nozzle valves under such heads have been a constant source of trouble, but they do save water, which is very important when a little water means so much power. Nearly every plant on the Pacific slope uses the deflecting nozzle, with a similar waste of power. We wish that some one would make a careful study of the hydraulic efficiency of a plant so constituted, as might be done in some cases by means of a weir in the tailrace, with a view to determining the actual all-day hydraulic efficiency under these usual conditions. Unless we greatly err, the figure would be shocking to a degree which the average engineer hardly could bring himself to realize. Of course, sometimes it happens that the water would run to waste if not used, and if all the water be efficiently employed at the peak, the case is not so bad.

But on the other hand, at these high heads the storage of water is often very simple and cheap, and if the waste could be stored and used at the peak, the earning power of the plant might be very largely increased. On the coast a good water supply is nearly or quite as good as a gold mine, and economy in its use ought to be a step so obvious as to need no discussion. As to the general equipment of the big power house, one feature should be mentioned with particular commendation. This is the plan of installing the transformers, high-voltage switches, lightning arresters and the like in a separate building from the generators as a safety precaution. This is good practice, but let our Vancouver friends beware of making the Niagara mistake of running all the cables so that an accident to one will involve the others. Conduit and insulators are cheap, and the experience at Niagara ought to prevent any mistaken notion of order and symmetry from exposing the cables to a common danger. In fact, the lightning arresters need a separate fire-proof pen of their own more than any other class of apparatus, but oil transformers must be treated with respect on general principles and should be so placed that they cannot easily involve other apparatus in case of accident. The lines proposed have the excellent feature of being in duplicate, as all important lines should be. We are glad to note, too, that the apparatus is of the 60-cycle type, which has shown itself quite able to cope with all practical conditions yet encountered in power transmission. The low-cycle fad has never obtained a strong hold on the Pacific coast, where the really serious problems of long-distance transmission have been worked out. On the whole, this Vancouver plant is a capital type of the radical and daring engineering work that put the Coast in the front rank of progress, while the East was pottering about with fine-drawn theories and nursing conservative precedents.

Professor Walther Nernst.

Prof. Nernst, of Gottingen University, is in attendance at the meeting the present week in New York of the American Electrochemical Society, and on Thursday evening is to be a guest at the banquet of the society. As one of the originators and exponents of the modern theory of electrochemistry, which the new society is doing so much toward advancing in this country, and as the inventor of the electrolytic glow lamp, the distinguished professor needs but few words of introduction to our readers.

Prof. Walther Nernst was born in the neighborhood of Graudenz, in West Prussia, in 1864. He was a student of Prof. F. Kohlrausch, who has since become the president of the Reichsanstalt, and attended the Universities in Gratz, Wurtzburg, Zurich and Berlin. He was Privat Docent at Leipzig under Prof. W. Ostwald at the same time that Arrhenius was also at Leipzig. These two young men began life work in electrochemistry at this time and were much in each other's company, and their work is interlinked.

In 1895 Prof. Nernst, who had become full professor of electrochemistry at Gottingen, founded the first institute for this science. In the beginning of the year 1897, he began investigations of the theory of the light emission of the Welsbach mantle, and this led up in the same year to the discovery of the electrolytic light, the first patents for which were applied for at the end of the year 1897.

Prof. Nernst came to this country in the spring of 1898 for the first time and arranged for the development of his lamps, under the control of Mr. George Westinghouse. His example and personality have inspired many young investigators to dedicate their life to the work of discovery, among whom may be named Dr. Dolezalek, whose classic work on the accumulator is dedicated to Prof. Nernst.

PROF. WALTHER NERNST.

Aluminum Litigation.

Last week there was argued in New York before Judges Wallace, Lacombe and Coxe the case of the Cowles Electric Smelting & Aluminum Company vs. the Pittsburg Reduction Company, involving the Bradley electric furnace patent. This patent claims the electrochemical process consisting of the fusion by electric current of the charge in an electric furnace, the regulation of the current to the requirements of the fused bath, and the fusing of new matter as added to the bath. The case was on appeal from the United States Circuit Court at Buffalo. The present suit dates from 1879 and the issue was decided against the Cowles Company by Judge Hazel in December, 1900.

On April 4, Judge Wing, of the United States Circuit Court of the Eastern District of the Northern District of Ohio, handed down a decision which reopens the case of the Pittsburg Reduction Company vs. the Cowles Electric Smelting & Aluminum Company, the issue being the Hall patent. In a suit under this patent the Cowles Company in 1893 were declared to infringe the Hall process, and damages to the amount of several hundred thousand dollars have been assessed against the company under this decision. Judge Wing, in his decision, said that Judge Taft, when he refused a former petition for a rehearing, was much influenced by the fact, as it then appeared to him from the proofs used, that Hall, by his process, had lowered the cost of reduction of aluminum in a most marked degree. Important testimony, however, is proposed to be offered on the question as to whether or not internal heating sufficient to fuse is necessarily incident to the use of electric current in electrolysis; and there are other important questions raised by consideration of the proposed new testimony, the solution of which seems essential to a correct final decree. The court added that while it fully appreciates the weight and importance which should be given to a decision of so able a jurist as Judge Taft, it is of the opinion that, had he the case before him as now presented upon the present petition, unless restrained by the consideration of some imperative rule of practice in equity, he would give the defendant the opportunity of supplementing his proof in the manner prayed for.

As a condition to the granting of the petition, and of the defendant being allowed to reopen the cause and adduce new proof, the court required that all costs taxed in connection with the hearing before the master in ascertainment of damages and profits, should first be paid by the defendants. Upon the payment of such costs, an order may be drawn, providing for the reopening of the cause and the rehearing thereof, the defendant to be allowed to adduce such additional proof as he has set forth in his petition for a rehearing.

Chicago Meeting of the A. I. E. E. on High Tension Lines.

The Chicago branch of the American Institute of Electrical Engineers held a meeting Tuesday, April 7, to take up the subject of "High tension Lines." The paper by Mr. Ralph D. Mershon on "Mechanical Specifications for a Proposed Standard Insulator Pin" was read by Mr. W. G. Carlton and an abstract of the communicated discussions also presented. By way of discussion, Mr. Carlton spoke of the advantages to purchasers if high tension insulator pins could be obtained regularly in the market without special orders; something which cannot be done when there are no standards.

Mr. H. M. Lyman read the paper by Mr. F. O. Blackwell on the "Testing of Insulators" and also the discussion communicated thereon. Mr. Ernest Gonzenbach, in discussing the paper, said that while glass was condemned by some engineers, it was as warmly endorsed by others; and that as long as some of the highest voltage lines working commercially were equipped with glass it could certainly not be claimed that glass was not successful. Prof. P. B. Woodworth said that many glass insulators had been submitted to him for puncture test. He had found that the defective glass insulators were almost entirely those that had severe internal strains due to uneven cooling. Such insulators would fly all to pieces under a puncture test, and if their defective spots were pried at with a knife they would fly to pieces in the same way. They were evidently under interval mechanical tension. Such defective insulators could be sorted out by inspection, without test. Mr. H. H. Wait read the paper on "Transposition and Relative Location of Power and Telephone Wires," by Mr. Paul M. Lincoln. Mr. J. R. Cravath read the paper by Mr. C. C. Chesney on "Burning of Wooden Pins on High-Tension Transmission Lines," and also abstracted the discussions communicated on that paper. He further called attention to the fact that as long as the leakage current permitted by the insulator is sufficient in volume to burn a pin, the trouble can only be removed from the pin to some other point on the cross arm if iron pins are to be used, with wooden cross arms. The only final solution of the trouble was an insulator which would not leak or an iron pole line, and the latter is too expensive for common use in this country unless the new plan of the Guanajuato transmission were to be followed and the lines run on steel towers with spans of 400 or 500 ft. The burning of pins due to salt sea mist had been exceedingly troublesome on one plant that he knew of, but had been overcome by the use of boxes which prevent the drifting of fog and dust against the petticoat of the insulator.

At a meeting of the Executive Committee of the Chicago branch held before the meeting, action was taken on the resignation of Mr. R. H. Peirce as local secretary by deciding to recommend to the Chicago membership the nomination of Mr. Peter Junkersfeld, of the Chicago Edison Company, as local secretary.

This recommendation was endorsed by a vote of the members and referred to the council in New York for final action. Mr. Junkersfeld has been active in his work for the Institute and it is felt that the selection is an excellent one. The recent activity and development in Institute work in Chicago has rendered the post of local secretary a most important one.

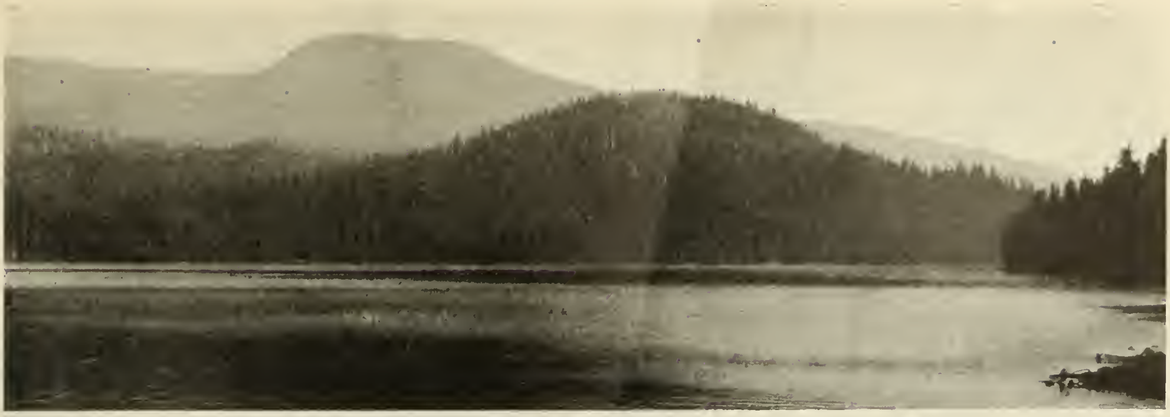


Fig. 1.—Coquitlam Lake from Tunnel Portal, Looking Towards Outlet of Lake.

Vancouver Transmission Plant.

By Wyatt H. Allen.

In the early summer of 1902 work was commenced on the hydro-electric transmission plant of the Vancouver Power Company, Limited, near Vancouver, B. C., and while the completion of the undertaking is yet a matter of a year or more, there are many items of interest connected with the construction in progress and the plans for the completed equipment.

The installation of the plant is for the purpose of furnishing light and power for operating the street and interurban railways in Vancouver, New Westminster and Burnaby, and will ultimately have a capacity of 24,000 hp, for which the hydraulic end of the plant is being developed. The initial installation of machinery will have a capacity of 6,000 hp.

The sources of water supply for power are two very deep glacial lakes, known as Coquitlam and Trout, or Lake Beautiful. Their situation with respect to one another and to Vancouver is shown on the accompanying map. The first mentioned lake has an area of 2,300 acres, and is at an elevation of 32 ft. above the latter, which has an area of 460 acres. Both lakes are surrounded to their outlets by rugged mountains, rising abruptly from the shore lines, and between the two towers a granite range, 4,000 ft. above the water.

It is through this range that a tunnel, 13,000 ft., or nearly 2½ miles in length, is being driven to connect the two lakes for the purpose of using the stored waters of Coquitlam for the main supply and Trout Lake as a balancing reservoir.

Both lakes will be controlled by dams at their outlets, and from the dam at Trout Lake steel pipe lines will convey the water under an effective head of 390 ft to the power station, located just above high tide mark on the shore of the North Arm of Burrard Inlet, into which the water wheels will discharge.

The dam at the outlet of Coquitlam Lake will raise the water 12 ft. above low water level. It will be constructed of rock-filled timber crib, a type which has proven thoroughly successful in many mountain streams. The materials are provided by nature in ample quantity at the point where they will be used. The dam will be planked and constructed with an apron, extending far enough down stream to prevent any back cutting action by the water flowing over.

The tunnel is 9 ft. wide by 9 ft. in height, with rounded corners, and is being driven from both ends by compressed air drills. At the portals open cuts were carried into the solid rock, and at one end, where the depth of the open cut became inconvenient, a tunnel was driven for a short distance, temporarily timbered, and the ground above the roof of the tunnel stoped down through chutes in the roof directly into the car. Before the machine drills and air compressors arrived, hand drills were used, and the average progress was two feet per day in each heading, but since the advent of the drilling machinery this has been increased to 10 ft per day. A system of electric haulage has been installed to facilitate the rapid and economical removal of the muck. The plant at each end includes a 100-hp boiler, 60-kw, 500-volt generator and a four-drill, two-stage air compressor.

Ventilation is provided for by a 12-in. galvanized iron pipe, through which the air is exhausted by means of an air jet under 100 lbs. pressure, acting as an ejector. This is only put in operation for a few minutes after each blast to remove the smoke, the exhaust from the air drills furnishing all the fresh air necessary at other times.

A concrete dam 350 ft. long on the crest and 50 ft. high is now in course of construction across the outlet from Trout Lake, and arrangements have been made for bringing ten 54-in. pipe lines from the dam, but only three lines will be completed at the present time. Each steel pipe line will be 1,600 ft. in length, 48 in. in diameter at the upper end, 44 in. in the middle section, and 42 in. at the power station. Close to the power station site on the shore of the North Arm, a wharf has been erected, at which steamers and barges from Vancouver may discharge their freight on to the cars of an incline tramway, built from the wharf to the tunnel portal at Trout Lake. By this means all material for the camp at the tunnel portal and for the dam and pipe lines is delivered rapidly and with the least possible handling.

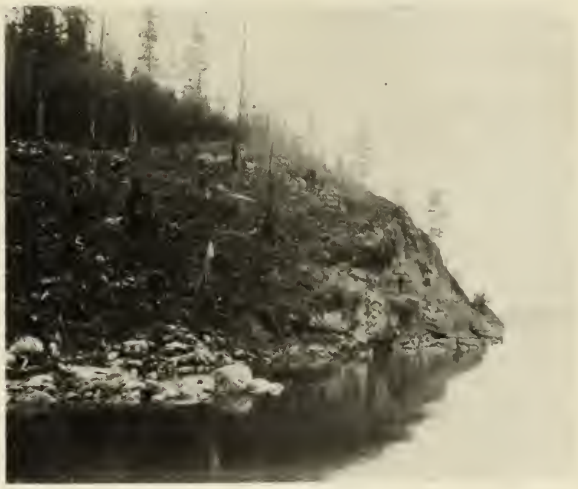


FIG. 2.—POWER HOUSE SITE.

To deliver material to the tunnel camp at the Coquitlam portal is quite a different undertaking, since it can only be reached by wagon road from a station on the Canadian Pacific Railway, ten miles distant. For the greater part of the distance the road penetrates the dense forests, and in winter can be kept in a passable condition only by constant attention.

The power station will be constructed of granite masonry and much of the material excavated to obtain a building flat will be used in the walls.

The water wheel equipment will consist of three sets of impulse wheels, made by the Pelton Water Wheel Company, each set capable of developing a maximum of 3,000 hp at 200 r.p.m., under the effective head of 390 ft., and one set consisting of 200-hp wheels for driving

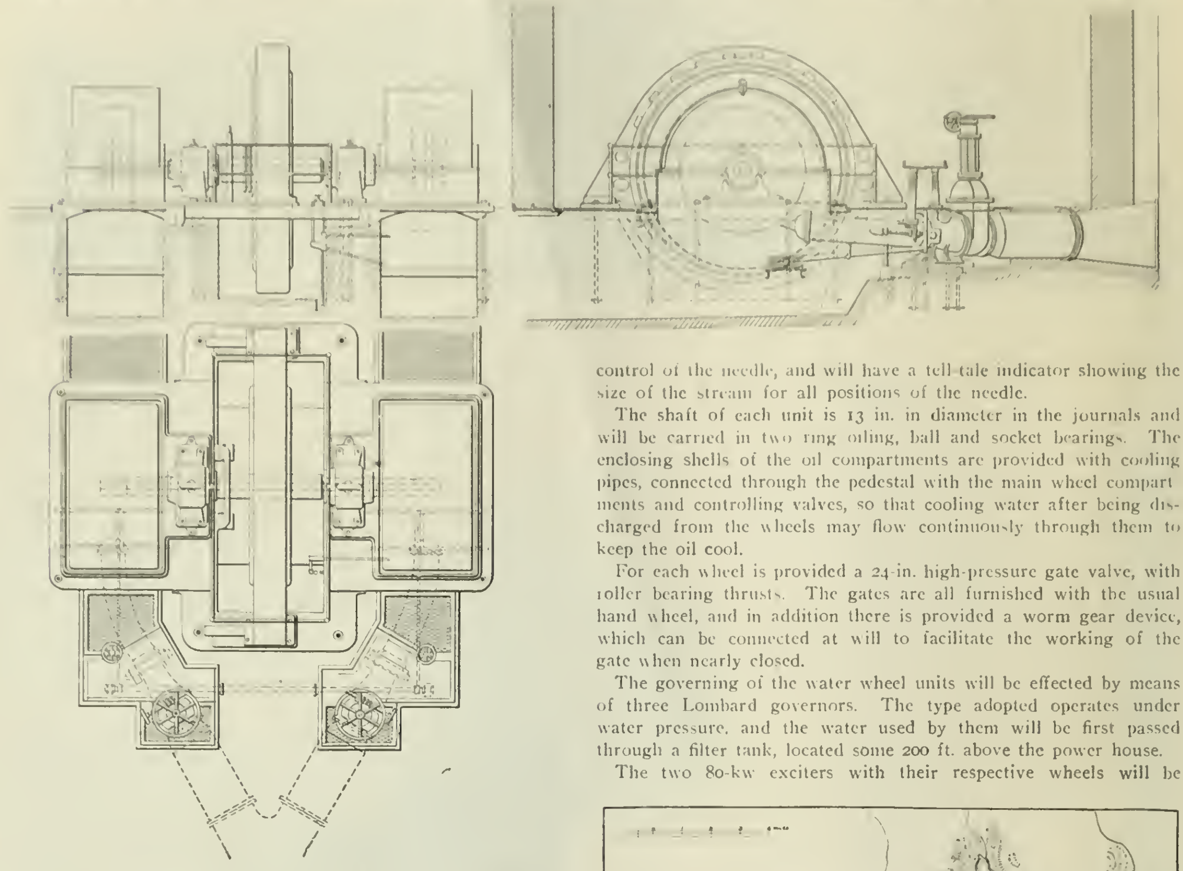
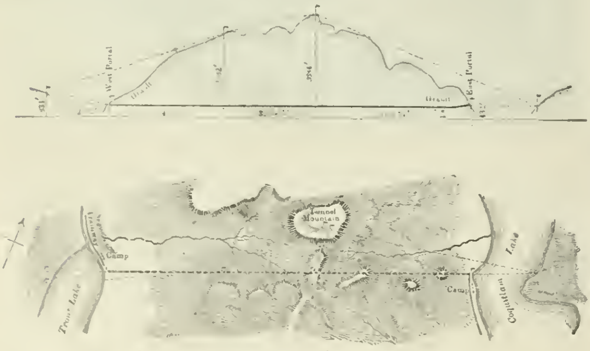


FIG. 3.—ELEVATIONS AND PLAN OF WATER WHEELS AND GENERATORS.

the exciters at 380 r.p.m. Each of the main units will consist of two overhung wheels, one mounted on each end of the shaft of a 1,500-kw Westinghouse engine type rotating field generator. The wheel centers are of the steel disc type, and fitted with cast steel buckets secured to the wheel rim by turned steel bolts driven in reamed holes. The hubs of the wheel centers are bored out for a press fit on a shaft 12 in. in diameter, and will be pressed on in place at the power station. Each wheel will be enclosed in a cast-iron housing, and provided with centrifugal discs and pockets, and suitable drain pipes for preventing leakage of water along the shaft.

Probably the most interesting feature of the equipment is the single combination, deflecting and needle regulating nozzle provided for each water wheel, and fitted with a high-pressure ball joint, which is leather-packed, and rocks on forged steel trunnion bolts. The joint permits of effecting regulation by deflecting the nozzle by governor or hand, independent of the control of the needle, thus permitting of load and speed variations, independent of any change of velocity in the pipe line. The deflecting portion of the nozzle is counterbalanced by hydraulic pressure, so that quick operation can be secured from the governor on account of the absence of inertia of heavy counterbalanced weights. The taper pipe of the nozzle is provided with the necessary geared connections for hand control of the needle, and will have a tell-tale indicator showing the size of the stream for all positions of the needle.



Plan of Tunnel

FIG. 4.—CROSS-SECTION AND PLAN OF TUNNEL.

The shaft of each unit is 13 in. in diameter in the journals and will be carried in two ring oiling, ball and socket bearings. The enclosing shells of the oil compartments are provided with cooling pipes, connected through the pedestal with the main wheel compartments and controlling valves, so that cooling water after being discharged from the wheels may flow continuously through them to keep the oil cool.

For each wheel is provided a 24-in. high-pressure gate valve, with roller bearing thrusts. The gates are all furnished with the usual hand wheel, and in addition there is provided a worm gear device, which can be connected at will to facilitate the working of the gate when nearly closed.

The governing of the water wheel units will be effected by means of three Lombard governors. The type adopted operates under water pressure, and the water used by them will be first passed through a filter tank, located some 200 ft. above the power house.

The two 80-kw exciters with their respective wheels will be mounted on a common bed plate, with a 120-hp induction motor between the two exciters. Each exciter will be provided with a pair of jaw clutch couplings and shifter rigging, so that either water wheel will drive its exciter and the induction motor at the same time. The motor leads are connected to the main bus-bars, and the motor

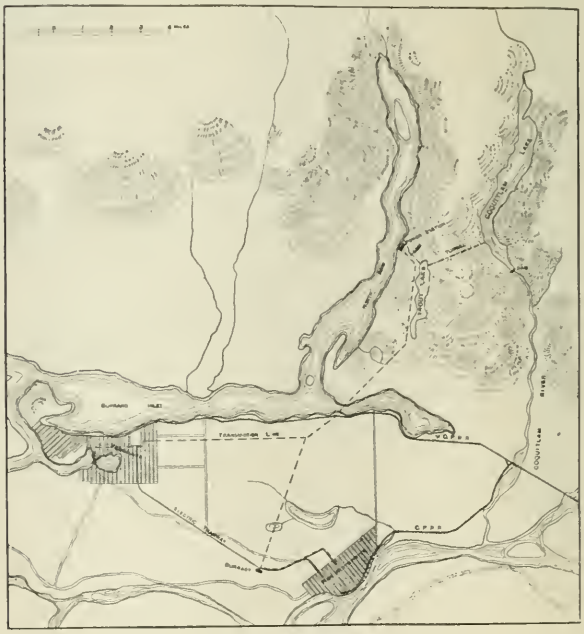


FIG. 5.—MAP OF PROPOSED DEVELOPMENT.

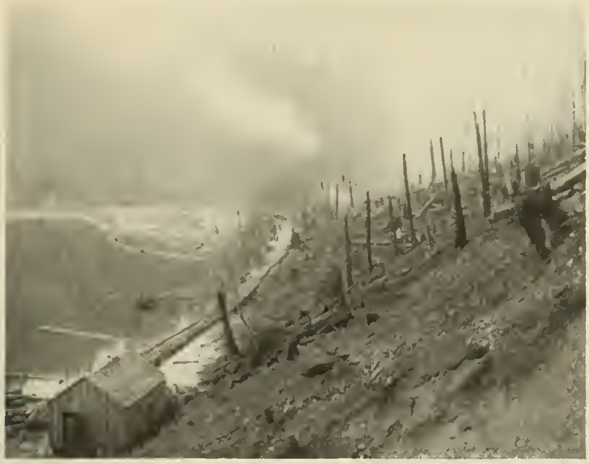


FIG. 6.—TUNNEL CAMP, PLANT AND BUILDINGS; TROUT LAKE PORTAL JUST ABOVE TUNNEL PORTAL.

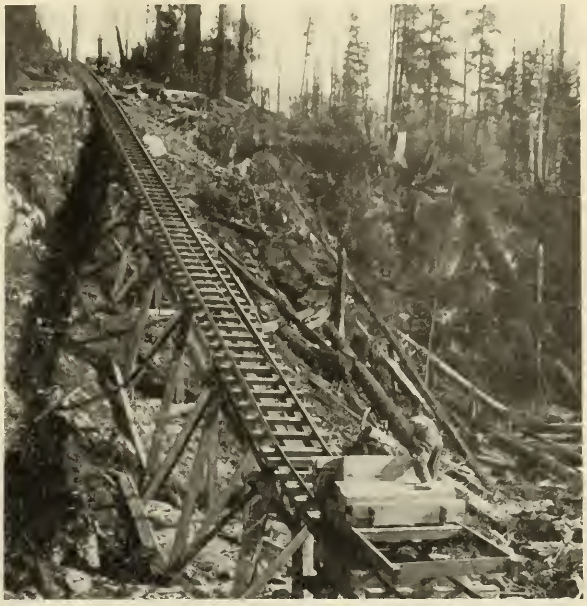


FIG. 9.—VIEW OF INCLINED TRAMWAY FROM WHARF.

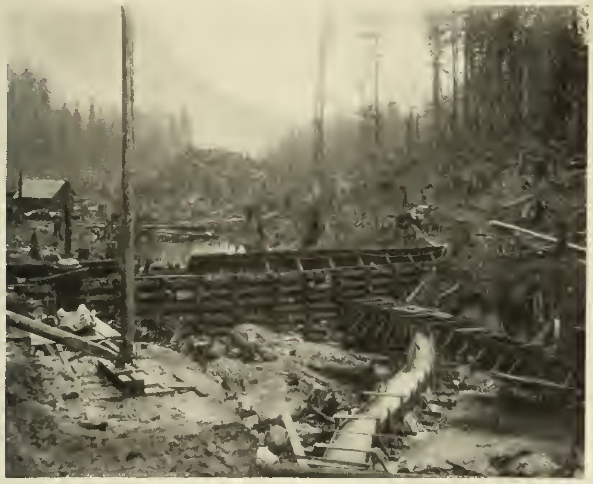


FIG. 7.—TEMPORARY CRIB DAM.

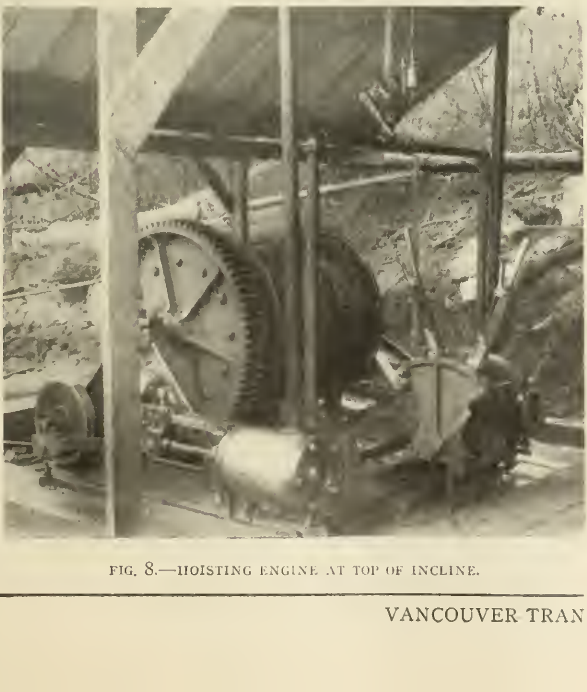


FIG. 8.—HOISTING ENGINE AT TOP OF INCLINE.

FIG. 10.—WAGON ROAD TO COQUITLAM PORTAL.

VANCOUVER TRANSMISSION PLANT.

is normally run at synchronous speed, neither giving nor taking electric power. Should the exciter water wheel nozzle become clogged and the speed fall, the motor immediately takes power from the bus bars and drives the exciter until the nozzle is cleared by the attendant, or the other exciter unit started up. The deflecting nozzles of the exciters are arranged for hand regulation from the exterior of the wheel case through worm gearing.

The contract for the entire electrical equipment has been awarded to the Westinghouse Electric & Manufacturing Company, and includes the apparatus for the generating station and the sub-stations at Vancouver and Burnaby.

The three 1,500 kw, 60-cycle, 2,200-volt alternators for the power station are of the rotating field type, and arranged for a movement of the external frame in a direction parallel to the shaft to allow access to the windings.

For the control of the apparatus at the power station, the switchboard will contain nine panels, one for the induction motor and one for each exciter, three panels for control of the main units, and three for the control of the three sets of 550-kw air-cooled transformers, with their motor blower sets, consisting of 20-hp motors and 110-in. Sturtevant fans.

The step-up transformers, static interrupters, high-potential switches and lightning arresters will be installed in a separate building located on the hill above and just back of the power house. As the static interrupters contain oil, they will be separated from the main room and each other by brick partitions.

The machinery for the sub-stations includes the usual transformers, rotary converters, switchboards, etc., for the reception and distribution of transmitted power.

The route of the transmission lines to Vancouver is 16 miles in length, and involves the crossing of a navigable arm of Burrard Inlet, with a span of 2,800 ft. On one side two steel towers 140 ft. in height will be erected to support twelve 9-16 in. galvanized plow steel cables with wire centers, but on the opposite side there is high ground and the cables will be supported on poles.

Two independent transmission lines, each consisting of two 3-wire circuits of No. 2 copper, will be constructed on the same right of way, to a point near Barnet. From here one line will be continued to Vancouver and the other to Burnaby.

A transmission line already exists between Burnaby and Vancouver, which will be reconstructed to carry 20,000 volts, the pressure to be used on the new lines, and a new line will be built from Burnaby to New Westminster, thus providing what is in effect a double transmission line over the entire distance between the power station and each of the sub-stations.

Mr. Wynn Meredith, of the Engineering Offices, of San Francisco, is directing the entire work, assisted by Messrs. Hermon and Burwell, civil engineers, of Vancouver.

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St. Louis Exposition Congresses.

The administrative board of educators and scientists appointed to organize and conduct the international congresses to be held in connection with the World's Fair in St. Louis in 1904, met last week at the Eastern offices of the exhibition, at 23 West Thirty-fourth Street, New York City. There were present President Butler, of Columbia University; President Harper, University of Chicago; President Jesse, University of Missouri; Dr. Herbert Putnam, Librarian of Congress, and Frederick W. Holls, member of The Hague Tribunal. The board met to consider the report of the Committee on the Congress of Arts and Science, which had been in session the two preceding days. The members of the committee met with the board. They are: Prof. Simon Newcomb, Washington; Prof. Hugo Münsterberg, Harvard University, and Prof. Albion W. Small, University of Chicago. Howard J. Rogers, Director of Congresses, was also present.

There is to be one "Congress of Arts and Science," but there will be 128 sections in the congress, and for ordinary purposes there will be that many congresses, although they are grouped together, as showing the unity of knowledge.

The board adjourned to meet in St. Louis on April 29, when the final announcement of the schedules, with the names of those who will take part in the exercises at the meetings of the various sections, will be made.

The Development of the Electron Idea.*

By W. Kaufmann.

Translated by A. P. Wills.

It is not an uncommon occurrence in the history of science that ideas, which have long been held as antiquated and discarded, suddenly make their appearance again in a more or less modified form. The revolution of our ideas in the course of the last decade concerning the electrical phenomena about which I have the honor to report to-day, offers an extremely interesting example of this.

The modern theory of electrical phenomena and the closely allied theory of optical phenomena, which may be affiliated under the name electrontheory, indicate to a certain degree a return to ideas enunciated by Wilhelm Weber and by Zollner in the years between 1860 and 1870, but modified through the results of the researches of Maxwell and Hertz. W. Weber conceived electrical phenomena as the action of electrical particles, so-called electrical atoms, whose mutual influence depended not only on their position but also upon their relative velocities and accelerations. Now, although Weber, by means of his assumption, succeeded in describing perfectly the then known electro-dynamical processes, and even in giving a qualitatively useful explanation of the proportionality between electrical conduction and heat conduction in metals as well as for Ampere's molecular currents in magnets, still, his theory was far from becoming the common property of the physicists of the time. The reason for this may well be sought in the fact that most of the laws of electro-dynamics expressed in the form of differential equations show up much more conveniently and simply than the Weber formulæ; furthermore, Weber made no attempt to calculate the magnitude of the electrical atoms conceived by him or to test the results of calculation through their application to other molecular processes. But finally, it came about, through the work of Faraday and Maxwell, that every one was convinced that in electrical and magnetic process a propagation requiring time is involved instead of immediate action at a distance, a claim, moreover, which Gauss established in a letter to Weber in 1845, but which was not satisfied by Weber's law. The articles of Maxwell, which had already appeared in 1861-62, and which he collected in his celebrated "Treatise on Electricity and Magnetism," in 1873, and the striking experimental confirmation of Maxwell's results by Hertz from 1887 on, appear capable of taking the last vestige of right to existence from Weber's notions.

In fact, the formulæ of Maxwell represented the fundamental electrical phenomena just as well as those founded on the notion of action at a distance while the atomic ideas are not at all involved in these formulæ; and the recently discovered Hertzian waves could only be represented on Maxwell's theory.

It appears as though this striking result had blinded investigators as to the insufficiency of Maxwell's theory as regards the more delicate optical phenomena. According to Maxwell light vibrations should not be regarded as mechanical vibrations of the ether, but as electrical vibrations, and the two constants by means of which Maxwell defined the electrical and magnetic behavior of bodies (the dielectric constant and the magnetization constant) must also be criteria of their properties of light refraction. Now, although the relation demanded by Maxwell (namely, that the index of refraction be equal to the square root of the dielectric constant) was tolerably well satisfied by many bodies, still, on the other, hand, many bodies, water, for example, showed such tremendous deviations that the theory in its original form was proved insufficient. The question of the dependance of the refractive index upon the color came in here, for which the original theory gave no explanation.

Now, Helmholtz, after a previous yet unsatisfactory attempt of Sellmeier, in 1874, framed a mechanical theory of color dispersion, whose basis consisted in this: *That the mass molecules have certain vibrations of their own.*

In the year 1880, at a time, when physicists in Germany still scarcely believed in Maxwell's electromagnetic theory of light, H. A. Lorentz showed that the principles of an electromagnetic theory of dispersion could be obtained quite analogously to the earlier mechanical theories if only every molecule be considered as the origin of electrical vibrations of a fixed period. He says: "There may be in each particle of a body numerous points charged with electricity of which, however, only one with the charge e and the mass μ may be movable." With the aid of this fundamental assumption of elementary charged particles capable of vibration, Lorentz derived the equations of dispersion.

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* The original of this paper was presented in the form of an address before the Gesellschaft Deutscher Naturforscher und Ärzte at Hamburg, Sept. 25, 1901. This translation has been authorized by Dr. Kaufmann.

Now the next question is: How may we assume the presence of electrical particles in a transparent body? The answer leads to a new field of phenomena which only with difficulty fits into the theory of Maxwell. I refer to the processes of electrolysis. According to Faraday's law, when an electric current flows through an electrolyte, for every unit of current which flows a chemically equivalent quantity of matter is separated out on the electrodes. The process can be regarded as though each chemical valence of each of the migrating ions in the electrolyte were connected with an entirely determinate invariable amount of positive or negative electricity.

In an address at a memorial to Michael Faraday in 1881, H. V. Helmholtz asserted that we must admit, from Faraday's law, the existence of electrical atoms. Since the charged chemical atoms designated by Faraday as ions (i. e., migrating) are separated on the electrodes as neutral substances, there must take place there a surrender of the charges, or a partial exchange with charges of the opposite sign. During this process, which cannot take place instantaneously, these charges must be capable of a separate existence, at least for a short time; what is more natural than to regard this continuously equal unit of charge of a valence as an elementary quantity of electricity, as an electrical atom? And when a neutral molecule, NaCl (sodium chloride) for instance, dissolved in water breaks up into positively charged Na and negatively charged Cl, it is most probable that the sodium and the chlorine atom each had its charge before, and that these charges remained undetected because the positive charge and negative charge were equally large. Now, if we imagine a ray of light to traverse a NaCl crystal, then must the charges and the atoms connected with them come into vibration and influence the light motion. *The electrolytic valence charges are, therefore, those which we have to regard in transparent bodies as the vibrating electrical particles* (whose forces of attraction, as Helmholtz pointed out, make up by far the greatest part of chemically related forces).

Although, as before mentioned, the ground lot for the structure of the electromagnetic theory of light had already been indicated by H. A. Lorentz and even, suggestively, much earlier by W. Weber, it still needed a full decade before physicists, stimulated meanwhile by the discoveries made by H. Hertz, began to get the building stones together and to build. In the years from 1890 to 1893 a series of researches appeared by F. Richarz, H. Ebert, G. Johnson Stoney, which in large measure had to do with the mechanism of light emission from glowing vapors and in which from the standpoint of the kinetic theory of gases it was attempted to determine the magnitude of the elemental electrical quantity supposed by Helmholtz, and for which Stoney proposed the generally used name, electron.

The result of these calculations is of importance in so far as it shows us that the numbers found contain no contradiction with other knowledge.

For example: B. H. Ebert showed that the amplitude of vibration of an electron in glowing sodium vapor needs to be only a small fraction of the diameter of a molecule in order to excite a radiation of the absolute intensity determined by Wiedermann.

The method of calculating the quantity of electricity contained in the electron is very simple. The quantity of electricity necessary for the electrolytic deposition of 1 c.cm of any monotomic gas is divided by the number of gas molecules contained in 1 c.cm. On account of the uncertainty of this last number one can only say that *an electron contains about* 10^{-10} *electrostatic units.*

The value of this result were very problematical had not a whole series of other entirely different methods (which will be entered into to some extent later) led to quite similar values.

While it was thus being demonstrated that the observed phenomena were compatible in order of magnitude with the assumption of vibrating electron charges, two independent researches appeared through which the electromagnetic theory of light was made a complete structure. Concerning these researches the first by v. Helmholtz was concerned only with the special question of color dispersion in absorbing media; the other by H. A. Lorentz goes decidedly further. Here it is shown how through the assumption of vibrations of charged particles in transparent bodies all obstacles disappear which oppose a satisfactory explanation of the propagation of light in moving bodies as, for example, the aberration of starlight. Lorentz's theory allows Maxwell's equations for free ether to remain unchanged. A material body influences optical, as electrical processes, only through the moving charges present within it, while in the ether filling the interspaces everything remains unchanged. There is, therefore, no longer, according to Lorentz, a "dielectric constant" as a fundamental idea, as with Maxwell. It becomes a derived idea; and one also sees immediately that for rapid vibrations where the inertia of the vibrating charges comes into consideration it has no longer any meaning. The same holds mutatis mutandis for the constant of magnetization.

By virtue alone of the ease with which the theory of Lorentz explains the phenomena of dispersion and aberration, a direct proof of its correctness is scarcely necessary. At the same time this ought not to be deferred.

In 1896, P. Zeeman, a student of Lorentz, discovered a phenomenon, the existence of which Faraday had already (1862) sought in vain.

If one brings a glowing vapor, a sodium flame, for instance, into a strong magnetic field, the spectrum lines of the vapor show peculiar changes consisting essentially in a doubling or trebling of the lines according to the direction from which the phenomenon is viewed; changes which, according to the theory of Lorentz, are completely predicted.

Further, the Zeeman phenomenon permitted the determination of the material masses connected with the vibrating charges with a result which is somewhat striking: *the vibrating electron is always negatively charged, while the positive electron is at rest; the ratio of charge to mass amounts to 17,000,000 El. M. U. per gram; now,* since a gram of hydrogen, that is, a gram valence, contains only 9,650 El. M. U., the mass connected with the vibrating electron amounts to only the two-thousandth part of an atom of hydrogen. The assumption, almost tacitly introduced originally, that the whole ion that is chemical atom plus valence charge vibrates, must therefore be done away with; we must suppose that the charge in a light omitting molecule has an independent motion, just as in electrolytic deposition at the electrodes of an electrolytic cell; and that the mass *involved in the Zeeman phenomenon is that of the electron itself.*

Accordingly, a point of view is attained which nearly coincides with the old assumption of Weber, but, of course, with the important difference that in place of immediate action at a distance there has appeared propagative action through the ether; and that we now possess a fully determinate numerical representation of the magnitude of the electrical atoms. Still another difference, as regards Weber, must be brought out here. Weber assumed at random, in his theoretical considerations, the positive particles as the freely movable ones. But now, on account of the Zeeman effect, we have always to assign this place to the negative particles. Moreover, it has happened that in other phenomena in which electrons come into consideration *the negative ion always enters as the freely movable one;* of some of these phenomena we shall learn hereafter. As to the question whence this remarkable dissymmetry originates, we must await the decision of the future as to whether it will sometime be possible to recognize the free positive electron, or if, perhaps, in place of the dualistic a unitary conception of electricity has to be adopted.

There soon followed upon the development, just sketched in, of the electron idea in the domain of the theory of light a wholly similar one in the domain of purely electrical phenomena.

Physicists for a long time had tried to consider electric discharges in gases as a process related to that of electrolysis. It was W. Giese who first lent important support to this hypothesis through investigations on conduction in gas flames, and who also sought to explain conduction in metals through the migration of ions.

But before all, it was to the so-called cathode rays that physicists now devoted the greatest attention partly on account of the resulting discovery of Röntgen rays toward the end of 1895. Plücker and Hittorf were the first to study accurately the peculiar fluorescence of the glass walls in very highly exhausted discharge tubes. In the course of further investigations, in which E. Goldstein accomplished so much, it appeared that a peculiar kind of radiation must be considered; this proceeds from the negative electrode, that is, the cathode of the tube, and on this account Goldstein proposed the name cathode rays. Crookes attempted to explain the behavior of these rays in a magnetic field, then heat actions and then supposed mechanical effects on the assumption that the rays consist of gas molecules which, charged negatively at the cathode, were propelled into the tube after the manner of the "electric dancing spheres." In fact, most of the observed phenomena may be tolerably well interpreted on this hypothesis.

More accurate investigations, namely, numerical tests, very soon showed, however, the insufficiency of Crookes's hypothesis, at least in its original form. Thereupon, unfortunately, physicists in Germany "poured out the child with the bath", they discarded the whole hypothesis because the entirely special conception that it had to do with molecules charged through contact proved false. But they were not in a position to furnish anything better in its place; the more facts were heaped up the more problematical became the cathode rays, and finally it went so far that it was considered unworthy of a reputable physicist to occupy himself with these phenomena so inaccessible of quantitative and theoretical treatment. Suddenly there came of all enigmas the greatest: *the discovery of the X rays by Röntgen*, and with it a new spur to take in hand the solution of many questions. The pains taken ought soon to be crowned with success.

The investigations of E. Wiechert, W. Kaufmann and E. Aschinass, J. J. Thomson, W. Wien, Ph. Lenard, Th. des Coudres all indicated that only a modification of Crookes's hypothesis was required to furnish a non-contradictory explanation of almost all the phenomena. One only needs to consider the cathode rays as charged mass particles, *which are much smaller than ordinary atoms*. A whole series of measurable properties of cathode rays makes it possible to determine how great the charge is on these particles per gramme mass. The result was somewhat different with different observers; it varied between 7 and 19 El. M. U. per gram; but in any case these numbers lie so near that found from the Zeeman effect that one can unquestionably agree with the hypothesis, first enunciated by E. Wiechert, that we have to do in both cases with the same particles, namely, the electrons. We have, therefore, bodily before us, so to speak, the electrons in the cathode rays, which in optical phenomena lead a somewhat hidden existence.

A whole series of results of experiment was now capable of explanation in a very simple manner. Such an electron flying with tremendous velocity (according to the direct measurements of Wiechert, ⅕ to ⅓ that of light, depending on the applied force) must, when it rebounds from a fixed body, send out an electrical wave of explosive nature into space, exactly as a striking projectile sends out a sound wave: we have valid grounds for the assumption that Röntgen rays are such waves. Furthermore, if the electrons fly off from the surface of the cathode, then they must have moved from within the cathode to the surface; *that is, electrical conduction in metals consists also in a migration of electrons*. While in liquid electrolytes the electron always appears connected with a material atom as an "ion," in metals we have to do with free wandering electrons. This electron theory of metals, of which we have to consider W. Weber the author, has recently been so far worked out mathematically by E. Riecke and P. Drude that it permits a trial at the hands of experiment; the number found for the ratio between electrical and heat conduction in metals agrees to a few per cent. with those observed; moreover, the optical behavior of metals seems, so far as the observations go, to stand in good agreement with this theory, and furthermore, it has been shown by Ph. Lenard that through radiation of ultra-violet light upon a metal surface the electrons can be brought into such strong vibration that they fly off from the surface with great velocity and then show a wholly similar behavior to the ordinary cathode rays produced by discharges.

Let us consider finally the conduction in any gas that is made conducting through the passage of Röntgen rays or ultra-violet light or through heating; here again it appears that an explanation, free from objections, of the numerous results which have been obtained by J. J. Thomson and his students, is only possible on the assumption of migrating particles in the gas; from certain differences in the behavior of the positive and negative particles in these processes, it appears that the negative ions are principally the free ions; most of these, however, after a short migration, are caught up by gas molecules, and loaded by these lose a large part of their original mobility. The positive particles after the splitting off of a negative electron from the molecule, remain in a state of rest. The point of view sketched in above completely ignores the objection which formerly physicists sometimes believed to refute the ion theory for conducting gases. How can, they asked, a monotomic gas, mercury vapor for example, dissociate into ions? *Into electrolytic ions certainly not, but into a positively charged ion and a negative electron. Both together form the neutral monotomic molecule.* J. J. Thomson has succeeded, through observations on conducting gases, in measuring directly the absolute magnitude of a single ion, and there resulted a very good agreement with the value for the elemental quantity mentioned above. It is to be added further that a nearly equal value has been found by M. Planck in a third, completely independent way, from the laws of radiation of the so-called "black body."

In all conditions of aggregation, in electrical and optical processes the electrons play a very important rôle; they are, up to now, the smallest known constituents of our visible world; furthermore, in the absence of external electrical or optical evidences that is the direct proof of their actual existence, their actual appearance would, as it were, form the keystone in the logical structure whose rise I have endeavored to exhibit to you; and we have no need to seek far for this stone.

Shortly after the discovery of the Röntgen X-rays, Becquerel found that compounds of uranium send out continually, without outside influence, a kind of radiation which has a great similarity to Röntgen rays; and later G. C. Schmidt showed that thorium compounds send out similar rays. Further investigations, namely, on the part of M. and Mme. Curie, established the fact that these rays do not proceed from the uranium itself, but from certain impurities which may be separated out by an exceedingly tedious fractional process and finally so concentrated that they radiate about 50,000 times more strongly than the uranium. It appears that in the final product, which for the most part consists of a salt of barium, a new element is contained to which the name radium has been given, though to be sure it is by no means proven that it is just this new element which is the origin of the radiation. Now, concerning these Becquerel rays, which, in the beginning, were held to be closely related to Röntgen rays, Giesel and shortly afterward Becquerel, likewise St. Meyer and Schweidler, found them to be capable of deviation with a magnet, and hence preferably to be classed with cathode rays. After Dorn and Becquerel had established the electric deviability of these rays and its amount had been measured, although only roughly, the velocity and the charge per unit mass could be calculated; and the result was, in order of magnitude, in agreement with the numbers obtained for cathode rays. From the latest and more accurate experiments of these physicists a complete agreement seems to follow.

Consequently, we have in the radium salts a class of bodies which are in the position to throw off electrons without any outside influence. We stand before a perfect riddle as regards the source of energy, likewise of the whole mechanism of this phenomenon, especially as it appears that here velocities have to be treated which are nearly equal that of light; velocities which we can reach by means of electrical forces, that is, in actual cathode rays, only after overcoming enormous difficulties. Thick lead plates are radiated through at this velocity without a noticeable loss of energy. But just this behavior of the electrons at such tremendous velocities seems suited to furnish explanations in connection with the deepest questions concerning the constitution of the electrons, likewise of the atoms. Above all it is possible through direct measurement to decide whether the mass of the electron is perhaps only "apparent," due to electromagnetic actions. The experiments carried out up to the present time show that at any rate a considerable fraction of apparent mass is present.

And here we come upon a question which deeply concerns the structure of matter in general:

When an electrical atom merely by virtue of its electrodynamical properties behaves so exactly like a mass particle, is it not then possible to consider all masses in general as only apparent? May we not now, instead of all the fruitless experiments to explain mechanically electrical phenomena, attempt to refer back mechanics to electrical processes? Here we come back again to ideas which were cultivated by Zöllner thirty years ago, and which have recently been taken up and improved upon by H. A. Lorentz, J. J. Thomson and W. Wien. *If all material atoms consist of a conglomerate of electrons then their inertia follows of itself.*

For the explanation of gravitation, the attraction between unlike charges must be assumed somewhat greater than the repulsion between like charges. An *experimentum crucis would be the proof of* *the propagation of gravitation with time; of its dependency not only upon the position, but also upon the velocity of the gravitating bodies.*

The electrons would then be the "fundamental atoms" sought after by so many, through the various groupings of which the chemical elements are formed; the old dream of the alchemists would be placed strikingly near actuality. It could be assumed, perhaps, *that among the innumerable possible groupings of electrons only a relatively limited number are sufficiently stable to occur in large quantities; these stable groupings would then be the chemical elements known to us.* Through a mathematical treatment of these questions it will, perhaps, sometime be possible to represent the relative abundance of the elements as a function of their atomic weights and to solve, perhaps, many other riddles of the periodic system of the elements.

If from the earth we throw a glance about the universe we see many phenomena to which physicists, not without prospect of results, have sought to apply the electron theory; among these belong the sun's corona, the tails of comets and the northern lights.

While much of what has just been said may appear somewhat too hypothetical, yet so much clearly follows: that the electrons, these petty particles whose magnitude is to that of a bacillus as that of a bacillus to the whole earth, and whose properties we are still able to measure with the greatest precision, form one of the most important constituents of our whole world structure.

Effect of High Potential Discharge on Mica Insulation.

By John Härdén.

In a paper in the *Transactions* of the American Institute of Electrical Engineers, 1892, p. 1162, Mr. W. S. Andrews shows that mica loses its insulating properties if it is dipped in oil, or if oil is put on it. He states that a thin sheet of mica which would stand in air a potential of 10,000 volts alternating, dipped in oil it breaks down at 4,000 or 5,000 volts. One might suppose that a change in the surface of the mica takes place, but that this is not the case, the following experiment shows. Mr. Andrews used an apparatus represented in Fig. 1.

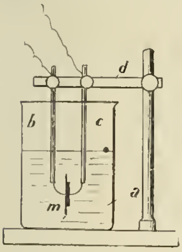


FIG. 1.—DIAGRAM OF APPARATUS.

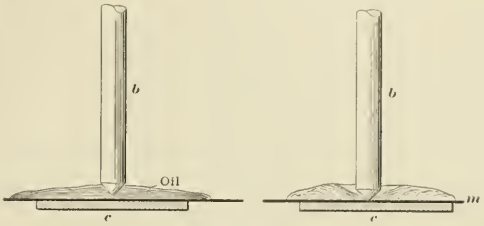
In the vessel, *A*, containing oil, two rods, *B* and *C*, are dipped. The rods are insulated by the piece of rubber, *D*. The brass rod, *B*, is sharply pointed, while the rod, *C*, ends in a brass disc. Between the two, sheets of mica, *M*, are placed between point and disc, supported by a steady pressure of the brass rods. Rods *B* and *C* are connected with the terminals of a step-up transformer. The mica had in one case a thickness of .002 in. and withstood a pressure of 8,000 volts with no oil in the vessel. When a drop of oil was put at the point, *B*, or oil was poured in the vessel, the insulation broke down at about 5,000 volts.

I tried this experiment in order to find the explanation of the phenomena, and obtained the following result. No change in the material of the dielectric took place, except that if a spark is passed through the oil, the insulating property of the oil will drop, as it will be carbonized through the heating effect of the spark, and small particles of carbonized oil act as a bridge for the electric discharge. While no change was observed on the surface of the mica, there was a change in the current density per unit of surface of the mica, and this is characteristic of all dielectrics if dipped in oil. This phenomenon can be explained in the following way:

Referring to Figs. 2 and 3, if a sheet of mica is placed between the point and the disc, and an electric charging apparatus is so connected that a high-potential difference is maintained between the point and the disc, if the point has the sign plus, a radial discharge takes place from the point to the edge of the mica if no hindrance is opposed. This energy of the discharge is transformed into heat so that the mica becomes hot. Since the discharge coming from the point has always the same sign, the particles repel each other, and the discharge is spread over the whole surface. This distribution of the electric charge on the surface of the dielectric is combined with a fall of potential over unit of surface; or in other words, the electric pressure per unit surface, *dc df* is less.

If a drop of oil is now placed on the plate, the oil will be driven out in a cup shape all around the point, as indicated in Fig. 3. The walls of the cup made by the oil concentrate the discharge all around the point, so that the electric pressure per surface unit in the neighborhood of the point will be higher. Suppose that the mica thus breaks down at 6,000 volts; if no oil is placed on the surface, the discharge will be distributed over the whole plate, so that a potential difference of 10,000 volts on the terminals of the transformer will be necessary to make the pressure per unit surface equal to that when 6,000 volts are used with oil. If, however, oil is on the plate, or the plate is dipped in oil, so that no distribution of the discharge can take place, the potential fall will be less. The dielectric will then break down at 6,000 volts, this voltage being present both at the terminals and at the points.

In order to prove this, I took a sheet of mica 1-32 in. thick and placed it between the terminals of a spark coil. The terminals were in the form of a point and a disc. The mica was quite free from oil. The potential difference of the spark coil was increased until the insulation just stood the pressure without breaking down. In this case thick radial discharge was observed going from the point to the edge of the mica. Next, a circle of oil was spread around the brass point, and with no change of potential difference in the spark coil. The inner diameter of the oil circle was about ¾ in. After the circuit was closed, the insulation broke down. It was observed that the insulation could be broken down at a much lower potential difference between point and disc, with the oil circle than without it. The same phenomenon took place if paraffine or stearine was used instead of oil.

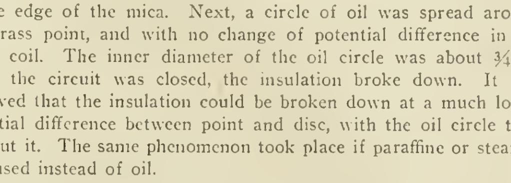


FIGS. 2 AND 3.—EFFECTS OF HIGH-POTENTIAL DISCHARGES ON MICA.

If a drop of oil was placed right under the brass point, a forcing up of the oil around the point could be observed. One appeared as if the oil was vaporized, and the vapor increased the capacity of the conductor around the brass point. To test this a circle of sealing wax was used instead of oil. In this case the insulation broke down long before the sealing wax could be melted by the discharge, showing that a vapor was not necessary to cause the insulation to break down. A lower potential difference would break down the insulation, if a ring of sealing wax was placed around the discharging point instead of oil. The explanation of this appears to be that the oil circle is driven out by the discharge, so that the surface is larger when oil is used than when sealing wax is used.

Another investigation showed that the theory of the concentration of the electric discharge around the point, by the wall of the oil or sealing wax, is a correct one. The experiment was made in the following way:

A semi-circle of paraffine or sealing wax was placed as in Fig. 4. In this case the insulation did not break down, but the discharge was driven out through the opening in the circle, as shown in the sketch. Without a change of potential difference in the spark coil, the circle assumed a wall shape, as in Fig. 5, when the insulation broke down in the farthest corner, *x*, showing that the electric pressure was highest at this point. This is a result of the electric repulsion of discharges of the same signs.



FIGS. 4 AND 5.—EFFECTS OF HIGH-POTENTIAL DISCHARGES ON MICA.

It was early observed that a sheet of varnished paper under the same electric pressure acts the same when placed in oil or in air, the effect of discharging on varnished paper being thus different from the effect on mica. This is easily explained on the grounds set forth above. The distribution of the discharge causes a heat effect on the surface of the varnished paper, the varnish melts and acts like a ring of melted sealing wax on the paper. In this case a drop of oil made no difference, since the electric pressure per unit surface was already sufficiently high to break down the paper. In other words, the density, $de \div df$ was high enough to break down the insulation.

Investigation with sealing wax on varnished paper gave quite the same result as on mica. Varnished paper thus breaks down with a lower potential difference than a like sheet of mica, and this when the insulating property of varnished paper exactly equals that of mica.

The result of the whole investigation goes to show that a solid insulation combined with mica in condensers or similar apparatus, would be most effective without the use of oil. The details of the apparatus would, however, be more complicated in this case, but a good insulating jelly would serve the same purpose without making the repair of the apparatus difficult. Air bubbles in the insulation must be avoided, because the discharge will always pass through an air bubble

Parallel Operation of Direct Connected Alternators.

By P. C. Oscanyan.

Some experiments made last year (see issue of September 13, 1902) demonstrated that the successful operation in multiple of alternators directly connected to Corliss engines is dependent upon the frequency of the oscillation which results from the synchronizing power of the generators, in combination with the moments of inertia of the revolving parts of the unit. It was found that when a balance existed between these two factors an equilibrium results which is most difficult to maintain. Also, that when the effect of the moments of inertia predominated the frequency of the oscillation is decreased, and when the synchronizing power predominated the frequency increased.

During the past year we have discovered that successful operation may also depend upon the amplitude of the oscillation, which in turn has been found to be dependent upon the sensitiveness of the governor, the number of cylinders of the engine and the dampening effect of the generator field. The more sluggish the governor, the fewer the cylinders and the greater the dampening effect of the field producing an oscillation of minimum amplitude, so it now appears that successful operation depends upon both the frequency of the oscillation and its amplitude, both of which are dependent upon the component effects of the characteristics of the generator and engine. We are, therefore, compelled to admit that it is impossible to design a generator to operate successfully in multiple unless the charactericties of the engine to which it is to be connected are known, and vice versa.

Furthermore, the old stereotyped phrase of engine specifications, which states that the variation in angular velocity shall not exceed a certain limit, must be entirely disregarded; for if the generator is not so designed as to conform to the characteristics of the engine, the generators will build up and multiply any variation in angular velocity of the engine until a point is reached where they will go out of step. Therefore, to be consistent with intelligent engineering, it is necessary to treat the design of the unit as a whole, predetermining the frequency and amplitude of the oscillation. It is, however, safe to state that ninety-nine units out of a hundred will successfully operate in multiple if the fields of the generators are properly provided with dampening devices, as it would only be in the case of units having excessively light wheels that satisfactory results could not be obtained; but since the proof of the pudding is in the after effects, it may be interesting to state that the two units considered in an article in this journal under date of September 13, the variation in angular velocity of which was then analyzed have had their faults rectified by placing dampening devices upon the pole pieces of the fields, so that they now run more perfectly in multiple than any two units ever observed by the writer. This opinion is based upon the fact that the two units operate perfectly without the aid of any friction device upon the governors, which are permitted to run free.

In this particular case the characteristics of the generators and engines produced an equilibrium or balance of unity which, the writer does not hesitate upon being put on record as stating, could also have been overcome by unbalancing the fly wheels. Such an expedient, however, could hardly be considered good engineering, and while it would accomplish the desired result, should not be resorted to without first making the most careful calculations as to the strength of the wheel and its factor of safety.

Annual Convention of the Iowa Electrical Association.

The Iowa Electrical Association held its annual convention this year at Davenport, Iowa, April 8 and 9. This is one of the best of the State electric light associations, as shown by the number of central station men in attendance. About thirty Iowa central station companies were represented. The first session was held Wednesday morning, April 8. President W. J. Greene, of Cedar Rapids, called the meeting to order and Secretary W. S. Porter, of Eldora, read the minutes of the last meeting and executive committee meeting. President Greene made a short address in which he said that the objects of the association were to promote the common interests of its members by coming together and discussing station topics and exchanging ideas and experiences, and in gathering data. In his opinion, the membership of the association should include not less than 100 central station companies. The work of the association had been organized according to the plan of having certain members each investigate specially certain particular subjects and collect data on them. This had worked well and resulted in the compilation of considerable valuable information. He thought the idea could be carried still further to advantage. For example, he had been collecting the results of tests made by various companies on different makes of meters, showing the number defective when new and the number defective after a period of use.

No definite details were given, but further figures were promised for the next meeting, and the subject was cited as an example of how companies might compare notes as a guide in purchasing apparatus, and eliminating poor supplies. Among recent features of interest to the central station owner as being likely to broaden their field were mentioned the Nernst and mercury vapor lamps and the Bremer arc lamp.

Treasurer George S. Carson, of Iowa City, made his report, showing receipts during the year of 6429.40 and a balance of $169.20. A nominating committee was appointed to report the next day.

Mr. W. S. Porter, owner of the Eldora Electric Light Company, made a report on the price received for street arc lighting by various companies in the State. He had received particulars from 77 companies in Iowa and the results had been put in tabular form showing the price received for street lighting reduced to a kilowatt-hour basis, the cost of fuel, and kind, number of years' term of contract, number of hours lamps were in service, kind and capacity of lamps used and price per month. The report showed that the price paid per ton for coal varies all the way from $1 to $3.50, according to the distance from the mine and the quality used. Figured on a kilowatt-hour basis, the lowest price received for street arc lighting is .033 per kw-hour and the highest price .177. Out of the 77 companies, 19 are using alternating-current series enclosed arcs in whole or in part. Fifteen of these use the alternating-current series arc lamp exclusively for street lighting. Thirteen small companies are using alternating-current, constant-potential arcs. Direct-current series open arcs still are in the large majority, as would be expected. The remainder is divided among enclosed series arcs and direct-current, constant potential arcs. The figures will prove of considerable value to the members in the renewal of city contracts, as it puts definite figures in their hands as to what is being done in 77 towns in the State. One of the greatest troubles members of the association have had in renewing city contracts in the past has been the ignorance of city councils as to the prices generally paid elsewhere for street lighting. Some of the very low figures are usually brought up on such occasions, and the central station manager cannot be too fully equipped with data. This report will be published in full in the association proceedings to which members are entitled. A report on street lighting by incandescents, giving the price received and other particulars was also presented in an incomplete form, and is to be completed in time for the published proceedings.

WEDNESDAY AFTERNOON SESSION.

The Wednesday afternoon session was opened by a discussion of the report on street lighting data. Mr. D. F. McGee, of Red Oak, asked for an expression of opinion from the members as to whether there was really any profit in street lighting at the rates given for most places on the list.

Mr. N. J. Higley, of Burlington, thought the price for street lighting should be governed by the price of coal. When most of these prices were made coal was very low. It had since gone up and higher prices are likely to prevail.

Mr. W. S. Porter, of Eldora, outlined the form of report he had asked in compiling this street lighting data. His plant pays $1.65 a ton for fuel, has a nine-year contract, gave in the year 2,125 hours of lighting service, and operates 27 direct-current, 10-amp. open series arc lamps at a price of $5.64 per lamp per month. The receipts were .059 per kw-hour at the switchboard and .063 per kw-hour at the lamp. The lamp hours were 54,187; percentage of lamp outage, 6-10; globes broken, 23.

Mr. R. E. Lee, of Clarinda, wanted to know if he considered .063 per kw-hour at the lamp terminals a good price.

Mr. Porter said the plant was not losing money. That was about all he could say. Mr. D. F. McGee thought the price too low on 75 per cent. of the list. Prof. G. W. Bissell, of Iowa State College, Ames, said he had observed that the prices obtained for street lighting in small towns averaged less than in large, which was contrary to what one would expect from the general rules of economic production and the wholesale price of goods as compared to the retail.

Mr. Walsh, of Davenport, spoke of the unreliability of figures given out by municipal plants on cost of lighting.

Mr. Geo. S. Carson, of Iowa City, said that the cost per kilowatt-hour depended in any plant very much on the load that plant carried in proportion to its capacity. In a lightly loaded plant, the cost was high.

Mr. Austin Burt, of Cedar Falls, in speaking of the difficulty sometimes experienced in changing from open to enclosed arcs, because of the apparent lower candle-power of the enclosed arc to a casual observer, said that when he originally changed from open to enclosed arcs he used inner globes of ground glass, as is usual. There was some dissatisfaction on the part of members of the council until the globes were changed to clear glass, so that the dazzling effect of the open arc was secured, and everyone was apparently satisfied.

Mr. Walsh, of Davenport, mentioned a case his company (the Davenport Gas & Electric Company) had in court in which the City of Davenport brought suit against the company to force them to change from direct-current open to alternating-current enclosed arcs on their city contract. The court decided after hearing the testimony of experts brought in by both sides that the City of Davenport was getting as good a light as the electrical industry had to offer. The testimony of the city electricians of Chicago and St. Louis was brought in, in defense of the company.

Mr. T. W. Kelley, of the People's Light Company, Davenport, without venturing an opinion as to the relative merits of open and enclosed arcs, thought that the Davenport case in court did not really decide anything because it was simply the opinion of a judge who knew nothing of technical matters formed through the hearing of testimony of experts paid by either side. After a somewhat heated discussion of the value of the court's opinion in this case, Mr. Austin Burt summed up the matter by saying that while the open, direct-current arc gave the most light for the power expended, the alternating-current, enclosed arc was the best for street illumination because of the better diffusion and distribution, and the lower cost, everything considered, at which it could be produced in connection with commercial lighting.

President W. J. Greene, of Cedar Rapids, said that his company was gradually working from direct-current open to enclosed alternating-current series arcs. In testing the relative street illumination from the two kinds, both lamps had been installed on the street, so that every other lamp was enclosed, and every other open. The relative illumination obtained between lamps was determined by a rough oiled paper photometer moved along the street until the point of equal illumination was determined. This demonstration was for the benefit of the city officials.

Mr. H. T. Fiske, of Muscatine, then read a paper on the "Maintenance and Operation of a Central Station Using Steam Power." This paper was mainly a concise statement of the necessity of keeping regular records of coal consumed, water evaporated, and kilowatt output. Systematic records were absolutely necessary if an intelligent knowledge of where there was room for improvement was to be obtained. He enlarged especially on keeping a record of water evaporated per pound of coal in order that a check could be had on the quality of coal and on the performance of the firemen.

Mr. Austin Burt said that his company, at Cedar Falls, was evaporating 4.5 pounds of water per pound of Iowa coal and this meant at former normal prices for coal a cost of 16½ to 17 cents per 1,000 gallons evaporated. At recent abnormal prices, it meant 30 to 40 cents per 1,000 gallons. This was by water meter measurements.

Prof. Bissell said that tests carried on in a boiler plant at his institution and verified by the results in the city lighting plant at Ames showed that the lowest priced (Polk County) Iowa coal that they could obtain was the most economical, as it not only gave the most heating value for the money expended, but was of higher heat value than some of the coal imported from Illinois.

Mr. George S. Carson, of Iowa City, read a paper on "Maintenance and Operation of a Central Station Using Water Power." He gave a brief description of the plant of the Iowa City Electric Light Company on the Iowa River, about three miles from town. It is a water power plant with an auxiliary steam plant using high-speed steam engines. "W. H. C." voltage regulators are used. Such regulators are considered essential if lights and motors are run from the same circuits. Separate step-down transformers are used at consumers' premises for motors and lights, in order to keep down voltage variations. The transmission line is two-phase, 2,000-volt. Barbed wire is strung two feet above the transmission line for lightning protection. The cost of this water power plant with steam auxiliary complete, together with transmission and distribution system and transformers was about $275 per horse-power.

Mr. Austin Burt said that the cost of his company's new steam-driven plant, with distribution system and transformers, was less than half that figure, or about $125 per horse-power.

After adjournment many of the delegates visited the sub-station of the People's Light Company in Davenport, which gets its power from a hydraulic plant across the river in Moline. The plant of the Davenport Gas & Electric Company was also visited.

THURSDAY MORNING SESSION.

At the opening of the Thursday morning session an invitation was extended by the government authorities and the Tri-City Railway Company to visit the Rock Island Arsenal by special car.

The first report to be taken up was that of Mr. D. F. McGee, giving "Data on City Pumping." The information collected by Mr. McGee showed that twenty electric light companies in Iowa are doing city pumping for water works and of these five are doing it with electrically-operated pumps. Nine of these stations pump at a flat rate of so much per month. Ten have a minimum rate with a measured rate for all pumping over a certain daily maximum. One pumps at a regular rate of so much per gallon. The various information was compiled in tabular form, which gives some insight into the conditions in each case. Mr. McGee thought that "many members were either inexperienced in this class of work or were unable to secure definite information as to cost of doing it when they made their contracts for pumping. "As a result, we are doing it at a loss. Our company was one of the first in the State to attempt to do city pumping with electric power. We have been successful in saving money for the city, but our margin of profit, after figuring up cost of fuel and other expenses, interest on investment and depreciation, has not been very large. We furnish day power service and operate a heating plant; have a large standpipe and can pump water at most convenient times."

The rate at Red Oak is $125 per month minimum, with 4 cents per gallon additional for all in excess of 100,000 gallons each day. The pumps work against 100 lbs. pressure, drawing from open wells. Allowing 6 per cent. interest and 6 per cent. depreciation on apparatus, the rate received worked out practically at about 4 cents per kw-hour. The saving to the city was $1,800 to $2,000 per year.

Mr. A. W. Zahm, of Mason City, said his company had been recently figuring with the city on doing the pumping, as the city's apparatus was in need of replacement. It was now costing the city 8 cents per 1,000 gallons to pump from a deep well and then to a standpipe.

Mr. George S. Carson, reporting on the subject of lamp testing, said that arrangements had been made with the electrical department of Iowa State College, Ames, whereby energy consumption and candle-power tests would be made at $1 per dozen on lamps delivered at the college. Without some kind of checking-up test on lamps purchased, companies were groping in the dark. Prof. Bissell, of Ames, spoke a few words of explanation regarding the lamp tests.

They consisted of measuring the mean horizontal candle power and the end on candle power, together with the watts consumed at rated voltage. Special tests could be arranged for at special price. He said the engineering department of Iowa State College would be glad to undertake the work of testing for central stations of the State.

Mr. G. C. Gardner, of the Mt. Vernon Electric Light Company, told of his experience in putting in meters. He put in meters on all customers last fall (he would not recommend the fall as the best time, however) and where before they had been carrying 15 to 20 amp. alternating current load from 1 to 5 A. M., they now had only 2½ to 3 amp. during that time. They had lost but few customers, saved a lot of coal and saved on lamp renewals.

A number of members compared practice as to meter rentals. Some rent meters at 15 to 25 cents each per month, and others sell the meters to the customers, agreeing to buy them back upon discontinuance of service.

Mr. A. W. Zahm carries a blanket insurance policy on all meters and arc lamps. Mr. D. F. McGee also advocated such a blanket fire insurance policy.

In response to a question as to the legality of charging a minimum rate per month, Mr. George S. Carson said that there was no reason why a "readiness to serve" investment should not be considered, and this had been legally established in a suit brought by the New York Edison Company.

President Greene said that the Cedar Rapids franchise ordinance permitted a minimum rate. Mr. R. E. Lee, of Clarinda, said that the Clarinda ordinance recognized and specified a minimum rate. Mr. George S. Carson, returning to the subject of lamp testing, said that it must not be forgotten that it is light that the company is selling, and that the efficiency of the lamps was important. Mr. T. F. Kelly, of Davenport, said the Nernst lamp had been found very efficient, but the cost of renewals so far was rather high.

Mr. Austin Burt gave some data on his company's new plant. The plant at Waterloo was designed to furnish light and power in Waterloo and also to supply Cedar Falls as a sub-station, over 7.4 miles of 10,000-volt line. The voltage of 10,000 had been selected because it involved only the use of standard apparatus and made it possible to reach out further than Cedar Falls. Three General Electric 75-kw transformers were at each end of the transmission line. The pole line was mainly Idaho cedar poles 40 ft. long, with 7-in. tops. They were set from 90 to 110 ft. apart. The 40-ft. poles cost $9.70 and the 60-ft. poles $14.10 each. The cost of pole hauling, setting and gaining for the cross arms averaged $2.75 per pole. This high cost was because part of the route was off the highway on soft ground. The conductors were No. 6 bare copper wire on Locke No. 1, 15,000-volt glass insulators. The cross arms were braced on one side with an iron brace. The wires formed a 28-in. triangle. The cost of the transmission line was $800 per mile. As a temporary expedient while awaiting some of the 10,000-volt apparatus, power was being transmitted over this line at 2,300 volts with 400 volts line loss, which was compensated for by induction regulators at each end and by a boosting transformer, which consisted of an ordinary 2,200 to 220-volt transformer with its secondary in series with the 2,200-volt mains.

President W. J. Greene, of Cedar Rapids, read a short paper on the "Necessity of Grounding Secondary Circuits." He gave a short summary of the actions by various bodies that led up to the recommendation of grounding all low-tension circuits in the National Code rules. The Cedar Rapids Electric Light & Power Company at first tried grounding on only part of its transformer secondary circuits. It was found that if anything, contrary to expectations, there was less trouble from breaking down of transformers on the grounded than on the non-grounded circuits. All his company's secondary circuits were now grounded with a copper plate in a bed of charcoal 5 to 10 ft. deep. In conclusion, he said it was hard to understand why companies still fail to take advantage of this sure method of securing absolute safety of consumers from dangerous high-voltage shocks. He urged all who had not done so to begin the work of grounding at once.

FINAL SESSION, THURSDAY P. M.

A short executive session was held Thursday afternoon, and officers for the ensuing year were elected as follows: President, D. F. McGee, Red Oak; vice-president, W. L. Bowers, Davenport; secretary, W. S. Porter, Eldora; treasurer, Rufus E. Lee, Clarinda. Executive Committee—The officers and Austin Burt, Cedar Falls; George S. Carson, Iowa City; N. J. Higley, Burlington. The next meeting will be at Des Moines in April, 1904.

Among those present were: A. R. Walsh, Davenport Gas & Electric Company; N. J. Higley, People's Gas & Electric Company, Burlington; G. C. Gardner, Mt. Vernon Electric Light Company; P. J. Bellamy, Knoxville Electric Company; W. A. Mall, Belle Plaine Electric Light Company; O. J. Johnson, Sac City Electric Company; F. L. White, Traer Electric Company; M. W. Hovey, Marshalltown Light, Power & Railway Company; W. C. Walters, Tama & Toledo Railway & Light Company; W. H. Scott, Grundy Center Electric Light Company; T. W. Kelley, People's Light Company, Davenport; D. F. McGee, Red Oak Electric Company; Edward Reavy, People's Light Company, Davenport; Prof. G. W. Bissell, Iowa State College, Ames; E. R. Cummings, Webster City Electric Company; A. L. Hindert, Perry Electric Power & Light Company; C. H. Hinkhouse, Tipton Lighting & Heating Company; Rufus E. Lee, Lee Electric Light Company, Clarinda; M. N. Harrison, Osceola Electric Company; W. S. Porter, Eldora Electric Light Company; H. T. Fiske, Citizens' Railway & Light Company, Muscatine; W. H. Groner, Cherokee Electric Company; Frank Bredoo, Davenport Gas & Electric Company; W. J. Greene, Cedar Rapids Electric Light & Power Company; A. W. Zahm, Brice Gas & Electric Company, Mason City; L. B. Hovey, Independence; F. J. Pfiffner, Greene Electric Light Company; R. W. Morse, Shenandoah Electric Light & Power Company; C. A. Felker, Sigourney Electric Light & Power Company; George S. Carson, Iowa City Electric Light Company; Thomas Sloss, Cedar Rapids Electric Light & Power Company; T. A. Meyers, Grinnell Electric & Heating Company; G. C. Hoyer, Nashua Electric Plant; Austin Burt, Waterloo & Cedar Falls Gas & Electric Company; Prof. D. B. Spinney, Iowa State College, Ames.

Discussion of New York Municipal Plant Scheme.

At the meeting of the legislative committee at Albany, N. Y., on April 7, to consider the Monroe scheme for a municipal electric lighting plant for New York City, Mr. John M. Bowers appeared on behalf of the Consolidated Gas Company and the New York Edison Company, to reply to statements made by Mr. R. G. Monroe, the Commissioner of Water Supply, Gas and Electricity. After first addressing himself to the gas question, Mr. Bowers turned to the subject of electric lighting, and in the course of his remarks said:

The main criticism, however, of Mr. Monroe is directed to the cost to the city of electricity as an illuminant. He states that the prices paid in the Borough of Manhattan for a 2,000-cp lamp is $146 per year; that he has secured reports from 68 cities throughout the country showing the prices paid in those cities for supplying the same with lamps of 2,000 cp, and that the average cost is $88.60 per lamp per year.

Concerning the question of electricity it is proper to say: The electric lighting companies in the city of New York have from time to time voluntarily reduced their rates to the city and private consumers without any pressure from the municipal authorities or legislative action. The cost for arc lamps in the Bronx, involving nearly 1,000, was reduced in 1902 from 45 cents to 40 cents per lamp per night, and a number of lamps in special localities in the Borough of Manhattan, for which the city had previously paid 50 cents and 45 cents per lamp per night, was reduced to the uniform rate of 40 cents.

The Edison Company also reduced the price of electric current in 1898, and at the same time modified its price schedules, so that the smallest as well as the largest consumer could obtain a discount. A second reduction was made two years later, and on September 1, 1902, the third in the series of reductions made and contemplated was announced, this change reducing the maximum price of electric current from 20 cents to 15 cents per kilowatt-hour. This reduction, in many cases 25 per cent from former bills, will amount to nearly $400,000, the entire expense of electric street lighting in the Borough of Manhattan for one year. This change will be the better appreciated when it is recalled that in Chicago and Boston, where many items of cost are lower than here, the maximum price is still 20 cents per kilowatt-hour.

On analyzing the table prepared by Mr. Monroe as a basis of comparison with bids made for electric lighting for lamps in the city of New York, we find: The electric light plants in some of the cities so selected are operated by water power; many of them have limited light schedules of 3,500, 3,650 and 3,800 lighting-hours per year, instead of 3,950, as required by the New York schedule. In many of the selected cases, the current supplied is far less than required in New York. In almost every case the service is largely, if not entirely, overhead, with wooden poles or outriggers, and in but one case is the service entirely underground as in the Borough of Manhattan.

It is, therefore, apparent that the general figures collected by Mr. Monroe form no basis for a comparison with the fair cost of electric lights in the city of New York. The main basis of comparison, however, that is made by Mr. Monroe, both on the question of incandescent mantles and the question of electric lighting is the cost to the city of Chicago. It is claimed in his report that the cost to that city by reason of the operation of its municipal plant in the year 1902 was, for electric lighting, a total cost per lamp of 2,000 cp the sum of $53.51.

An examination of the reports of the city of Chicago, as corrected by Haskins & Sells, as to the cost per lamp for its municipal system of electric lighting for the entire period of its existence, to wit: from the year 1888 to and including the year 1900, was at the rate of $165.62 per lamp. It seems, therefore, scarcely reasonable to select a particular year in which it is claimed that the cost was way below the average as a basis of comparison. Neither can any comparison be safely made with such cost, for the reason that items aggregating a large amount are wholly omitted in preparation of the figures. On examining this question, we find that careful and exhaustive investigations have been made of the same matters cursorily covered by Mr. Monroe by other municipalities, and especially by the city of Boston. The investigation made by that municipality which led finally to the making of a ten-year contract with the Boston Electric Light Company for the supplying of electric lights to that city was in the year 1898. In the preceding year the estimate of the cost per lamp at Chicago was the sum of $87.38. Omitted items were estimated by the Boston authorities as raising this estimated cost of $87.38 to the sum of $153.03, and this latter cost, by the addition of certain items of difference existing between Chicago and Boston was increased to the sum of $154.80 for Boston conditions. This latter item would have been $170.40, had the Boston system, as is the case in the Borough of Manhattan, been entirely underground.

Accepting as correct the claim that the city of Chicago did in 1902 supply itself at a cost of $53.51, and supplying omitted items, as was done in the Boston investigation, it will be found the real cost to that city would be the sum of $119.16, and then, by correcting the same figures so as to apply to the conditions existing in Boston and New York with an underground system, it will be found that the true cost. based upon the Chicago estimate as above, is at the rate of $138.81, instead of $53.51.

There can be no doubt that the cost of supplying public lighting to the municipality of the city of New York is at least as great, if not greater than the city of Boston. The mere cost of the real estate essential for the use of the plants in the city of New York, as compared with the cost of land necessary for the same purposes in the city of Boston, will in itself considerably increase the cost of production. As an example, the land on which the Boston Electric Station is built cost at the rate of 30 cents per square foot; while the land on which the Water Side Station of the New York Edison Company was built cost at the rate of $5.75 per square foot.

While Chicago is adopted as the main basis of comparison by Mr. Monroe he also makes reference to the cost of the Detroit Municipal plant. As Mr. Monroe refers to criticisms of such report in the Electrical World and Engineer of February 28, 1903, it may not be amiss to quote the editorial on that article in the same number. (The editorial pointing out the inaccuracy of the figures was here quoted.) It may be further stated that less than ten per cent of the Detroit service is underground, the current is less, and the lighting schedule is 3,744 hours, instead of 3,950 hours, as required by the New York contracts, and over 4,100 hours as actually delivered.

This question of municipal lighting in Detroit was also carefully considered by the Boston authorities at the time of the making of the contract above set forth, and it was shown that the cost, as stated by the municipal authorities, was underestimated by leaving out a large number of items in the same manner as was done in the Chicago estimate. It is a singular fact that the estimated cost per lamp of the municipal plant in the city of Detroit for the year 1897 was the sum of $53.06 per lamp, while the estimated Chicago cost in 1902 is $53.51. The omitted items in the Detroit estimate for 1897, as found in the Boston report, raised the cost to that municipality to the sum of $111.74, and when compared with the basis of cost in Boston was increased to the sum of $134.57, which would be still further increased, if compared with an underground system to the sum of $152.45. It is thus apparent that the price bid for municipal lighting in the city of New York is at a far lower rate than it is reasonable to anticipate the city could obtain by furnishing its own electric supply.

If based upon a comparison with the cost to the Chicago authorities during the entire period of the existence of their municipal plant at the rate of $165.62 per lamp, the bids made for electric lighting in the city of New York are $19.62 better. If based upon a comparison with the cost in the year 1897 in the city of Chicago, and increased in accordance with the difference in cost by the difference in local conditions as between Chicago and Boston or New York the difference is between the sum of $170.40 and the sum bid in New York, to wit: $146, or $24.40. And even when based upon the alleged cost to Chicago in the last year of $53.51, such cost, when increased by omitted items and by comparisons with the differences in local conditions as between Chicago and New York, will be the sum of $138.81, or $7.19 less than the bid of the electric lighting company in New York.

In considering the question of the cost of furnishing gas or of furnishing electric lights in the city of New York, there must also be borne in mind the exceedingly onerous conditions under which the corporations exercise their franchises in this city. The companies are not permitted to repair the pavements which they are compelled to open themselves, but such repairs are required to be made at the company's expense by the asphalt companies, and the cost of these repairs runs from $3.09 to $6.75 per square yard, whereas the same could be reasonably done for the sum of from $2.50 to $3.50 per square yard. For replacing a granite pavement on concrete the companies are charged by the city $8 for the first square yard and $4 for the balance, whereas this work could be reasonably done for the sum of $2.50 per square yard. The companies are also compelled to employ inspectors appointed by the Department of Highways, some of whom are paid at the rate of $1,200 per annum, and the rest $4 per day. The company has also been recently advised that additional inspectors to do the same work must be obtained from the Department of Water Supply, Gas and Electricity. It is a matter of regret that these gentlemen are not sufficiently constant in their attendance upon the work to justify the lighting companies in accepting their services in place of their own inspectors. One thing is certain, and that is, that the cost at which electric light has been furnished to the city of New York by the Brush Electric Light Company, which uses three-fourths of its output for city lighting, is at a figure which, since that corporation placed its wires underground, has paid no dividends and has not produced a sum over operating expenses sufficient to meet even a reasonable allowance for depreciation.

Mr. Monroe also makes a tabulation of certain cities stated to furnish their own electric lighting. The cities so selected that furnish lamps of 2,000 cp are comparatively few in number. The first is Columbus, Ohio, which is stated to furnish 320 lamps at a cost of $47 per lamp; St. Joseph, Missouri, 70 lamps, at $70 per lamp; Allegheny, Pa., 1,414 lamps, at $74 per lamp, Jacksonville, Fla., 152 lamps at $90 per lamp. These form Mr. Monroe's basis of comparison, save the cities of Chicago and Detroit. Aside, therefore, from the cities of Chicago and Detroit, Mr. Monroe's tabulation contains no city of any large size operating municipal plants. No statement whatever is made of the condition under which these plants are operated, whether by water power and overhead or underground system, and, indeed, no reference whatever is made to any local condition. It cannot for a moment be seriously contended that any basis of comparison can justly be made upon such a small number of cities or with such meagre information. No other city has ever pretended to act on such an investigation.

The five important cities that have undertaken or seriously considered municipal ownership are Chicago, Detroit, Boston (to all of which reference has already been made), Philadelphia and Worcester. The city of Philadelphia for many years managed its own public lighting plant. Notwithstanding that gas was sold to private consumers, giving to the city the benefit of profits derived therefrom, the result was that the manufacture and sale of gas was conducted at such an enormous loss that the city was glad to abandon the same and lease its plant to a private corporation.

In December, 1901, the city of Worcester investigated the question of municipal ownership. The committee appointed to make inquiries obtained reports from a number of municipalities engaged in supplying electricity with a municipal plant. The result of the inquiries made was that the average cost per lamp hour of the street arcs furnished by the municipal plants in the State of Massachusetts, as shown by the reports of the board, was, for a 500-watt lamp, 4.58c. per lamp hour.

At the present bid of the New York Edison Company, a standard arc lamp at 4,100 hours per annum costs 3.56c. per lamp-hour.

The result, therefore, of the Philadelphia, Worcester and Boston agitation justifies the conclusion that the Consolidated Gas Company has in the past and will in the future supply the city with municipal lighting of every kind at a far less expense than would result from any municipal ownership.

Mr. Bowers concluded by saying that the public lighting of the Consolidated Gas Company is less than 4 per cent of its entire business.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

DECOMPOSITION OF WATER.

The electrolytic apparatus of Garuti and Pompili, which has long been in use in Italy for the production of hydrogen and oxygen by the electrolysis of alkali hydroxide solutions, employs for the purpose of separating the gases a vertical metallic plate, finely perforated for a short space above its bottom, this plate being insulated from the electrodes and the voltage employed being too low to permit it to act as a bipolar electrode. The combined area of the perforations has necessarily been small, and the resistance of the apparatus has been correspondingly high, so that the maximum available current density at the voltage used has not hitherto exceeded 14 amperes per square foot of electrode surface.

A distinct improvement in the cell has now been made by providing the iron diaphragm plate with an aperture of largely increased area, corresponding nearly to the surface area of the electrodes, and covering this aperture on each side with a thick sponge composed of several layers of fine wire cloth. This web endures in the solution used and is found to entangle effectually the gas bubbles which would otherwise pass between the compartments and interfere with the purity of the products. The resistance offered to the current is much lower, so that the current density may be increased to 36 amperes per square foot, and the separation of the gases is said to be equally effective.

STRIPPING PLATES.

The thin metal sheets which serve as the base for receiving the deposit of copper in the electrolytic refining methods are usually produced by electro-deposition upon a polished cathode plate and subsequent stripping. To prevent marginal growths or excrescences these plates have been provided with a wooden frame; or, according to more recent suggestions, a mere scratch upon the face of the cathode has been sufficient to so alter the character of the deposit above it that the portion of the deposit within the limits defined by the scratch could be torn away. Mr. C. J. Henry, of Perth Amboy, New Jersey, now patents a cathode plate intended to receive these temporary deposits, consisting of a sheet of copper or lead provided with a marginal flange in the plane of the metal, but of reduced thickness; this flange is perforated at intervals and a plastic insulator, as putty, is applied to opposite faces of the flange to form the frame, the plastic layers upon opposite sides of the flange interlocking through the perforations. This frame may extend slightly above the plane of the metal, which is treated according to any of the usual methods to prevent too close adherence of the deposits. The cathode plate is conveniently extended above the upper line of the insulating frame to provide for its suspension in the bath. The accompanying figures, showing the plate in elevation with the deposit partially stripped, and also in section, are self-explanatory.

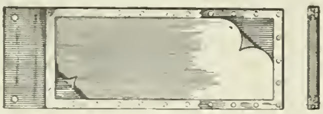


FIG. 1.—STRIPPING PLATES.

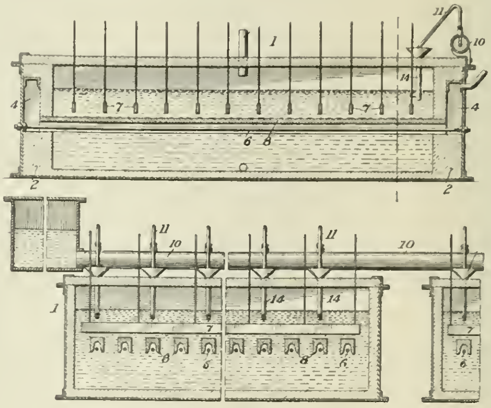
EDISON BATTERY.

Reference has frequently been made in describing the patented forms of the Edison battery to the use of flake graphite, mercury, or copper, mixed with the active material of one or the other electrode for the purpose of insuring a better contact between the individual particles of the active mass and between these particles and the metal conductor. The function of these substances being to increase the somewhat low electrical conductivity of the oxides, it is, of course, essential that they remain unoxidized in use. For this reason mercury and copper are used only in that electrode which is oxidized on discharge, whereas graphite may be employed in the electrode which is oxidized in charging and which is therefore subjected to stronger oxidizing conditions than could be borne without change by the metals.

In other words, the cell may comprise an electrode consisting of electrically active iron or its oxide in admixture with mercury or copper or both, opposed in an alkaline electrolyte to a composition consisting of nickel oxide and flake graphite. The best results follow from the use of mercury in quantity equal to one-fourth the weight of the iron, but on account of the high price of mercury it is more economical to use but 6 per cent of this metal mixed with 30 per cent of copper and 64 per cent of iron. The mercury in this case amalgamates with the copper and protects it from surface oxidation, and the quantity of iron used is such that it is somewhat more than equivalent to the oxidizing capacity of the nickel, whereby further protection of the mercury and copper from oxidation is afforded.

CAUSTIC CELL.

A cell patented to Rudolph Johanns, of Brooklyn, and assigned to Friedrich Junge, of Silver Lake, New York, is intended for the production of caustic soda and chlorine by the electrolysis of alkali chloride solutions, and belongs to the gravity type which employs neither mercury nor a porous diaphragm for the separation of the products. Instead, dependence is placed for effecting the separation of the products upon the differences in their specific gravities, and therefore the question of importance becomes one of design, the parts being so combined as to obviate to the greatest possible extent the formation of currents of liquid due to the escape of gases, the impoverishment of the electrolyte, or any other cause. This may be said to involve three conditions; the withdrawal of the hydrogen from a point immediately above the cathodes, the placing of the anodes above the cathodes and near the surface of the electrolyte, and the distribution of the inflowing brine over the surface of the electrolyte in such manner that it will mingle evenly with the main body of the solution. The caustic is withdrawn from the lower portion of the cell.



FIGS. 2 AND 3.—SECTION VIEWS OF CAUSTIC CELL.

As illustrated in longitudinal and transverse section in the accompanying figures the cell comprises a lined tank 1, 2, provided with a series of horizontal cathode bars 6 traversing the entire tank and secured to its iron sheathing. Each cathode bar is surmounted by an inverted glass trough 8, which is arranged to collect the hydrogen and conduct it to chambers 4 formed within the cement end walls of the cell. The anodes, 7, of platinum or carbon, are placed above the cathodes, and are arranged transversely of the latter, in order to diminish as far as may be the convection currents due to impoverishment of the solution around the electrodes. The fresh brine is drawn form mains 10, and is introduced into each cell through a series of adjustable siphon-tubes 11, by the raising or lowering of which the flow may be regulated, and may, if necessary, be reduced to a drop-by-drop feed whereby the electric circuit between successive cells may be broken. These siphons discharge into inlet tubes, 14, each of which is provided with a horizontal discharge nozzle immediately beneath the surface of the electrolyte.

New Telephone Patents.

A patent covering a message counter containing rather novel features was issued March 24 to G. A. Long and assigned to the Gray Telephone Pay Station Company. This counter is of the type which is located at the subscriber's station and operated by the subscriber by means of a knob or key. The sounding of a gong or bell accompanying the registering of one count notifies the central office operator that the proper registration has been made.

There are two obvious ways in which a subscriber might try to falsify his count: First, by turning back the register after the signal is given, and second, by causing the signal to sound by means other than the key. Both of these are guarded against in this counter, as the operating tumbler engages the gong-striking hammer at all times in such a manner that a reverse movement of the key is impossible, and as the gong is provided with a damper which is only raised just after a count has been made, it is necessary to make a count before the gong can ring.

The Patent Office issue of March 31 contained three patents relating to telephony. The subject of one is a new party line system, the patentee being E. A. Terpening, of Geneseo, Ill. This is based upon dividing the generated alternating signal currents into two sets of impulses, one positive and one negative, either of which may be used at will. The bells are not wired directly to the line, but are in local circuits controlled by selectors. These selectors are very similar in type to the ordinary magneto bell, but instead of having a hammer, the armature rod connects with the piston of a dash-pot, which renders motions of the armature sluggish, and thus it is not responsive to alternating currents. The armature on moving in one direction closes the local bell contacts, this in response to impulses of the proper polarity. Motion in the opposite direction has no function. A biasing spring is provided to cause the armature to return to the middle position when not actuated by current. Such an arrangement allows of four selective parties and of a considerably larger number of parties upon a hybrid "selective code-ringing" system. The presence of the liquid damper appears, however, to be decidedly objectionable.

Of the remaining patents of March 31, one describes a combined telephone, fire alarm and burglar alarm system, the invention of B. O. Fox; and the second a telephone apparatus for military field service. This is the invention of Captain Edgar Russel, of the United States Army. In his combination system Mr. Fox arranges his circuits so that in case of fire a thermostat will set a call box in operation. This sends an alarm to central on a single-stroke bell, rings a continuous signal at both central and the subscriber's premises, and in addition throws the central office drop. The burglar alarm through a relay performs these same functions except that the code alarm is omitted.

Captain Russel's telephone patent emasculates to the merest rudiments the apparatus of a telephone system. No bells are provided, but a stylus connected to one side of the battery may be rubbed along a serrated surface connected to the line. This results, through the action of an interposed inductance coil, in high-potential current impulses. These produce a buzzing in all receivers connected to the line which serve as a call signal.

In the patent issue of April 7 there are four telephone patents. Of these the most important is probably that for a "Signalling Apparatus" granted jointly to W. H. Dean and F. W. Dunbar, and assigned by them to the Kellogg Switchboard & Supply Company. This apparatus is designed for local battery systems and embraces the combination of a special hook switch and induction coil with grounded drops in a manner such that the drop signals are operated by the mere motion of the hook switch lever.

Fig. 1 shows the elements of the invention. The usual telephone induction coil is shown at m, while the special signalling coil is shown at r. At the central office is shown at c a grounded line drop wired to one side of the line, and at c c' are shown two clearing-out drops wired respectively to the neutral points of the two sides of the repeating coil. When the receiver hook rises in the usual manner, springs, h and h' making contact, close the battery circuit through the primary, r. This causes an inductive "kick" of moderate strength to issue from the secondary, r^2, to ground in one direction, and through the spring, h^3, pin, e^2, hook lever, e, spring, f^3, and wire, 3, to and through the line, a, and drop, c, in the other direction. This "kick" may throw the drop, but is not depended upon to do so, as its volume is held down by the rather slow magnetization of the core of the coil. As the hook switch proceeds, however, it soon breaks the primary circuit at the contact, h h', when a second and reversed momentary current of much greater value than the first will be thrown upon the line. This current will always affect the signals. The last portion of the hook lever motion serves to cut out the signal coil completely, and to perform the usual telephone switching of receiver and transmitter circuits. Upon the depression of the hook by the replacing of the receiver a reverse order of operations takes place with exactly similar results. The inventors state and claim as one of the essential features of the system, provision for a sufficient interval between the closing and breaking of the primary signal circuit, with the normal movement of the lever, to insure the magnetic saturation of the coil core.

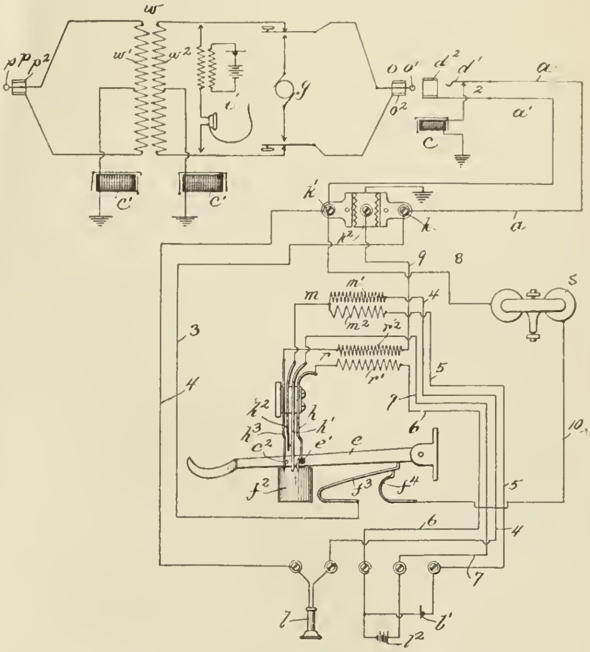


FIG. 1.—DEAN AND DUNBAR SIGNALLING APPARATUS.

Some time ago a selective party line signalling system was patented based upon the Wheatstone bridge principle. In the present issue the use of this principle again appears, now applied, however, to talking circuits. Although this system has been worked out for a complete switching intercommunicating system, it is most easily discussed in reference to a diagram setting forth the merest rudiments of the circuits. Such a diagram is given in Fig. 2. It will be seen that in this diagram there are virtually three superimposed Wheatstone bridges, all using the same battery. Thus the main line wires, 1 and 2, to which the battery is connected, tap each of the

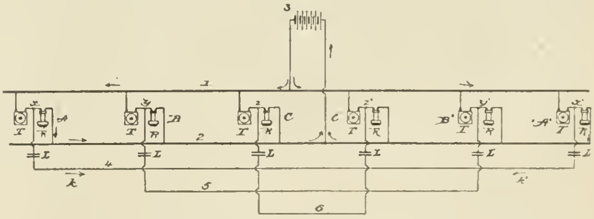


FIG. 2.—DIAGRAM OF CIRCUITS.

three bridges, the respective arms of which are the transmitters and receivers of stations, A and A', those of stations B and B', and those of stations C and C'. Each bridge has its own auxiliary, or if it may be so called, galvanometer wire. These are respectively wires 4, 5 and 6 in the diagram. Now suppose a momentary diminution of resistance occurs in the transmitter at, for example, station A. At once the potential of the point x will change and a current will flow over the wire 4 to the point x', and raising the potential of that point will cause a momentarily increased potential at point x and a consequent impulse through receiver R at C'. Corresponding results accompany any other changes in the transmitter resistances.

Mr. J. H. Mason, the patentee of this system, states that simultaneous conversations may be carried on over all bridges without cross talk, and this is one of the principal specified advantages. This statement does not seem to bear investigation, however, as the resistance of the line wires, 1 and 2, must have their effect. Thus the increased current to station A considered above will cause a readjustment of the potential drops along the line wires, 1 and 2, in virtue of their resistance, in addition to the effects already noted. In consequence there will be a fluctuation in the currents in the receivers at B and C, resulting in cross-talk. These fluctuations will have no direct effect upon the potentials of the points, y' and z', and therefore no direct effect in producing cross-talk at stations B' and C'. There may possibly be an effect at these stations, but if so it will be due only to the impulse sent over the wire, 4, from its effect on that part of line wire, 2, between the battery and station A'.

"Electrical Protector" is the title of a patent issued to C. A. Rolfe, of Chicago. This device combines in one apparatus a sneak current heat coil and an open-space cut-out. The chief novelty lies in a mounting of the line plates of the open-space cut-out upon spring members secured in position by semi-fusible stops or pins. Upon the continued flow of an excessive current to ground, the pin softens and allows the plates to be violently separated by the spring mountings.

The fourth patent relates to a novel design of hook switch for desk stands. This is the invention of Charles Holmok. The switch arm is pivoted upon a non-conducting support contained within the upright of the stand. From this arm flexible contact springs are extended through guides so placed that the springs will either clear or contact with stationary terminals, according as the hook lever is moved down or up. The contact is of a sliding nature found essential in telephone practice.

Summer School for Artisans.

The Summer School for Artisans, conducted under the direction of the College of Engineering, of Wisconsin University, will open July 6 at Madison, and continue until August 14. Five sections will be organized as follows:

I. Heat, Steam, Gas, Gasoline and other heat engines. II. Applied Electricity. III. Machine Design. IV. Materials of Construction, Fuels, Lubricants, etc. V. Shop Work.

There are eight courses in the section of Applied Electricity, which includes the theory, management and testing of electrical machinery. The courses are on dynamos and motors, electric wiring, meters, transformers, lamps, telephone service, electric batteries, electric station records, elementary theory of alternating currrnts and their applications, and electro-plating and electrotyping. It is assumed that those entering are acquainted to a greater or less extent with the practical operation of electrical plants, but the lectures to be given will include such an amount of the theory of electricity and magnetism as seems desirable, or is necessary to fully explain the practical applications.

A uniform entrance fee of $15 is charged for all students taking the course, with additional shop and laboratory fees at the rate of 5 cents per hour of actual total time spent in a shop or laboratory. It is estimated that the entire outlay for the six weeks' term, including living and school expenses, may be fairly estimated at $50, not including transportation.

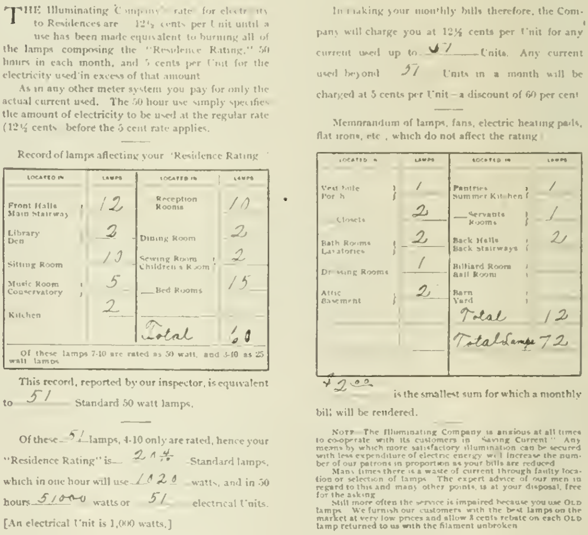
Two or three lectures may be followed daily in addition to laboratory or shop work, the latter being in periods of four hours daily. The students will have the benefit of the magnificently equipped university laboratories and shops, and will also have an opportunity to attend lectures at the summer session of the College of Letters and Science.

The Individual Plan of Charging for Current at Cleveland, Ohio.

By Samuel Scovil.

In the Electrical World and Engineer of September 6th, 1902, was printed an explanation of the differential system of charging for current as adopted by the Cleveland Electric Illuminating Company in 1889, of which I am vice president and treasurer, and also some reasons for its use. As therein stated, all the lamps connected by a customer are made the basis in business places for arriving at the amount to be billed to him monthly at the base rate. I have been asked how this differential rate is adapted for use in residences by us and how it works in practice.

As every electric lighting company manager knows, it would not be fair to the consumer to take all the lamps connected in his residence as a basis for arriving at the amount of current to be billed at the base rate, for if the house be thoroughly wired throughout, all of the lamps will not be used at any one time, and even on special occasions when there is a large percentage of them used, probably less lamps than usual are used in other adjoining residences at the same time. In short, the diversity factor in residence lighting is very much greater than in business lighting. A simple way, of course, would be to take a certain definite percentage of all the lamps installed in a residence as being the demand of that residence. The objection to such a method, however, is that it would result in residences, generally speaking, not being so fully wired throughout as would otherwise be the case. To obviate this difficulty, we determined to exclude the lamps in certain parts of residences from the rating. This, of course, makes it necessary to take a larger percentage of the lamps that are included. In order to show the lamps that are included and those that are not included, we give here a copy of our rating card showing the actual rating of a residence.



The Illuminating Company's rates for electricity to Residences are 12½ cents per Unit until a use has been made equivalent to burning all of the lamps composing the "Residence Rating," 50 hours in each month, and 5 cents per Unit for the electricity used in excess of that amount.

As in any other meter system you pay for only the actual current used. The 50 hour use simply specifies the amount of electricity to be used at the regular rate (12½ cents) before the 5 cent rate applies.

Record of lamps affecting your "Residence Rating."

LOCATED IN	LAMPS	LOCATED IN	LAMPS
Front Halls Main Stairway	12	Reception Rooms	10
Library Den	2	Dining Room	2
Sitting Room	10	Sewing Room Children's Room	2
Music Room Conservatory	5	Bed Rooms	15
Kitchen	2		
		Total	60

Of these lamps 7-10 are rated as 50 watt, and 3-10 as 25 watt lamps.

This record, reported by our inspector, is equivalent to 51 Standard 50 watt lamps.

Of these 51 lamps, 4-10 only are rated, hence your "Residence Rating" is 20 4/10 Standard lamps, which in one hour will use 1020 watts, and in 50 hours 51000 watts or 51 electrical Units.

[An electrical Unit is 1,000 watts.]

In making your monthly bills therefore, the Company will charge you at 12½ cents per Unit for any current used up to 51 Units. Any current used beyond 51 Units in a month will be charged at 5 cents per Unit—a discount of 60 per cent.

Memorandum of lamps, fans, electric heating pads, flat irons, etc., which do not affect the rating.

LOCATED IN	LAMPS	LOCATED IN	LAMPS
Vestibule Porch	1	Pantries Summer Kitchen	1
Closets	2	Servants Rooms	1
Bath Rooms Lavatories	2	Back Halls Back Stairways	2
Dressing Rooms	1	Billiard Room Ball Room	
Attic Basement	2	Barn Yard	
		Total	12
		Total Lamps	72

$2.00 is the smallest sum for which a monthly bill will be rendered.

Note.—The Illuminating Company is anxious at all times to co-operate with its customers in "Saving Current." Any means by which more satisfactory illumination can be secured with less expenditure of electric energy will increase the number of our patrons in proportion as your bills are reduced.

Many times there is a waste of current through faulty location or selection of lamps. The expert advice of our men in regard to this and many other points, is at your disposal, free for the asking.

Still more often the service is impaired because you use Old lamps. We furnish our customers with the best lamps on the market at very low prices and allow 8 cents rebate on each Old lamp returned to us with the filament unbroken.

RATING CARD, ABOUT HALF SIZE.

By excluding from the rating, as we do, the lamps in closets, basements, etc. etc., such lamps are installed, and the convenience of having lights in these places is an important factor in electricity being given the preference over other illuminants in the home. When we first started this rating system, we used to take the actual candle-power of the lamps included in the rating. A short experience, however, demonstrated that there was a tendency on the part of the consumer to install in the first instance 8 to 10 cp lamps entirely, so as to get the rating low, and afterwards when he found they did not give him sufficient light, as was evident to us at the outset would be the case, he would install a standard 16 cp lamp, which would result in a much larger demand than the company figured upon in arranging its basis of charge. We, therefore, concluded to asume that in all cases the lamps in the house should be rated as 7-10ths of them standard 50-watt lamps, and 3-10ths of them as 25 watt lamps. In the main this assumption has worked out satisfactorily.

In this connection, however. I beg to emphasize the fact that whenever there is any serious complaint on the part of any consumer as to the equity of the rating as determined by the system used to arrive at it, we never insist upon it, but offer to intsall a demand meter, and to take 40 per cent. of the actual demand made as the basis for the monthly bill. The result of this policy has been that in only a few instances has the customer accepted the proposal to install a demand meter. The fact is that the method of rating used by the company, if the house be wired throughout, results in a demand for billing purposes less than the residence would secure if a demand instrument were installed upon it.

As to how it works in practice, we have been using the system now nearly four years, and with results entirely satisfactorily to the company, and with no friction being occasioned by it between the company and the consumers. There undoubtedly is some pressure on the part of consumers at times to get their rating reduced, but this has not been nearly so pronounced as we feared would be the case at the outset.

It will be noticed that I say the system has worked without occasioning any friction between the company and its customers. The fact is that in those cases where the customers have sought an explanation for our charging for current at two different rates, they very generally admit the justice of the method, and agree that the customer making the longest average use of the investment placed at his disposal is entitled to the better average rate which he earns. That the company continues to have complaints in regard to the comparative sizes of bills under this system of billing (one month with another, and one season with another) goes without saying. This would be the case under the most ideal system of billing. A "tax-gatherer" is never popular with the people from whom he collects taxes, and a lighting company is a monthly "tax-gatherer." The best, therefore, that it can expect to do in the gathering of these taxes is to collect them with as little friction as possible. It seems to me that any system which gathers taxes from the individuals in proportion to the service actually rendered them is likely to be attended with the least complaint.

In my judgment, the differential rating system for lighting companies comes more nearly accomplishing this result than any other system with which I am familiar. In practice it applies a graded scale of discounts to the customers in proportion to their use of the service they demand of it. They always get their bills at the same rate; the amounts of current used at the different rates making the difference in the average rate secured by any one customer as compared with another customer, and even as between one month's bill and another month's bili of the same customer.

Under this system of billing, the customer is charged for the same amount of current each month if he uses it, and in the heavier lighting months usually all the increase in the bill is for current used at the lower rate, so that the relative differene in the size of the bills between the summer and the winter months is not so great as where one flat rate is charged throughout the year. This is an advantage that can readily be appreciated, as it means less difference between a summer and a winter bill.

In business places a customer if he desires to be billed for current used according to the differential system is asked to make a guarantee per lamp connected per month. This is necessary for the tendency here is to install lamps for special seasons, and to use a much smaller number during the rest of the year. To such places a company cannot afford to have its lower second rate apply. In residences we do not ask for a guarantee. When a person wires his house we assume that he prefers to use electricity for illumination entirely and the differential system brings home to him forcibly the fact that when he has used in any month all the higher rate current for which the company will bill him, the lower rate current (5 cents per kw-hour) is cheaper than any other illuminant; hence it is better for him to make use of electricity throughout his house than to resort to any other illuminant. Having gotten, therefore, all the light he needs to use in his house, we do not feel the necessity of asking him for a guarantee.

The system of billing for current according to the lamps connected, as is done by the Cleveland Company, requires an inspection department, which is a source of some expense. In business places this inspection has to be thorough, and made at no infrequent intervals. In residences, however, we find that after the lamps have once been installed, it is but seldom that any changes occur in the installation, so that there is little or no inspection required in the residence part of the business. If a residence makes any material change in the lights installed in it, the attention of the meter reader is likely to be called to the fact when making his rounds, or the accounting department may have its attention called to it because of the increased use of current.

We were led to adopt this differential rating system for residences partly because of the desire to avoid the investment in demand meters, but more particularly because of the fact that we did not want to take upon ourselves the additional onus of continually verifying the correctness of any measuring instrument other than the wattmeter. One such instrument is quite sufficient. It may be interesting to know that the result of our method of rating is, that we find the total demand as arrived at by the system is equivalent to 28 per cent. of all the lamps connected in residences. When we compiled it, our idea was to take about 30 per cent. of all the lamps connected in a residence.

An objection raised by some to the lamps connected being used as a basis for arriving at the amount of current to be charged for at the higher rate is, that it prevents the installation of as many lamps as would otherwise be wired up. It does have that effect, and this may result in some loss in gross revenue, but our experience is that some check upon the installation of lamps is not altogether a bad thing. How often it happens that a party arranging for the use of electricity wires up his place profusely, and after he gets his first bill realizes that he cannot afford to use all his lamps, and then proceeds to vent his disappointment on the company, and in disgust not infrequently resorts to gas, or if he continues to use electricity, cuts out part of his installation, or uses such part only on special occasions—and special occasion lamps mean a direct loss to the supplying company.

Third Rail Methods in Brooklyn.

As the result of a report by Mr. C. R. Barnes, State electrical expert, the Brooklyn Heights Railroad Company has been directed by the State Railway Commission to place a timber between the third rail and the platform at the forty-one stations where the third rail is located on the side of the tracks.

This action is due to an accident generally attributed to the third rail, at the Fifty-second Street station of the Fifth Avenue line. Two plans were suggested for the protection of the public. One was that where the third rail is contiguous to the platform it be covered, and the second where the third rail is on the near side of the platform it be carried to the far side with wire connection with the main portion of the third rail. John B. Creighton, secretary of the Brooklyn League, laid these plans before the Board of State Railroad Commissioners, with the desire that a full investigation be made. The Commission immediately sent Mr. Barnes as an electrical expert to Brooklyn to look into the situation and make a special report.

The report states that the man met his death by being crushed between the train and the station, and further makes the following conclusions:

"The third rail at the different stations can be changed to the opposite side of the tracks. The estimated expense of this change at the forty-one stations is $11,500.

"As to the walks on the elevated structures, those on the outside of the tracks are equipped with hand rails, and these walks are necessary for the purpose of enabling passengers in times of panic in a car or when trains become stalled to leave the cars and walk to the station. If the third rail were located on the opposite side of the track from the station platforms the danger from this source to passengers leaving the cars between stations and walking to them would be very great.

"To prevent passengers falling from the station platforms and coming in contact with the third rail where it is located on the station side of the structure, the rail should be protected by an open trough extending above the top of it. But the third-rail shoes used on this system are eight inches in width, and the connections to the shoes are made in such a manner that this trough in order to accommodate the shoe and connections would have to be over twelve inches in width. This width of shoe is necessary for the operation at the Brooklyn Bridge terminus. A trough of this kind would not afford much protection against a person who has fallen from the platform coming in contact with the third rail.

"The danger from persons coming in contact with the third rail would be increased by placing it on the opposite side of the track from the station platforms. On account of the width of the shoe and the connections to it it is not practicable to box in the third rail at the stations; but a timber could be placed between the third rail and the platforms, extending as near as possible and clear the shoe, and extending above the rail as far as the operation of the cars will permit."

It is understood that steps will be taken by the road to carry out the suggestion involved in the report, so far as possible.

Automatic Motor-Starter Litigation.

A decision recently rendered in the United States Circuit Court of the Northern Division of the Northern District of Illinois in sustaining the Blades patent on automatic motor-starters, defines the principle of *res adjudicata* as it may enter in patent litigation. The suit in question was for infringement of a patent on an automatic motor-starter issued January 7, 1890, to Harry H. Blades, of Detroit, Mich., on an application dated November 30, 1888. One of the defences was that this same patent when the subject of litigation some years ago, was declared void for want of patentable novelty. It was urged that the decision in that case was *res adjudicata*, and that the court should by way of comity concur in that decision. The court held that in view of the difference of parties in the suit at the bar and the former suit, he did not consider the claim of *res adjudicata* sustainable. As to comity, the judgment of another court upon the same subject matter is of great weight, when the same matters are presented in substantially the same manner. But if the reasoning of the court or the presentation of facts in such case fails to appeal to the judgment in view of the new presentation of the case, such judgment should prevail.

The opinion then proceeds to discuss the Walter patent, which figured in the earlier suit, and also other patents brought forward as anticipations by the defence, and concludes that the Blades patent relies for its strength on the location of the releasing magnet within the shunt motor circuit, thereby controlling the arm which contacts with the resistance sections located between the armature of motor circuits in such a manner as to provide automatically against accidents to the field circuit. The decision concludes that both the Blades combination and the result it attained were new; that the end attained was most desirable, and that the invention has gone into extensive use in a modified form, the defence having found it to their advantage to use it. The court, therefore, decided that it amounted to patentable novelty and that the patent is valid. The parties to the suit were the Cutler-Hammer Manufacturing Company and Edward W. Hammer *et al.*

A. I. E. E. Extra Meeting.

The extra meeting of the American Institute of Electrical Engineers on Friday evening, April 17, at which Mr. W. J. Hammer will read his paper, will be held at the Chapel of the College of the City of New York instead of at the Chemists' Club, as previously announced. The paper of Mr. Hammer will be one of unusual interest, not only on account of the subjects treated, but also because of the large number of experimental demonstrations that will be given. Mr. Hammer has prepared apparatus which will exhaustively illustrate the properties of radium and other radio-active substances, and of phosphorescent and fluorescent substances. Experiments prepared to illustrate the properties and application of selenium will also be of particular interest. The lecture will also deal with the treatment of disease by ultra-violet rays, to study which subject Mr. Hammer recently made a visit to the Finsen Institute in Stockholm.

Sale of Ries Patents Unratified by the Court.

On April 7 Judge Morris, of the United States Circuit Court, sitting at Baltimore, refused to ratify the sale of certain patents and patent applications granted in the name of Mr. Elias E. Ries, which sale took place March 3 by auction in Baltimore, the purchaser being Albert G. Thompson, of New York, whose bid was $60,000. In a bill of exceptions opposing the ratification of the sale, Mr. Ries alleged that his alternating-current converter electric railway patents included among those sold are fundamental and controlling, and are now being extensively used by all the larger electric railway companies in this country; that the rights to recovery for past infringement, which was included in the sale, is worth, aside from the present and future value of the patents themselves, many times more than the total price paid for the entire property. It was stated that in Greater New York alone there are now in operation and under construction electric railways involving a capital investment of over $200,000,000, which, it was alleged, have already adopted or are about to adopt the system of electrical transmission, conversion and distribution covered by some of the patents sold.

Mr. Ries further averred in his petition to the court that the prospective one-half interest in the patents held by his late associate had been previously acquired without the knowledge of the petitioner by certain parties in whose interest the entire title to the patents was eventually purchased at the public sale, and certain irregularities were charged with relation to the manner in which the preliminaries to the sale were conducted. The petitioner stated that he has secured two bidders who are willing to begin a new bidding for the patents at $120,000.

A list of the Ries patents and applications was given in the issue of March 14. One of the most important of the patents was issued to Mr. Ries April 11, 1899, on an application filed by him in 1887 after passing through interference proceedings extending over the period of twelve years. It is claimed that this patent is of such broad scope as to cover the entire modern electric railway industry. A hearing was granted at which arguments may be presented to show cause why the sale of March 3 should be set aside and a new sale ordered.

CURRENT NEWS AND NOTES.

LINEMEN AND TREES.—Gov. McCullough, of Vermont, in designating April 17 as Arbor Day, after describing the advantages to the community derived from the planting, says in his proclamation: "But besides planting, it behooves this generation to preserve. Preserve the trees by the highway from the wanton felling, cutting and slashing of the modern vandal, especially the linemen of the trolley, the telephone, the telegraph, the electric light—more destructive in their ravages than the gypsy moth or the elm beetle."

MUNICIPAL LIGHTING AT ST. JOSEPH, MICH.—An elaborate analysis of the report of the municipal electric lighting plant at St. Joseph, Mich., has been made by Mr. W. Worth Bean, the well-known manager of lighting and traction properties. He shows that nothing is allowed for depreciation, taxation, interest, insurance, etc., while sundry items of expense are wholly omitted. Even the amount of investment is incorrectly stated. Mr. Bean's company stands ready to supply lights at figures far below the actual cost of lights from the city plant.

INTERNATIONAL COMPLICATIONS.—In a recent editorial note on electroculture, we appear to have been misled as to the origin of some of the data, and thus to have located Helsingfors in Norway instead of Finland. We believe most of our readers are aware that Finland is not in Norway, but is a reluctant part of Russia, and therefore in order to avoid further international complications, we hasten to make a needed correction. We would point out that in the article Prof. Lemstroem is spoken of as a Russian, but we are not sure of his native place.

WIRELESS TELEPHONY.—A recent dispatch from London to a Montreal paper refers to some experiments made at Alexandra Palace with a system of transmitting speech and signals through the ground, the inventors being J. T. Armstrong, a Devonshire electrician, and Axel Orling, a Swedish electrical engineer. According to the dispatch, "A characteristic feature of the system was a peculiar combination of high-potential discharges and low-tension currents. Experiments with bombs proved that explosives could be syntonized within the same radius, so that all could be fired simultaneously or each in turn by means of earth currents without wires." Other experiments illustrated the transmission of Morse signals and musical sounds by a wireless telephone.

BRITISH PACIFIC CABLE.—Advices from London state that the British Pacific Cable Board estimates that there will be a loss on the working of the cable of £92,000 for the year ending March 31, 1904. This will throw a responsibility of £30,700 on to New South Wales, Victoria and Queensland. The contributors to the Pacific cable and their proportions are: Great Britain, 5-18ths; Canada, 5-18ths; New Zealand, 2-18ths; Victoria, 2-18ths; New South Wales, 2-18ths; Queensland, 2-18ths.

ELECTROLYTIC COPPER PLANT IN CANADA.—A Canadian correspondent states that within the next few months a plant will be established either in the City of Montreal or at Shawinigan Falls, Quebec, for the conversion of crude black copper into refined copper. This will be followed by the establishment of extensive works for the manufacture of the free copper into sheets and tubes. It is also reported that Mr. C. K. Milbourne, an English capitalist, has been locating a site for a plant for the refining of copper by the Cowper-Coles process.

SALE OF MUNICIPAL PLANTS.—Representative Curry, of Philadelphia, has introduced in the Pennsylvania Legislature a bill authorizing any city, town or borough owning or operating its own gas works or electric light plant to sell, or lease, or otherwise dispose of the same to individuals or corporations and to secure to the lessees or purchasers thereof by proper covenants and agreements the exclusive right to furnish gas or electricity within such city, town or borough under such regulations and for such periods, not exceeding 50 years, as the municipal authorities of such city, town or borough shall deem advantageous.

WIRELESS TELEGRAPHY FOR SUBMARINES.—A cable dispatch from London of April 11 says: In the course of experiments with the new submarines at Portsmouth an attempt was made to communicate with them by means of wireless telegraphy, which was found possible. A further trial revealed the fact that communication could only be established so long as the light penetrated to the submarine; it ceased as soon as they were submerged to a depth where the light was unable to reach them. This discovery will, it is expected, have an important bearing on the future of submarine warfare. Experiments made aboard ship to detect the approach of submarines were also successful.

WATER POWER OF THE ESCANABA.—A telegram from Negaunee, Mich., states that Minneapolis and St. Paul capitalists are planning the utilization of the water power at the falls on the Escanaba River, some thirteen miles from that city. It is estimated that 100,000 hp may be developed. A representative of the company states that one of the largest pulp mills in the United States is planned; also the transmission of power to Escanada, Iron Mountain, Menominee and Marinette. He also stated that agents of the company would be in Negaunee, Ishpeming and Marquette with a proposition to furnish power at prices much below the present cost of production.

SWEDISH BRAKE FOR ELECTRIC MOTORS.—Consul R. S. S. Bergh reports from Gothenburg, March 18, 1903: Mr. Arthur Hultqvist, assistant engineer in the workshops of the electrical street railways of this city, has recently constructed a brake for electric motors which consists of a small automatic reversing switch (omkopplare), which is fastened near the motor. On every machine is a pendant handle bearing the words "emergency brake" in red letters. If a workman should happen to be caught in the machinery or any other accident should occur, the machinery can be quickly stopped by pulling the handle, which sets the brake in action. It is claimed that the machine can be stopped in this way within one-half or one-fourth rotation.

WATER POWERS IN GEORGIA.—The Director of the United States Geological Survey, Mr. Charles D. Walcott, announces that a comprehensive system of mapping the areas adjacent to the undeveloped water powers of Georgia, which will prove to be of great value to manufacturing interests, has just been inaugurated. Careful surveys will be made of all the important streams in the State throughout their whole length, to show the amount of their fall and the position of their banks and islands; and contour maps of possible dam sites, and, finally, topographic maps of their drainage basins will be prepared. This system of surveys has been undertaken by the United States Geological Survey, and Messrs W. O. Tufts and J. R. Eakin have started work respectively on the Ocmulgee River from Atlanta to Macon, and on the Savannah River from Augusta to its head, including the Broad, Tallulah, Tugaloo and Chattooga tributaries.

ELEVATOR CONTROLLING DEVICES.—A patent issued April 7 to Mr. C. O. Mailloux on an application filed July 23, 1890, relates to Mr. Mailloux's system for controlling elevators, which has been the subject of other patents, two of which were granted in 1895. The system consists of the use on each floor of push button controlling switches in connection with locking mechanism for producing non-interference. The operation of a switch at any floor landing throws all the switches at all the landings into a temporary inoperable condition. Upon closing a switch at any landing, the elevator car ascends or descends to that landing, stopping there; all the controlling switches on the several floors are then locked, and upon a passenger entering the car and closing the door, the car is left completely under the control of the switch in the car. Upon closing the landing door after the passenger leaves the car, the apparatus is placed in such a condition that the system will be in condition for calling the car to any other landing.

MARCONI IN ENGLAND.—A special cable dispatch to the *New York World* from London of April 11 says: Mr. Marconi is disgruntled because the British Post Office still refuses him facilities for sending telegrams to his trans-oceanic wireless station at Poldhu. "The English Government is slow but sure," he said to the *World* correspondent with a tinge of bitterness in his tone. "It does not move as rapidly as the American Government does, and is not so sympathetic as the Italian, but doubtless it will do all I desire in time." The London *Times'* daily Marconigraph service has been intermittent, and this is pointed to as justification of the Post Office Department's refusing facilities to the public to offer dispatches which probably could not be transmitted. Being asked concerning the future developments of his system Marconi said: "I only forecast what I know to be certainties. I cannot commit myself to predictions which, if not fulfilled to the hour, would excite malicious criticism. My system has a future before it that will shame those who now are sceptical."

CHICAGO MUNICIPAL OWNERSHIP.—In discussing the statement of Mr. Carter Harrison, Mayor-elect of Chicago, that his narrow election is a victory for municipal ownership, the *Wall Street Journal* says: "If the policy of municipal ownership of public utilities is ever adopted in this country it will hardly be as the result of Chicago's example. The kind of municipal ownership that thrives in Chicago is not exactly the kind that the people of the country as a whole are in favor of. A city notorious the world over for its official blackmail of corporations seeking franchises is not the government to take the lead in the direction of municipal ownership. Chicago's official corruption has for years been a stench in the nostrils of honest people. Systematic blackmail has become a fine art there. Chicago must purge itself before it can hope to show to the country the advantages of municipal ownership. It is remarkable that the two cities where the idea has been tried on a large scale, Philadelphia and Chicago, have enjoyed the most unenviable municipal reputation. The first pre-requisite for the establishment of municipal ownership is municipal honesty and purity. The thought occurs to us that Mayor Harrison advocates municipal ownership in order to make it impossible for any one else to do so. If he desires a monopoly of the idea that is a good way to achieve it."

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LETTERS TO THE EDITORS.

Fuel Consumption in Central Stations.

To the Editors of the Electrical World and Engineer:

Sirs:—The recent suggestions that the economy of power station operation be expressed in pounds of water used per kilowatt-hour are of doubtful value. It is true that the usual method is unsatisfactory and allows no accurate comparison of stations operating under different conditions The pounds of water evaporated per kilowatt-hour, including only the energy transformations in pipe line, engines, generators and cables, gives no indication, unless the pounds of water evaporated per pound of coal is stated, of the boiler room operation where the largest losses always occur. When separation is made into these two stages, discrimination between the very dissimilar performance of the engine and generator has become pertinent, and thus the real need of a simple expression for the economy of the station as a whole is not supplied. Were it not that most stations have insufficient facilities, a better practical method of stating power station economy would be pounds of combustible per kilowatt-hour or pounds of coal "dry and free from ash." The energy in one pound of combustible in ordinary coals is nearly constant, and efficiencies based on it would be directly comparable with sufficient accuracy for practical purposes.

Brooklyn, N. Y. Hartley Le Huray Smith.

The Proposed New York State Electrical Laboratory.

To the Editors of Electrical World and Engineer:

Sirs:—We were surprised to read the report of the statements made at the hearing before the Senate Finance Committee held in Albany, March 17th, on the McEwan bill to establish a State Electrical Laboratory, particularly the references to the testing of electricity supply meters made by Mr. C. P. Steinmetz.

It has been the invariable practice of this company, and we believe of all properly conducted electricity supply companies, to test the meters in use by the consumers, upon request, at any time; and if the meter is found to be outside the limits of commercial accuracy, a prompt rebate is made to the full extent of the meter's inaccuracy, without process of law. In the regular routine of the meter department a test of all meters in use by the customers is made at least once every year. The customer is invited to be present at these tests in person or, if he desires, he may be represented by an electrical expert of his own selection.

The charter of the City of New York provides for a meter test by the Department of Water Supply, Gas and Electricity, on request of the customer, and such tests have been made in a number of cases. We believe that electrical testing laboratories of standing, conducted by private capital, are already in existence—notably the Lamp Testing Bureau, duly incorporated under the laws of the State of New York—to make electrical tests of any kind on behalf of the public on the payment of moderate fees. It is to be observed, moreover, that tests of this character should be made on the customer's premises under the conditions of environment in which the meter is actually used.

With the National Bureau of Standards at Washington, certifying to the accuracy of the fundamental standards used in meter tests, and with municipal authorities or private corporations by whom meter tests can be made, the electricity supply customer should have no difficulty in satisfying himself that his meter is recording correctly, and that he is paying for only such current as he is using.

The New York Edison Company,
Nicholas F. Brady,
New York. *Vice-President.*

Electric Traction on the Swedish Private Railroads.

To the Editors of Electrical World and Engineer:

Sirs:—In an article in Electrical World and Engineer of March 21 the writer reported on the provisions by the Swedish Railroad Administration for adopting electric traction on the government roads. Now the "Road & Water Building Administration," to the jurisdiction of which the private railroads belong, has taken the matter up for those lines. It submitted on March 5 to the Swedish Government a petition for a grant for making tests with electric traction on a part of the Falun-Västerdalarnes Railroad. That company, from which the initiative has come, has engaged to give up a new part of its track for free use for the tests during two years, and the Stora Kopparbergs Bergslags Company will furnish, free of cost, for the same period of time, 1,100 hp from its adjacent power house. The Road & Water Building Administration has received offers to participate in these tests from the following foreign firms, viz: Oerlikon Company, Zurich; Westinghouse Company, Pittsburg; Schuckert & Co., Nuremberg; Siemens & Halske, Berlin, and Allgemeine Elektricitat-Gesellschaft, Berlin. They place at the Road & Water Building Administration's disposal, free of charge, an engineering staff, as well as, in some cases, rolling stock.

This test, which is going to be held in Sweden between the most prominent electric railroad systems, will, no doubt, be extraordinarily interesting to the whole electrical world

Nashville, Tenn. Akvid Westerberg.

"Water Pail" Electric Lighting.

To the Editors of Electrical World and Engineer:

Sirs: Referring to the interesting article by M. Paul Hoho, in your issue of March 28, I had practically the same experience as described by him, and for the same purpose, in 1894, at the East End Electric Light Plant, Pittsburg, Pa., while engaged in research on the subject of aluminum. The results obtained were communicated to Superintendent Lucas of the above plant, to a number of friends in the student course of the Westinghouse Electric & Manufacturing Company, and others.

My experiments were made with a "cell" consisting of a glass jar, with electrodes of both equal and unequal size (area of surface exposed to electrolyte) and an aqueous electrolyte, with an arc between electrodes or electrode and the electrolyte. The electrodes were cylindrical, as shape did not seem to be of consequence; and among those tested were carbon, the common metals, and metallic oxides, such as ferroso-ferric, plumbic, stannic, stannous, cuprous and cupric, both in a porous and solid state. The electrolytes investigated were water; acid, alkali and salt solution: and to prevent noxious fumes arising, recourse was had to solutions of boric acid, and similar soluble acids of the metals, salts of such acids (such as bichromates and permanganates) and soluble compounds similar to sodium-aluminate.

The use of such a method (patented several years ago) to heat or fuse metals, while accomplishing the results desired, is much less efficient than heating by the direct resistance method of metal to metal, owing to the amount of water converted into steam with consequent loss of energy, and the absorption of the gases set free by electrolysis by the metal, which causes the latter to oxidize more rapidly when exposed to the air.

I question very much whether carbon is fused, as my results tended to show that the carbon of the electrode combined with the gases set free (to form carbo-hydrides, in the case of hydrogen being evolved) and at the same time the disintegrating action of the passage of the current, which happens whether an arc is formed or not, tears from the electrode fine particles which float around in the electrolyte.

The article did not apparently comprehend investigation of the alternating current, but my experiments with both alternating (133-cycle) and direct current showed results almost the same, except that with the former electrolytic action was much modified.

The article states that "there only remains to clear the theoretical process of the imperfections inherent in all new systems." These imperfections, however, happen to be numerous, and some most difficult, among which is the great loss of the light produced due to the transformation of many of the actinic rays into heat rays during their passage through the electrolyte and the loss of energy caused by the conversion of much of the water of the electrolyte into vapor, which vapor would require some special means of removal in the case of indoor lighting, and would possibly cause trouble in outdoor lighting in cold weather.

I did not abandon the matter, but deferred it for further investigation. In view of the recent developments, I desire to state that I have found the use of such a combination (carbon, metal or composite electrodes, an aqueous electrolyte and an arc between the electrodes and the electrolyte), offers an interesting and efficient means of producing many simple and complex compounds; particularly endothermic ones, some of which are not readily made otherwise, and many only by means of the high temperatures of the electric arc. One of the simplest reactions is the production of acetylene by the use of a carbon cathode, and preferably a direct current, with a simple electrolyte such as sodium hydrate or borate, in a closed vessel; the hydrogen liberated at the cathode combines with the latter forming acetylene (C_2H_2) and with the steam generated by the arc, and a certain amount of the volatilized electrolyte is carried over to a condenser, where the water and electrolyte is caught and the acetylene passes over to a gasometer. It may be interesting to note that there is a certain critical temperature (result of current density at the electrode) under which acetylene is not formed, and in the manufacture of other and more complex compounds, certain temperatures of the arc cause the production of other compounds than those desired. This method may no doubt prove an important factor in the ever-broadening field of electrochemistry.

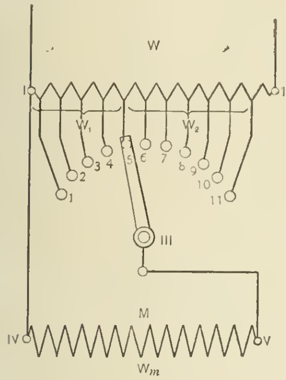
JOSEPH B. HALL.

CHICAGO, ILL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Shunt-Regulating Resistance for Separate Excitation.—KINZBRUNNER.—An article illustrated by diagrams. In some cases, especially in test rooms and in laboratories, it is desirable to accomplish a regulation of the shunt current of dynamos within very wide limits; this is especially the case in determining magnetizing curves, and in the tests of boosters. In both cases the magnets are in general separately excited and a continuous regulation is desirable. If this is done by a resistance in series, in many cases very large resistances are required. He recommends using instead, at least in special cases, the arrangement shown in the adjoining diagram, in which the regulating resistance, *IV*, is directly connected to the source of the exciting current, *I* and *II*. The magnet winding, *M*, is connected at one end with *I*, and at the other end with the lever, *III*, so that the magnet winding may be connected to any part of the resistance, *IV*. This arrangement has the evident disadvantage that the loss of energy is in any case greater than with a series regulating resistance. Hence this arrangement should be used only when this energy loss is of no account, and when a regulation within very wide limits is desired. This is the case for some purposes in laboratories and also in connection with boosters.—*Elek. Zeit.*, March 26.



SELF-REGULATING RESISTANCE.

Direct-Current Dynamos.—DRUCBERT.—A very long article in which he analyzes the design of the direct-current dynamos exhibited at the Paris Exposition and compares them with various formulas developed by S. P. Thompson, Knapp, Arnold, Picou, Fisher-Hinnen and others. In a long table he gives for 20 machines of various size and design, the principal dimensions and details of design. The various properties are then discussed and the different formulas applied. In summing up he says that in spite of difference of opinion existing between different designers concerning the principal dimensions, the number of poles, the induction and the heating limit, there are now evident uniform tendencies toward the employment of multipolar types of restricted dimensions and of a shape agreeable to the eye, towards a reduction of the diameter of the armature (due to the use of drum windings), of the teeth and of the channels for ventilation, towards the use of employing means for getting good commutation in order to reduce the wear and tear of the commutator, and finally towards the nearly general use of cast steel for the polar system.—*L'Eclairage Elec.*, March 21.

REFERENCE.

Compounding of Alternators.—BOY DE LA TOUR.—A mathematical article illustrated by diagrams, in which he discusses the general principles and the conditions which a method of compounding must satisfy. He remarks that the use of compounding is desirable only when the variations of load which may occur are large compared with the power of the generating set.—*L'Ind. Elec.*, March 10.

POWER

A European 40,000-Volt Plant.—A note stating that the Oerlikon Company is about to erect a large electric power plant on the Caffaro River, which has its source on the Alps, forming the frontier between Italy and Tyrol, and discharges its waters into the Chiesa River. An up-stream station, which will be built later on, will supply 5,000 hp, while the station to be erected now in the Italian township of Bageline will make some 10,000 hp available. In both stations three-phase current of 9,000 volts and 42 cycles, taken from the generator terminals, will be transformed up to 40,000 volts. Current at the pressure will be transmitted to Brescia, some 40 km distant, where it will be partly used for power and light distribution in the Province of Brescia, and partly for operating large electrochemical works. The station, which is now in course of construction, has a water supply of 4,000 litres per second, with a head of 254 metres, which corresponds to an effective turbine output of 10,160 hp. The head-race has a length of 4,500 metres and includes three tunnels, one of which is 2,300 metres long. Five 2,500-hp generating sets will be installed, each consisting of a turbine directly coupled to a three-phase generator and running at 315 r.p.m. Besides these large sets there will also be two 160-hp turbines running at 600 r.p.m. and coupled to exciters. One exciter will suffice for four of the main generators, the other exciter and the fifth main set serving as reserve. The alternators are designed for 2,340 kv-amp. at a power-factor of 0.75. Five step-up transformers, each of 2,340 kv-amp., raise the pressure to 40,000 volts, and after transmission it is transformed down to the working pressure by a like number of step-down transformers.—Lond. *Elec.*, March 27.

Electric Power in Mines.—NOWAK.—An illustrated description of the electric installation of the Gneisenau mine near Dortmund, Germany. Last year it was decided to considerably enlarge the existing small lighting plant so that electric current should be used for power purposes, especially for pumping. For the latter purpose a 665-hp motor was installed, which consumes about one-fourth of the whole load. The three-phase system at 2,500 volts and a frequency of 25 were chosen. For lighting and for power transmission on the surface of the earth, the three-phase currents are transformed to 500-volt, direct-current, while the pump motor, which is placed under ground in the mine, is operated directly at 2,500 volts. The plant contains two steam-driven, 625-kw, three-phase generators; two converters for excitation and lighting of 50-kw, and a direct-current dynamo of 38 kw, which was available from the old installation. The installation of the large pump motor in the mine was very difficult on account of the small dimensions of the shaft; the stator had to be brought into the mine in four parts and the rotor in two parts and both the stator and the motor had to be wound in the mine. For starting the motor two methods are used; in the first one, which is generally used, the short-circuited motor is connected with one generator which is then at rest; when the generator is started, the motor also starts and runs up to full speed with the generator. This necessitated the employment of two three-phase circuits on the switchboard, one for the normal light and power service, the other for starting the pump motor. In some cases, however, it was desirable to start the motor without first stopping one generator; for this purpose a resistance is provided in the well-known manner, to be inserted in the motor circuit; it consists of nickeline wire in oil.—*Glueckauf.*, February 28.

TRACTION.

Third Rail for High-Speed Electric Service.—GONZENBACH.—A summary of a paper in which the writer reviews the advantages of the third-rail system as compared with the overhead trolley, and then takes up the several features of construction and operation of roads equipped with the former style The practice of locating the third rail at one side of the track is commended and the necessity of adopting a standard-gauge line and elevation for surface work and elevated roads, is urged upon builders of both classes of lines Considerable attention is given to the question of insulators, and some experiences gained on the Boston & Albany and the New York, New Haven & Hartford roads are described to show the need of adopting some other form than wooden insulators. The writer mentions that the average in a series of readings taken under his direction was between 6,000 and 7,000 ohms, and in no case does he recollect a reading exceeding 12,000 ohms per mile. In fact, very often the record shows as low as 2,000 ohms under ordinary weather conditions. Mention is made of the experiments with contact shoes to be used on protected third rail systems, and while it is conceded that these would avoid difficulty from sleet, it is questioned whether they would be suitable in an open country where snow would be likely to drift and pack tightly between the rail and the guard. The tendency of locating sub-stations so as to get ideal power distribution, regardless of other conditions, is condemned, as is also the practice of making these sub-stations miniature power plants and "providing in them all sorts of engineering freaks in the way of apparatus." The writer, from experience, advocates as simple a design as can be adopted, and the location of these stations so as to serve for passenger and freight depots, where the men in charge may be used in other capacities than mere attendants on the apparatus.—*St. R'y Jour.*, March 28.

Surface-Contact Systems.—Bornand.—An abstract of a paper read before the Birmingham Association of Civil Engineers. He discusses the subject under two categories: the first including systems which have a switch for each stud, placed underneath the stud, or grouped 10 or 15 together in a single box, the chief characteristic of the second system being one single switch, which commands as many as 40 studs, and which automatically distributes the current to each stud when the car is traveling. The author emphasizes the importance of sound wiring and the soldering of all the electrical joints. The effects of moisture on an electric cable carrying power for electric traction, must be carefully guarded against; a constant and forced ventilation of the tube or conduit into which the cables are drawn would be a great improvement, it would tend to keep the wiring system dry, and assure safety and avoid the danger of such an installation losing its insulation. Lead-covered wires should be avoided as much as possible, armored cables being used and enclosed in cast-iron pipes in the same way as in electric light distribution systems. Dealing with the studs and switches and the consequence of bad insulation, he advises that the switch recess should be made of incombustible material, and the insulation of the switch box and stud should be as perfect as possible. If the insulation be bad, the leakage of current with 500 or 600 volts, attains such a magnitude that an arc occurs and persists between the two contacts, rendering the stud alive. Tests with switches breaking in oil have shown them to be unsuitable in surface-contact systems. Any arcing decomposes the oil, which then forms a paste of a certain conductivity. Every possible means should, therefore, be taken to prevent the occurrence of moisture inside the switch boxes. In some systems the switch is opened by gravity, which is the simplest way; in others by magnetic influence or springs. Referring to magnets and skates, he says that if the magnetizing coils are not spaced at proper lengths along the magnetic bar, it may cause non-uniformity of the magnetic field throughout the length of the skate, and so create variable attractive forces and variable pressure between the two switch contact pieces; these bad contacts will cause undue heating and some sparking of a detrimental nature. Magnetic skates have the inherent defect of carrying and accumulating on the track all the iron particles left in the road by the wear of horseshoes and of the wheels of vehicles. The general form of safety device used on surface-contact systems consists in fixing at the rear end of the car a skate directly connected to earth through the car frame; a fuse is interposed, but it often happens that these fuses do not blow out when required, and, in the author's opinion, the only proper and reliable instrument for this purpose is the magnetic circuit-breaker. He concludes with a description of the one single-switch arrangement, which, however, is only applied to one system, known as the Claret-Veuillumier system. It is noticeable, however, that this system has only one-fiftieth of the number of switches required by other surface-contact systems.—Lond. *Elec. Eng.*, March 27.

Labor-Saving Tools—An extended and profusely illustrated article on labor saving tools in Baltimore repair shops. A machine is illustrated for cleaning insulation from field coils, which differs slightly from other devices of the kind. With the Westinghouse 56 field coil, the wire is so large that it is impossible to straighten it out in an ordinary machine The coils are therefore rewound. The wire is slipped off without being straightened; the insulation is then scraped off by hand and the wire is taped and slipped back into place. The cost for labor and material of rewinding a No. 56 coil in this way is $1.50. Another illustration shows a method of winding No. 56 armature coils. The novel feature of this machine is that there is a short arm bolted to the form on which the coil is wound, and before the last quarter turn is given the wires are bent around this arm. The result is that when the wires are cut off there are from 6 to 8 in. more slack than if they were cut off directly; this slack is just what is needed to make the first quarter turn around the machine when winding the next coil; as a result, all of the unreeling is done by machine power and none by hand. An oven for baking armatures is described, the principal novelty of which is the rack on which the armatures are carried. A car hoist is shown for use for changing trucks. The cars are run under the hoist and the bodies are raised fro mthe trucks by its means. The trucks are then taken out and new trucks are put in. A transformer is described for testing armature coils and another for testing insulation. Any voltage desired from 350 to 1,400 can be secured. Compressed air is used extensively for cleaning large motor cases and controllers. The power hammer is used, run by compressed air. The heating and ventilation of the buildings is secured by hot air; it is drawn in by blowers and forced through a nest of steam pipes and then distributed along the upper part of the buildings by galvanized pipes. The principal novel feature of the closed car is that the door is set slightly at the side, but not so far as to interfere with the use of longitudinal seats running the entire length of the car.—*St. R'y Jour.*, April 4.

Philadelphia.—Wheatly.—A description of the tramway system of Philadelphia, which has a single-line trackage of 440 miles. Tables are given showing the receipts from passengers and other sources, operating expenses, taxes, interest on bonds, and net income. As will be seen, the transportation expenses of the company are extremely low compared with those of other companies. The company charges off 6¼ per cent. of its gross receipts for depreciation of roadway and track, 5 per cent. for depreciation of power plant, and 3 per cent. for the payment of damage and accident claims. Under ordinary conditions, these amounts are found to be sufficient. The company pays various taxes, making altogether over 8 per cent. of the companies' gross earnings. The company also carries a large part of its own fire insurance. None of the cars is provided with heaters.—*St. R'y Jour.*, March 28.

Mersey Railway.—A description of this line which runs under the Mersey River at Liverpool, and was completed in 1886, being operated by steam; it has just been electrified. The ventilating and draining systems are very elaborate and are described in detail. The power station contains three 1,250-kw and three 200-kw generators. The distribution is by direct current at 650 volts, and two third rails are used for each track. There are 24 motor cars and 23 trailers. The cars are all 60 ft. long and the trains are operated on the multiple-unit system.—*St. R'y Jour.*, April 4.

Snow Fighting.—An article on the methods used on the Buffalo tramways for snow fighting. For ordinary snowfalls the company uses a two-axle plow and for heavy snowfalls a rotary plow. The latter has two novel features. There are two sets of rotating cutters, and the body of the plow can be turned at any angle to the track, so as to cut away a high drift to a considerable extent from the track. The company is also employing a four-axle car with long wings. The prevailing wind in Buffalo is east, and it was found that if the snow on the east track of a double-track road was thrown to the east it would drift back again after the plow had passed. It was necessary, therefore, to throw the snow from the east track to the west and outside of the west-bound track. For this purpose the plow is equipped with a long wing, which, when the plow is running on the east track also cover the west track. The long wing can be folded in when a car is met.—*St. R'y Jour.*, March 28.

REFERENCES.

Lighting of Railway Cars.—Goetze.—The first part of an article in which he discusses the various systems of electric lighting of railway cars.—*Centrallblat f. Accum.*, March 15.

New Subway in Philadelphia.—A section is given of the new subway for the electric cars under Market Street, in Philadelphia.—*St. R'y Jour.*, March 11.

Labor Clauses in Franchise Grants.—A discussion of this subject from a legal standpoint. The courts in several States have declared unconstitutional, provisions in franchises or in contracts made by municipalities calling for special hours of service and wages to be paid to laborers. The grounds for this have been "interference with freedom of contract," and "the spending of public money for other than public purposes." The same provisions have been upheld in other States. A list of cases bearing on this point is given.—*St. R'y Jour.*, March 14.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Earthing Dynamo-Electric Machinery.—Bloemendal.—An article referring to a recent accident at Fulham and to the subsequent discussion on the advisability of earthing. He deals with the protective value of earthing for high-pressure systems and refers to a practice which he has adopted with the United Electric Company, of Vienna. In order to prevent any fatal interference with high-pressure machinery and apparatus, two methods may be recommended, either the use of complete insulation from earth or earthing the parts which do not carry current. The latter method is to be preferred, as by a conscientious and practical application it insures absolute safety and excludes any danger from handling the apparatus. The high-pressure machines are surrounded with sheet-metal flooring, which again is connected with earth. The earthing cable is carried round the sheeting one or two inches from the outer edge, thus forming a complete framework for the machine; only then is the earthing cable connected with the earth plate. When working with or near the machine under pressure, the workman treads on the metal flooring, which must have the same potential as the skeleton of the machine itself. Naturally, the metal flooring must be so large that a contact with the machine is only possible while standing on the metal; this should also be considered when making switchboards for high-tension installations. A similar case is that of the step-down transformer houses used in the Alpine districts of Austria, where a station furnishes high-tension current to various separate communities for lighting and power; at the place of consumption the high-tension current is transformed into one of lower pressure; usually at the place in question iron derricks are erected, the lower parts of which are formed into small transformer houses. Thus the high-pressure conductor is led within the iron structure on the masts down to the transformer by means of insulated wires. It has frequently been shown that pressure differences exist between the transformer house and the surrounding ground which constitute a danger to persons that happen to touch the house in question; this objectionable feature is overcome by placing, as in the case of the machines above described, round the transformer house an iron plate, which is earthed and electrically connected with the house itself. The metal flooring round the transformer house is covered over with earth. He thinks that these methods are preferable to that of insulating, as the maintenance of a perfect insulation is almost impossible, and a test of the excellence of the insulation appears to be very difficult, while it is easy to insure a good earthing. —Lond. *Elec. Rev.*, March 27.

ELECTRO-PHYSICS AND MAGNETISM.

Nature of Röntgen Rays.—Rayleigh.—An editorial note on an opinion expressed by him concerning the nature of Röntgen rays in a recent lecture on light. If Blondlot's recent observations can be accepted as perfectly reliable, whereby he found that they are polarized as usually obtained and that the plane of polarization can be rotated, then little doubt can be felt that they are really ordinary light of extremely short wave length, as was surmised by Stokes and J. J. Thomson several years ago. The wave length must be very short to yield such slight effects as have, up to the present, been observed. Of course, Blondlot's results must, till they are confirmed by other observers, be accepted with some reserve.—Lond. *Elec.*, March 27.

Intensity and Wave Length of Röntgen Rays.—Holtsmark.—An account of experiments in which he utilizes the secondary rays produced by the impact of Röntgen rays in order to measure the intensity of the latter. This is necessary on account of the uncertainty which attaches to their measurement by means of the photometric and ionization methods. A plate of lead or platinum is enclosed in an aluminum box and exposed to x-rays. The secondary rays produce a negative charge on the aluminum and a positive charge on the lead or platinum. On connecting the latter with the earth, a continuous current may be observed and measured; this current is directly proportional to the intensity of the Röntgen rays. The author has used this method for the measurement of the absorption of x-rays by various metals. Taking the values obtained, and using Helmholtz's theory of dispersion, he shows that the wave length of a radiation is proportional to the square root of the coefficient of absorption. In Röntgen rays, the refractive index equals unity, as it should if the frequency is about the same as the frequency of vibration of the electrons or greater than that. The values for the wave length vary according to the metal used for absorption. The highest value is 51.8 milli-microns, obtained from gold, and the lowest 2.4 milli-microns, obtained from steel and zinc. —*Ann. d. Phys.*, No. 3; abstracted in Lond. *Elec.*, March 20.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Copper Refining.—Ulke.—A summary of the progress made in 1902 in the electrolytic refining of copper. The world's average daily production of electrolytic copper is about 883 short tons, of which 764 tons, or 86.5 per cent., are supplied by the United States. Of the balance of 13.5 per cent., Great Britain furnished a little over 8.8 per cent., Germany about 2.75 per cent., and France a little over 1.6 per cent. The United States now produces electrolytic copper annually at the enormous rate of 278,860 tons, which at $260 per ton, is valued at $72,503,600. The copper exports of the United States consist chiefly of electrolytic copper, and for 1902 alone represented a value of $45,485,598, as compared with $33,534,899 in 1901. There are now in operation, or ready, in the world, 33 electrolytic copper refineries. The author thinks it is only a question of time when all the fine copper produced in the United States will be made electrolytically. He comments on the numerical coefficients in Philip's formulas for area, output, power, cost, current density of copper refineries noticed in the Digest last year, and believes they are not valid for the conditions in the United States, and should be largely increased, in most cases made fully twice as large. The average density employed in the 23 European refineries is less than 6 amp. per square foot, while in American refineries current densities up to 45 amp. seem to yield good copper at a profit. Under otherwise favorable conditions, therefore, the profitable use of high current densities, in order to enable the refiner to turn out copper at a very rapid rate, is seemingly limited solely by the excessive losses of current through heating, or boiling of the electrolyte, which occur with currents above 45 or 50 amp. in density. Anodes are now being cast very thick and heavy, about 400 lbs., as compared with 180 or 200 lbs. in former years; the percentage of scrap copper being then only about one-half that with light anodes, say 7 per cent., as compared with about 15 per cent. The Ottokar Hofmann method for the purification of four electrolytic solution, is discussed. He concludes with a statistical table of the copper refineries of the world.—*Eng. & Min. Jour.*, March 14.

Lead Accumulator.—M. U. Schoop.—A long paper in which he compared pasted (Faure) plates with Planté plates when used in buffer batteries; that is, in a service in which the battery is partially charged and discharged alternately in short intervals. The main results are as follows: The determination of the "true" total surface of a positive or negative accumulator electrode is so very difficult that it may be questioned whether it will ever be possible to determine it numerically. The apparent surface of a plate as found from length and breadth, is extremely small, compared with the true surface. With positive Planté plates the acid diffusion is better than in pasted plates, so that in very quick charges and discharges the active mass is utilized to a greater degree in the former than in the latter; but this advantage is counterbalanced by the fact that the internal resistance of a Faure accumulator, for the same capacity, acid density and density between the plates, is smaller: in buffer service the Faure accumulator is, therefore, thought to be the better. He also studied the change of weight of positive plates during charge and discharge; as the chemical reactions are the same in both cases, the differences in the behavior of both types of plates as to change of weight, represents the different conditions of acid diffusion in the plates; the results are given in diagrams, which show very clearly the difference in the conditions of diffusion in both types of plates, the diffusion is much better in the Planté plate than in the pasted plate.—*Elek. Zeit.*, March 19.

Preparation of the Active Mass for Lead Storage Batteries.—Lehmer.—The first part of an article in which he gives an account of an experimental investigation of the value of nine different substances added to a mixture of water and lead oxides, to make the active mass more adherent and durable. The further preparation of the plates is described. The article is to be concluded and then the results will be given.—*Centralblatt f. Accum.*, March 1.

Sal-Ammoniac.—Rosset.—A description of simple practical methods for determining rapidly the purity of commercial sal-ammoniac, which is to be used for galvanic cells. The two methods which he found most practical are to determine the specific gravity of the solution at a given concentration and the temperature decrease due to the solution in water.—*Centralblatt f. Accum.*, February 1.

Ionizing Power of Organic Liquids.—Di Giommo.—An account of experiments in which he studied the effect on the resistance of the mixture, produced by adding a solid insulator to an insulating liquid. Such mixtures were made by dissolving sulphur in carbon bisulphide, or naphthaline in benzol or toluol, and in every case it was found that the addition of the solid non-conductor diminished the resistance of the other, the diminution increasing rapidly at first with the percentage of the solid dissolved, and less rapidly afterwards, indicating that the resistance tends towards an asymptotic limit. If the carbon bisulphide has a resistance of 17 million megohms, 1.6 per cent. of sulphur dissolved in it reduces the resistance to 8.5 millions, 3.3 per cent. to 4.6 millions, and 16.5 per cent. to 4.1 millions. But the greatest diminution is not such as to affect the order of magnitude of the resistance. The author concludes that no real ionization takes place.—*Phys. Zeit.*, February 15; abstracted in Lond. *Elec.*, March 6.

Mineral Spring Waters and Physical Chemistry.—Juettner.—He discusses the abuse of the electrolytic dissociation theory and of the teachings of physical chemistry, by physicians who are in charge of mineral springs. One physician claims that dissociation takes place only in natural and not in artificial mineral waters. Another claims that a certain mineral spring is very healthful because the conductivity of its water is 6.1 times that of pure distilled water; but he does not say that ordinary water has a still better conductivity. The electric charges of the ions are credited with the healthful properties.—*Zeit. f. Elektrochemie*, February 26.

REFERENCES.

Tribelhorn Storage Battery.—An illustrated description of this accumulator, the characteristic feature of which is that the cells are cones placed one above the other, and constituting the plates, like in the old Voltaic pile. The saving of space is claimed to amount to as much as 50 to 75 per cent. The installation of such a battery in a lighting plant is described; it gives 840 or 1,200 amp-hours if discharged in 3 or 10 hours, respectively. The illustrations also show an end cell switch of very simple construction.—*Centralblatt f. Accum.*, February 1.

Galvanic Cells.—Mugdan.—The first part of an article on the possibility of commercial carbon cells. This part is on the principle of the galvanic cells in general, from the standpoint of the electrolytic dissociation theory and the principles of thermodynamics. He considers the galvanic cell as the most simple ideal machine for obtaining the maximum possible mechanical work from a given process in the light of the second law of thermodynamics.—*Chem. Zeit.*, March 15.

Units, Measurements and Instruments.

Micro-Magnetometer.—Cremieu and Pender.—A description of a magnetometer which they have in the course of their joint researches on the magnetic effect of electric convection, had occasion to devise, and which is based upon an entirely new principle, which fits it for very delicate measurements. With the aid of an ordinary astatic combination, it is not possible to reduce the disturbance due to the earth's magnetic field down to 0.000001 electromagnetic units of field-strength, or anywhere near it. Besides, every astatic combination has a slow and continuous displacement in one direction, and due to the unequal demagnetization of the two needles, which is increased by the use of alternating discharges or current. All these objections may be avoided by using a very simple contrivance, consisting essentially of a small horizontal beam carrying at one end a vertical magnet, and at the other a brass counterweight, and suspended by a torsion thread, preferably of silver, attached to its center. When the magnet is exactly vertical, the earth's force produces no couple whatever upon the suspended beam. If, now, the lower end of the magnet is introduced into the field to be measured, it is easy so to arrange matters that the upper end should be practically unaffected by the field. The authors have been thus enabled to obtain a deflection of 68 mm for a field of 0.00001 C. G. S. units.—*Comptes Rendus*, March 9; abstracted in Lond. *Elec.*, March 27.

Electric Thermostat.—Marie and Marquis.—A description of a simple and easily regulated thermostat in which a vessel contains distilled water heated by means of a platinum wire placed at the bottom of it. The regulation is effected by means of a wide glass tube filled with acetone, and acting as a liquid thermometer. The thermometer tube bends down into a vessel filled with mercury and communicating with a mercury reservoir. As the temperature rises, the acetone depresses the level of the mercury and thereby breaks the contact between a platinum wire and the surface of the mercury. The current through the platinum wire works a relay, which in turn controls the heating current. An electrically-driven turbine keeps the water at a uniform temperature. The box containing the water is surrounded with wood shavings to prevent loss by radiation. The level of the mercury surface and through it the temperature to be held constant, is regulated by means of an additional mercury reservoir, which can be connected with the first reservoir and disconnected when the desired temperature is attained. The temperature can be kept constant to within two or three-hundredths of a degree C., which means that a body placed in the bath will have a temperature constant to within 0.01 degree.—*Comptes Rendus*, March 9; abstracted in Lond. *Elec.*, March 27.

Measurement of Small Capacities and Inductances.—Fleming and Clinton.—A (British) Phys. Soc'y paper. For the measurement of small capacities, when the dielectric is air or some other substance not possessing absorption, the rapid charge and discharge of a condenser through a galvanometer has been extensively used. The authors have designed a rotating commutator, which renders the measurement of small capacities as easy as that of resistance. For use with the instrument a moving coil differential galvanometer has been designed; the magnetic field at either of the coils can be varied by means of a piece of soft iron, which can be moved about in the field. They have made a number of experiments upon the capacity of arial wires, and have investigated the laws governing the capacity of such wires when grouped together in certain ways; in all cases the total measured capacity of *n* wires is less than *n* times the capacity of one wire. For the measurement of small inductances they have constructed an instrument similar to the secohmmeter of Ayrton and Perry, upon the same lines as their rotating commutator. In the discussion Campbell exhibited the commutator used for condenser tests at the (British) National Physical Laboratory; in this commutator the ebonite insulation does not fill the spaces between the segments, and is never touched by the brushes, thus giving satisfactory insulation. By its aid many measurements have been made of the Brit. Ass. air condensers, the capacity of each of these being about 0.02 microfarad. In the earlier experiments an ordinary moving-magnet galvanometer was used, but it was discovered that if the magnet at its zero position was not exactly parallel to the planes of the coils, its deflection was partly due to the mean current and partly to the square root of the mean and square current. A moving coil galvanometer was found to be quite free from such effects, and this type had been used in nearly all the tests.—Lond. *Elec. Rev.*, March 27.

Measuring the Temperature of Furnace Gases.—Price.—An editorial note on a paper, read before the Manchester section of the (Brit.) Inst. Elec. Eng. on the use of the potentiometer in the measurement of temperatures of flue and furnace gases. Experiments were made to show, by means of a reflecting galvanometer, in conjunction with a potentiometer and a thermopile, the recalescent points of steel and copper. He stated that his thermopile was composed of platinum for one electrode, and an alloy of platinum and iridium for the other, and with temperatures of about 2,000° F. readings can be obtained with an accuracy of 10°. The chief use to which the apparatus has been put was that of testing samples of magnet steel. In the discussion which followed, Pooley said that he had thought that the method of taking furnace temperatures by testing the resistance of a platinum coil inserted in the furnace was one mostly employed and was quite simple, seeing that the resistance of platinum varies very evenly for different temperatures.—Lond. *Elec.*, March 27.

Standard Cells.—Jaeger.—An article on some recent researches referring more especially to the Weston cadmium standard cell. It had been found that some cadmium cells showed irregularities when used near 0° C., but this was found to be due to the use of too strong an amalgam, containing 14.3 parts (by weight) of cadmium per 100 parts of amalgam, which undergoes a change at 0°; if a slightly more dilute amalgam is used, there are no irregularities. About 80 cadmium cells at the Reichsanstalt made partly with a 12 per cent., and partly with a 13 per cent. cadmium amalgam, were tested, and although they were kept for a week at zero temperature, no irregularities were found. The supposition that the irregularity found in the cells with the 14.3 per cent. amalgam were due to a change of the electrolyte (cadmium sulphate) has been shown to be wrong, as there is no change whatever in the cadmium sulphate, and if a 12 to 13 per cent. amalgam is used, the cadmium cell is absolutely reliable and very convenient on account of its small temperature coefficient.—*Centralblatt f. Accum.*, March 1.

MISCELLANEOUS.

Copper-Cadmium Alloys.—Denso.—An account of some experiments in which he found that the compound ($CuCd_3$) crystallizes out from all molten copper-cadmium alloys of various compositions, with an excess of cadmium.—*Zeit. f. Electrochemie.*, February 12.

REFERENCE.

Igniters.—Armagnat.—A long article, illustrated by diagrams, in which he describes various systems of electric igniters for gas motors.—*L'Eclairage Elec.*, March 14.

New Books.

Physico-Chemical Tables. Vol. I. Chemical Engineering and Physical Chemistry. By John Castel Evans. London: Charles Griffin & Co. Philadelphia: J. B. Lippincott Co. 548 pages. Price, $8.00.

This handsomely-bound and well-printed volume of 548 pages is another one of those ever-welcome works, the preparation of which involves a great deal of conscientious and painstaking labor on the part of the compiler. The author, who is superintendent of the chemical laboratories and lecturer on inorganic chemistry and metallurgy at the Finsbury Technical College, has set himself a high standard, by designing, as he says, the work to be of use to all engaged or interested in any branch of chemistry or metallurgy—to the toiler at original research; the professor, the hard-pressed works manager, and the humblest worker in the laboratory. The aim has been throughout to save time, to bring together widely scattered information and to lighten the labor of calculation. The book is not merely a collection of tables, but contains a considerable amount of explanatory matter. Many original tables are introduced and others considerably extended and the information brought up to date. The book will prove a valuable addition to the library of any chemist or physicist. There will be a second volume, but each will be complete in the department covered.

Elektromagnetische Aufbereitung. Handbuch for Elektrochemie. By F. Langguth. Halle: Wilhelm Knapp. 64 pages, illustrated. Price, 3 marks.

This small volume is intended to be a part of the proposed large Handbook of Electrochemistry, compiled by various authors, and to be published by Wilhelm Knapp. The author gives in the short space of 64 pages a condensed review of the history and principles of electromagnetic ore dressing, the various types of magnetic separators and some results obtained by magnetic separation. He is thoroughly conversant with the subject, due to his connection with the Mechernischer Bergwerksactien Verein, the constructors of the Mechernich separators. The section on magnetic separators is treated from their historical development and the discussion of the various types is very brief and lacking in detail. Separators for strongly magnetic materials are only shortly dealt with and most of the space is devoted to a description of several constructions of Mechernich and Wetherill separators for feebly magnetic material. As an interested party, the author does not venture to give an opinion on the superiority of these last two types over each other, but hold that only practical results on a large scale can decide that question. The little volume, coming as it does from a practical man, is well worth reading, and comes at an opportune time, as much interest is being taken in the matter of separating feebly magnetic substances. It is to be regretted that the subject has not been treated more in detail.

BOOKS RECEIVED.

La Tecnica Della Correnti Alternate. Vol. I. Parti qualitativa e descrittiva. By Giuseppe Sartori. Milan: Ulrico Hoepli. 336 pages, 260 illustrations. Price, 8 lire.

Public Lighting by Gas and Electricity. By W. T. Dibdin, F. I. C., F. C. S. New York: D. Van Nostrand Company. 537 pages, 216 illustrations. Price, $8.00.

Die Bahnmotoren fur Gleichstrom. By M. Muller and W. Mattersdorff. Berlin: Julius Springer. 418 pages, 231 illustrations and 11 plates. Price, 15 marks.

Correnti Electriche Alternate. Semplici, bifasi e trifasi. Manuali Hoepli. By Attilio Marro. Milan: Ulrico Hoepli. 615 pages, 217 illustrations. Price, 6.50 lires.

Elementare Vorlesungen uber Telegraphie und Telephonie. By Dr. Richard Heilbrun. 3 lieferung. Berlin: Georg Siemens. Complete work, 11 marks.

Die Funkentelegraphie. By C. Arldt. Leipzig: Theod Thomas. 72 pages, 75 illustrations. Price, 1.80 marks.

Descriptive Geometry. With numerous problems and practical applications, and a quarto atlas of 18 plates. By William S. Hall, C. E., E. M., M. S. New York: D. Van Nostrand Company. 76 pages and portfolio of 18 plates. Price, $3.50.

Die Grundgesetze der Wechselstromtechnik. By Dr. Gustav Benischke. Braunschweig: Frederick Vieweg & Sohn. 141 pages, 113 illustrations. Price, 4.20 marks.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. Next meeting, New York, April 16, 17 and 18, 1903.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting, April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association. F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

National Association of Manufacturers. Secretary, Marshall Cushing, 170 Broadway, New York. Annual convention, New Orleans, La., April 14, 15 and 16, 1903.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich, July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

New York Electrical Society, Secretary G. H. Guy, 104 Liberty Street, New York.

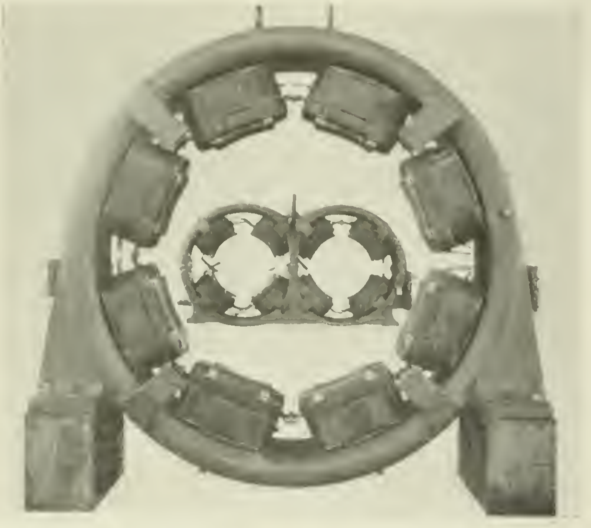
Northwestern Electrical Association, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association, Secretary, E. W. Pichardt, Huntingburg, Ind.

Turbine vs. Reciprocating Engine Generators.

By David Hall.

The public in general has learned to know that the output of a machine is increased as the speed is increased. At the same time, the fact that the frame of a 200-kw may be placed within the frame of another machine of the same rating may be worthy of notice. The development of the steam turbine has given birth to a demand for high-speed dynamos. Fig. 1 shows the frames and poles of a 200-kw dynamo at 100 r.p.m. and a 200-kw machine at 900 r.p.m.



FIELDS OF TWO TYPES OF DYNAMOS.

This picture was recently taken in the shops of the Milwaukee Electric Company, where a full line of these high-speed machines is being built, as well as a complete line of standard direct-connected machinery.

The 200-kw, 900-r.p.m. generator is of peculiar construction, made especially for the De Laval Steam Turbine Company. There are two armatures, each of which is enclosed by four pole pieces. The pole pieces are of laminated steel bolted to a cast-steel magnet frame. The 200-kw, 100-r.p.m. generator is for direct connection, and is of standard construction, having laminated pole pieces and a cast-iron magnet frame. The overall horizontal dimension is 8 ft. and 3 in., while that of the high-speed machine is 6 ft. 2½ in. The difference in the weights is still more noticeable. The slow-speed machine weighs 35,000 lbs., while the high-speed machine weighs 9,500 lbs. Of this weight the large machine has 5,000 lbs. of copper, against 1,300 lbs. for the small one. In comparing the weights of these two machines it should be remembered that the large machine has a cast-iron frame, while that of the small machine is cast steel.

By reducing the above total weights to weight per kw at 100 r.p.m., we obtain 175 lbs. for the large machine and 427 lbs. for the small machine, which means that there is 2.44 times as much material in the small machine per kw-revolution as there is in the large machine.

As both of these machines are for 250 volts, the full-load current is 800 amp. The commutator of the large machine weighs 2,000 lbs., and has a radiating surface of 980 sq. in. on the periphery. The total watts on the commutator being 2,875, gives 2.94 watts per sq. in. of radiating surface. As the temperature rise of the commutator was 31½° C., after full load for eight hours, we obtain a factor of 10.7° C. rise per watt per sq. in. This factor of degrees rise per watt per sq. in. might be expected to be less on the high-speed machine, due to the increased windage, especially so because the mechanical construction of both armature and commutator was made with a view of obtaining the best ventilation. This factor is 7° rise per watt per sq. in. on the high speed machine as compared with 10.7° rise per watt per sq. in. on the low-speed machine.

The two commutators on the high speed machine have a total surface of 905 sq. in. on the periphery and weigh 1,000 lbs. The watts per sq. in. were 3.57 and the temperature rise 25° after full load for 7 hours, thus giving the above mentioned factor of 7° rise per watt per sq. in.

Comparing the armatures, we have a factor of 3.38° rise per watt per sq. in. on the high-speed machine and 13.5° rise per watt per sq. in. on the low-speed machine. The term "watts per sq. in." is a useless one unless it is known how it is obtained; in determining these factor in the present case the periphery of the armature core was taken as the radiating surface and only that portion of the armature winding in the armature slots was considered in determining the C^2R watts on the armature. The C^2R loss was added to the iron losses to determine the total loss on the armature.

The great difference in the above factors of degrees rise per watt per sq. in. on the armatures is very noticeable, and is mainly due to the ventilation. The speed on the surface of the large machine is 1,520 ft. per minute, whereas on the small machine it is 4,700 ft. or almost a mile per minute. As a result of this high speed there is a great volume of air forced through the armatures of the small machine with a consequent reduction in temperature. This fact emphasizes the importance of good ventilation.

Both of these machines will run from no load to 25 per cent. overload without sparking, the brushes remaining fixed.

The above results may be tabulated for convenience as follows:

Kilowatts	200	200
Volts	250	250
Rev. per minute	100	900
Overall horizontal dimension	8 ft. 3 in.	6 ft. 2½ in.
Total weight	35,000 lbs.	9,500 lbs.
Weight copper	5,000 lbs.	1,300 lbs.
Total weight per kw, at 100 r.p.m.	175 lbs.	427 lbs.
Weight of commutator	2,000 lbs.	1,000 lbs.
Temperature rise per watt per sq. in. commutator	10.7 C.	7 C.
Temperature rise per watt per sq. in. armature	13.5 C.	3.38 C.
Peripheral speed of armature in ft. per min.	1,520	4,700

This subject causes a reflection on the wide deviations of the requirements which are to be met to-day in dynamo design. Dynamos are built side by side, of the same kilowatt output but varying in speed in the ratio of nine to one; and even greater variations than this might not be considered unreasonable.

Westinghouse Turbo-Generators.

We illustrate herewith in detail the Westinghouse turbo-generator designed for direct-connection to the Westinghouse-Parsons steam turbine. Like any other rotating field machine, a turbo-generator may be wound for any practical voltage, the potential being limited only by the ability to insulate a stationary winding. The wave form is about the same as that of commercial alternators, and the high speed of the collector presents no unusual difficulty.

The available speeds for the turbo-generator are, however, approximately determined by the speed of the turbine, and its high speed in connection with the comparatively low frequencies employed—25 to 60 cycles—rather closely determines the number of poles. Thus, a 25-cycle machine must have two poles at a speed of 1,500 r.p.m., or four poles at a speed of 750 r.p.m. A 60-cycle machine at 3,600 r.p.m. may have two poles, four at 1,800 r.p.m., six at 1,200 r.p.m., and eight poles at 900 r.p.m.

The armature yoke is a solid, well-ventilated casting. As in the Westinghouse engine-type alternator, it holds a laminated yoke of soft steel. The yoke is pierced with partially closed slots and is ventilated by openings placed at intervals in the laminated mass. These openings register approximately with similar ones in the rotating field.

The high speed of the turbine also affects the design of the armature winding. As the speed is high, the voltage per conductor is high, and but few turns are required for ordinary voltages in a high-tension winding. This limitation, while convenient in high-voltage windings, sometimes limits the potentials possible in low-voltage windings. The question is more difficult in two than in four-

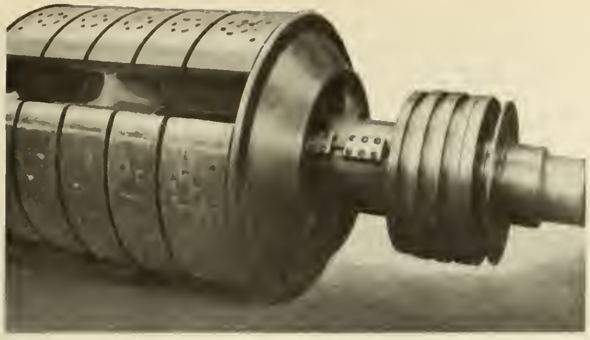


FIG. 1.—1,000-KW ROTATING FIELD.

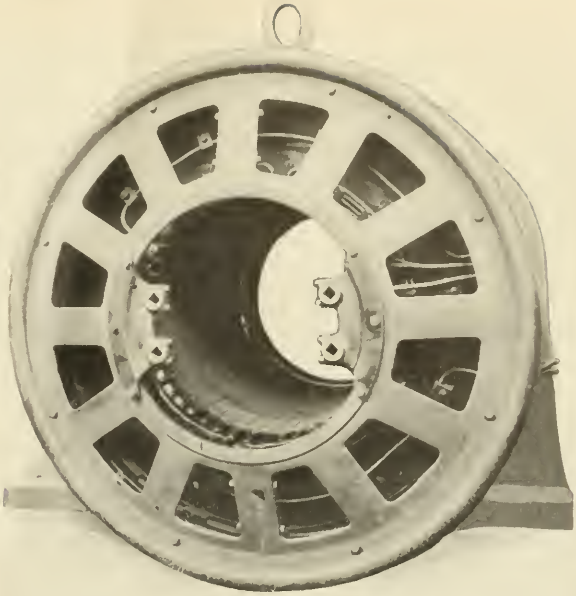


FIG. 4.—ARMATURE OF 1,000-KW TURBO-GENERATOR, UNWOUND.

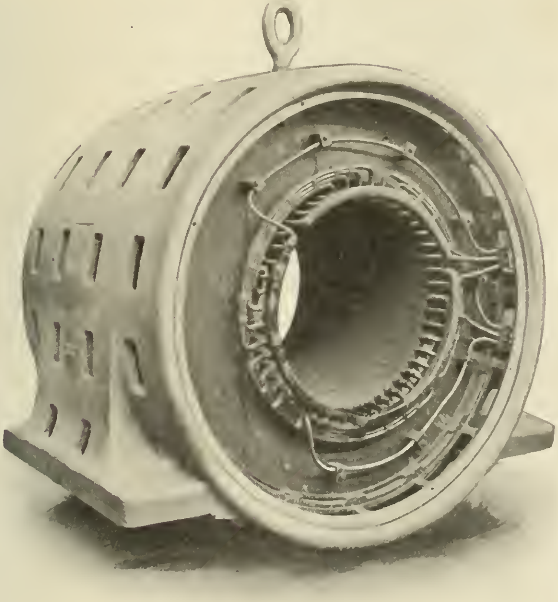


FIG. 2.—1,000-KW TURBO-GENERATOR ARMATURE, SHOWING WINDING.

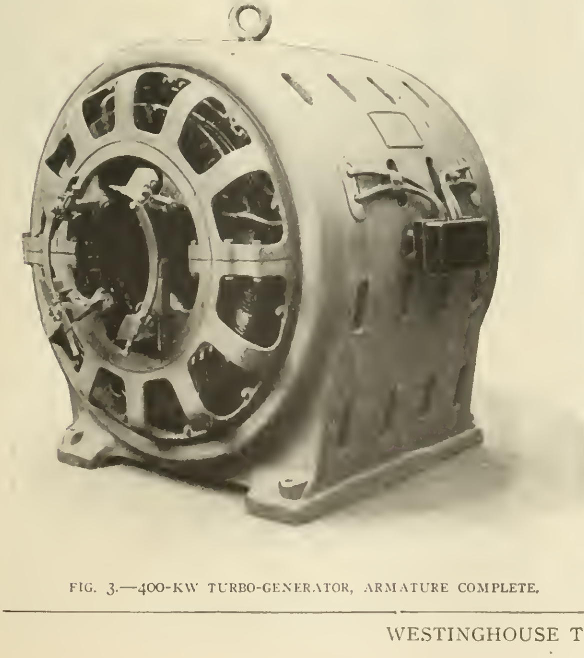


FIG. 3.—400-KW TURBO-GENERATOR, ARMATURE COMPLETE.

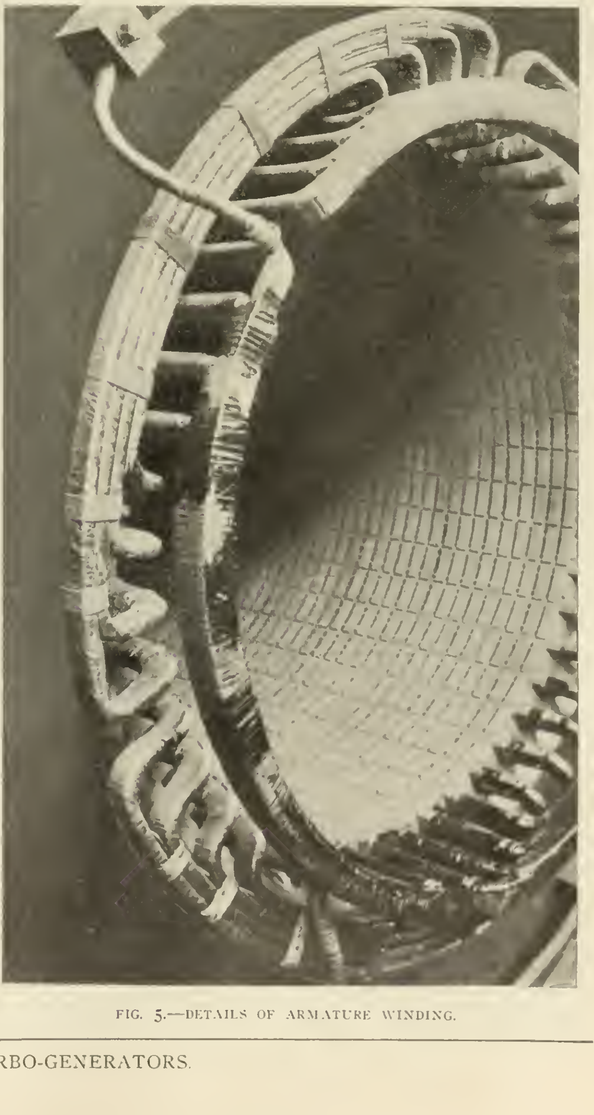


FIG. 5.—DETAILS OF ARMATURE WINDING.

WESTINGHOUSE TURBO-GENERATORS.

pole machines, because only two windings can be placed in parallel on a two-pole machine, while in a four pole machine there are four windings to parallel for the lowest voltage.

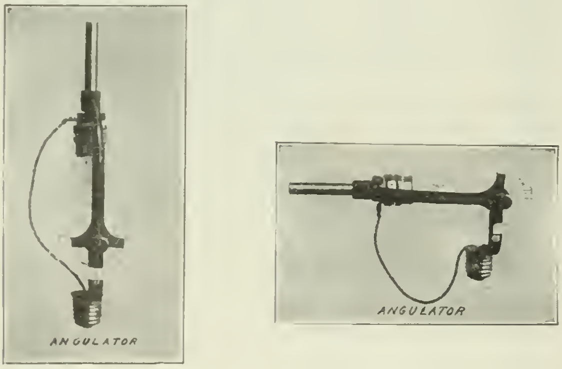
The two pole rotating field is of solid steel, cylindrical in shape, with coils of copper strap, wound flat in grooves in the solid steel. The winding is thus subdivided and supported against centrifugal force. The grooves are afterwards closed by brass wedges and the outside of the rotating part is turned down so that it presents a smooth cylindrical surface. The smooth surface reduces windage and noise. The rotating part is provided with large air passages for cooling its windings. On four and six pole fields, the winding is subdivided and secured in the same manner.

Exhibits at the Iowa Electrical Association Meeting.

A number of supply companies were represented at the Iowa Electrical Association convention. A local supply house, the Tri City Electric Company, had an extensive exhibit on the main floor of the Masonic Temple, where the meetings were held in which exhibit many manufacturers were represented. The Western Electric Company also made a display in a store near the St. James Hotel. The companies represented were as follows: Electric Appliance Company, P. R. Boole; Kuhlmann Electric Company, E. Kuhlmann; Columbia Incandescent Lamp Company, John G. Boyd; Porter & Berg, E. R. Mason; Western Electric Company, Harry Byrne; General Electric Company, F. N. Boyer, G. A. Seabury, M. B. Beattie; Westinghouse Electric & Manufacturing Company, W. R. Pinckard, A. M. Miller, Arthur Huntington; Adams-Bagnall Company, J. G. Pomeroy; Buckeye Electric Company, J. H. Cooke, W. R. Bonham; Philadelphia Electric Manufacturing Company, C. L. Bundy; Manhattan Electric Supply Company, A. O. Einstein; Central Electric Company, J. W. Mason; American District Steam Company, J. Charles Young; Tri-City Electric Company, Edw. Kunkel; Mr. Butterworth, S. M. Howe; Ft. Wayne Electric Works, Walter Goll, E. A. Wagner and Frank McMaster; Western Electrical Supply Company, J. W. Hardy; Stanley Instrument Company, F. J. Alderson; Ewing Merkle Electric Company, O. T. Watkins; American Steel & Wire Company, B. H. Ryder.

Photometer Attachment.

It appears evident that most disinterested authorities strongly favor the method of determining the real value of an incandescent lamp as a source of light by obtaining the spherical candle-power of the lamp and considering it in connection with the actual current required to operate it, in preference to measuring the lamp in the arbitrary manner most generally used at present, namely, for its horizontal intensity.



FIGS. 1 AND 2.—PHOTOMETER ATTACHMENT.

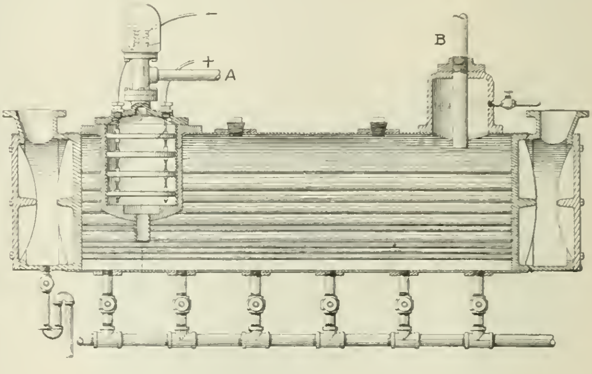
The principle argument against rating lamps by their spherical candle-power is that there has not been an instrument by which the spherical candle-power measurements can be taken at one reading that is not extremely complicated. To determine the spherical candle-power by taking numerous readings requires considerable time and is, therefore, conceded to be uncommercial. These facts do not, however, alter the true condition, and the real value of the lamp cannot be determined in any other way. In view of the expense of a photometer especially designed for determining spherical candle-power, the Shelby Electric Company has designed and is placing on the market an angulating device (see Fig. 1) which readily fits into the socket of any standard photometer. By the aid of this device the horizontal candle-power can be determined and the lamp can then be turned so that the light can be measured at any angle (see Fig. 2).

Illumination is divided into two classes, namely, general illumination and local illumination. The value of lamp for general illumination can only be determined by considering the light emitted in all directions, while by far the greater part of the light that is used for local illumination is delivered through the end of the lamp opposite the base, or within 45° therefrom. These conditions existing, the Shelby Company condemns the practice of rating the lamp solely by the light delivered horizontally, which light does not enable one to determine the value of the lamp for general illumination, and which enters into the value of local illumination only after having been reflected by walls and surfaces, the reflecting qualities of which vary. The angulator illustrated herewith has been designed with a view of placing at the disposal of owners of a photometer a method of determining the value of his lamps regardless of whether the lamp is used for general illumination or for local illumination.

Electric Process for Water Purification.

The accompanying illustration shows an apparatus invented by Mr. C. C. Clark and manufactured by the American Electric Improvement Company, Philadelphia, Pa., for the purification of water by electrical means. Referring to the accompanying illustration, the vertical cylindrical receptacle to the left contains horizontal circular perforated electrodes insulated from the sides of the cylinder by a jacket of insulating material, and supported by rods passing through insulated openings to the exterior, where they are connected to the source of current; the rod carrying one series of electrodes is insulated where passing through the other series of electrodes, by a tube of insulating material, as shown. The material of one series of electrodes is copper, and carbon that of the other series.

The water enters the cylinder through the pipe *A*, and after being subjected to electrical action between the plate electrodes, passes out at the bottom into a large horizontal cylinder from which the purified water is drawn through the pipe *B*. The sediment and impurities deposited from the water are blown off through the several blow-pipes, shown connected to the bottom. In case the apparatus is used for the purpose of purifying feed water for a boiler, the water is heated by passing the exhaust steam through the horizontal tubes shown connected between heads, the exhaust being admitted in one head and discharged from the other. It is claimed that the impurities in the water are decomposed in the electrode cylinder, being finally deposited at the bottom of the large horizontal cylinder, the capacity of which is so large that the circulation of the water therein is sufficiently slow to allow precipitation. Floating impurities are discharged by a surface blow connected to the drum *B*. The voltage employed is 240, though the apparatus may be designed for any commercial voltage.



WATER-PURIFYING APPARATUS.

Among the applications claimed for the apparatus are the purification of boiler feed water and sewage, the purification and aging of alcoholic liquids and of water for ice plants and other potable use.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered freely at declining rates. The closing quotations of Thursday, when the market closed until Monday for the Easter holidays, were 5½ per cent. for 60 days; 5 a 5¼ per cent. for longer dates. There was an improving tendency in the stock market due to indications of easier money conditions, but on Thursday afternoon a heavy selling movement throughout the list followed the news that the Circuit Court of Appeals had upheld the government in the Northern Securities case and declared the combination of the Northwestern railroad lines an illegal one. The United States Steel stocks showed heaviness in spite of the favorable annual report, but had better support on Thursday. Among the industrials, a leading feature was the heaviness of Amalgamated Copper. That stock sold off on what appeared to be a liquidation of long holdings, accompanied by a withdrawal of the pool support, which had been so conspicuous in it. Brooklyn Rapid Transit was again the object of favorable reports in connection with earnings and future prospects, and showed a firm tone at a moderate improvement. Manhattan was also strong. Brooklyn Rapid Transit closed at 66⅞, being a net loss of ⅝ of a point, the highest price of the week being 69¼. Transactions in Metropolitan Street Railway were limited to 5,500 shares, this stock showing a firm tendency and closing with a net gain of 1 point, the last quotation being 133½. Manhattan Elevated closed at 138 —⅛ of a point loss. General Electric fluctuated between 187½, the highest figure, and 183, the lowest, closing at 185, this being a net loss of 1 point, and Westinghouse lost 3 points, closing at 193, after having reached 198. Western Union Telegraph closed at 85. The stock market closed on Thursday for the Easter holidays. Following are the closing quotations of April 14.

NEW YORK.

	Apr 7.	Apr. 14		Apr. 7.	Apr. 14
American Tel. & Cable	81¾	..	General Electric	185	182½
American Tel. & Tel	155	152	Hudson River Tel	..	..
American Dist. Tel	..	30	Metropolitan St. Ry	133⅛	133⅜
Brooklyn Rapid Transit	67¾	66	N. E. Elec. Veh. Trns	..	26
Commercial Cable	..	..	N. Y. & N. J. Tel	..	160
Electric Boat	23	23	N. Y. E. V. T. Co	..	8
Electric Boat pfd	37	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1½	1	Western Union Tel	85⅛	85½
Electric Vehicle	12¼	10	Westinghouse com	194½	185
Electric Vehicle pfd	16	14	Westinghouse pfd	194	189½

BOSTON.

	Apr 7.	Apr. 14		Apr. 7.	Apr. 14
American Tel. & Tel	154	154½	Western Tel. & Tel. pfd	97*	95*
Cumberland Telephone	..	..	Mexican Telephone	2	1⅞
Edison Elec. Illum	265	.	New England Telephone	135	135
General Electric	186	181	Westinghouse	98	..
Western Tel. & Tel	20	19	Westinghouse pfd	98	..

PHILADELPHIA.

	Apr. 7.	Apr 14		Apr. 7.	Apr. 1
American Railways	..	50	Phila. Traction	97¼	97
Elec. Storage Battery	77*	75*	Phila. Electric	7	6⅞
Elec. Storage Battery pfd	77*	75*	Pa. Electric Vehicle	..	..
Elec. Co. of America	8¾	8⅝	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Apr 7.‡	Apr. 14		Apr. 7.‡	Apr. 14
Central Union Tel	..	..	National Carbon pfd	..	97¼
Chicago Edison	..	..	Northwest Elev. com	..	..
Chicago City Ry	.	205	Union Traction	..	7
Chicago Tel. Co	..	.	Union Traction pfd	..	37
National Carbon	..	24½			

*Asked. †Ex Dividend. ‡Election.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended March 20 and since December 20 shows:

	1903.	1902.	1901.	1900.
Gross output	84,280	96,557	76,751	65,878
Returned	38,172	42,847	37,517	20,664
Net output	46,108	53,710	39,234	45,214
Since Dec. 20:				
Gross output	305,961	279,553	216,109	183,003
Returned	116,646	114,498	89,427	63,004
Net output	189,315	165,055	126,682	119,959
Total outstanding	3,339,635	2,691,065	2,079,498	1,700,464

The month of March was another exceptionally good one for the Chicago Telephone Company. The gain in subscribers for the period was approximately 1,500, and it is confidently expected that with favorable weather the April showing will exceed that of its predecessor. The company now has in the neighborhood of 64,500 telephones in service and the management predicts that the total will have reached the 75,000 mark by fall.

KEYSTONE TELEPHONE.—The application of the Keystone Telephone Company of New Jersey to have its stock listed on the Philadelphia Stock Exchange has been favorably acted on by the board of governors. The authorized capitalization of the company is $10,000,000, $5,000,000 of which is 6 per cent. cumulative preferred stock and $5,000,000 common stock, each $50 par. The whole of the $5,000,000 common stock, and $1,935,350, or 39,067 shares of the preferred have been admitted to the list. Such preferred as was subscribed for by the public received a bonus of 25 per cent. in common stock. Not having succeeded in raising sufficient funds by stock subscription, the company had to go to the market for a loan. A bond issue became necessary, and a new company had to be formed under Pennsylvania laws. Hence a charter was obtained for the Keystone Telephone Company, of Philadelphia. City councils passed an ordinance in November last granting the new company the same privilege as the old. The Keystone Company of Philadelphia has: Common stock, par $50, $2,500,000; first mortgage 5 per cent. bonds, $2,500,000. The amount of cash put in the property from all sources would, therefore, appear to be $3,353,350, against which there are outstanding in stock and bonds $9,453,350, without including the $2,500,000 stock of the Keystone Company of Philadelphia, owned by the New Jersey Company. The Keystone's net gain of new telephones in March was 684, in comparison with 1,500 in the record month of June, 1902. The average number installed per month has recently been 500, but with new exchanges opened and new cables laid, a larger force can be put to work and a higher average attained. The company has now on hand unfilled contracts for some 5,000 or 6,000 telephones. The Pennsylvania Railroad Company is having its Philadelphia offices and stations equipped with Keystone instruments and other large contracts are said to be pending. The total number of Keystone telephones now in service in the City of Philadelphia is 8,718 and connections are made with 35,000 or 40,000 outside of Philadelphia in the surrounding States.

MEXICAN LIGHT & POWER.—The Mexican Light & Power Company, of the City of Mexico, is rapidly pushing its new work. Mr. F. S. Pearson, of New York, vice-president and consulting engineer of the company estimates as follows in gold the gross earning power of the first installation:

Gross earnings	$912,000
Operating expenses	202,000
Net earnings	$710,000
Interest on $5,000,000 bonds	250,000
	$460,000
The earnings of the first and second installations, combined	$1,732,000
Operating expenses	287,000
Surplus	$1,445,000
Interest on $8,500,000 bonds at 5%	425,000
Net surplus for stockholders	$1,020,000

INDEPENDENT TELEPHONE DEAL IN THE SOUTHWEST.—A deal was closed at Muscogee, I. T., on March 31, which merges all the telephone interests in the Indian Territory, Oklahoma and Northern Texas, control thereof passing into the hands of the North American Telephone Company. This arrangement gives direct communication between all of the lines in the merger with Galveston, St. Louis and Kansas City. The properties involved in the deal are estimated to be worth $5,000,000, and Kansas City capitalists are heavily interested. The plans of the North American Company contemplate connection with Kansas City lines at Chetopa, Kan., and the control of many systems in Southern Kansas. Lines are also to be built from St. Louis to Joplin.

DIVIDENDS.—The directors of the Chicago Edison Company meet about April 15th to declare the regular quarterly dividend of 2 per cent., which is payable May 1. United Traction, of Albany, N. Y., has declared the usual quarterly dividend of 1¼ per cent. The directors of Henry R. Worthington (Inc.) have declared the regular semi-annual dividend of 3½ per cent. on the preferred stock, payable May 1. The regular quarterly dividend of 1½ per cent. will be paid on the preferred stock of International Steam Pump May 1.

BRITISH ELECTRICAL SECURITIES.—The Traction & Power Securities Co., Ltd., which acts as a securities company for the British Westinghouse Electric Manufacturing Co., as noted recently in this column, is to increase its capital from $2,105,000 to $10,000,000 as recently contracts of great value have necessitated a larger working capital.

DENVER GAS & ELECTRIC REORGANIZATION.—The reorganization plan of the Denver Gas & Electric Company made public makes the following propositions: 1. To return to depositors upon the final adoption of the plan their certificates of stock without cost. 2. To make payment to the holders of consolidated bonds of their eighteen months' back interest in scrip, exchangeable in $1,000 denominations for new general mortgage bonds. 3. To issue prior lien bonds—6 per cent. fifteen-year—to the amount of $1,000,000. 4. To issue present treasury stock to the amount of $500,000. 5. To place a new 5 per cent. general mortgage of $8,000,000 upon the property, of which $2,580,000 will be issued in exchange for the present $2,400,000 consolidated mortgage bonds, with the additional $180,000 for back interest; $3,270,000 reserved in the hands of the trustee, to retire the underlying bonds (inclusive of the $1,000,000 prior lien bonds), and $2,150,000 held in the treasury for future extensions and other uses of the company under proper restrictions.

PHILADELPHIA ELECTRIC.—The Philadelphia Electric Company's annual report for the year ending December 31, presented at the annual meeting, shows as follows:

	1902.	1901.	Changes.
Gross income, all sources	$3,422,411	$3,295,971	Inc. $126,440
Op. ex., taxes and fixed charges..	2,967,968	2,980,791	Dec. 12,824
Surplus	$454,443	$315,180	Inc. $139,263
Prev. surplus	446,677	131,497	Inc. 315,180
Total surplus	$901,119	$446,676	Inc. $454,443
Less dividends	337,552	......	Inc. 337,552
Sur. Dec. 31	$563,567	$446,676	Inc. $116,891

NORTH AMERICAN STOCK.—Subscriptions to the new stock of the North American Company, for which stockholders were allowed to subscribe at par to the extent of 40 per cent. of their present holdings, slightly exceeded half of the $4,800,000 offered, the remainder going to the underwriting syndicate. According to the official circular the purpose of the new stock issue was "to pay for the stock of the Laclede Gas Light Company of St. Louis and to enable the company to extend and increase its investment and interest in the gas and electric lighting business in St. Louis and elsewhere." The total amount of new stock authorized was $5,000,000, increasing the total capital stock of the company to $17,000,000. The covering committee of the New York Stock Exchange has listed $2,594,500 additional North American Company stock, making the total amount listed to date $14,531,200, and empowered the committee on stock list to add the balance of $2,468,800 "on official notification that it has been issued and paid for, making the total amount to be listed $17,000,000."

COLORADO TELEPHONE COMPANY.—The stockholders of the Colorado Telephone Company, at their recent annual meeting, authorized the issue of $1,000,000 new stock to provide for extensions and additions. This will make the outstanding issue $4,400,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Among the favorable features of the week were the annual Easter buying at retail, which was reported of excellent volume; some improvement in the re-assorting demand with jobbers at interior markets resulting therefrom, and a slight but perceptible improvement in the labor situation. Prices during the month of March showed exceptional strength, despite seasonal changes downward in dairy products, grains and fuel, partly counteracted, however, by advances in live stock and meats. Railway earnings are quite favorable; gross receipts for March indicate an increase of between 10 and 11 per cent., while net returns for February showed a gain of 6 per cent. on an increase in gross receipts of 14 per cent. The best trade reports, relatively speaking, come from the leading Western markets, but all centers report a satisfactory spring trade done at wholesale. Retail business has improved in the Central West, but collections fail to show corresponding growth. Southern trade reports are of a more cheerful character. The high water has subsided in the Mississippi Valley and the railroads have resumed handling freight and passengers in the formerly flooded districts. The iron situation is one of marked strength in finished products, but of unsettlement and even weakness in the cruder forms. Domestic rail manufacturers are full of orders, and it is reported that American and Canadian roads are inquiring for steel rails abroad. Structural orders are in large volume. Among the other metals, copper and tin have weakened again, but lead retains its old firmness. As to copper, the metal was offered very cheaply by second-hands, especially abroad. Transactions were few and far between, and the closing quotations were rather nominal at 14 a 14½c. for Lake, electrolytic in ingots, cakes and wire bars, and 14 a 14¼c. for cathodes and casting stock. The business failures for the week ending April 9, as reported by *Bradstreet's*, numbered 153, against 145 the previous week, and 182 the corresponding week last year.

EQUIPMENT FOR PERUVIAN TRACTION SYSTEMS.—An extensive electric traction system is to be constructed between Lima, Peru, and Miraflores and Chorillos, seaside resorts much frequented by residents in the Peruvian capital. Another road will be built between Callao, the port of Lima and that city. The two roads will make a total length of about 30 miles. Power for both the lines will be derived from the existing power plant in Lima. Each of the systems will employ two rotary converters of 300 kw each. This equipment will be furnished by the General Electric Company. The cars for the Lima-Chorillos line—ten in number—will be built at the Stephenson Car Works, Elizabethport, N. J. They will have a 28-ft. body. The trucks will be built by the Peckham Manufacturing Company, Havemeyer Building, 26 Cortlandt Street. They will be 14B3X type. The motor equipments are to be 50-hp ones of General Electric manufacture.

MEAD CONVEYORS FOR CEMENT PLANT.—John A. Mead & Co., Bowling Green Building, New York, have just been allotted a contract by the International Portland Cement Company, of Ottawa, Canada, for a large hot and cold cement clinker conveying plant. The equipment will handle the clinker from the rotary kilns to the clinker storage and thence to the dry grinder mills. The plant will be electrically operated. Almost a similar contract has been secured through the Osborn Engineering Company, of Cleveland, Ohio, for a clinker conveying plant to be installed in the factory about to be constructed by the Midland Portland Cement Company, at Bedford, Ind. This factory's initial capacity will be 1,600 barrels, but is designed with a view to eventually turning out double that quantity. Everything will be electrically driven. The company will generate its own power.

EQUIPMENT OF CANADIAN CEMENT PLANT.—The International Portland Cement Company, which is composed of interests identical with those of the Southern States Portland Cement Company, Rockmart, Ga.; the Peninsula Portland Cement Company, of Jackson, Mich., and the National Portland Cement Company, of Durham, Ont., is about to erect a large cement-making plant at Ottawa, Canada, operated entirely by electrical power. The initial capacity of the plant will be 1,600 barrels. Energy is to be derived from the Ottawa power plant. Contracts will be let very shortly for rotary converters and several motors.

GENERAL ELECTRIC MOTOR EQUIPMENTS FOR SOUTH AFRICA.—The General Electric Company will furnish the motor equipments for the Delagoa Bay (South Africa) electric traction system, the contract for the construction and equipment of which road was recently secured by the British electrical engineering and contracting firm of Macartney, McElroy & Co., Limited. There will be eight double equipments, two 25-hp, for each car.

ANOTHER LARGE MEXICAN ELECTRIC ROAD.—The Rey del Oro Mining Company, which operates extensive mines in the State of Sonora, Mexico, proposes to construct an electric railway, over 200 miles long, to run from its properties to the Southern Pacific Railroad. Power will be generated by a waterfall located in the immediate vicinity of the east terminus.

MEXICO CITY STREET RAILWAY TO BE EXTENDED.—The Compania de Ferrocarriles del Distrito Federal—the Mexico Electric Tramways, Limited—which operates the extensive electric traction system in the City of Mexico and immediate vicinity, is about to construct a line between Loreto and Buenavista—two suburbs of the Mexican capital.

EQUIPMENT FOR NEW DETROIT EDISON PLANT.—Contracts are now being let for the equipment of the big new Edison plant about to be built at Detroit, Mich. The contract for the boilers, which calls for a 12,400-hp equipment in 24 units, has been allotted to the Stirling Company.

PLANT WANTED.—C. C. Radabaugh and others will build an electric light plant at Campbell, Mo. They are now in the market for a 1,500-light alternator, a 100-hp, high-speed engine, and inside and outside supplies. Mr. Radabaugh can be addressed at Malden, Mo.

MEXICAN ELECTRIC RAILWAY.—An electric railway is to be built between the City of Durango and San Dimas, both located in the State of Durango, Mexico. The road will be about 70 miles long. G. B. Denis, of Mexico City, has secured the concession.

TEPIC WATER POWER PLANTS.—Mexican advices state that the installation of several water power plants in Tepic are being contemplated. Ignacio C. Curiel, a Mexico City engineer, is engaged in drawing up plans, etc., for the plants.

WESTINGHOUSE IN EUROPE was treated not long since in an article by Mr. Frank A. Vanderlip, vice-president of the National City Bank of New York, and formerly Assistant Secretary of the United States Treasury, on the general subject of American development across the Atlantic. Financially, the Westinghouse Companies of Europe represent a share and debenture capital aggregating a total of $38,000,000, of which over $30,000,000 has been issued. Commercially the investment of this capital has proved profitable in itself, and has enabled the erection of six large factories, of which two are in England, two in France, one in Germany and one in Russia. The works at Trafford Park, near Manchester, where 27 acres are under roof, are considered the largest and at the same time the most perfect and up-to-date works of the kind in Europe. The most important of the European companies are: The British Westinghouse Electric & Manufacturing Company, Limited, with a share and debenture capital of £3,250,000 sterling, of which £2,750,000 has been issued. The shares and debentures stand at a considerable premium in the market. Among the important contracts which that company is now carrying out are those with the Metropolitan and Metropolitan District Railways of London, the Mersey Railway of Liverpool, the Clyde Valley Power Company of Glasgow, the Admiralty, the Savoy Hotel, the Manchester Town Council, etc. The Société Anonyme Westinghouse of Paris, has an issued capital of 20,000,000 francs, of which a large portion is placed with the leading financial houses of France. They have just secured an important contract with the Metropolitan Railway of Paris. There is a separate company for Russia, a separate company for Germany, and the Westinghouse Brake Company, all of which are purely manufacturing concerns. The Traction & Power Securities Company, as noted recently in these columns, is a financial company closely associated and co-operating with the different Westinghouse companies. Their capital is £2,000,000, of which at present about £1,000,000 has been issued. For the first period of its operation this company has paid a dividend of 6 per cent., after making ample provision for a reserve fund. Mr. George Westinghouse, who directs the policy of all these companies, is chairman of most of them, and Mr. J. H. Lukach, who represents his interests on the other side, is on the board of all of them.

WESTINGHOUSE, CHURCH, KERR & CO. continue to receive numerous export orders for power apparatus. The new Westinghouse horizontal double-acting gas engine, recently placed upon the market, has already been introduced in Mexico, in the power plant of the Potosina Electric Company, at San Luis, Potosi. This installation will contain five units aggregating 1,225 hp, operating on 120 B.T.U. producer gas. An electrical supply company, Lima, Peru, will install a 330-hp Westinghouse compound engine for generator driving, this being an extension to their present plant; 200-hp engine type generating outfits have also been supplied to Negociacion Minera de Promontorio, Durango, Mexico, and to S. Pearson & Son, Limited, Salina Cruz, Mexico. The latter firm has also purchased a number of standard engine generating outfits. The Mexican National Iron & Steel Company, also located at Durango, will install a 45-hp compound engine for general power work, and a 150-hp Westinghouse compound engine type outfit will be installed by Michaelis Hallenstein & Co., Fookeray, Victoria, Australia, for lighting and power work. The demand for Westinghouse junior engines of all sizes, especially from Chilian territory, continues, and a large number of these engines are continually under exportation. The two 1,000-kw Westinghouse steam turbine generating units for the De Beers mines at Kimberley, South Africa, have recently been shipped. These are the largest steam turbines that have been exported from this country up to the present time.

COEUR D'ALENE POWER PLANT.—The Empire State-Idaho Mining & Developing Company, of Spokane, Wash., has purchased of the Westinghouse Electric & Manufacturing Company three motors for driving concentrating mill machinery and a large air compressor in the Coeur d'Alene. These motors will be supplied with power from the 2,300-volt secondary circuits of the Washington Water Power Company, of Spokane, whose 50,000-volt transmission line is now extending into the Coeur d'Alene in Northern Idaho, a distance of approximately ninety miles. There are two 150-hp, three-phase, 2,300-volts, 580-r.p.m. induction motors to be supplied, one for driving the air compressor of the Empire State mine at Wardner, Idaho, the other to operate the Sweeney concentrating mill, a short distance from Wardner. The third motor will be of the synchronous type, 240-hp, 2,300-volts, three-phase, 514-r.p.m., and will drive the concentrating mill of the Tiger-Poorman mines at Burke, Idaho. These motors will be placed in operation about June 1, 1903.

EXPORT TRADE IN FEBRUARY.—We have already noted the excellent export trade figures for February. The detailed electrical figures are not bad in view of the congestion of traffic on the railroads and the difficulty in getting goods to the seaboard from interior manufacturing points. The total export of electrical machinery for the eight months ending February was $4,084,471, against $3,556,070 in the corresponding period of 1902. The output for the month was $416,039, against $592,374 in 1902. The export of electrical instruments for the eight months was $2,742,472, against $2,503,602 in 1901-2. The output for the month was $246,104, against $255,163 in February, 1902. With the freight embargo lifted, vast quantities of electrical apparatus have been going abroad in March and April, both of which should make, therefore, a good showing.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the Exide battery, has added a number of new battery depots to the list of stations hitherto announced, the complete list at present embracing the following stations: New York, 148 West Eighteenth Street; Philadelphia, 250 North Broad Street; Boston, 39 Stanhope Street; Buffalo, 200 Pearl Street; Chicago, 264 Michigan Boulevard; St. Louis, 3937 Olive Street; Rochester, 158 South Avenue; Toledo, 715 Jefferson Street; Detroit, 265 Jefferson Avenue. The increasing use and the great convenience of these depots to users of electrical vehicles equipped with the Exide battery has encouraged the company to increase them as rapidly as favorable locations can be secured. New stations will, therefore, be announced from time to time.

EQUIPMENT FOR JAPANESE ROAD.—Takata & Co., of Japan (10 Wall Street), have secured a contract for the equipment to be used in the installation of a short narrow-gauge electric traction system on a small island in the southern part of Japan. The contract calls for four Westinghouse single equipments and a similar number of narrow-gauge Brill trucks, together with a small quantity of overhead material to be supplied by the H. W. Johns-Manville Company. A lot of Crown bonds of American Steel & Wire Company's manufacture have also been ordered.

NEW BALL ENGINE SHOPS.—The new works of the Ball Engine Company, Erie, Pa., are rapidly approaching completion, and the machine tools will soon be placed in position. These works will be modern in every respect; the tools will be of the latest and best types and will be electrically-driven. The demand for the Ball self-oiling engines still continues very large and the present works of the company are crowded with many months' work ahead, so that it is probable both works will be kept going, for some time to come at least.

THE BARNUM & BAILEY "Greatest Show on Earth" has recently arranged for seventy Nernst lamps, ranging in size from the one-glower to the six-glower type, for the purpose of illuminating their large canvas pavilions, enabling everyone to see the smallest objects at a great distance in the vast arena. To furnish current for operating the Nernst lamps, Barnum & Bailey have purchased special engines to generate power. They will also use the Nernst lamp exclusively for display advertising.

WESTINGHOUSE TURBINE ORDER.—Westinghouse, Church, Kerr & Co. have secured an order from the Rome Brass & Copper Company, Rome, N. Y., for a 400-kw Westinghouse steam turbine unit for both light and power work. A 130-hp Westinghouse vertical cross-compound engine, direct-connected to an alternating-current generator, has also been requisitioned for, which will be operated when the power required to be generated for use in the shops can be supplied by the smaller unit.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has sold the following apparatus to the New York Edison Company, supplementing the half million dollar contract reported in this column some months ago: 1,000-kw S. K. C. generators and seven 150-kw booster sets. The Stanley Electric Manufacturing Company has also contracted to furnish three 550-kw S. K. C. synchronous motors to the Municipal Gas Company of Albany.

BALL ENGINE ORDERS.—The Monongahela Valley Electric Company, Bellevernon, Pa., is adding a 300-hp unit, the Ball Engine Company, Erie, Pa., furnishing the engine. The Morreau Gas Fixture Company, Cleveland, Ohio, has purchased a direct-connected unit, consisting of a 175-hp engine, built by the Ball Engine Company, direct-connected to a 100-kw Westinghouse generator.

BULLOCK ELECTRIC MANUFACTURING COMPANY has recently sold three 1,800-kw generator sets to the Pacific Electric Railway Company, of Los Angeles, Cal.; also a 300-hp, 12,000-volt motor-generator set for San Bernardino, Cal., duplicating the equipment installed a year ago. The Bullock bid was higher than others.

BOILERS FOR HARTFORD (CONN.) PLANT.—The Hartford Electric Light Company, Hartford, Conn., has placed a contract with Thayer & Co., Incorporated, 39-41 Cortlandt Street, New York, for four boilers of 250-hp capacity each, built by the Aultman & Taylor Machinery Company.

BIG LAMP ORDER FOR EXPORT.—The Federal Electric Company, 141 Broadway, has just secured a foreign contract for 100,000 incandescent 16-cp lamps.

General News.

THE TELEPHONE.

CALGARY, ALBERTA.—The Bell Telephone Company will build long distance lines to Cardston and Edmundton.

LITTLE ROCK, ARK.—The Harris & Proctor Telephone Company, of Junction City, has been incorporated with a capital stock of $2,000, to build long distance telephone lines in Union County. The officers are D. F. Harris, president; C. A. Harris, vice-president; J. D. Proctor, secretary and treasurer.

REDONDO, CAL.—Application for a franchise has been made to the Board of Trustees by the Home Telephone Company.

WILMINGTON, DEL.—The American Telephone Company, of Wilmington, has been incorporated to construct telegraph and telephone lines in Atlanta, Ga. The capital stock is $400,000.

MOSCOW, IDAHO.—The Interstate Telephone Company has applied to the city council for a franchise.

MERIDIAN, IDAHO.—The Independent Telephone Company, of Boise, will install a new Globe automatic switchboard at this place.

KINMUNDY, ILL.—The Kinmundy Mutual Telephone Company has been organized.

PEKIN, ILL.—The Citizens Telephone Company will extend its lines from Pekin to Washington.

PONTIAC, ILL.—The Pontiac City Council has granted a 25 year telephone franchise to the Streator Independent Telephone Company.

CHICAGO, ILL.—The Chicago Great Western Railroad will commence next month the construction of a private telephone system between its three terminal points, Chicago, St. Paul and Kansas City.

MOUNT VERNON, ILL.—The Tri-County Telephone Company has elected officers as follows: President, Dr. J. T. Marlow; vice-president, C. H. Judd; treasurer, J. J. Pearce; secretary, W. D. Eaton.

ARMINGTON, ILL.—The Armington Mutual Telephone Company has elected officers as follows: C. Darnel, president; Frank Bogar, treasurer; C. B. Hanger, clerk; J. E. Kelly, George Cruse and A. F. Hoerr, directors.

EDWARDSVILLE, ILL.—Another farmers' telephone line is being constructed in Liberty Prairie, running north from this city, by the Central Union Company. A number of prominent farmers are subscribers and many more will join after the line is in operation.

CHICAGO, ILL.—The Chicago Telephone Company continues to gain in point of new subscribers. During March nearly 1,500 new customers were added to the company's list. The new telephones installed are nearly all party line service, or nickel-in-the-slot kind. The company now has in service slightly more than 64,500 telephones all told, and officials predict that the 75,000 mark will be reached before the summer is over.

STOUT'S CREEK, IND.—The Stout's Creek Telephone Company has been incorporated with a capital stock of $700.

GREENTOWN, IND.—The Sims Co-operative Telephone Company has been formed by the farmers in the east end of the county.

JASPER, IND.—The Crystal Telephone Company has incorporated with a capital stock of $10,000. William A. Line, Walker Mickler, J. M. Sinclair, B. P. Smith and S. N. Clapp are the directors.

INDIANAPOLIS, IND.—The Shady Grove Telephone Company has been incorporated with a capital stock of $100,000. The directors are J. M. Birch, Joseph F. Shelby, W. H. Foster, W. W. Piles and William Tague.

OGDEN, IA.—The Ogden Telephone Company is being incorporated here.

RADCLIFFE, IA.—A franchise has been granted to the Radcliffe Telephone Company.

SIOUX RAPIDS, IA.—A franchise has been voted to a local company for a telephone exchange.

ALEXANDER, IA.—The Latimer Telephone Company has been granted a franchise in this place.

SPENCER, IA.—The Citizens' Telephone Company has been granted a franchise at this place.

COUNCIL BLUFFS, IA.—The Pottawattamie Mutual Telephone Company is seeking a franchise in this city.

MINDEN, IA.—The Shelby Independent Telephone Company has been voted a local franchise in this place.

GOLDFIELD, IA.—The Goldfield Telephone Company has been granted a franchise and will establish a system.

ARMSTRONG, IA.—The Kossuth County Telephone Company will build from 150 to 200 miles of toll line during the summer.

NEW SHARON, IA.—The New Sharon Independent Telephone Company has been incorporated with a capital stock of $25,000.

QUIMBY, IA.—The Farmers' Telephone Company, of Quimby, has been incorporated with a capital stock of $10,000. Mr. M. F. Hoffman is president.

HORNICK, IA.—The Iowa Clark Automatic Switch Company, of Sioux City, and the Peiro Telephone Company have been granted franchises in this place for local exchanges.

WATERLOO, IA.—The Commonwealth Telephone Company has given the Automatic Electric Company a contract for an automatic switchboard which will be installed as soon as possible.

MUSCATINE, IA.—The South Prairie Mutual Telephone Company has filed articles of incorporation with a capital stock of $10,000. The first directors are J. P. Mountain, J. P. Nichols, A. B. Anderson, W. J. Barclay and Adolph Vogel.

LEWIS, IA.—At the recent city election franchises were granted to the Lewis Electric Company, of which Stevens Bros. are the promotors, and to the Town Mutual Telephone Association. The telephone company has already partly established its system.

ONAWA, IA.—The Maple Valley Telephone & Telegraph Company has filed articles of incorporation with an authorized capital stock of $100,000, of which $50,000 is preferred stock. The officers are president, W. H. Leathers; vice-president, J. C. Hammond, secretary, C. H. Smith, treasurer, T. B. Lutz.

SHENANDOAH, IA.—The stockholders of the Independent Mutual Telephone Company have voted to increase the capital stock of the company to $100,000. The company has made exchange arrangements with the Tabor Telephone Company, thus giving connections with any part of Fremont County from Shenandoah. Toll connections with Red Oak will enable the local company to reach the principal points throughout the state.

TOPEKA, KAN.—The independent telephone companies of Manhattan, Abilene, Beloit, Minneapolis and Concordia have been merged into one concern, which will be known as the Union Telephone and Telegraph Company, with headquarters at Abilene. The capital stock of the company will be $150,000. The stockholders are W. W. Dilworth, A. T. Rogers and F. M. Daily, of Beloit, G. A. Rogers and C. L. Brown, of Abilene; J. W. Smith and F. L. Flint, of Minneapolis; C. P. Dewey and H. P. Wareham, Manhattan, and F. W. Dougherty, Concordia. Rogers, Daily and Dilworth own the Beloit plant; Dougherty owns the Concordia plant, Dewey and Wareham own the Manhattan plant; Smith and Flint own the Minneapolis plant; Rogers and Brown own the Abilene plant. The capital stock of the merger company is divided equally among the five independent concerns. Each gets 300 shares.

LONDON, KY.—The London Telephone Company has been sold by N. Starkey to J. W. Creech, of East Bernstadt, and others. Mr. Starkey has purchased the exchange at Pineville.

LAKE CHARLES, LA.—The Cumberland Telephone Company is making extensive improvements in its service at this place at a cost of about $40,000 to $50,000. The company has 600 subscribers here and orders for 200 more are on file.

PORTLAND, ME.—The Lewiston & Auburn Telephone Company has been organized here with a capital stock of $25,000. The principal share holders are directors in the Northeastern Telephone Company which is now installing an automatic exchange in Portland. The directors of the new company are Thomas R. Brooks and Edward W. Gearhart, of Scranton, Pa., Lewis A. Goudy, of Portland, Edward W. Gross, of Auburn, and Charles C. Benson, of Lewiston.

GALESBURG, MICH.—The village has granted a 30-year franchise to the Citizens Telephone Company.

MUSKEGON, MICH.—The Bell Telephone Company will expend about $7,000 in overhauling the system in this city.

ANN ARBOR, MICH.—Pennsylvania capitalists are endeavoring to secure a franchise for an independent exchange at Ann Arbor.

SPRINGPORT, MICH.—The directors of the Springport Mutual Telephone Company have elected officers as follows: President, Emery Craver; secretary, Jay Courtright; treasurer, W. Elmer; manager, G. Tabor.

DETROIT, MICH.—Mr. William A. Jackson, formerly general manager of the Michigan Bell Telephone Company, the predecessor of the Michigan Telephone Company, has been employed by the Union Trust Company, which is the receiver for the Michigan Telephone Company, to make a thorough examination of all the telephone properties in Detroit to determine their exact value. The Union Trust Company has withdrawn its application for leave to lease the Detroit Telephone Company's property. Don M. Dickinson, attorney for the receiver, stated that the application was made in order to insure service to some 2,600 subscribers during the litigation between the Michigan Company and the Old Colony Trust Company, of Boston. These 2,600 subscribers were formerly subscribers to the Detroit Company and, it is stated, the two systems have been so interwoven it would be impossible to identify the lines, hence the withdrawal of the application.

JUDSON, MINN.—A farmers' telephone company is being organized here.

MADELIA, MINN.—A local telephone company has been organized in this place.

NEW LONDON, MINN.—The Co-operative Rural Telephone Company will build lines in this section. Mr. E. E. Lawson is secretary.

OSAGE, MINN.—The Farmers' Co-operative Telephone Company has been organized to build a line to Park Rapids and other points. Mr. Edward R. Smith is secretary.

ST. PAUL, MINN.—The Eden Valley Telephone Exchange Company has been incorporated with a capital stock of $10,000. The names of the incorporators are C. T. McDonald, M. E. Williams, W. L. Hutcheson, Math. Weiler, William O'Brien, George Tompers and L. R. Christ.

JEFFERSON CITY, MO.—The Buffum Telephone Company, of Louisiana, Mo., with a capital stock of $150,000, has been incorporated by Frank W. Buffum, Charles G. Buffum, Richard H. Goodman and others.

KEARNEY, NEB.—The Buffalo County Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are G. Biscel, Peter Wink, J. G. Reiter and J. D. Lowenbiem.

CRAB ORCHARD, NEB.—The Crab Orchard Home Telephone Company is being formed at this place with a capital of $10,000. Three or four lines will be operated in southwest Johnson County in addition to an exchange in town.

BEATRICE, NEB.—The Filley Independent Telephone Company has filed articles of incorporation. The company is capitalized at $2,000, and is composed of the leading business men of the town. The officers are P. M. Andersen, president; L. C. Andersen, vice-president; R. Petersen, treasurer; Harry Yohe, secretary.

SOUTH OMAHA, NEB.—As soon as the deal can be closed the Interstate Independent Telephone Company of this city will begin the construction of a local system to cost $100,000. It is stated that the Kansas City Independent Telephone Company is the backer of the local enterprise. All of the lines in the business section of the city will be laid in conduits.

EAST CHATHAM, N. Y.—The New Britain Co-operative Telephone Company has been incorporated with a capital stock of $1,000, by Samuel F. Phillips, Dow V. Wadsworth and Chas. H. Carpenter.

ALBANY, N. Y.—The Queechy & Flat Brook Telephone Company, of Canaan Four Corners, N. Y., has been incorporated with a capital stock of $500. The incorporators are O. F. Walker, Ezek Finch and W. J. Lord.

EAST CHATHAM, N. Y.—The Old Turnpike Co-operative Telephone Company, of East Chatham, has been incorporated with a capital stock of $300. The incorporators are O. F. Walker, Esek Finch and W. J. Lord.

MARCELLUS, N. Y.—The Marcellus Telephone Company has been formed by the following named stockholders: D. R. Bowen, A. E. Drake, T. F. Walsh, F. W. Knapp, C. E. Yahu, A. V. Smith, F. T. Schoonmaker, J. E. Woodbridge, A. L. Stone, D. D. F. Coon, C. A. Roe and R. M. Cornwell, of Syracuse.

WAHPETON, N. D.—The Great Western Telephone Company will erect a new exchange building in this place.

EAST ROCHESTER, OHIO.—The Eastern Ohio Telephone Company, of Columbiana County, has increased its capital stock from $5,000 to $25,000. Lewis Walker is president.

COPLEY, OHIO.—The Akron People's Telephone Company has asked that a receiver be appointed for the Copley-Sharon Telephone Company which is owned by William Arnold, of Copley.

TORONTO, OHIO.—A new telephone company has been organized to construct a line between Jewett, Germano and East Springfield with many short branches to the farms along the way. G. O. Fleming is president.

TOLEDO, OHIO.—The Toledo Home Telephone Company has purchased from Barber & Brailey, of Wauseon, a number of toll lines connecting Toledo with surrounding towns. The consideration is said to have been $50,000.

PLEASANT HILL, OHIO.—The Pleasant Hill Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are A. J. Vernier, L. E. Seines, George H. Probeck, C. M. McLaughlin and D. E. Rothermel.

ATTICA, OHIO.—The Farmers' Mutual Telephone Company has been organized with J. W. Walker, president; Jacob Zellers, secretary; Henry Deuchley, treasurer. The company will operate farmers' lines in Seneca, Huron and Wyandot counties.

RICHWOOD, OHIO.—The Richwood Telephone Company is making extensive improvements. New telephones will be installed and a large amount of cable will be put up. Several new toll lines will be built. The company has increased its capital stock to $20,000.

BELLEVUE, OHIO.—The Local Telephone Company has elected these directors: Frank A. Knapp, W. M. Halliday, D. Calhoun, S. M. Wolf, G. A. Wright, C. R. Callaghan, J. H. Beatty, A. K. McConnell and James Verdin. The board of directors authorized extensive improvements to be made at the exchanges at Wakeman, Attica, Sulphur Springs and New London, and a toll line will be built connecting Berlin Heights and Wakeman. The company is in a prosperous condition. A dividend of 1½ per cent. was declared.

GUTHRIE, OKLA.—The Pioneer Telephone Company, of Guthrie, has filed a charter in Kansas, the capital stock being $500,000. The company contemplates building long distance and local telephone exchanges, telegraph lines and manufacturing and dealing in electrical goods in Kansas, Oklahoma and the Indian Territory. The stockholders of the company are John M. Noble, John N. Coulter, J. C. Shepard, Bird McGuire, E. D. Ninis, E. E. Westervelt and D. McKinstry.

BRUCE, S. D.—Mr. M. E. Hall proposes to establish a rural telephone system.

ORIENT, S. D.—A company is being formed to build a telephone line to Miller.

HETLAND, S. D.—The Hetland Telephone Company contemplates extending its system.

PLANKINTON, S. D.—The Plankinton Telephone Company has been organized with a capital stock of $25,000.

HIGHMORE, S. D.—The Stockmens Telephone Company has been incorporated with a capital stock of $5,000.

MILBANK, S. D.—Local business men propose to organize a telephone exchange. Mr. A. F. Lindquist is secretary.

GREENVILLE, TENN.—The People's Telephone Company has applied to the city council for a franchise.

GAINESBORO, TENN.—The Gainesboro Telephone Company has re-elected the present officers, G. W. Stevens, president. The company has some 25 exchanges and 2,000 miles of toll lines. A number of new exchanges and toll lines will be built. The capital stock is $165,000.

SAN ANGELO, TEX.—Sonora is to have a telephone exchange. J. Y. Rust, of the San Angelo & Sonora telephone line, is interested.

GREENVILLE, TEX.—The Home Telephone Company, of Greenville, has been incorporated with a capital stock of $100,000. The incorporators are R. T. Hicks, L. A. Chamberlain, E. D. D. Glandon and others.

SALT LAKE, UTAH.—The name of the Utah Home Telephone Company has been changed to the Utah Independent Telephone Company. C. S. Hall, an engineer from West Virginia, has charge of the work, and as soon as he selects a location the work of erecting a large fire-proof central office will begin.

RAPIDS, WIS.—The Rapids & Western Telephone Company has bought the Western Telephone Company's lines and will make improvements.

BELLEVILLE, WIS.—The Belleville Telephone Company has been incorporated with a capital stock of $5,000. The names of the incorporators are Stanton E. Miller, Henry Ulerich and Orin Scott.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—A franchise has been granted to T. H. Aldrich and T. H. Aldrich, Jr., Trustees for the Birmingham District Coal, Light & Power Company. The company expects to start work within 30 days on by-product coke ovens, using the gases to generate electrical power.

PRESCOTT, A. T.—A large electric power plant is to be located on Fossil Creek, about 57 miles from Prescott.

SANTA MARIA, CAL.—Reuben Hart is about to petition for a franchise for an electric light plant.

STATESBORO, GA.—The citizens have voted to issue $37,000 bonds for an electric light plant and water works.

NEZ PERCE, IDAHO.—Z. A. Johnson will begin immediately the erection of the power house and dam he has had in contemplation. The sites have been selected and contracts let for the building. He will expend $35,000 in the enterprise.

GRANGERVILLE, IDAHO.—The Buffalo Hump Power Company, Ltd., has filed articles of incorporation with a capital stock of $100,000. The plant will be erected at once. The primary object in forming the company was the desire to substitute electricity for steam in the Cracker Jack mine.

SPRINGFIELD, ILL.—A. L. Ide & Sons have petitioned the Council for a franchise for a hot water heating system and electric light plant.

CHICAGO, ILL.—The Perfection Light & Heating Company, of Chicago, has been incorporated with a capital stock of $50,000. The incorporators are I. E. Butter, E. W. Wray and G. M. Ludlow.

ELKHART, IND.—The City Council has granted the National Mfg. Company a franchise for an electric plant. The company proposes constructing a plant at Bristol on the St. Joseph River. Walter Brown is reported interested.

REINBECK, IA.—W. P. Walsh has secured a franchise to install a complete electric light plant.

RADCLIFFE, IA.—The citizens have voted to grant a franchise to the Radcliffe Heating & Lighting Company.

FORT DODGE, IA.—It is stated that the Light & Power Company will enlarge the electric light plant, extend the street railway system and rebuild its gas plant.

IOWA FALLS, IA.—The Ackley electric light and heating plant, valued at $20,000 has been sold to the Daly Land Company, of St. Paul, Minn., and parties from that city will operate the plant in the future.

HARRODSBURG, KY.—J. H. Cochran, of Louisville, has been employed by City Council to prepare plans for an electric light plant to cost $18,000.

BOWLING GREEN, KY.—Jackson & Omberg, of Dyersburg, Tenn., have been employed to prepare plans, estimates, etc., for an incandescent electric light plant in conjunction with the street lighting system already being operated by the city.

GUTHRIE, KY.—According to reports this town is anxious to secure an electric light plant and offers a bonus of $1,000 cash, lease at site upon which to erect a plant for 20 years without consideration, release the plant from municipal taxes for five years and a 20-year franchise free. R. F. Warren is town clerk.

NEW ORLEANS, LA.—The City Council has passed an ordinance authorizing Comptroller Tujague to advertise for bids for the construction of a municipal electric lighting and power plant. This means that the city proposes to light the streets and provide power for the public buildings by electricity generated in its own plant.

ANNAPOLIS, MD.—The Independent Electric Light & Power Company is about to petition the City Council for a franchise. H. Lewensohn, of Baltimore, is the promoter and manager.

BALTIMORE, MD.—John Waters, 23 E. Centre St., has secured the contract to erect an electric power sub-station for the United Electric Light & Power Company at McClellan Alley and Little Sharp St. The building and equipment will cost about $100,000.

MALDEN, MASS.—The Malden Electric Company is to enlarge its plant. The new building is to be erected around the present structure. The improvements will cost about $100,000.

SAULTE STE. MARIE, MICH.—Messrs. Wallace-Jaastad-Drewsen, Temple Court, New York, N. Y., will design a new hydraulic power station for the Edison Sault Electric Company.

WINONA, MINN.—C. J. Grove has petitioned the City Council for a franchise for an electric light plant.

CALEDONIA, MINN.—The citizens have voted to issue $8,000 bonds for the construction of an electric light plant.

NICOLLET, MINN.—It is proposed to construct an electric light plant, to cost $3,000. H. A. Hildebrandt, St. Peter, is the engineer.

MANKATO, MINN.—The Council has rescinded all previous actions as to water works, rejected all bids received on March 23 for a building and returned unopened the bids for the lighting plant. J. R. Thompson is city engineer.

FARIBAULT, MINN.—The Polar Star Electric Company is going to put in a motor circuit and will operate it in about 60 days. It will also establish a day commercial circuit.

FARIBAULT, MINN.—The Faribault Gas & Electric Company has been incorporated, capital $250,000. Incorporators: B. W. Cowperthwaite, John Haug and Ellis F. Preston.

COLUMBUS, MISS.—The stockholders of the Columbus Light & Power Company have decided to construct a new electric plant, to cost about $30,000.

STORRS, MONT.—The Cashier Washoe Copper Company proposes to construct an electric light plant and water works under the supervision of P. M. Gallaher, of Storrs.

TRENTON, N. J.—The Illinois Railways and Light Company; capital, $3 ,000 has been incorporated here by Louis B. Daly, Joseph M. Mitchell, H. O. Coughlan, Warren N. Akers and B. B. Lewis.

NORTH LAWRENCE, N. Y.—L. L. Dewey has purchased the Townsend water power at North Lawrence, and expects to put in electric lights at that place and Lawrenceville.

ELMIRA, N. Y.—The Chemung Electric Company has been incorporated with a capital stock of $3,000. The incorporators are Frank S. Pitcher, William D. Miller and F. Watson Personius.

BINGHAMTON, N. Y.—Bids will be received on April 20 by A. W. T. Back, Clerk of the Board of Supervisors, for the construction of a county heating and lighting plant on the Court House Square.

NEW YORK, N. Y.—The People's Illuminating Company has been incorporated to supply electricity in Manhattan and the Bronx boroughs; capital, $25,000. Directors: C. C. Freeman and H. C. Eldert, of Brooklyn, and W. L. Worrall, of New York.

GARDEN CITY, L. I., N. Y.—The Corporate Electric Company has been incorporated, with a capital of $300,000, to manufacture electricity for light, heat and power purposes in Garden City and the five boroughs of New York City. Directors: Harold S. Recknagel and Walter L. Worrall, of New York, and C. C. Freeman and Henry C. Eldert, of Brooklyn.

BUFFALO, N. Y.—The Frontier Electric Lighting Company, of Buffalo, was incorporated March 26 to operate in Buffalo and the towns of Tonawanda, Cheektowaga and West Seneca; capital, $800,000. Directors: Alex. C. Humphries and Stephen Peabody, of New York City; Howard L. Clark, of Providence, R. I.; Robt. L. Fryer, of Buffalo, and others.

BARBERTON, OHIO.—The proprietors of Barberton Inn are preparing to install an incandescent plant of 2,000 lights.

ATTICA, OHIO.—The village will probably issue $6,000 worth of bonds to insure the building of a municipal electric lighting plant.

TOLEDO, OHIO.—The Council has declined to grant a franchise to the Central Heating & Lighting Company for a heating and electric lighting system.

DAYTON, OHIO.—The Dayton Heating & Power Company has been organized by Henry Zwick, Newton Thacker and others to build an electric lighting and steam heating plant.

RAVENNA, OHIO.—The Ravenna Gas & Electric Light Company has increased its capital stock from $40,000 to $60,000 and will make improvements. Charles Mertz is president.

SANDUSKY, OHIO.—The Central Heating & Lighting Company has been granted a franchise to install a heating and lighting system in Sandusky. The company will erect a plant at once.

MT. GILEAD, OHIO.—The Mt. Gilead Water, Light, Heat & Power Company has increased its capital stock from $60,000 to $70,000 and will make improvements. Mark Cook is president.

DALLAS, ORE.—The Dallas Electric Light & Power Company has been incorporated, capital $20,000. Incorporators: M. D. Ellis and T. A. Wagner.

AVONDALE, PA.—The Avondale Borough Electric Company has been incorporated, capital $10,000. Directors: Edw. H. Wert, C. Raymond Fritcher and Herbert F. Harris, of Harrisburg.

MT. HOLLY SPRINGS, PA.—The Mt. Holly Springs Light, Heat & Power Company has been incorporated, capital $5,000. Directors: Patricio Russ, Harrisburg; C. Faller, of Carlisle, and others.

WESTGROVE, PA.—The West Grove Borough Electric Company, of West Grove, has been incorporated with a capital of $10,000. The directors are Edw. H. Wert, C. Raymond Fritcher and Herbert F. Harris, of Harrisburg.

WESTERLY, R. I.—The Senate has passed the bill authorizing the town to issue $150,000 bonds for the construction of an electric light plant.

RAPID CITY, S. D.—Frank M. Lockhart and W. H. Chambers have secured a franchise from the City Council to build and equip an electric light plant.

FOUNTAIN GREEN, UTAH.—The Fountain Green Electric Light Company will install an electric light plant at Ephraim, Utah.

COLEMANS FALLS, VA.—Gleaves & Co., of Lynchburg, have secured the contract for the construction of a dam and power-house at Colemans Falls for the Bedford Pulp and Paper Company. The contract is reported to amount to about $100,000.

BRATTLEBORO, VT.—The Connecticut River Power Company will build a $50,000 dam across the Connecticut at Brattleboro. It will probably be 20 feet high, and generate from 4,000 to 5,000 horse-power.

MONROE, WASH.—S. A. Buck has petitioned for a franchise for an electric light plant.

SEATTLE, WASH.—It is stated that bids are wanted May 9 for $590,000 municipal lighting plant bonds. John Riplinger is City Comptroller.

LA CROSSE, WIS.—It is stated that the Central Electric Company will increase its capital from $50,000 to $100,000 to meet several improvements which have been planned.

TWEED, ONT.—The town proposes to take over and reconstruct the electric light plant which was burned. Water power is proposed. The probable cost of the work will be about $7,000.

TORONTO, ONT.—Bids will be received April 18 by the Raven Lake Portland Cement Company, Toronto, for constructing an electrical transmission line between Raven Lake and Elliott's Falls.

FT. WILLIAM, ONT.—The Council is reported to have contracted with the Anglo-American Power Company, of Chicago, to develop the water power on the Kaministiquia River. The agreement calls for the development of at least 5,000-hp in two and one-half years.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—Application has been made by Leslie C. Brand for a franchise to build an electric railway from Los Angeles to Glendale, a distance of 10 miles, at a cost of $200,000.

PENSACOLA, FLA.—The Pensacola Terminal & Electric Street Railway has applied to the City Council for permission to extend the present system, and to equip a portion of the steam division within the city limits with electricity.

SPRINGFIELD, ILL.—The Quincy & Western Illinois Railway Company has been incorporated, with a capital stock of $500,000, to construct an electric railway from Quincy to Beardstown, and from Rushville to Havana, and from Quincy to Niota.

VINCENNES, IND.—The council has granted a franchise to the Western Indiana Traction Company which proposes to build a road from Vincennes to Sullivan.

WABASH, IND.—It is reported that the Union Traction Company has purchased the Wabash River Traction Company's line between this city and Logansport. The price is said to be $850,000.

MADISON, IND.—The Madison, Greensburg & Indianapolis Electric Railway Company has incorporated with a capital stock of $50,000. Richard Johnson, Nicholas Horuff, M. D. Wilson, N. V. Craven and David Johnson are the directors.

HARTFORD CITY, IND.—The directors of the Muncie, Hartford City & Ft. Wayne Traction Company have elected S. M. Hextor, of Cleveland, president; A. L. Johnson, Muncie, vice-president; and F. M. Osburn, Cleveland, secretary.

LOGANSPORT, IND.—The Western Electric Railway Company, with principal offices in this city, has filed articles of incorporation. The capital stock is $150,000. Newland T. Depaw, H. B. Smith, William Elliott, E. B. Sellers and George R. Ross, Sr., constitute the board of directors.

LOGANSPORT, IND.—The Frankfort & Logansport Traction Company has been incorporated with a capital of $100,000 by J. E. Hillis, W. H. Coulter and W. P. Sidewell, of Frankfort; Dennis Uhl, G. W. Seybold and M. A. Jordan, of Logansport; C. S. Karoly, of Aurora, Ill., and A. P. Clatton, of Chicago.

SIOUX CITY, IA.—Captain R. A. Talbot, of South Sioux City, has filed with the Board of Commissioners of Dakota County, S. D., an application for a franchise granting him the right to construct an electric railway from South Sioux City through Dakota City, S. D., to Homer, S. D.

WICHITA, KAN.—George W. Baumhoff, of St. Louis, engaged as expert to pass upon the advisability of building an electric railway between Wichita and Arkansas City, has reported favorably on the project to the Wichita Interurban Railway Company, which has been organized to build the road. W. E. Wilcox, of Arkansas City, is interested in the company.

OWENSBORO, KY.—The Owensboro City Railway Company has filed a mortgage for $200,000 with the Louisville Trust Company, of Louisville.

NEWPORT, KY.—The council will advertise for bids for electric railways over several routes in Newport. The South Covington & Cincinnati Street Railway Company is seeking the franchise.

WORCESTER, MASS.—The Hartford & Worcester Street Railway Company has organized as follows: Fred C. Hinds, of Boston, president; Thomas C. Perkins, of Hartford, vice-president; Charles H. Wilson, of Boston, treasurer; Charles L. Wilson, clerk; Herbert E. Shaw, of Wales; Charles S. Tarbell, of Brimfield; John F. Hebard, of Sturbridge; Edward Akers, of Charlton; Fred C. Hinds, Charles H. Wilson and Thomas C. Perkins, directors.

ADRIAN, MICH.—The Toledo & Michigan Electric Railway Company has been incorporated for the purpose of building an electric railway from Adrian through the counties of Lenawee, Hillsdale and branch to Coldwater, a distance of about 56 miles. The capital stock is $450,000, and the directors are William P. Heston, Peter P. Duket and Samuel C. Heston, of Toledo; Charles H. Lards, James W. Helme, Jr., and Robert W. Kirk, of Adrian.

CAMDEN, N. J.—The Philadelphia Interurban Railways Company has been incorporated here with a capital stock of $2,500,000. The incorporators named are Edward Chew, Walter J. Parsons and Ralph Boyer.

CHARLOTTE, N. C.—There is talk of building an interurban trolley line from Mullins to Dillon, S. C., and thence to Bennettsville on to Cheran.

BISMARCK, N. D.—The Legislature has authorized the construction of an electric railway from the depot to the capitol, and appropriated $20,000 for the purpose.

DAYTON, OHIO.—The Union Traction Company has been incorporated with $5,000 nominal capital by W. H. Clapper and others.

KENTON, OHIO.—The contract for building the Kenton & Southern Railway has been awarded to the Great Northern Construction Company.

SPRINGFIELD, OHIO.—The American Railways Company, controlling the Springfield Railway Company, is to expend $85,000 in improving that property.

UPPER SANDUSKY, OHIO.—Dr. D. J. Johnson, of Wharton, is at the head of a project to make this city the center of a network of interurban lines.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Railway Company will erect its power house, car sheds and repair shops on a site near this city.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has placed a contract with F. E. Gribbon, of Cleveland, for the erection of its new power house.

TOLEDO, OHIO.—Toledo parties have recently ordered 10,000 tons of steel rails from Germany for delivery in this city at an early date. They will be used on railways building in Ohio and Indiana.

WASHINGTON, C. H., OHIO.—The Columbus & Washington Railway Company has been incorporated with $10,000 by Richard Emory, Otto Ehring, Frank Johnson, W. R. Pomerene and George Thomas.

COSHOCTON, OHIO.—It is reported that Tucker, Anthony & Company have secured control of a fine water power near Coshocton and will erect a power house there for the proposed railway from New Philadelphia to Newark.

BOWLING GREEN, OHIO.—Stockholders of the Lake Erie, Bowling Green & Napoleon Railway have voted to increase the capital stock from $300,000 to $1,000,000, and bonds to that amount will be issued. The money will be used to extend the road to Port Clinton.

TOLEDO, OHIO.—The Toledo & Michigan Railway Company has been incorporated under Michigan laws with $450,000 capital stock, by W. P. Heston, S. C. Heston, W. W. Betz and P. P. Ducket, of Toledo, and J. W. Helme, C. H. Lards and R. W. Kirk, of Adrian.

TOLEDO, OHIO.—The People's Rapid Transit Company has been incorporated, with a capital of $400,000, for the purpose of building a line from Toledo to Cincinnati. Adam Burger, George Bloodheart, of Toledo; Thomas N. Franey, of Perrysburg, and Albert Merkley, of Tontogany, are the promoters.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company has been incorporated with $1,000,000 capital stock, by George Koehler, W. D. Breed, G. M. Frick, O. N. Little and F. A. Koehler. This is the company that has succeeded the Citizens Railway, Light & Power Company. There will be no change in the management.

CLEVELAND, OHIO.—After many discouraging vicissitudes the financing of the Lake Shore Electric Railway Company, of Cleveland, has been completed, and by order of Judge Wing, of the United States Court, the receivership was terminated April 1. Mr. Albion E. Lang, who was appointed receiver in January, 1902, was discharged and will take a much needed rest.

KELLY'S ISLAND, OHIO.—The Superior Manufacturing Company, of Minneapolis, which owns large lime stone quarries on the island has applied for a franchise to build an electric railway from the quarries to the docks. The islanders are willing to grant the franchises provided the company will build the road across the island and carry passengers during the summer; also install a lighting plant from which the streets can be lighted. The company does not favor the proposition but is considering it.

MAUCH CHUNK, PA.—Hugh E. Crilly, of Allentown, has been appointed receiver of the Mauch Chunk, Lehighton & Slatington Railway Company.

MASONTOWN, PA.—F. A. Maddas, of Masontown, has applied for a charter to build an electric railway from Masontown to McLane's Landing.

PHŒNIXVILLE, PA.—These directors of the Phœnixville & West Chester Electric Railway Company, soon to be chartered, have been elected: A. D. Warner, of Wilmington; W. P. Sharpless and T. W. Marshall, of West Chester; J. W. Howell, of Philadelphia, and R. K. S. Alleback, I. J. Brower and John S. Dismant, of Phœnixville.

TIVERTON, R. I.—The Tiverton & Seaconnet Beach Railway Company is seeking incorporation. William H. Briggs and Abel B. Simmons are interested.

CUMBERLAND, R. I.—The Valley Falls & Franklin Street Railway Company is seeking incorporation to build an electric railway from Valley Falls to Franklin. It will be capitalized at $300,000. Andrew J. Currier, John F. Clark, William H. Bolster are among the incorporators.

NARRAGANSETT PIER, R. I.—The Sea View Railroad Company has in contemplation improvements calling for the expenditure of $100,000. The changes proposed contemplate the generating of all power for both the railroad and the Narragansett electric lighting plant at the power station at Hamilton. There is to be a new engine room, 60 ft. x 65 ft. in size, and a boiler room 55 ft. x 40 ft. in addition to the present plant at Hamilton. Two new engines, one of 600-hp and the other of 400-hp are to be installed in this new plant. Transformers will be installed to step the voltage up to 10,000, and a new transmission line will be built from Hamilton to the Pier. The present power station at Narragansett Pier will be discontinued. A sub-station is to be built at Sea View Junction.

AUSTIN, TEX.—A. J. Dull, of Harrisburg, Pa., and Thomas Pierce, of Boston, Mass., are considering the proposition of building an electric interurban railway between New Braunfels, Tex., and Seguin, a distance of about fourteen miles.

PARKERSBURG, W. VA.—The Ohio Valley Electric Street Railway Company, recently incorporated, has organized as follows: V. B. Archer, president; J. H. McCoy, of Sistersville, vice-president; R. J. A. Boreman, secretary; C. L. Williams, superintendent and treasurer; G. E. Moffett, of New York, consulting engineer; P. H. Anderson, of Friendly, superintendent of right of way.

KENOSHA, WIS.—The Kenosha Electric Railway is to be extended into Pleasant Prairie as far as Grand View Park.

OCATLAN, MEX.—Dwight Furness, of the City of Mexico, has been granted a concession by the Mexican government to build an electric railway between Ocatlan and the town of Jamay.

CITY OF MEXICO, MEX.—Andrew Mackenzie, president of the San Rafael & Xico Railroad, is interested in a project to build an electric railway between Cordoba and Tierra Blanca, Mexico, a distance of about 70 miles.

QUERETARO, MEX.—An electric interurban railway is being constructed between the city of Queretaro and the town of Tequisquiapam, by the Compania Explotadora del Tequisquiapam. The electrical energy will be generated by water power in the Tequisquiapam River.

TORONTO, ONT.—A scheme is being promoted whereby the revenue derived by the city from the Toronto Electric Street Railway shall be put into a special fund for the purchase of the railway company's plant at the termination of the franchise, which has yet 18 years to run.

MONTREAL, QUE.—Plans are being prepared for an electric railway from Montreal to Three Rivers, a distance of 95 miles. The capital of the company will be $500,000. Jacques Bureau, of Three Rivers; Hector Caron, J. H. Legis, Alp. Clermont, R. Cook and A. Cuthbert, of Berthierville; F. O. Lamarche, J. M. Wilson and L. O. Hétu, of Montreal, and others are interested.

NEW INDUSTRIAL COMPANIES.

THE AMERICAN DISTRICT TELEPHONE COMPANY, capital $100,000, has been incorporated by R. M. Beard, S. W. Slayden and B. A. Judd.

THE KENNETT TOWNSHIP ELECTRIC COMPANY, of Kennett township, Chester Co., Pa., has been incorporated with a capital stock of $10,000.

THE WELSH LAFFTUS URANIUM AND RARE METALS COMPANY, of Buffalo, has been incorporated; capital $100,000. Directors: S. T. Lockwood, M. S. Gibbs and G. J. Banta, Buffalo.

THE YORK ELECTRIC & MACHINE COMPANY, of York, Pa., has been granted a charter at Harrisburg, the capital stock being $10,000. This company is manufacturing apparatus used in the production of incandescent electric lamps.

THE BACHELLE AUTOMOBILE COMPANY, of Chicago, has been incorporated with a capital stock of $100,000, to manufacture automobiles and vehicles. The incorporators are Otto von Bachelle, S. W. McKee and J. F. McBridge.

THE ELECTRIC AND POWER MANUFACTURING COMPANY has been formally organized at Spartansburg, S. C., with W. C. Bennett, president and treasurer. The capital stock is $100,000 and the company has the privilege of increasing the stock to $3,000,000.

THE NEW LEXINGTON HIGH VOLTAGE PORCELAIN COMPANY has been incorporated at New Lexington, Ohio, with $30,000 capital stock, by J. G. McDougal, A. Garlinger, C. A. Donahue, P. W. Newlan and J. G. Courtright. The company will manufacture high-voltage insulators.

THE SOUTHWEST ELECTRICAL COMPANY has been incorporated at San Bernardino, Cal., with a capital stock of $25,000. The directors are C. M. Grow and J. W. Curtis, of San Bernardino; C. E. Gage, of Redlands, and H. S. Roach and G. A. Roach, of Riverside. The company will devote itself exclusively to the manufacture and sale of electrical apparatus.

LEGAL.

CUTTING TEXAS TELEPHONE WIRES.—It is an offense under the Penal Code of Texas to interfere wilfully with the transmission of messages along a telegraph or telephone line. The Civil Code of Appeals of that State holds that to constitute an offense under such provision, there must be a breaking, cutting, etc., of some wire, post, machinery, or other necessary appliances, so as to interfere with the transmisison of messages. An action in which the question arose was one by a constable against a telephone company to recover the reward for the conviction of a person guilty of cutting telephone wires, etc., or unlawfully obstructing the transmission of messages. The court also held that the defendant had the right to plead that the wire cut by the person convicted was a dead one, and did not come within the offer, and that plaintiff had personal knowledge that the reward did not apply to such wires. It was further held that a constable who arrests a person for misdemeanor in the discharge of his duties is not entitled to recover a reward offered for the conviction of any one committing such misdemeanor.

PERSONAL.

MR. CHARLES A. COFFIN, president of the General Electric Company, sailed last week on a short European trip.

MR. F. S. PEARSON, consulting engineer of the Metropolitan Street Railway, has gone on a trip to the other side of the Atlantic.

PROF. CLARENCE CHEYNE GORDON, Ph.D. (Gottingen) has organized a course in applied electricity at the Central University of Kentucky, Danville, Ky.

MR. THAD. AVERY, JR., Graeter Electric Company, Dillon, Mont., requests us to state that he wishes to receive catalogues, etc., on all apparatus relating to electrical and power construction, etc.

DR. J. B. DE LERY, who introduced the Wenstrom patents into this country, is now on a visit to the United States. He may be found at the offices of the Federal Electric Company in the Washington Life Building.

MR. P. A. B. WIDENER, the street railway magnate, has offered the city of Philadelphia his entire art collection worth $3,000,000, providing the city will build an art museum at the Green Street entrance to Fairmont Park.

MR. JOHN I. SABIN, President of the Pacific States Telephone & Telegraph Company, has returned to San Francisco to reside. Mr. Sabin's Company now has about 40,000 telephones in San Francisco and over 161,000 on the Pacific Coast.

MR. W P. CONOVER, JR.—The stockholders of the Philadelphia Electric Company, at the annual meeting, elected Wm. P. Conover, Jr., a director in the place of John M. Mack, who resigned some time ago. Mr. Conover has been connected with the interests of the concern for some years past.

MR. E. R. AVERY, superintendent of the Pony, Mont., Electric Light Company, has recently secured a patent on improved rail joints for connecting the meeting ends of rails without employing the usual bolts or fish plates, and preventing displacement while allowing nominal expansion and contraction.

MR. C. L. EDGAR, president of the Boston Edison Electric Illuminating Company has purchased a majority control in the Greendale Chemical & Electric Lighting Company, of Needham, unincorporated. The company operates on a small scale and has but $7,434 capital. It has a profit and loss balance of $5,488.

MR. CHARLES BRANDEIS, electrical engineer of the Montreal Light, Heat & Power Company, was in New York City calling on numerous friends last week and at the office of this journal. He was much pleased at the interest shown in the remarkable power developments in and around Montreal, including the transmission from Shawinigan Falls.

HALL-HANKS.—The marriage is announced on April 8 of Miss Florence Helene Hanks to Mr. Milton Warner Hall, of West Cheshire, Conn. The bride is the daughter of Mr. Wilbur F. Hanks, formerly of the *Electrical Engineer* business staff and more latterly one of the publishers of the well known "Central Station Directory," and of automobile journals, etc.

MR. G. P. ROBINSON, formerly of the Central Union Telephone Company, of Chicago, has been appointed traffic manager of the entire system of the Sunset Telephone & Telegraph Company on the Pacific Coast. This is a newly-created office. Mr. Robinson will also have charge of the lines, boards, operators and everything pertaining to the working of the system.

MR. FRANK KLEPETKO, consulting engineer, Maritime Building, is now on his way back from Peru, to which country he went in the interests of Mr. J. H. Haggin and associates, who propose to build an electric plant with a capacity of 5,000 horse-power for the purpose of operating a smelting and other plants in the Cerro de Pasco district. Contracts for equipment, etc., are expected to be given out almost immediately after Mr. Klepetko's arrival in New York.

MME. RADDE, who arrived last week by the French liner *La Lorraine*, from Havre, is here to establish institutions for the cure of blindness and tuberculosis. She asserts that she has had great success with her remedy, in which electricity plays an important part. She applies the remedy "through the bones and pores" instead of internally. Her plan is to build hospitals for patients afflicted with partial blindness and tuberculosis in all its stages, incipient and advanced, and she promises to cure multitudes.

MR. P. W. WILLIAMS, of Detroit, who was Governor Roosevelt's telegraph operator on the campaign tour of the West in 1900, is to accompany the President in the same capacity on the present trip. On the tour of 1900 Williams picked up a cowboy hat in a Wyoming town which he converted into an autograph album, securing first the signature "Theodore Roosevelt," and then the names of other members of the party and distinguished persons met on the trip. The hat also bears the name of every State through which the party passed.

MESSRS. OSCAR & THOMAS BRANIFF, JR., of the house of O. & G. Braniff, Mexico City, which concern represents the interests of the Westinghouse Electric & Mfg. Company, are now on a visit to New York for the purpose of conferring with the Westinghouse people regarding the construction of a large hydraulic plant. Two concessions have been secured from the Mexican authorities for the utilization of water from the Atoyac and Tuxpango rivers, located on the Canton of Cordoba, about half way between Mexico and Vera Cruz. The rivers are about three miles apart and the water and the falls are sufficient to generate 50,000 horse-power.

MR. T. H. ALDRICH.—The city of Birmingham, Ala., has granted to T. H. Aldrich and others a franchise for the erection of a gas, light and power plant in Birmingham, Mr. Aldrich paying $7,500 cash for the franchise. Mr. Aldrich will build a by-product plant, using the patents of the United States Gas & Improvement Company, building 150 ovens and using their product. The plant is to be located either at East Birmingham or North Birmingham and will cost $300,000. Mr. Aldrich has come north to complete the organization of the company, which is known as the Birmingham District Light, Power & Gas Company and to purchase machinery for the plant.

MR. CHARLES G. CURTIS, whose steam turbine is now attracting the attention of the whole engineering world is a son of the late distinguished publicist, George Ticknor Curtis. As a graduate of Columbia College, New York, he took up electricity very early in the eighties with his friends, now Prof. F. B. Crocker and Dr. S. S. Wheeler, and the famous "C. & C." motors were one of the first outcomes of his work. Later on he designed and introduced some excellent street railway motors. For several years past his energies have been concentrated on the problems to be overcome in perfecting the steam turbine. He will now give attention to its use on steamships of all sizes.

MR. S. Z. MITCHELL, of Tacoma, Wash., states that the power plant of the Tacoma Industrial Company on White River and that of the Pierce County Imp't Co., on the Puyallup River, will both be operated in multiple for the service of the public on Puget Sound, making the largest and best constructed power plant in the world, outside of Niagara, and will be examples of the very latest and most up-to-date engineering methods. These two water power plants will also work in multiple with the steam plants of the Stone & Webster interests in Seattle and Tacoma, and will have an aggregate normal capacity of practically 50,000-hp. Both plants originated with Mr. Mitchell and are being handled by him.

MR. W. M. ANTHONY, of Chicago, auditor of the Chicago Edison Co., reoprter on office methods and accounting for the twenty-sixth convention of the National Electric Light Association, to be held in Chicago, May 26, 27, 28, has sent out a letter to members, asking for forms, etc., used by them in connection with meters, billing, ledgers, purchases, vouchers, classification of accounts, expenditures and general information as to any matters relating to this department of their business. From responses received, a very complete report is being compiled. The association has already done excellent work in helping central stations to systematize their accounts, the standard classification presented two years ago by a committee of which Mr. Anthony was a member having been widely adopted. His present work will cover a somewhat broader field and is sure to be welcomed by central station managers and accountants.

MR. R. H. PEIRCE, of the company of Peirce, Richardson & Neiler, Chicago, expects to leave Chicago on May 1 to take up his residence in Boston, where an office of the company will be maintained by him. An increasing clientage in the East and some personal interests of Mr. Peirce's in Boston induced the move. Mr. S. G. Neiler will remain in charge of the Chicago office. As has been the case for some time, Mr. R. E. Richardson has given practically all of his attention to the management of the Kansas City Electric Light Company, where a splendid showing has been made in the three years of his management. Messrs. Peirce and Neiler will therefore continue the company's extensive consulting engineering business; the former in Boston, the latter in Chicago. Mr. Peirce in going has the satisfaction of leaving the Chicago branch of the A. I. E. E. in thriving condition, for which he is largely responsible, because of the long years of adversity through which he maintained the office of local honorary secretary and kept the spark of interest alive which has now been fanned into a fire of enthusiasm among the Chicago members of the Institute.

MR. CHARLES A. LIEB, the well known electrical engineer and inventor of New York City, has invented and patented a guard for automobiles, which when struck in collision or by an outsider automatically shuts off the power, be it electricity, gasolene or steam, and puts on a band brake on the rear wheels. Mr. Lieb has been engaged in motor vehicle manufacture for several years, and has taken out several patents in connection therewith. It was Mr. Lieb's father, George Lieb, who was one of the builders of an automobile trotter, made in the form of a human pedestrian, to comply with the then existing laws prohibiting any but machine driven wagons of human form to be run in the streets of this city. Mr. Lieb's device consists of a guard or fender of bicycle tubing projecting in front of the automobile from a point on a line with the floor of the body, having its sides curving downward. The guard is kept up by a spring. When struck in collision or knocked down by a policeman's club or another's weapon, a crank arm is reversed. Rods connect into this crank arm with the motor and also with a band brake on the rear axle. The reversal of the crank shuts off power from the former and applies the latter.

MR. GEORGE E. FISHER has just returned to Detroit from New York, having completed arrangements with an Eastern syndicate to finance electric railway, lighting and gas properties, which he will undertake to organize, construct and operate. He will continue his office in the Majestic Building, and has already several large railway and gas propositions under consideration. Mr. Fisher was formerly president of the Chase Construction Company, and has had many years practical experience in building and equipping railroads and lighting plants. The construction company has built four of the seven interurban roads running out of Dayton, Ohio, and two of the Cleveland roads, as well as several electric railroads in Indiana and Pennsylvania, all of which are in successful operation. Mr. Fisher also secured the contract for the entire municipal lighting plant for the City of Grand Rapids. He is president of the Pontiac Standard Lighting Company, being a two-thirds owner of this plant, which has been lighting the City of Pontiac for a period of twelve years. During this time, the construction company has built and equipped some sixty central station lighting plants through Michigan, Ohio and Indiana. It is understood that Mr. Fisher's relations with the syndicate being formed by Jas. T. Lynn, who recently moved to New York, are very close, and it is probably through its office that the gas properties will be handled. This syndicate now controls gas and lighting plants in twenty-six cities.

OBITUARY.

MR. HENRY VAN BRUNT, a well-known architect, who designed the Electricity Building at the Chicago World's Fair of 1893, is dead. He was a native of Boston and a resident in Kansas City.

MR. W. W. CARD, second vice-president of the Westinghouse Air Brake Company was run down by a trolley car in Wilkinsburg, Pa., near his own home, on April 4, and was killed. He entered the service of the company in 1872 and became its secretary in 1879. He was connected with other important enterprises, and was a man of considerable wealth, which he used freely for public objects.

MR. JAMES W. BENNETT, Mayor of Lowell, Mass., in 1897, died in that city on April 14, after a lingering illness. He was a native of Newmarket, N. H., where he was born in 1833. He was for many years interested in the Erie Telephone Company, and served as its president. He was a director in the Wamesit National Bank. He served as a member and chairman of the Republican City Committee of Lowell, was a member of the City Council, Water Board, and then served two years in the lower branch of the Massachusetts Legislature.

MR. S. MORGAN SMITH.—We regret to note the death of Mr. S. Morgan Smith, of York, Pa., president of the S. Morgan Smith Company, at Los Angeles, Cal., aged sixty-five years. Mr. Smith was one of the largest manufacturers of water wheels in the United States. He went to Los Angeles two months ago for the benefit of his health. The industry which he developed was one of the best known in its field in this country and abroad, and large numbers of the wheels he built are to be found in modern hydroelectric plants for power generation and transmission.

EDUCATIONAL.

UNIVERSITY OF MISSOURI.—The class in geology and mining of the Missouri School of Mines and Metallurgy will make a summer excursion this year, in charge of Director Ladd, to the Black Hills, Butte and Anaconda and the Yellowstone Park. Similar excursions will in the future be a required part of the work of this institution. The new catalogue of this School announces that there will be made, during the spring and summer months, as a part of regular courses, excursions to the Joplin mining district for mine surveying; to the Gasconade River for field practice in lines of communication; to southeast Missouri for geological field work; and to Joplin, St. Louis, Herculaneum and the Flat River district for the study of mines and ore-dressing and metallurgical plants.

Trade Notes.

AMERICAN MICA COMPANY has moved its general offices to the factory at Newton Lower Falls, Mass.

EXHAUST HEADS.—The Baldwin Locomotive Works has sent to the Burt Mfg. Co., Akron, Ohio, its 16th order for exhaust heads, to be used in the works.

THE NATIONAL ELECTRICAL SUPPLY COMPANY, Washington, D. C., has issued a couple of bulletins illustrating and describing one style of its party-line telephone switchboard and the improved bulls-eye combination drop and jack.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has published a new telephone price list dated April, 1903. This price list contains a complete line of telephones and telephone parts, also construction material of every description. A copy will be sent upon application.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in bulletins 33 and 34, describe and illustrate electrical apparatus for motive power in machine shops and the use of electric power in the making of cement. The latter subject was covered in our issue of July 19, 1902, when the cement-making plant at Alsen, N. Y., was fully described and illustrated.

ELECTRO-THERAPEUTICAL APPARATUS.—The Des Moines Battery & Electric Company, Des Moines, Ia., has issued a pamphlet descriptive and illustrative of its electro-therapeutic apparatus and devices. It gives copies of a few indorsements received by it showing that its combination battery is giving the best of satisfaction to all users of the same.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for Gutmann alternating current wattmeters, is especially enthusiastic just now over the large sales of its glass-case meter. It is neat in appearance, light in weight and small, and its superior workmanship guarantees maintenance of accuracy and of service. It will send its new wattmeter catalogue to any one interested.

THE WHEELER REFLECTOR CO., 156 Pearl St., Boston, reports business as increasing in the various lines of reflectors which it manufactures. It was compelled by steadily growing demands to remove from its old location at 100 Purchase St. In the new quarters it has every facility for taking care of all orders. The business this year shows an increase of 50 per cent. over that of last year.

THE PRESIDENT'S TELEPHONE.—A letter has been received at the office of the Stromberg-Carlson Telephone Manufacturing Company in acknowledgment of receipt of a gold paper weight, which was a reduced model of the Stromberg-Carlson receiver, mounted on a base. A small silver plate bearing the words "To the President" fastened to the base completed an attractive ornament, which was presented to the President April 2nd, as a souvenir of his visit to Chicago.

UNITED TELPHERAGE COMPANY, of 20 Broad Street, New York City, has issued a very interesting bulletin in Circular No. 22, showing and describing the equipment of a dock freight shed with the electric telpher system. A speed of 1,000 to 1,500 feet per minute can be made, and the telpher can be raised clear of the floor in travel. The truck for freight is ten feet long. One telpher and three trucks will elevate, convey, lower and return faster than ten men can load and unload with drays.

PRIZES FOR MECHANICS.—Men who use or employ chain blocks will be interested in the offer of the Yale & Towne Mfg. Co., of prizes for information from mechanics concerning triplex chain blocks. This contest is open to all. Practical statements are the only thing required, and not fine writing. There is no question that scientific chain blocks are as much a benefit to the man behind the chain as to the one behind the bills; and any enlightenment on this subject is bound to be eventually profitable to both. Employers ought to call the attention of their foremen and mechanics to this offer.

STILWELL-BIERCE-SMITH-VAILE CO. has recently opened an office at San Francisco at 11 and 13 First Street. The pumping machinery and air compressor departments will be looked after by Mr. Geo. W. Ingils, formerly with the Worthington and other pump interests. The water wheel department will be in the care of Mr. Edward G. De Wald, one of the company's assistant engineers, who has hitherto traveled from the Dayton headquarters and had made several successful trips to California in regard to large turbine equipments for high heads.

HUNTER ADVERTISING SIGN.—The Hunter Electric Advertising Sign Company, of Cincinnati, recently incorporated, has a capital stock of $20,000, all of which has been subscribed. The concern is as yet manufacturing only in a small way. Its plant will be located at 118 East Front Street, and its offices 304 Commercial Tribune Building. The company has control of a new device for the display of advertising on a movable curtain or screen, with various electric lights behind it. George B. Roley is president; Samuel Cohn, vice-president; J. C. McWilliams, treasurer, and John F. Ankenbauer, secretary.

THE ST. JOSEPH BOAT MANUFACTURING COMPANY, of St. Joseph, Mich., announces that it has developed an unusually attractive line of electric and vapor launches, combining to a very high degree of perfection the desirable features of speed, comfort and economy in operation. The company has under construction a large twin screw excursion steamer, embodying a very unique design for shallow draft, to ply the St. Joseph River. This company builds all kinds of ocean, lake and river going craft. Mr. Ernest F. Smith, vice-president and general manager of the company, announces contracts for craft to the limit of the company's productive capacity for some months ahead.

MACHINE AND FAN SPEED CONTROLLERS.—A bulletin has been issued by the Ward-Leonard Electric Company, of Bronxville, N. Y., covering its latest "open" types of machine and fan speed controllers. The resistance part of these controllers is stated to be non-corrosive, moisture proof and non-abrasive, as well as possessing the feature that the turns of the coils cannot become short circuited. There is therefore no fire risk. Considering the special automatic features, shown in this bulletin, in connection with the properties of the resistance itself, it would seem that every essential requirement for machine or fan speed control is embodied in these types of controllers.

A REMARKABLE TRAFFIC RECORD. On Tuesday, February 3rd, the New York Central handled a total of 25,982 cars. This exceeded by 500 the maximum number of cars ever moved in one day. This record, however, was again broken on Tuesday, February 10th. For the twenty-four hours ending 11.59 P. M. on this date the New York Central moved 16,605 loaded cars and 9,480 empties, a total of 26,085, which is the largest number of cars ever handled in one day on this line. On the same date the Lake Shore Railway handled 10,915 loaded cars and 3,316 empties, a total movement of 14,231 cars; or a total on both lines of 40,316 cars. This exceeds all previous records in the handling of cars on these lines.

A RAILROAD NUMBER.—The April issue of *The Booklovers Magazine* is largely a railroad number. An article on "The Men Behind the Railroads," by E. J. Edwards ("Holland") gives an excellent and authoritative account of the course of railroad consolidation from 1896 to the present. His discussion of the personalities behind the movement is illustrated by admirable portraits in tint of A. J. Cassatt, William K. Vanderbilt, George J. Gould and James J. Hill. Mr. Henry Lloyd contributes a lively and pointed article on the discussion of railroad consolidation from a radical point of view, while Mr. H. T. Newcomb, of the *Railway World*, shows the benefits this movement has brought to the small investor.

SPRAGUE BOWLERS.—Some fifteen or twenty representatives of the different departments in the general office of the Sprague Electric Company, New York City, have inaugurated a bowling club, which met for the first time on Thursday night, April 2nd. A number of the men proved to be first-class bowlers, and a very enjoyable evening was spent by all present. Mr. Tretheway, of the engineering department, was captain of one team and made the highest score, bowling 202 in the second game. Mr. Taylor, of the treasurer's department, was captain of the other side and made the second highest score, 183. After the bowling supper was served, which was followed by vocal and instrumental music by the members.

"HOW TO PACK GAS ENGINE CYLINDER HEADS," is an interesting leaflet, giving full directions for cutting gaskets, preparing the flange and applying the gasket, so that the most efficient service may be obtained. The difficulty of packing cylinder heads of gas engines for stationary, launch or motor service has been one of the discouraging features in the use of these engines. The methods described in the leaflet have been proved by years of experiment to be successful in avoiding the difficulties and securing the best results. Anyone interested can secure a copy of the leaflet from the H. W. Johns-Manville Co., 100 William St., New York, or from its branch offices in Milwaukee, St. Louis, Chicago, Pittsburg, Cleveland, New Orleans, Boston, Philadelphia and London.

SOCKET AND CLUSTER FINISHES.—Harvey Hubbell, Bridgeport, Conn., has just issued a large sample card of the special finishes he is introducing for sockets and clusters. The card shows in full size, half section, nine of the finishes applied to socket shells, and enumerates no fewer than eleven others in which the goods can be obtained. The various shades of brass, gold and silver, of bronze, copper and wrought iron, are most beautifully brought out in these handsome goods, and Mr. Hubbell will inevitably derive a rich reward for his enterprise and taste, while the influence exerted on the art in general must be excellent. We recommend all our readers interested in any way in lighting fixtures to get one of these sample cards. They will then order the goods.

THE NEW YORK & OHIO COMPANY, Warren, O., which recently placed a line of insulating cloths and varnishes on the market is issuing sample books showing about a dozen specimens of various grades of insulating cloth and paper. Among these it calls special attention to its "soft finish" muslin. Instead of using a preliminary coating or filling of starch to lay the nap, as is customary, the nap of this particular cloth is singed or burned off. Since nothing but pure varnish is used, the result is a perfectly flexible cloth, and one which cannot lose its insulating qualities through deterioration. The entire line of cloths and varnishes is the direct result of the company's own experience in seeking the very best materials obtainable for use in Packard high potential transformers. It goes without saying, that the high standard implied in the name Packard will be fully maintained.

MAST ARMS, ETC.—The name of T. H. Brady, of New Britain, Conn., has been associated with the development of outside construction and fixtures for electric light lines almost since the beginning of the art of electric lighting, and the fact that he is still at the old stand and doing more business than ever is proof that his products are of the best and standard quality. In a neat catalogue of 64 pages, just issued, Mr. Brady illustrates his line of electrical specialties, including mast-arms, fuse and cut-out boxes, knife switches, hanger boards, storm protectors, lamp holders, storm-proof pulleys, hoods, brackets, etc. Accompanying each illustration is a brief description of the features of the device so shown, together with the prices of the different styles, sizes, etc. Mr. Brady's business was established in 1879, and has kept pace with the development of electric lighting. By keeping close tab on the requirements of the art, and indeed anticipating its wants, Mr. Brady has succeeded in building up a large trade in his special line. He will be glad to send a copy of his latest catalogue to anyone interested.

W. E. FAN MOTORS. The Western Electric Company's Catalogue of 1903 fan motors, just issued, bears evidence of having quite as much pains and thought bestowed upon its production as are given to the manufacture of its motors. Like the fans, each year's catalogue is an improvement on its predecessors. This year's catalogue cover is a work of art, the design representing relief work, with high lights and deep shadows, on a mottled background. A handsome illustration of a desk fan occupies the centre, and is so realistic that it is comforting to look at. On the inside of the front cover two fine half tone views of the company's Chicago factories are given. The contents of the catalogue are no less artistic. There are shown desk fans, bracket fans, ceiling fans, ventilating fans, etc. These fans are in the direct-current and alternating current types and of many styles and finish. The principal constructional features, current consumption, voltage, and other information are given for the benefit of the trade, and there is a complete code for facilitating ordering by telegraph. On the back cover are given front and rear views of the company's New York factory.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 7, 1903

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

724.451. SIGNALING APPARATUS, Francis W. Dunbar and William W. Dean, of Chicago, Ill. App. filed Dec. 26, 1900. (See page 657.)

724.478. SWITCH MECHANISM FOR TELEPHONE TRANSMITTERS; Charles Holmok, of Cleveland, Ohio. App filed April 30, 1902. (See page 657.)

724.484. FIELD MAGNET CORE; Charles R. Meston and Thomas M. Meston, St Louis, Mo. App. filed June 14, 1902. A field magnet core composed of laminations in which less metal is presented at the polar face by some of the laminations than by others.

724.498. ELECTRICAL MOTOR FOR CEILING FANS, Walter F. Phelps, Dayton, Ohio. App. filed Feb. 2, 1903. The resistance devices are mounted upon a stationary part of the motor below the moving part thereof.

724.507. ELECTRICAL PROTECTOR, Charles A. Rolte, Chicago, Ill. App. filed June 6, 1900. (See page 657.)

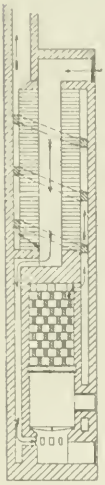
724.544. ELECTRIC BRUSH HOLDER; Niels A. Christensen, Milwaukee, Wis. App. filed May 16, 1900. Relates to the means for adjusting the force with which the brushes are held against the commutator and to other details.

724.572. THERMO ELECTRIC BATTERY; Benjamin J. Hall, Barnes, England. App. filed July 10, 1902. The improvement consists in so arranging the parts in conjunction with a suitable furnace as to form a cold air inlet channel on one side of the furnace and a hot air outlet channel on the other side.

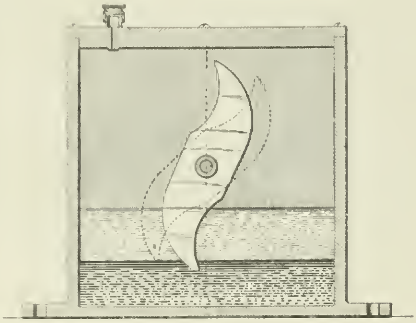
724,580. ELECTROLYTIC CELL, Rudolph Johanns, Brooklyn, N. Y. App. filed Dec. 11, 1902. An inverted trough is arranged above the cathode and a conduit extends from it to a point beyond the limiting surface of the electrolyte, for the purpose of uniformly distributing the incoming brine. (See page 656.)

724.594. TELEPHONE SYSTEM; John H. Mason, Philadelphia, Pa. App. filed April 12, 1902. (See page 657.)

724,611. CONTROLLING DEVICE FOR ELECTRIC MOTORS; William B. Potter, Schenectady, N. Y. App. filed Aug. 13, 1898. A lost-motion connection between the handle of the switch and the circuit changing devices together with means for causing said devices to follow the motion of the handle at a uniform rate irrespective of the speed with which the motorman may operate the latter.



724.572.—Thermo Electric Battery.



724.704. Circuit Breaker.

724,613. LOW WATER ALARM FOR STEAM BOILERS; Stephen H. Ralph, Marion, Ind. App. filed July 31, 1901. Details.

724,619. ELECTRIC ACCUMULATOR; Albert Schmidt-Predari, Weimar, Germany. App. filed July 24, 1902. A lead plate and a magma for the negative pole electrode, composed of a mixture of lead oxide, red lead, calcium hydroxide, alkali thiosulphate and a suitable binding material.

724,627. SYSTEM FOR THE ELECTRICAL PROPULSION OF CARRIERS; Abram D. Swegle, Fayette, Mo. App. filed July 18, 1902. A switch supported by the carrier and adapted to be automatically controlled to affect a circuit including the motor and a magnetic brake.

724,628. TELEGRAPH KEY; Edwin T. Thorpe, Dickerson Run, Pa. App. filed Dec. 12, 1902. An auxiliary spring-supported button is placed above the key to afford a yielding action.

724,645. MEANS FOR PREVENTING FLUCTUATIONS IN ROTARY MOTORS; James J. Wood, Fort Wayne, Ind. App. filed May 31, 1900. The fly-wheel is connected to the shaft through a spring to compensate for fluctuations.

724,662. CONTROLLING DEVICE FOR ELEVATORS; Albert H. Buckelew, Newark, N. J. App. filed Nov. 17, 1897. A push button system with which anyone can operate the elevator and including certain safety devices.

724.704. CIRCUIT BREAKER; Samuel T. Hutton, Chicago, Ill. App. filed March 15, 1902. A shaft carrying a rotating arm is mounted in the wall of a box containing mercury, the rotation of the shaft brings the arm intermittently into contact with the mercury.

724.705. ORE SEPARATOR, Hans G. Johnson and Monroe S. Howard, Waukon, Iowa. App. filed Sept. 5, 1902. Details.

724.721. ELECTRIC TOOL HOLDER; Max Loewenthal, New York, N. Y. App. filed July 24, 1902. When the tool is applied to the holder, a heating circuit is automatically closed.

724.722. ELECTRICAL CONTROLLING SYSTEM FOR ELEVATORS; Cyprien O. Mailloux, New York, N. Y. App. filed July 23, 1896. A simplification of the invention described in patents 536,730 and 543,495.

724.724. PRESSURE GAGE FOR STEAM BOILERS OR THE LIKE; Frederick Mitchell, Redcastle, Victoria, Australia. App. filed May 22, 1902. An adjustable contact is arranged so as to close a circuit when struck by the index of the gauge.

724.730. CUT OUT SWITCH FOR ELECTRIC LIGHTING OR OTHER CIRCUITS; Geo. W. Nistle, Chicago, Ill. App. filed April 28, 1902. Details of a switch in which contacts are arranged on both sides of the pivot of the lever in such a manner that the circuit on one side is closed before the other is opened.

724.762. THIRD RAIL ELECTRIC RAILWAY SYSTEM; Wm. G. Wagenhals, Cincinnati, Ohio. App. filed Jan. 28, 1903. An arrangement for mounting an inverted third rail.

724.778. ELECTRICAL SMELTING APPARATUS; Robert L. Barnhart, Charleroi, Pa. App. filed May 14, 1902. The minerals are suitably fluxed and made into the form of paste, which is then formed into rods; these are used as electrodes between which an arc is formed to smelt the mineral.

724,827. ELECTRIC MOTOR; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 15, 1903. Instead of starting a motor by means of the usual rheostat, the relative speed of rotation of the field and armature is controlled.

724,842. VOLTMETER FOR THE ELECTROLYSIS OF WATER; Pompeo Garuti and Riccardo Pompili, Tivoli, Italy. App. filed April 11, 1902. An improvement on patent 629,070, relating chiefly to a modified form of the metallic diaphragm used therein. (See page 656.)

724,848. INSULATOR; Ferdinand W. Gregory, New York, N. Y. App. filed Aug. 9, 1902. A knob insulator having a flat side containing a straight groove in which the wire is held.

724,853. SOLDERING IRON; Charles R. Gutner, Brooklyn, N. Y. App. filed Aug. 13, 1902. Details.

724,856. SECONDARY BATTERY ELECTRODE; Josef Hahmann, Berlin, Germany. App. filed July 19, 1902. Details.

724,860. ATTACHMENT FOR OVERHEAD ELECTRIC CARRIERS; Henry M. Harding, New York, N. Y. App. filed April 21, 1902. The conductors are housed in a slotted conduit to prevent sparks from falling therefrom.

724,862. CATHODE; Charles J. Henry, Perth Amboy, N. J. App. filed Aug. 6, 1902. A frame used as a cathode in the production of metallic sheets by electrodeposition, arranged so that the sheets can be readily stripped from the cathode. (See page 656.)

724,917. AUTOMATIC AUDIBLE FIRE ALARM TRANSMITTER AND SIGNAL; John H. Munchausen, Brooklyn, N. Y. App. filed Feb. 25, 1902. Details.

724,927. TROLLEY; Charles A. Olsen, Pittsburg, Pa. App. filed Dec. 24, 1902. The trolley arm has a knuckle joint enabling it to open and close as the elevation of the wire changes.

724,928. ELECTRIC CONTROLLER; Carl T. J. Oppermann, London, England. App. filed Feb. 18, 1903. An arrangement whereby four different speeds forward and one backward are obtained with the fewest number of contact pieces.

724,948. VENTILATOR FOR ELECTRIC MOTORS FOR CARS; Horace B. Rowland, Philadelphia, Pa. App. filed March 25, 1902. This patent and those which follow in the same name relate to the collection of air by a funnel and conducting the same to a casing surrounding the motor for cooling the latter.

724,949. VENTILATING DEVICE FOR ELECTRIC MOTORS FOR CARS; Horace B. Rowland, Philadelphia, Pa. App. filed April 19, 1902. See preceding patent.

724,950. VENTILATOR FOR MOTORS FOR CARS; Horace B. Rowland, Philadelphia, Pa. App. filed May 13, 1902. See 724,948.

724,951. AUTOMATIC ELECTRIC ELEVATOR; Harold Rowntree, Chicago, Ill. App. filed June 28, 1901. The system includes among other things two motors one of slow speed and the other of high speed and means for transferring the load from one to the other.

725,001. INDICATING AND CONTROLLING APPARATUS; Cyprien O. Mailloux, New York, N. Y. App. filed July 23, 1890. (See Current News and Notes.)

725,006. FUSE BLOCK; John B. Morgan, Youngstown, Ohio. App. filed Aug. 7, 1902. Details.

725,010. AUTOMATIC CIRCUIT OPENER OR CLOSER FOR ELECTRIC BELLS, ETC.; Carl C. Rasmussen, Harlan, and Hans P. Rasmussen, Callender, Iowa. App. filed Sept. 26, 1902. A rotary circuit closer is arranged in connection with a belt and driven thereby; centrifugal force keeps its terminals apart until the belt stops, when the terminals collide and send a signal.

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ELECTRICAL WORLD AND ENGINEER.

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CONTENTS.

Editorial 681
The John Fritz Medal 684
A. I. E. E. Philadelphia Meeting 684
Magnetic Club Dinner to Col. Clowry 684
Telephone Exchanges—I. By Arthur V. Abbott, C. E. 685
Telephone Development in the Philippines 688
Telephone Service in New York Hotels 689
Corrosion by Electrolysis 690
Meeting of the Chicago Electrical Association on Overhead Distribution .. 691
New Telephone Patents 692
An Electric Moving Platform Between New York and Brooklyn 692
The Daft and Williams' System of Electrical Prospecting for Mineral Ores. 693
General Meeting of the American Electrochemical Society 694
Lecture of Mr. W. J. Hammer 698
Current News and Notes 699
Digest of Current Electrical Literature 701
Cascade Water, Power & Light Co., Cascade, B. C., Canada. By W. G. McConnon 705
Development in Telephone Switchboard Equipment at Bloomington, Ill.... 706
Alternating Current Long Scale Voltmeter and Ammeter 708
Power Transmission in Connecticut 708
Core Type Transformers 709
Automatic Motor Starter 710
Tap and Reamer 710
Financial Intelligence 711
Commercial Intelligence 712
General Specifications for the Construction of Telephone Aerial Lines.... 713
News of the Week 731

Meeting of the American Electrochemical Society.

The meeting in New York last week of the American Electrochemical Society scored another success for this vigorous young body, not only with respect to the proceedings proper, but also through the admirable manner in which the social and other features added to the programme for this meeting were carried out. Credit for the latter is largely due to the local committee, which, under the enthusiastic leadership of Dr. Doremus and Mr. Von Isakovics, made a record that will tax to the utmost those in charge of local arrangements for future meetings to maintain. The banquet on Thursday evening, at which Dr. Nernst was guest of honor, and the lectures by Mr. Hammer and Dr. Recklinghausen on the two following evenings, were fitting daily finales to morning programmes of papers and afternoon excursions. The holding of a joint evening meeting with the American Institute of Electrical Engineers doubtless recalled to many with regret the failure of the effort to make definite arrangements for joint annual general meetings of two bodies so closely allied in their objects and overlapping so considerably in membership.

The lecture by Mr. Hammer was highly interesting from the great amount of new information it conveyed relating to most timely subjects, combined with numerous and brilliant illustrative experiments. In the course of his lecture Mr. Hammer brought out the fact that certain experiments of a German savant which have been widely published and which contradicted the accepted view that radium does not lose appreciable weight while giving forth radiant energy, were based upon experiments involving errors that invalidated the contradictory conclusions put forth. Mr. Hammer also made the important announcement that he had succeeded in reversing the Röntgen ray cycle, producing within a Crookes tube a cathode stream by bombarding the exterior with Röntgen rays, a process which he demonstrated experimentally before the audience.

Of the score or more papers read before the society, a considerable portion were of an academic character, and few of these having been printed in advance, discussion was either lacking or aimless in character. Those that dealt with controversial points, or related to experiments giving results apparently at variance with, or calling for extensions of, accepted theory, might with greater profit have been contributed to periodical publications, thereby attracting to subsequent issues the comment and criticism to which new or radical views should be subjected. Should papers of this class continue to be accepted without an explicit proviso that they shall be in type some days in advance of a meeting, members well qualified in the branch to which the subjects relate should be solicited to contribute communications to be printed with the papers in the *Transactions.* Otherwise the printed proceedings of the society will continue to be sprinkled with conundrums and "catch questions," with the answer aggravatingly absent.

About half of the papers read were on practical subjects, notably a paper by Profs. Burgess and Hambüchen, on the electrolytic production of metallic compounds, and one by Mr. Titus Ulke on modern electrolytic copper refining. Dr. Recklinghausen in a paper directed the attention of electrochemists to the subject of insulating materials, discussing the properties of those now in use and pointing out the direction in which improvements may be made. Different aspects of electrodeposition were treated by Messrs. Zimmerman, Keith, Johnson and Mailloux, the latter referring to some experiments he made which showed the practicability of a current density as high as 500 amperes per square foot. Mr. Carl Hering set forth the desirability of uniformity with respect to electrochemcial equivalents, and while not denying this, Prof. Bancroft pointed out the difficulty in the way due to conflicting values. Prof. Bancroft in a paper gave a useful classification of metals with respect to hydrogen, on the basis of the order in which deposition of the latter begins at different metals in aqueous solutions. Finally, mention should not be omitted of the generous gift by Mr. A. B. Freznel of a prize of $250 to the best paper read before the society on the subject of the practical treatment of certain rare metals. Mr. Freznel stated that great deposits of such metals exist in Arizona and neighboring sections, and the development of the fields only await the discovery of practical processes for the working of the minerals, which processes are most apt to come within the scope of research of the electrochemist.

Electrolytic Conduction Without Electrodes.

A paper of this title was read by Mr. A. B. Marvin at the meeting of the American Electrochemical Society last week. There is still much doubt in the minds of electricians as to the behavior of electrolytes in a circuit devoid of any extraneous electromotive force. It is universally admitted that an electrolyte will offer a conducting path to a current generated by an external electric source, such as a dynamo. But when the question is asked as to what happens in case the circuit were wholly electrolytic, and the conductors on the dynamo were glass tubes containing electrolytes, the answer is not so universally rendered. If the electronic theory be admitted, and if it is taken for granted that electricity is conducted wholly by the motion of electrons, either step-by-step between neighboring virtually stationary molecules in metallic wires, or by porterage on the back of moving ions in liquids, then there is no essential difference between the two classes of conductors, and a circuit composed wholly of an electrolyte —that is, a liquid circuit—should conduct to all intents and purposes exactly like a circuit composed wholly of copper wire, except in so far as the difference in conductivity might influence the strength of the current. Some experiments have been conducted and described by J. J. Thomson on the comparative conduction of electrodeless electrolytic tubes, and of electrodeless partial vacuum tubes. These experiments seem to show that both electrolytes and gases possess a definite conductivity, in the absence of electrodes. Moreover, it would appear that the best conductivity of electrodeless electrolytes is of the same order of magnitude as the conductivity of electrodeless gases, and both are extremely small by comparison with the conductivity of such metals as silver and copper.

The paper of Mr. Marvin describes certain experiments conducted with the view of putting the conductance of purely electrolytic circuits to the proof. A little unipolar dynamo was constructed, in which the rotating armature conductors were of electrolyte. There were difficulties in making this dynamo deliver a decided e.m.f., owing to centrifugal forces. The detecting galvanometer consisted of a solenoid of glass tube filled with electrolyte. The low speed of available rotation of the electrolyte dynamo armature, and the high resistance of the electrolyte circuit prevented satisfactory indications from being directly obtained. Successful results were, however, obtained by employing an alternating-current transformer with an ordinary copper wire primary winding and a single-turn secondary winding, consisting of an insulating trough filled with electrolyte. This was carried out to a small induction-coil at some distance, through electrolyte tubes, the primary winding of the induction coil being also an electrolyte tube. The secondary winding of the induction coil was of copper wire insulated in the ordinary way, and connected to a telephone. Opening and closing the electrolyte circuit, by the insertion and withdrawal of rubber stoppers in the tubes leading from the trough, was accompanied by clear indications of the cessation and passage of alternating current in the telephone.

While the experiment, if accurately performed and described, seems conclusive as to the passage of currents in wholly electrolytic circuits, yet any other result and conclusion would appear extraordinary. There can be no doubt, from experimental observation, that a moving magnetic field develops an e.m.f. in any region, whether the region contain an insulator or a conductor, and whether the contents of the region are solid, liquid, or gaseous. Consequently, when a moving magnetic field cuts a column of electrolyte contained in a glass tube, the column is subjected to electromotive force and electrostatic stress, in a manner which, at any point not in the immediate vicinity of the ends, must be equivalent to that produced by connecting the liquid column with electrodes connected to a corresponding electric difference of potential. Consequently, it is only reasonable to expect that if conduction took place through the mass of the column in the one case, it would do so through the other. Nevertheless, the experimental demonstration is well worth having.

Very Brief Electrical Contacts.

The last number of *The Physical Review* contains an abstract of a paper read by Mr. H. C. Parker at the December meeting of the Physical Society, on some experiments concerning very brief electrical contacts. The principle of these experiments is comparatively old, similar experiments having been reported by R. Sabine about twenty years ago; but the details of the experiments here described have especial interest. A gravity key was arranged so as to provide means for making contacts of duration varying between one-tenth of a second, and ten micro-seconds. A condenser was charged through the contact in circuit with a known resistance. The charge which accumulates in the condenser under such circumstances varies with the resistance and the time of contact. By comparing the charge with that obtained from the same e.m.f. in a steady prolonged charge, the time of contact is deducible.

Similar experiments are described using a steel ball suspended by a wire, and allowed to impinge upon a steel anvil. The period of contact between the ball and anvil is known to be exceedingly brief. It varies with the size of the ball, the modulus of elasticity of the metals, and the velocity of impact. In the experiments described, it varied between 79 and 390 microseconds. The period of contact between a steel hammer falling upon a steel anvil is of the same order of magnitude. It is possible to make short-circuits through the brief contact between an anvil and a rebounding hammer, which will give rise to but little rush of current when an appreciable amount of inductance is included in the circuit. For example, a small fuse in the circuit of such a hammer-and-anvil short-circuit can be arranged to withstand the application of a considerable e.m.f. without being melted, owing to the brief duration of the short-circuit and the repressing influence of a choking coil in the path.

Resonance in Electric Circuits.

The oscillograph is a most useful piece of apparatus in the hands of the electrical engineer and of the electrical investigator. It has proved of great industrial value in particular cases of troubles in electric circuits, where very sudden rises of pressure or current were apt to take place from unknown causes, and where oscillograms gave information as definite to the electrical engineer, as an indicator diagram may give to a steam engineer—in fact, more so since they record continuously instantaneous values. The Duddell oscillograph has been employed by Mr. M. B. Field to investigate some relatively feeble resonance phenomena observed in the Glasgow central station, and described in a recent paper before the British Institution of Electrical Engineers. A number of oscillograms taken under practical conditions appear in the paper. The three-phase generators supplying the system are of 2,500-kw capacity, and supply alternating currents at a normal pressure of 6,500 volts and 25 cycles per second. The waves of e.m.f. were substantially sinusoidal with a ripple of twelve times the frequency, and of appreciable amplitude, superposed. This harmonic was due to the armature teeth, there being 12 teeth per wave in the armature winding. This represented a superposed frequency of 300 cycles per second, although a closer analysis of the wave form indicated that the disturbance was more nearly a combination of the odd harmonics, eleventh and thirteenth, rather than of the even twelfth harmonic.

By appropriate connections and instruments these harmonics could be detected not only in the alternating currents supplied to the high-pressure distributing system, but also in the direct currents fed by the converters operating on, and driven by, the system. By driving one converter independently as a generator, as well as a second one from the alternating-current system, and bringing their direct-current terminals into opposition through an alternating-current voltmeter and direct-current voltmeter in parallel, the former indicated 12 volts when the latter indicated zero. That is to say, when the rippling direct-current pressure of the converter was adjusted into equality and opposition with a direct-current pressure of some 500 volts generated by a dynamo, the direct-current voltmeter between them was brought to zero, since the ripples would not indicate; whereas the alternating current voltmeter would measure the ripples and indicate their effective values. None of the experiments described showed any very marked resonance in the system due to the 300-cycle frequency, but many of the results obtained are both interesting and instructive.

ELECTROLYTIC CORROSION.

We have heard so much of electrolysis in the last few years that the subject of Mr. Knudson's paper was not particularly appealing, but on inspection it has proved to be somewhat out of the ordinary. The usual course of an electrolysis story is alleged to be about as follows: New city administration comes in and boss of water works finds it necessary to do some extra digging; finds pipes rusty and writes to the newspapers, also to the trolley company that didn't come down with the stuff during the campaign; boss gets letter from expert looking for a job; mayor and boss get him to help soak the trolley company; expert with many instruments arrives and finds volts thicker than Croton bugs in a Harlem flat; suit started against trolley company with injunctions on the side; smooth gentleman with patent bonds and things blows around to see the trolley company; trolley company's attorney sees mayor and presents smooth gentleman; long fight before facetious aldermen on the subject; expert endorses smooth gentleman's plan for avoiding further trouble; road closes contract; sees treasurer of campaign club; smooth gentleman and expert retire to corner and divide; everybody happy except the trolley company. We are far from disbelieving in electrolysis or holding remedies up to scorn, yet we feel that there is much misunderstanding on the subject, which Mr. Knudson's paper will materially help to clear up. We particularly note the excellent examples he gives of cases of dangerous corrosion in which no stray current was involved, but which arose from the presence in an electrolyte of dissimilar contiguous metals. This is a subject which deserves a thorough investigation experimentally, and we have no doubt that plenty of trouble will be found which does not arise from wandering trolley currents.

As a matter of experience it is rather difficult to find two samples of metal which will not show electrolytic effects under favorable circumstances. For instance, it has been found extremely difficult to avoid severe corrosion in the cases for submarine mines even when very nearly identical material is used throughout. Local action freely occurs even between steel bolts and sheet steel in such cases, and we have no doubt that an ordinary water pipe and a steel rail side by side in the moist earth of a city street will display electrolytic action quite irrespective of earth currents. On the other hand, even in localities admittedly dangerous electrolysis may produce very little real damage owing to the character of the soil. Given the specimens and the circumstances and it is often very easy to tell definitely the existence and cause of damage; but it is very difficult to predict either the conditions or the probable damage, to say nothing of the effect likely to be produced by proper remedies. Broadly, the better the rail return in a tramway system the less likely is severe electrolytic action, and in so far improving that return is a good thing, as from every other point of view, but Mr. Knudson is probably right in saying that any kind of rail return is liable to make trouble. There is no dodging Ohm's law, and rails laid with moist earth and water pipes beneath them will infallibly share their current with their neighbors. Moist earth has low specific conductivity, but a long stretch of it between a 90-lb. rail and a 2-ft. water main is in the aggregate a pretty good conductor, and once in the main the current will somewhere leave it with the usual parting kick. The real practical damage depends chiefly on the amount of concentration in the action. General corrosion may go on for years without causing serious trouble, while if localized it may ruin a pipe in a few weeks or months.

In and about New York the question of bridges becomes serious in its tendency to localize electrolysis. While it seems probable that no serious effect is to be expected on the bridges themselves, if reasonable care is exercised, the concentration of stray current is very marked and may be the source of considerable trouble. A careful watch with frequent tests should be kept for such effects, and a few years will locate the dangerous areas and enable local remedies to be applied. It is hard to say what is the probable value of local treatment, but it certainly has some importance and should be employed wherever there seems to be prospect of good results. One of the topics which Mr. Knudson might have taken up with advantage is the possible effect of electrolysis in steel buildings. In these days steel is used in enormous amounts underground as well as above ground in such structures, and we have as yet very little knowledge as to whether electrolysis is at work or not. Both lighting and railway currents may conceivably be at work in such cases, and it is some importance to find out the results. Even a small current steadily at work for a few years may do a great deal of mischief before it is discovered. Damage to buildings is particularly difficult to detect on account of its situation, and while it may be practically of very little moment it is well worth looking for. Possibly during the rebuilding of some of the earlier steel structures which is likely to occur as ground space gains in value, some very useful information may be gained. Where, as sometimes happens in exposed spots, returning railway currents rise to considerable magnitude, local damage may be severe at points least expected, for no man can say just where the wandering currents flow. Electric currents can hardly be forbade the earth at present, but they will bear constant watching. In any event, constant alertness is required in dealing with the electrolysis problem, and electrical surveys properly conducted are necessary to a proper control of the conditions. The difference of potential method used alone is, however, open to grave objection, and in cases is likely to lead to erroneous conclusions, as pointed out in the discussion of Mr. Knudson's paper.

The John Fritz Medal.

At Albany, N. Y., on April 18 articles of incorporation of the John Fritz Medal Fund Corporation were filed with the Secretary of State. It is formed to collect and hold funds for a permanent investment, the proceeds of which will be used in the purchase of the gold medal to be known as the John Fritz medal, to be awarded annually to the person who shall be selected as having made the most notable scientific or industrial achievement during the period since the last award.

The medal is named to perpetuate the memory of John Fritz, of Bethlehem, Pa., and the Board of Award is made up of members of the Americain Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The directors of the corporation are J. J. R. Croes, Alfred Noble, C. W. Hunt, E. E. Olcott, E. G. Spilsbury, James Douglas and C. Kirchhoff, of New York City; Robert Moore, of St. Louis; Gaetano Lanza, of Boston; John E. Sweet, of Syracuse; Robert W. Hunt, of Chicago; S. T. Wellman, of Cleveland; Arthur E. Kennelly, of Cambridge, Mass.; Carl Hering, of Philadelphia; Charles P. Steinmetz, of Schenectady, and Charles F. Scott, of Pittsburg.

The establishment of the medal was signalized last year by a banquet to celebrate the eightieth birthday of Mr. Fritz, and the fund contributed by about 480 subscribers represents a balance of about $4,000, the proceeds of which will be ample to provide the medal, the dies and designs of which are already familiar to the technical public.

A. I. E. E. Philadelphia Meeting.

The second meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held Monday, April 6, at the Engineers' Club of Philadelphia.

Mr. Carl Hering, the chairman, made a short opening address, and, after necessary business was transacted, Mr. Hewitt presented Mr. F. O. Blackwell's paper on the "Testing of Insulators" and Mr. Ralph D. Mershon's paper on "Mechanical Specifications for a Proposed Standard Insulator Pin." Mr. P. M. Lincoln, of Pittsburg, presented and discussed a paper by himself on "Transposition and Relative Location of Power and Telephone Wires."

Mr. H. H. Barnes, of Pittsfield, Mass., presented a paper on the "Burning of Wooden Pins on High-Tension Transmission Lines," read in New York by Mr. C. C. Chesney.

Mr. W. L. Hodges, the chief engineer of the Keystone Telephone Company, gave a brief résumé of the New York discussion of Mr. Lincoln's paper. Mr. Hodges disagreed with Mr. Gerry's statement that the ordinary telephone lightning arrester was an undesirable and unsafe piece of apparatus for properly taking care of telephone circuits. Mr. Hodges stated that he had had considerable experience with different types of arresters and found some that answered admirably. He stated that it must not be expected that an *ordinary* lightning arrester should be sufficient in *extraordinary* cases.

Mr. Hodges discussed the various difficulties liable to arise where telephone and high-tension circuits are run on the same poles, and came to the general conclusions that, in order to get the best transmission and safety combined,

First: Both power and telephone lines should be properly transposed. And this transposing is not altogether as simple a matter as it is generally supposed, as it would be possible to arrange the transpositioning so that the power and telephone wires would neutralize each other.

Second: The insulation of the telephone lines should be high, and, of course, the line should be strongly constructed.

Third: At each telephone station, the instrument circuit should be connected to the secondary of a transformer.

This transformer should have a high-resistance primary with a great number of turns, and the insulation between the primary and secondary should be high.

The middle point of the primary should be connected to ground through a retardation or choke coil. In each side of the telephone line circuit, at each station, there should be a so-called "lightning gap" arranged; designed so as to discharge when the potential of the telephone wires should approximate that which would break down the insulation of the line.

In the connection to ground of this lightning arrester, there should be placed an electromagnet of low resistance and low retardation; so arranged that by its operation it will open the telephone line between the arrester and transformer, and connect the ground side of the lightning arrester with the ground direct.

This method of construction, it will be seen, removes the objection that a workman would come in close proximity with the ground, while working on the telephone circuit. And also it provides necessary protection for the telephone user without allowing a path for leakage of the telephone current, or affecting the transmission by increase of capacity.

Mr. H. F. Sanville then gave an abstract of the New York discussions of the papers of Messrs. Blackwell, Mershon and Chesney.

A general discussion followed, during which a spirited controversy between Messrs. Lincoln and Hodges was carried on, regarding the electrostatic effect through a telephone receiver, due to the electrostatic effects of the main transmission line, Mr. Lincoln maintaining this is a constant current effect, and Mr. Hodges taking the stand that it is a constant potential effect.

Mr. Barnes, of Pittsfield; Mr. Theodore Spencer, Mr. Washington Devereux, Mr. C. B. Fulton, Mr. J. Silliman, Mr. R. L. Binder, Mr. Charles Hewitt, Mr. Hutchins and Mr. Carl Hering took part in the general discussion.

Magnetic Club Dinner to Col. Clowry.

The annual dinner of the Magnetic Club was given at the Hotel Vendome, Forty-first Street and Broadway, New York, on the evening of April 18, and was one of the most successful ever held by the club both in point of attendance and enthusiasm. Col. R. C. Clowry, president of the Western Union Telegraph Company, was the club's guest, and 250 members and their friends assembled to do him honor. The dinner was served in the large dining hall on the ninth floor of the hotel. Between the courses vocal and instrumental music was rendered by various artists, which kept the enthusiasm up to the highest pitch all through the evening. On the wall back of the president's table, at which all of the invited guests were seated, was the club's insignia—a horseshoe magnet with "73" between the two poles, in electric lamps; and at the other end of the room was hung on the wall the club's motto, in large letters, "Are You Happy?" On each table stood a miniature telegraph pole complete in its fittings.

At the conclusion of the dinner President F. W. Jones, in a few well-chosen remarks, introduced the guest of the evening, who was greeted with hearty applause, followed by the singing of "The Star-Spangled Banner," by the entire company.

Col. Clowry responded to the ovation in a brief address, in which he reviewed some of his early experiences as a telegraph operator. He expressed the belief that there is no better business training for a young man than telegraphy, and the careers of many leading business men of New York confirmed the opinion. Fully 85 per cent. of the railway managers of the United States, he said, were telegraph operators in their younger days, and he constantly met with men of prominence in every branch of business who served an apprenticeship at the key.

Remarks were also made by Col. A. B. Chandler, chairman of the board of directors of the Postal Telegraph Company; W. H. Baker, vice-president of the same company; H. D. Estabrook, solicitor for the Western Union Telegraph Company, and F. W. Jones, president of the club.

Letters of regret at their inability to be present at the dinner were read from Mr. Thomas A. Edison, Mr. Andrew Carnegie and other prominent gentlemen. A feature of the dinner was the serving of the punch in glass insulators, and each person received as a souvenir of the occasion a miniature glass insulator to be worn suspended from a button hole by means of a short length of magnet wire.

Among those present, in addition to those above mentioned, were J. C. Barclay, assistant general manager of the Western Union Telegraph Company; D. H. Bates, an old-time telegraph official, but now a bank official; B. Brooks, general superintendent of the Western Union Company; G. G. Ward, vice-president and general manager of the Commercial Cable Company; E. C. Platt, treasurer of the Postal Telegraph Company; H. L. Shippy, treasurer The John A. Roebling's Son's Company; E. G. Willyoung and many others well known in the various branches of electrical industry.

Telephone Exchanges.—I.

By Arthur V. Abbott, C. E.

THE SUB-STATION.

The sub-station is the *raison d'etre* of the telephone exchange, for it is the machinery that enables the subscriber to talk. The switchboard holds the apparatus for connecting subscribers' lines together; the wire plant is the path that guides the electric waves along their predetermined course; but the sub-station is (in a sense)) the thing that does the *talking;* it is the vital organ of the whole plant, without which neither pole lines, cables, conduits nor central offices could have any existence. The sub-station contains the *telephone;* and this single expressive phrase exhibits the vital relation of the sub-station to the exchange as a whole. To injure the sub-station is to devitalize the wire plant, and paralyze the busiest switchboard.

As telephone exchanges are now constructed every sub-station must be designed to perform two functions that are inherently completely distinct and separate from each other. These are:

A. The Signaling Function.

B. The Conversational Function.

On a still further analysis it is easy to see that each of them is again divisible into two parts. Thus the signaling function must be arranged so that the subscriber can call the exchange, and so that the exchange can notify the subscriber. Similarly the conversational function must be so organized that the subscriber can talk to other parties, and so that he may receive conversation from others. Therefore, there are four grand divisions of sub-station apparatus:

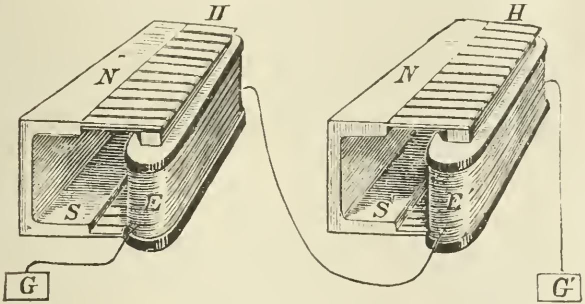

Fig. 1.—Bell's Early Model.

1. The Apparatus for Receiving Signals.
2. The Apparatus for Sending Signals.
3. The Apparatus for Receiving Conversation.
4. The Apparatus for Transmitting Conversation.

Subordinate to this general classification come the subdivisions comprising the various methods used for the assemblage of sub-station apparatus, the wiring of the subscribers' premises, and such auxiliary apparatus as protective appliances, message meters, coin boxes and the like, the types of batteries to be used in local battery sub-stations, induction coils, etc., and finally the various general modifications necessitated by party line service.

It is now proposed to take up each one of these parts and examine what appears to be the best current practice in the construction of sub-stations, and the lines along which development seems likely to take place. The history of the telephone, and the theory of the interconvertibility of sound and electricity will only be touched upon collaterally in so far as it may be wise to the complete development of the subject, while for further information on these very interesting and important subjects the reader is referred to the many excellent treatises extant, in which they are fully developed.

THE RECEIVER.

The history of the human race is a record of a step-by-step progress. No Venus, excepting in the annals of mythology, is born of the sea foam in the full panoply of beauty, but each child slowly passes through the repulsiveness of adolescence, and develops into the attractiveness of maturity. To this rule of progress even the most wonderful inventions are no exception. They never burst in full glory upon the startled horizon of humanity, but from small beginnings develop gradually to most marvelous proportions, and it is only a retrospective consideration that reveals them in their true bearing, while the perspective of the past causes astonishment at the seeming rapidity of development. Under this great law of progress the telephone has evolved, and from an historic standpoint it is convenient to commence a consideration of the sub-station with the examination of the receiver, for in point of time it is the foundation of telephony.

Working in conjunction with his father, Prof. Alexander Graham Bell had, many years prior to 1875, been carrying on experiments to perfect some kind of apparatus to teach the deaf to speak, by imparting to them a notion of sound, or rather an idea of the use of the vocal organs, through other nervous channels than those of the ear. Through these studies he was led to consider the possibility of the electrical transmission of sound. Many experiments were tried with all kinds of vibrating circuit-breakers, which were attended with as little success as the similar efforts of earlier workers in this field. Finally, following an idea suggested by an apparatus built by Helmholtz for the artificial production of vowel sounds, Prof. Bell devised an apparatus illustrated in Fig. 1. A series of reeds, *H,* are secured to a frame, *N,* and are placed in close proximity to the poles of a magnet, *E,* surrounded by a coil of wire, the end of which extends to a precisely similar apparatus located at a distance. When any one of the reeds at the sending station was vibrated mechanically, the corresponding reed at the receiving station was sent in motion, and emitted a sound of the same pitch as the original one. If several of the reeds at the sending station were simultaneously vibrated a composite sound issued from the receiver. While the device shown in Fig. 1 bears little resemblance to the modern receiver, it is very evident that steel reeds, the magnet, coil of wire and line embraced all the elements of the modern receiver, and the instrument could certainly sing if not talk.

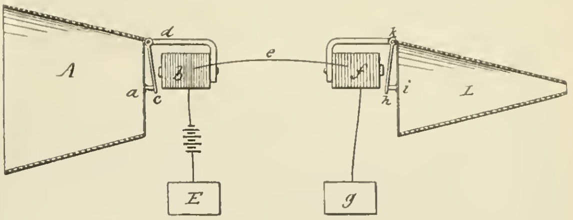

Fig. 2.—Model shown in Patent of March 7, 1876.

This harp-like affair was far too complicated to be of value. Perceiving this, the inventor strove to simplify, and on February 14, 1876, filed a patent application for an apparatus shown diagrammatically in Fig. 2, which is a reproduction of Fig. 7 of the famous Bell patent of March 7, 1876. At the sending station there is a funnel, *A,* to receive the sound waves, the small end of which was closed by a diaphragm, *a,* of gold beater's skin. The center of this was connected to a swinging iron armature, *c,* set in front of an electromagnet, *b,* while a battery, line and similar receiving station completed the outfit. For the first time this patent clearly and broadly describes the office of the moving armature, *c,* to vary the magnetic field in which it hangs, and thus originate an undulatory current in the line in distinction from the pulsating impulses of a circuit-breaking apparatus, though the model shown in Fig. 2 was still defective and failed to give good articulation by reason of the contact at *c.* The final solution of the problem was achieved in the instrument shown in section in Fig. 3. An electromagnet, *H,* was mounted on a baseboard, *F,* the circuit being extended to the binding posts. In front of the magnet a funnel was placed over the end of which, set directly in front of the magnet a piece of gold beater's skin was stretched. In the center of the diaphragm thus formed a small piece

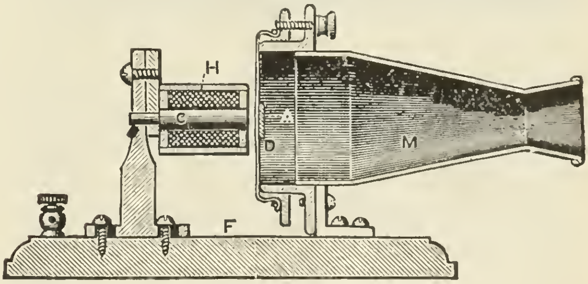

Fig. 3.—Articulating Model.

of soft iron, [illegible], was cemented concentrically with the pole of the magnet. In this device one recognizes at a glance all the elements of the most modern telephone receiver, and between the hand telephone of 1903 and the model of 1876, there is no functional change, the only modification being in mechanical details.

To even casually review the long, bitter and much-to-be deplored legal controversies as to priority of invention that at once arose between Bell and a host of would be inventors, who, seeing that the problem of the electrical transmission of speech was solved, immediately desired either a share in the glory or to enviously destroy the deserved tribute paid to another, is entirely foreign to these paragraphs. Unfailingly have the highest legal tribunals accorded to Prof. Bell the full credit of the undulatory transmission of sound, and from such a verdict it is only the malicious that would even desire an appeal.

At the Philadelphia Centennial of '76 Bell exhibited other models, shown in Fig. 4, one with a double pole magnet, and one in which the diaphragm is placed horizontally on a magnet supported on a base. To substitute a permanent magnet carrying a small wire coil for the electromagnet of the early types, and a thin iron diaphragm for the fragile gold beater's skin, is a bit of good mechanics, scarcely more, for the fundamental operation of the instrument remains unchanged. Such is the history of the birth of the telephone, for from these instruments has the entire art descended.

Consider now a little the theory of operation. Fig. 5 is a diagrammatic representation of a pair of magnetic telephones connected for conversation. Each instrument consists of a bar magnet, *N S*, on one end of which is a coil of wire, *H*. In front of the magnet is a thin iron diaphragm. These, then, the magnet, the wire coil and diaphragm, are the vital, and the only vital organs of the telephone receiver, though obviously there must be some kind of mechanical support to retain them in the relative positions shown in the sketch, and this support it will be found plays no unimportant roll in the successful operation of the receiver.

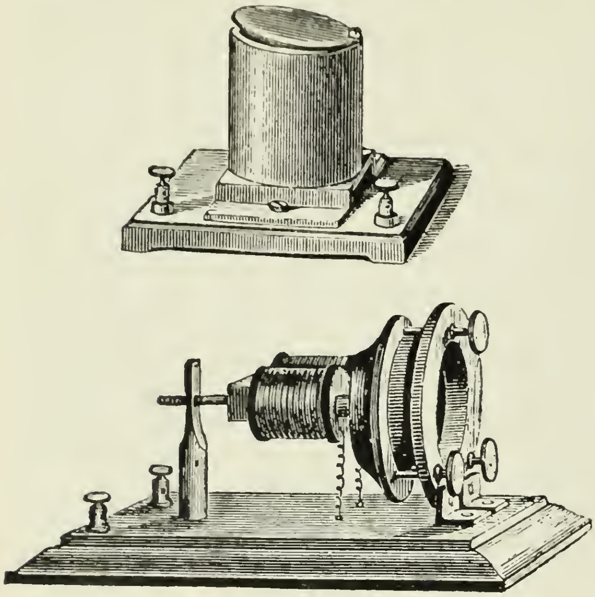

FIG. 4.—CENTENNIAL MODELS.

If any sound, articulate or otherwise, be produced in the vicinity of the diaphragm, the sound waves will impinge on the plate, and as this is thin and elastic, the impact of the waves will cause it to vibrate each excursion of the moving plate very closely, though not exactly resembling the sound wave that produced it. As the diaphragm is placed close to the magnet, *N S*, it is in a strong magnetic field, and thereby is magnetized. Experiment shows that any relative motion of magnets in close proximity to each other, disturbs and changes the magnetic field existing between them, and experiment also teaches that a coil of wire placed in a varying magnetic field becomes the seat of an e.m.f. that is proportional to the rate at which the magnetic field is changing. The magnetized diaphragm is moving synchronously with the sound waves that excite its motion, hence the magnetic field in which the coil of wire, *H*, is placed is similarly disturbed, and an e.m.f. correspondingly changing, and proportional to the rate of change in the magnetic field is set up in the coil. Suppose from the ends of coil *H* a circuit either by two wires, or by one insulated conductor and ground be completed to another precisely similar apparatus. The varying e.m.fs excited in the coil, *H*, will cause undulatory currents of electricity to traverse the circuit in which the coil of the second telephone is included. Experiment teaches that the magnetism of a bar magnet surrounded by a coil of wire carrying a current is changed approximately in proportion to the current passing; therefore, the magnetism of the second magnet will ebb and flow with the undulations of the current in the line wire. The diaphragm of the second telephone being in a similar magnetic field to that of the first one, is under a tension produced by the pull of the magnet. As this field is alternately weakened and strengthened by the reactions of the current in the coil, the stress on the diaphragm rises and falls, and with this flux and reflux obeying the laws of its own elasticity the diaphragm swings to and fro, repeating with wonderful, though not with absolute fidelity in shape, but displaced a whole period in time, the motions of the diaphragm, *T*. As the second diaphragm swings to and fro it carves the air into sound waves, and thus the second telephone faithfully reproduces what is spoken into the first one. This most remarkable and interesting cycle is one of the most convincing demonstrations of the law of conservation of energy and may be recapitulated as follows:

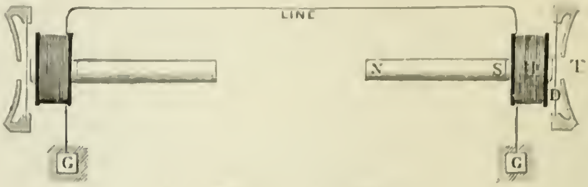

FIG. 5. DIAGRAM OF OPERATION

1. Sound waves impinge on the first diaphragm and set it vibrating.
2. The moving iron causes changes in the magnetic field.
3. The field changes excite undulatory e.m.fs in the wire coil of the first telephone.
4. These e.m.fs produce currents between the two instruments.
5. These currents cause corresponding changes in the magnetic field of the second telephone.
6. These field changes set the second diaphragm vibrating.
7. The vibrations of this diaphragm initiate air sound waves similar to the original ones.

Prior to Bell's researches much time and many experiments had been spent on an endeavor to transmit speech electrically. But all of the various pieces of apparatus devised were based on the plan of completely opening and closing a transmitting circuit with each sound wave; *vide*, the famous apparatus of Reiss, invented in 1861, which differed from Bell's only in this one very important particular. The Reiss telephone had a vibrating diaphragm armed with a platinum point that opened and closed a battery circuit with every pulsation. The line current from such an instrument would be represented by a diagram like *A*, Fig. 6, for with a make-and-break instrument, the current will be zero when the contact is open, and its full value immediately it is closed; there are no other conceivable values. Such an apparatus can repeat a simple sound that consists of only one set of waves, like the note of an organ pipe, or that of a whistle. As there is only one contact it is obviously impossible for it to do more. But in the voice there are coincidently many vibrations varying both in number or pitch, and in amplitude or loudness. Such complexity a simple make-and-break cannot repeat. In a diaphragm free to vibrate in a magnetic field the limitations of the make-and-break are removed, and such an apparatus causes a current that may be represented by *B*, Fig. 6. Here there is a delicacy obtained capable of reproducing all of the infinite gradations of vocal

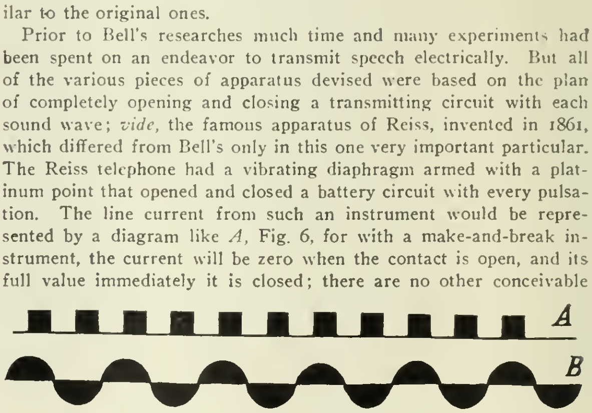

FIG. 6.—DIAGRAM OF PULSATING AND UNDULATING CURRENTS.

utterances. In 1875-6 very little was known of magnetic fields and the intimate reaction of current and field. So all the more credit is due to Prof. Bell for the contrivance of an apparatus which depended on *undulatory* currents without which complex speech cannot be reproduced, and the courts have always held Bell's invention to consist in the *undulatory* current, or rather its electro-mechanical production and utilization in the transmission of speech.

An examination of the sound waves emitted by the voice in speaking shows them to consist of a basic or fundamental tone, relatively low in pitch, but of great amplitude or loudness, on which are superimposed a large number of harmonics or over-tones, that consist of vibrations two, three or four times as rapid; all correspondingly higher in pitch, and of small amplitude.

It is the presence of these over-tones, and the relative proportion and intensity of each one that endows different voices with their distinguishing properties, and enables one to infallibly recognize the tone of a friend. As the quality of the voice depends in each case on the relation between the fundamental and each of the many overtones, it is essential, in any speech transmission, that this ratio should be most exactly preserved. If the short harmonic waves were transmitted faster than the fundamental, speech would presently become unintelligible, for a portion of one word would thrust itself into the middle of the preceding one. There is, however, little to be feared from this contingency, for while there is a perfectly measurable and accurately known amount of time consumed in the transmission of every telephone wave, each portion of every word, of every syllable, of every letter, is equally retarded, and though all are delayed, the ratio of delay for each is constant.

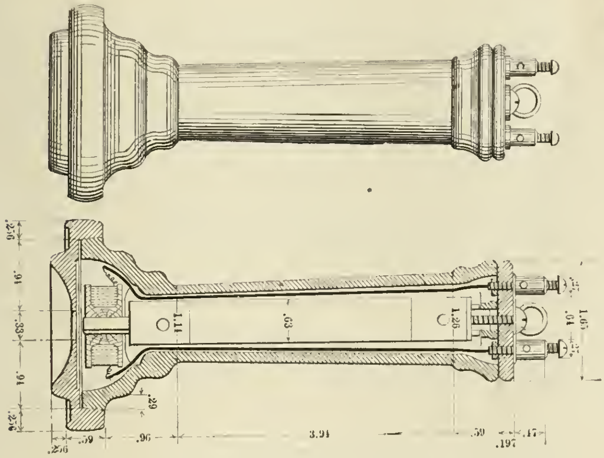

FIG. 7.—SINGLE-POLE BELL RECEIVER.

The mental impression produced by any sound depends on the number of vibrations per second (the pitch) and the square of the amplitude, or distance through which the wave rises and falls. It is for this reason that a high, shrill voice attracts more attention than a deep tone. A change in the amplitude (which varies the loudness) does not alter the pitch, but it does produce a very great change in the metal impression produced by the sound. If the amplitude of all the waves of a composite sound like the voice be uniformly changed, the ear at once knows that the sound is more or less loud, but is equally sure that its distinctive quality is unchanged. If on the contrary the waves of some of the harmonics are reduced more than others the sound entirely loses its characteristics, and the ear fails to recognize its source. Therefore, in telephonic transmission the *relative amplitude* of all waves must be exactly reproduced or speech will be unintelligible. It is perfectly legitimate to reduce within certain limits the amplitude of all waves and thus equally decrease loudness. But to change some waves more than others is to destroy characteristic quality. Unfortunately this is exactly what does occur, and moreover this distortion takes place not only in the receiver, but also in the line and the transmitter, and in an endeavor to eliminate this distortion, much investigation has been spent, with as yet but very partial success.

As the receiver is now used in telephony, its function consists in taking from line the undulatory waves of electricity impressed thereon by the transmitter, causing them to vary the field of a permanent magnet in which a diaphragm is suspended capable of vibrating with the field changes. *Ceteris paribus,* that receiver is the best whose electric, magnetic and acoustic properties are such that the sound waves emitted by the diaphragm correspond most closely in amplitude, shape and energy to the electric pulsation of the line, and the three organs of the receiver, the coil, magnet and diaphragm must be so planned in relation to each other as to secure this result.

Unfortunately, systematic investigations of the principles of the receiver designed from such a point of view are very meagre. In America, the most extensive studies are those undertaken at the Massachusetts Institute of Technology by Messrs. Cross, Williams, Hayes, Mansfield and Phillips and reported in the proceedings of the American Academy of Sciences.[1] A somewhat similar study was undertaken by Mercadier[2] in 1889. Other limited investigations have been made by Blake, Salet[3], Fröhlich[4] and Franke[5].

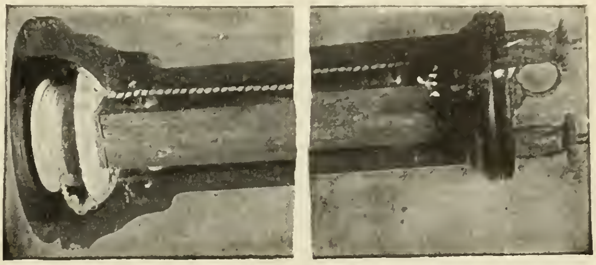

FIG. 8.—SECTION OF BELL RECEIVER.

Aside from these investigations there seems to have been little attempt to formulate a scientific receiver design. For a long time the American Bell adhered to the single-pole type, a dimension drawing of which appears in Fig. 7 and a photograph of a section in Fig. 8. Several years ago this company commenced to use the bi-polar design, shown in Fig. 9, which has proved itself so decidedly superior to single-pole that the latter has nearly disappeared. The American Bell has always been exceedingly averse to the diffusion of telephonic investigations of any description, so it is not surprising that there is little information extant as to the construction of this receiver.

The Bell receiver was, and is by no means perfect, and owing to excessive conservatism, it has changed little since the bi-polar type was adopted. The younger companies have been more flexible and quicker to profit by experience, and there are many Independent receivers that are far superior to the Bell in mechanical design, and several in which both the mechanical design and shop execution are far better, but in electric, magnetic and accoustic properties, the Independent instruments are less successful, for there are few receivers that talk as well as those of the American Bell, and only two or three that can be said to be perceptibly superior. The Independent Companies have been so occupied in catching up to telephone business that they have had little time for systematic study along scientific lines, but the time is now ripe for an investigation of the principles of receiver design. Competition is slowly but surely awarding business to those who do it best, and he who is sufficiently altruistic to do some missionary work in this field will surely reap a reward.

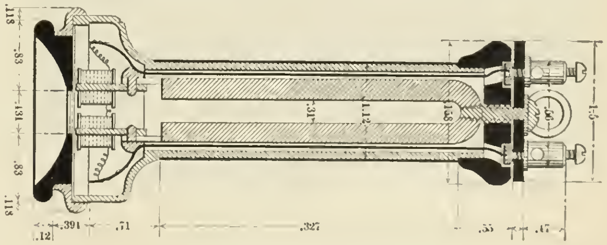

FIG. 9.—BIPOLAR RECEIVER.

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[1] See proceedings of American Academy of Sciences, Vol. for 1888, Page 113; Vol. for 1890, Page 233; Vol. for 1892, Page 93; Vol. for 1893, Page 234.

[2] See Comptes Rendus, Vol. cviii, Pages 735, 797. 1889; Vol. cxii, Page 96. 1891; Vol. xcv, Page 178. 1882.

[3] See La Lumiere Electrique, Vol. xxv, Page 180. 1887.

[4] See Elektrotechnische Zeitschrift, Vol. xl, Page 228. 1890.

[5] See Journal Society of Tel. Eng., Vol. vii, Page 247. 1878.

Telephone Development in the Philippines.

Since the successful establishment of telephone systems in Manila and suburbs, there has been considerable demand for the introduction of like systems in places like Iloilo, Cebu, Zamboango and places of equal importance in the Philippine Islands. The Signal Corps of the United States Army has done a wonderful work towards this problem by introducing government telephone lines at many points, but these of course are for the use of the military. Commercial concerns and individuals have the use of these military lines only as a matter of accommodation. The business men of the important islands and cities want lines put in specially to conduct the business of the localities. Take for example Iloilo, where the business men have been taking steps towards getting a telephone line in for months past, there are some 30,000 inhabitants, making it the second largest city in the islands. At present the "Muchachos," or native servants, are employed to run with notes and messages, but these people are exceedingly slow. Adjoining Iloilo are Jaro and Moro, and considerable capital is represented in these places. The writer remained several weeks in Jaro and became satisfied that subscribers enough could be obtained in this one place to start a line with an abundance of capital. In fact there are prospective investors in all of these places.

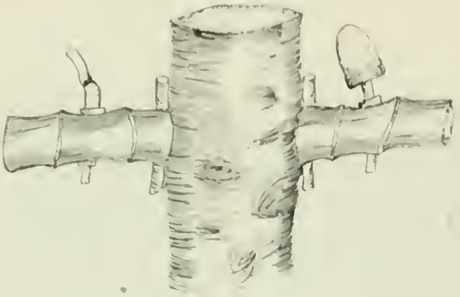
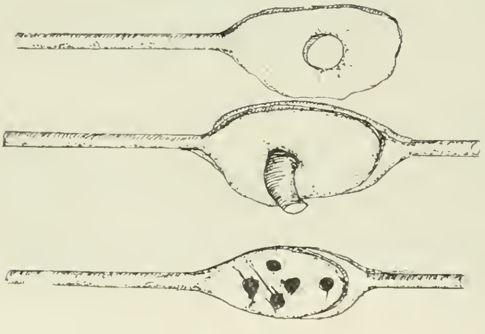


FIG. 1. CROSS ARM.

The Spanish had their lines of telegraph and telephones established in the leading commercial centers, and the natives were often employed to do the work on the line and in caring for the instruments. The writer found that the native lacked ingenuity in this line of operation, and does not seem capable of making repairs so skilfully as the American lineman. To give the reader an idea of the pattern of one of the native poles, cross arms and fittings, Fig. 1 is presented. The pole is usually a cocoanut trunk. These poles can be cut the required length, and as they are without branches except at the top, the work of preparing them for use is light. A pole can be got ready very quickly after it is felled. Then a hole is gouged through with crude native tools and the bamboo cross arm inserted as shown. The insulators in these arms are usually out of line, broken off, or otherwise disordered.


FIGS. 2, 3 AND 4.—WIRE JOINTS.

The native linemen have but very few tools with which to work, which often accounts for the poor work done by them. It may interest readers to notice the system of making unions of ends of wire as employed by the native lineman as taught, undoubtedly, by the Spanish. The writer saw that one lineman, in endeavoring to make a simple joint of two pieces of the line had laboriously hammered out the stubs, as shown in Fig. 2, until disks were formed. Then he slowly and carefully used his hand drill to make the hole through these flattened ends. Then he placed one above the other and inserted the bit of wire, as in Fig. 3. This made a union. Another form they use consists in boring several holes through the sides and inserting a pin in each as in Fig. 4. The native linemen are not liberally furnished with any of the metallic or glass or other parts of the apparatus used in the line work. It seems to have been the custom to start a line in operation and then the engineers would leave it, and not an extra part of any sort would be provided. Consequently, one sees old bottles used for insulators, and all sorts of metal devices employed in one way and another.

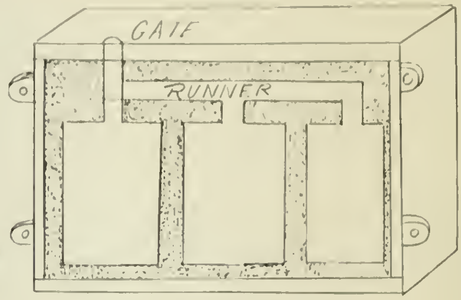
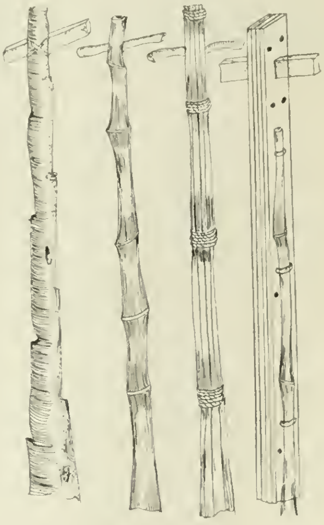


FIG. 5.—MOLDING FLASK.

In one place the natives employed at line work possessed a device for casting metals into required form, such as is shown in Fig. 5. The affair is an old Spanish molding flask, with gate and runner to receive and carry the metal to the molds, as represented. This device the natives used in varied form by molding the sand to the needed pattern desired to cast.

The types of poles used in the Philippine Islands, both for the telephone service and telegraph are notable curiosities. Fig 6 shows the cocoanut style of pole, previously mentioned. It will be noticed that there are notches cut into the sides. These form the steps by which the native lineman ascends and descends the pole at will. He is barefooted and can go up and down the pole very easily, even when carrying tools and equipments on his shoulders. The cocoanut wood seems to stand the climatic and noxious influences of the ant-filled earth well. Unless the ants conclude to nest in the wood, the trunk will last for years.


FIGS. 6, 7, 8 AND 9.—TYPES OF POLES.

The common bamboo type of pole is exhibited in Fig. 7. It is a very convenient pole, readily obtained along the route, and always strong, reliable and straight. For permanent service, however, the bamboo pole is not used. It is suitable for a temporary line, say for six months or a year. After that the poles usually weaken and fall. There is a system of binding up a series of small diameter, but lengthy pieces of bamboo employed, as illustrated in Fig. 8, which is considered effective. The natives collect the required lot of bamboo together and bind it up, with cordage, as shown, resulting in a substantial combination. Another form is illustrated in Fig. 9, consisting of four or five separate pieces of boards joined with wood pegs. The cross arm is inserted through the top. Sometimes, to add to the strength of the pole, a piece of bamboo is extended along the sides, and secured with bamboo fastenings. The native is not without the sign indicating the office of the telephone system, and this sign is in varied languages or separate signs are used, each with its appropriate wording. Fig. 10 is one of the artistic inscriptions of this order. The native has some fantastic ideas concerning finishing and decorating signs and he applies them freely. These are some of the ways and ideas relating to the old style and the new style telephone systems as observed in the different portions of the Philippine Islands. Where the line is operated exclusively by Americans, you even then see the handiwork of the native, because as a rule the native is the handiest and cheapest man available for this line of work.

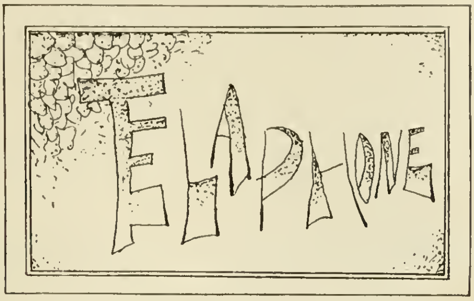


FIG. 10.—TELEPHONE OFFICE SIGN.

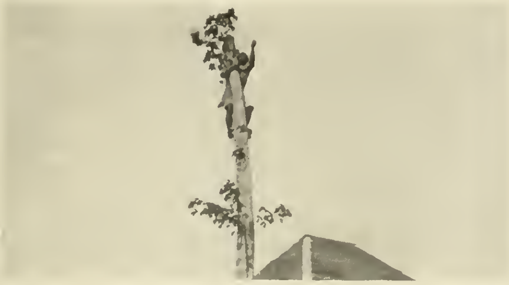


FIG. 11.—NATIVE LINEMAN.

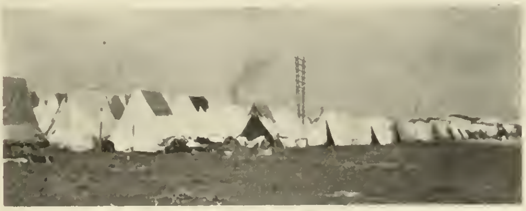


FIG. 12.—AMERICAN CAMP WITH DOUBLE POLES.

Dutch Cable at Guam.

Permission will be granted to a Dutch cable company to land on the Island of Guam a cable from Marshall Island. Guam is to be a relay station in the transpacific cable. There was some objection to the first application of the Dutch company on account of the position desired for its cable office. The cable from Marshall Island to Guam will probably be laid before the transpacific cable is completed, and the Navy Department will in a short time be able, by using the German cables in the South Seas, to send orders by telegraph to the naval Governor of Guam, at Agana, which is now connected with other ports only by steamer. By next September it is expected that there will be communication with Guam by the all-American cable of the Commercial Pacific Cable Company.

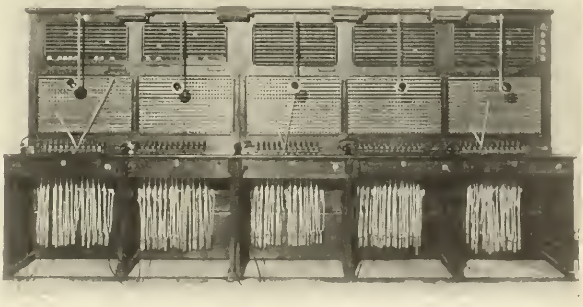
Telephone Service in New York Hotels.

In recent articles in these pages on the development of telephony in New York City, attention has been directed to the remarkable growth of the art in connection with private exchanges in commercial offices and especially in hotels and apartment houses of the more important class. The increase in the use of the telephone in New York in every direction has, indeed, been remarkable, but doubtless the feature of telephone development for the past year, which stands out most prominently, is the manner in which the service has been adopted at hotels. Since January 1st, 1902, contracts have been taken covering a complete long-distance telephone service for every room and working department in the following hotels:

Name.	Number of telephones.
Hotel Manhattan	678
Hotel Imperial	575
Hotel Astor	550
Plaza Hotel	400
Hotel St. Regis	389
Fifth Avenue Hotel	360
Ansonia Hotel	360
Holland House	350
Hotel Victoria	300
Marie Antoinette	300
Hotel Marlborough	300
Astor House	275
Buckingham Hotel	184
Hotel Vendome	175
Westminster Hotel	170
Hotel Lorraine	160
Hotel Endicott	150
Hotel Empire	150
Wellington	145
Hotel Belleclaire	145
Hotel Collingwood	135
Gregorgian	135
Winsonia	130
San Remo Hotel	130
Hotel Martinique	128
Hotel Cadillac	120
Algonquin Hotel	120
Somerset	115
Lenori	114
Seymour	100
Hotel Lafayette-Brevoort	100
Hotel Grenoble	100

And forty others ranging from 50 to 100 stations.

Except in cases where the hotels are not yet completed or opened for business, the service has been established and the manner in which it is used by the hotel guests from their rooms shows the very great favor with which it has been received. The traffic in nearly every case has exceeded the original estimate; in some cases it has been necessary to increase the number of central office trunks.



SWITCHBOARD IMPERIAL HOTEL, NEW YORK.

In planning important hotel installations, such as those above mentioned, a study of the situation is made by the Traffic Department of the New York Telephone Company, and switchboard equipment is installed in accordance with the estimates made by that department. The total switchboard equipment designed to cover the thirty-two hotels mentioned above covers eighty-seven operator's positions; the ultimate capacity is for 13,500 lines and the number of central office trunks contracted for is 320. We illustrate herewith the switchboard installed at the Hotel Imperial to take care of the equipment of no fewer than 575 telephones furnished there.

Corrosion by Electrolysis.

At the meeting last week of the American Electrochemical Society, Mr A. A. Knudson, in a paper entitled "Corrosion of Metals by Electrolysis," considered the subject under the heads of galvanic action between dissimilar metals, and destructive effects of railway current on subterraneous metals. Of the part of the paper under the second head we give an abstract below.

A brief historical resume was given as to the results of some surveys and tests made during the past few years in the City of New York. In the spring of 1897 Mr. Knudson discovered, while making an electrical survey in Manhattan in behalf of one of the railway companies, that a portion of the return railway currents generated at the Kent Avenue Power Station in Brooklyn, E. D., passed over the New York and Brooklyn Bridge to underground pipes in Manhattan. At that time it was supposed that these currents took the shortest and most direct path through these pipes back to Brooklyn, taking to the river in the vicinity of Grand Street, about opposite the power house, which is located on the water front in Brooklyn at Kent and Division Avenues.

In October, 1898, while making further measurements on the bridge, practically the same electrical conditions were found, viz.: currents from Brooklyn flowing over the bridge and down the pillars in Park Row which support the terminal structure and the elevated railway station, and from them to water and gas pipes in the street. In the early part of 1899 Mr. Charles R. Barnes, electrical expert for the New York State Railway Commissioners, made at their direction an extended survey through the Borough of Manhattan, and found the electrical conditions at the bridge and other points in the city practically the same as we found them in 1897 and 1898.

In the month of May, 1902, a further survey was made in this section of the city, for the purpose of ascertaining if currents of electricity flowed through underground pipes, what direction they were taking, and their identity and source. It was discovered that a portion of the Brooklyn railway currents generated at the Kent Avenue power station, in their return to that station pass over the New York and Brooklyn Bridge to Manhattan, thence flow through underground pipes as far north as Twenty-third Street, and flow east towards the river through pipes in streets running east and west, and also returning over the new East River Bridge. On the Brooklyn side of the river the currents were found to be leaving the river, and passing into the underground pipes as far north as Greenpoint at about opposite Twenty-third Street, Manhattan, thence flowing south to their starting point, the power station in Kent Avenue.

One means of identifying this trolley current was by a test during the so-called rush hours between 5 and 7 o'clock in the evening, at the foot of Twenty-first Street, between a pipe connecting with the gas mains and the river; the rise in voltage indicated when the cars are carrying the heaviest load, a little before and after 6 o'clock, and the falling off as the load becomes lighter. The maximum voltage of 1.2 volts, occurred several times between the hours of 5.30 and 6.30 P. M. The same test was made between one of the pillars at the Manhattan terminus of the bridge and a water pipe, on the following evening, where the maximum difference of potential was 3.6, this also at the same time as the previous test.

Potential readings through the streets were obtained by connections between gas posts upon the gas mains, and between hydrants on the water mains, using a millivoltmeter. A higher reading instrument was used for other tests. A few current readings were made upon pipes found exposed in the subway in Elm Street. In 1902 5.9 amp. were found flowing north upon a 12-in. pipe near Grand Street. This year, upon a 20-in. main a little north of Canal Street, 6 amp. were found flowing north; this, however, is only a portion flowing north, as it was found that current is passing through the metal of the subway as well. One point of contact between this 20-in. main and subway metals was discovered where a hub of the main rests against a girder just north of this point. On the other, or south side of Canal Street, no reading could be obtained, the cause being that this main came to a dead end about a block below; beyond the dead end for about half a block the main had been removed, current, therefore, passing north from the bridge by way of the metal work of the subway; thence just above Canal Street 6 amp. of it is transferred to the 20-in. main; how much more is passing through the subway structure cannot be ascertained, but the most of this same current no doubt finds its way through subway metals and pipes to and over the East River Bridge, while a smaller amount is spread through the pipes and passes by way of the river bed to the power station. The maximum readings a year ago between a hydrant and the structure were 5.4 volts; now they are 6.5 volts and 6 volts from the gas mains. On the Brooklyn side the test a year ago was 7.2 volts, the direction of flow being from bridge to pipes; this year the reading was only 0.5 volt. The reason for this much lower difference of potention than last year on the Brooklyn side was owing to the conditions being changed, viz., a 6-in. wrought iron pipe is now led up to, and rests upon, the steel girders of the roadway, making a fairly good connection between the bridge structure and the water piping of the borough.

This pipe supplies the engines upon the roadway with water. A current measurement (using the "fall of potential method") was taken upon that portion of this pipe which is close to the ground, and a maximum flow of 69.5 amp. was found passing off the bridge through this medium to the Brooklyn mains. This current flow was determined later by a test at Columbia College upon a pipe of the same size. This current found entering the mains in Brooklyn must again leave them in its course to the power house, and it is well understood that at such points where the current passes into the soil, electrolytic corrosion of the iron occurs.

Further tests between the structure and pipes in Brooklyn were as follows: About one block from the river, difference of potential, 2 volts; bridge positive to mains. Two blocks from the river, 2.5 volts; same direction of current. These latter tests indicate that by no means all of the current which passes over the bridge to Brooklyn, which is considerable, passes throug the 6-in. pipe, that is but one outlet; other outlets are such parts of the metal structure as may connect with the earth, where the resistance is sufficiently low, and at such places corrosion is possible.

The new bridge is, therefore, taking the larger portion of straying railway current, which formerly passed through the underground pipes in Manhattan to the north, or in other words it is in such position that it invites a more direct return path for these currents to flow back to the Brooklyn power station. This new return path will continue to improve as a conductor, as the bridge nears completion, when more current will be diverted in this direction, unless some method is devised to control it; the readings taken this year were made after the roadway had been joined, which may account largely for the increased flow indicated over last year.

It has been known for some years that pipes in the Navy Yard have been destroyed from time to time, by electrolysis, evidence of which we have seen in a number of samples shown us during recent visits. Wires have been run from a central station connecting with the water mains at different points; by this method the difference of potential can be taken between any two points in the system, and there were 14 of these connections. The direction of the railway currents is always towards the power station, which is located just across the channel from the cob dock. The most of the pipes which have been destroyed were in the cob dock. At one time it was feared that the steamship *Columbia,* used as a receiving ship, was being damaged on account of being in line of these currents, but we are reliably informed that the plates of this ship were carefully examined when the boat was recently in dry dock, and no action except what might be expected from sea water corrosion was discovered. The difference in potential now between points on the sides of the yard near Flushing Avenue and Navy Street, to the point nearest the power station, is 20 to 25 volts; formerly it was higher than that.

The railway company suggested that the damage caused, and being caused, to the pipes underground was not due to their currents, but was caused by the Navy Yard's own electric light and power circuits, which is of large capacity. While the officials were morally certain that the currents causing damage were from the railway power station, the question remained uncertain until the day of the late President McKinley's funeral, when the Kent Avenue power stations, as well as all others in the country closed down for five minutes.

It occurred to some of the engineers of the yard that it would be a good plan to make a few tests at that time, and while the lighting and power circuits were running, and the railway power station closed down, this was done. It was found that the voltmeter needles remained at zero at every test that was made, proving conclusively that the currents causing the damage emanated from the railway power station.

Several water and gas mains have burst in Brooklyn, owing to electrolysis. An 8-in. water main which burst in Flushing Avenue near the Navy Yard Hospital grounds July 14, 1899, had all the characteristics of electrolysis, viz., the soft state of the iron in several plates which was reduced to a condition of graphite, easily shaved with a pocket knife. The voltmeter readings taken from where this pipe was removed showed it positive to the rails; besides it was resting in wet soil. The pipe from which this sample was taken was of the Scotch iron make, which is identified by the bulging rings found on every length; they are from 3 to 4 in. wide. Subsequently to the bursting of this main at this point, there have been three other failures upon the same pipe in this street within short distances from each other. Two of these damaged sections were in practically the same condition as to holes and soft spots as the pipe above referred to. There is no doubt, therefore, that all of these four failures were caused by electrolysis.

A few years ago an impression prevailed to some extent, that underground mains in Brooklyn were immune from electrolysis. Some gave as a reason that, as many of the mains were made of Scotch iron, there was something about the construction of that metal which resisted the effects of electrolytic action. Another reason was advanced by Prof. Sheldon, who discovered that a thin "silicious compound" of the nature of glass is found upon the surface of pipes, and formed there during the process of casting, which is the "true cause of immunity" as that material is an insulator. In view of the fact of many failures of pipes in Brooklyn since 1899, due to electrolysis, Mr. Knudson considers that neither of the above reasons as to immunity will stand. Prof. Sheldon also states that this coating is extremely thin and contains perforations. Such a condition is a good reason for an earlier rupture of a main, than if the corrosion were more evenly distributed over the surface, as at the perforations or spots where there is no coating, the action would naturally localize, and the iron be penetrated more rapidly.

In the large majority of electrolytic effects upon cast-iron mains, those spots that are longer one way than another, very frequently take a position at right angles to the length of the pipe. These lengths of pipe while being handled are often rolled over other lengths or hard surfaces, and this may cause a removal of the coating spoken of at such spots, and the consequent localizing of electrolytic action, which follows the line of the bare iron. This is a suggestion of a further reason that such coating is present, although we can find no comfort as to its presence being a remedy against electrolysis, but rather the reverse. On a chart showing the entire surface of a 12-ft., 48-in. main taken from a street in another city, there were 80 furrows and pittings, caused by electrolysis. Of the 80 which showed a length as well as breadth, all but 5 (which were quite small) were transverse with the length of the pipe. One was over 2 ft. long and 5-16ths of an inch at its deepest point. Others were shorter and some deeper, the deepest being 9-16ths of an inch.

Our view of the case, therefore, is that electrolysis has been getting in its work upon the Brooklyn mains for several years. If the action has been slower than in other cities it may be due to heavier rails or more improved return. The absence, however, of frequent failures of mains from this cause, should not be taken as evidence that electrolysis does not exist; its progress may be slow, slower in some cases than in others. The extent of such progress, however, will not be discovered unless looked for. A main may be nearly ruined by this action, but, owing to the pressure of surrounding soil, will hold together and not reveal its state through final bursting for a long time; hence there are many places in Brooklyn to-day where this process exists in all its stages, from the small pitting of ⅛ of an inch deep, to those that have penetrated through the mains which are leaking and about to collapse.

The only complete solution for electrolytic corrosion of underground metals by railway currents, is what is commonly known as the double trolley. Such method has been in use for some years in the Borough of Manhattan, N. Y., as represented by the underground conduit system; also in Washington, D. C., where the same system prevails in the city proper, and the overhead double trolley upon some lines in the suburbs, with convenient appliances for changing from one system to the other.

The section of New York under consideration is peculiarly situated geographically—considering also the location of the power house for the returning currents to take the course referred to. Perfect immunity from possible electrolytic action upon the subterraneous metals of the two bridges, and the actual effect upon portions of the piping system in this section of the city, can only be had either in the method referred to, or a removal of these currents to some other section of the city. Modifications of the present grounded system tending to reduce the straying of railway currents may be undertaken, but changes looking to modifications only should not be accepted by the authorities as final, or relieving the railway companies in any way from further responsibility in the matter. It is commonly reported that the Kent Avenue power house with its 12,000 hp is to be enlarged to many times its present capacity.

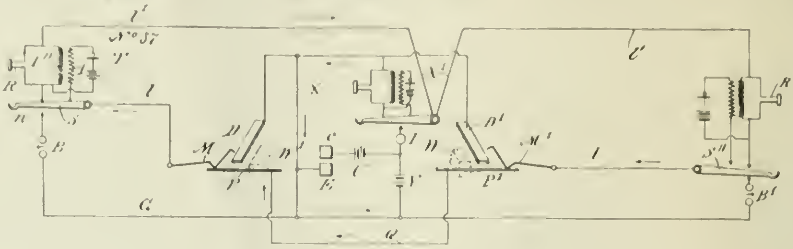
Meeting of the Chicago Electrical Association on Overhead Distribution.

Mr. H. B. Gear, the general inspector of the Commonwealth Electric Company, read an instructive paper on the Overhead Distributing System of the Commonwealth Electric Company, before the Chicago Electrical Association Friday evening, April 17. The paper in a general way covered the problems involved in the distribution of current by overhead lines. Mr. Gear considered these problems both from an economic and from an engineering standpoint. He called attention to the fact that although the greater portion of the territory within the corporate limits of the City of Chicago was covered by overhead lines, the amount of energy distributed from the overhead and underground systems, varied approximately in an inverse relation. This necessarily calls for an alternating system of distribution. The lighting feeders, as a rule, are single-phase, while motors are operated from three-phase, four-wire circuits, which also carry single-phase motors in many cases. Because of the rapid growth of the business the expansion of the system of mains necessarily has been great. This necessitates periodical arrangement of the feeder system, to provide for changed conditions. The calculation of feeders has led to a study of economic considerations, which should be kept in mind in the design of the same.

The annual cost of maintaining single-phase feeders is composed of the two elements that are common to electrical apparatus, namely, operating cost and fixed charges. These are related to each other in an inverse manner, so that any cause which results in the increase of the one produces corresponding decrease in the other. There is, therefore, a point at which the sum of these is a minimum for any given set of conditions. The operating cost of a feeder transmitting electric current consists of the expense of repairs and the value of the energy which is distributed on the feeder between the station and the center of distribution. The repairs are practically independent of the size of the wire used, and may, therefore, be disregarded in these calculations. The value of the energy lost in the feeder is, of course, dependent on the cost of energy per kilowatt-hour delivered at the station switchboard. The energy lost on the feeder is dependent upon the average daily load factor of the current transmitted over it. The maximum load and the average daily load factor being assumed, the annual output of the feeder may be readily calculated. Assuming various sizes of wires to be used on this feeder, the value of the kilowatt-hour loss may be determined.

The value of any theoretical calculation to the practical engineer lies chiefly in the fact that the principles underlying the theory are set forth so that in any practical problem the engineer may know whether his work is tending toward the ideal case or away from it. Practical conditions rearely coincide with ideal cases, and the engineer can, therefore, only approximate his work to the theoretical case as nearly as may be.

The transformer, the connecting link between the primary and secondary distributing systems, has been the occasion of much discussion among central station men during recent years. The installation of separate transformers for each building into which service was introduced has been the rule in the past. This resulted in the installation of a very excessive amount of transformer capacity in small units. The large all-day losses, which were the inevitable result, eventually directed the attention of manufacturers to the necessity of a study of these losses. The use of the transformer has, therefore, passed through a career of evolution which is no doubt familiar to all. In this evolution a large number of plants have found it advantageous to scrap their entire equipment of line transformers, and replace them with modern apparatus. In connection with this work secondary systems have been installed, this allowing a material decrease in the number of transformers required, and an increase in the average capacity per transformer. There has, however, been a considerable variance in the practice of companies throughout the country as regards secondary mains. Some have installed a heavy three wire network, inter-connected, throughout, whereas others have invested in secondary main capacity less heavily, inter-connecting only a few heavy lines along business streets, and using isolated transformers for more scattered districts. Still others have lagged behind the march of progress and are adhering more closely to the pioneer method of installing transformers very closely, with only occasional pieces of secondary work. Calculations have been made to ascertain the exact point at which the core losses of transformers are offset by fixed charges on the investment in wire and transformers at different loads. These have shown uniformly that smaller wires than are ordinarily employed give the best results. Of course the density of the load and its nature will determine the most economical size to be employed. Conditions arise which modify the general conclusions reached; but the calculations serve to furnish a basis for the formation of judgment as to the best policy to be pursued in handling this class of work.



PAUL TELEPHONE SYSTEM.

The selection of the transformer equipment to supply an overhead system is of great importance. Inaccurate judgment as to what capacity is requisite may lead to an excessive installation, thus increasing both investment and operating expenses unnecessarily.

It is apparent that the lights connected to a transformer in a residence will not require the same capacity in lights connected as those in a store or factory. There are five classes of lighting, which require separate treatment in the selection of transformers: (*a*) large residences, (*b*) apartments and small residences, (*c*) stores, (*d*) factories, and (*e*) churches. The power factor of the load, the nature and the duration of the loads, the requirements of good service and other factors enter into the selection of the proper size. The Wright demand indicator, connected in circuit with a transformer, has been found to be a valuable aid in getting exact data as to the load being carried in any particular case. There are numerous minor problems involved in the distribution of current, but which nevertheless require careful treatment.

In a short discussion which followed attention was called to the fact that although theoretically three factors enter into the calculations for determining the size of a wire, only one as a general rule is considered in practical work, and that is the size of wire which happened to be in stock. Although it is important to take up the mathematical side of the subject, it should not be forgotten that after all the earning power of any installation is the most important.

The next meeting, which will probably be the last one of the present season, will be held at the Albion Café.

New Telephone Patents.

The three telephone patents of the issue of April 14 have for subjects a strain insulator, a manually-operated message register and a switchboard system so designed that even with metallic circuit lines only single strand cords are necessary in making connections.

The new strain insulator, which is designed primarily for use in guying line wires away from obstacles, is the invention of Mr. C. Claydon. For such work in the past it has been customary to use a porcelain or glass knob having a central aperture with flared ends and having a groove about the middle of its length. The guy to the line passes about the insulator, lying in the groove, while the guy toward the support is passed through the hole. With such an arrangement the line wire is effectively insulated from the guy support. Mr. Claydon's insulator is based upon the same principle, except that instead of the usual hole the attachment for the line guy is a loop of wire about a portion of which the insulator knob is cast while in a molten state. The twisted joint made in forming the loop serves well to retain the loop securely within the insulator, and to make the retention of the loop doubly sure, the ends of the loop wire are bent outward and cut off at the surface of the insulating block.

Mr. W. Gray has patented the new message counter, which is of that type in which by means of a key left in his possession, a subscriber may turn his register and count one message, at the same time signalling the operator that the proper record has been made. The most novel features of the present register embrace the use of multiplying gearing between the key arbor and the recording device, and the use for this latter of the ordinary bicycle cyclometer. The multiplying gearing gives a characteristic buzzing sound, which notifies the operator that the record is being made, while a stroke of a gong signifies at just what time the count is complete. By the use of a standard article like the cyclometer, the necessity of manufacturing a special counter is obviated

The new "Telephone System," the subject of the third patent, is shown in diagram in the accompanying figure. As will be readily observed, the spring jacks have but one contact spring, which in its normal position bears against a contact plate common to all jacks. This contact plate serves as an operator's listening circuit, which will be broken by the insertion of a connecting plug. The operation of the system is analogous to the old Law system in its first stages, and analogous to the early annunciator systems in its last stages. Thus, when a subscriber desires to call, he removes his receiver from the hook and at once speaks to the operator through his own line and spring jack. The operator, to call the desired number, inserts a plug in the called-for line jack, say plug *P'*, and with the mate plug, *P*, taps the block, *C*, sending out current through the bell of the desired station. She then touches the plug, *P*, to block, *E*, and then listens for the subscriber to answer, whereupon she completes the connection with this plug, *P*, by inserting it in the line jack of the calling line. This last act disconnects the operator. Annunciators are provided to indicate the desire for disconnection, signified by the return of the receivers to the hooks at the respective stations. The operating disadvantages would prohibit the use of such a system in large installations, while it is only in such installations that the saving in cost of apparatus is important. The patentee of this system is Mr. T. Paul, of Canada.

An Electric Moving Platform Between New York and Brooklyn.

The moving platform from Bowling Green across to Williamsburg Bridge, including a proposed subway from the Battery to Delancey Street, is being pushed as a business enterprise. Schmidt & Gallatin, who are making the proposals for the syndicate, say that three plans were originally made to the Rapid Transit Commission by the syndicate. These were:

1. The city to build the subway and the sidewalk company to guarantee a one-cent fare during rush hours and a two-cent fare for other hours. 2. The city to build the subway and the company to pay to the city 4¼ per cent. on the investment and to obligate itself to make a two-cent fare at all other hours. 3. The company to build the subway at its own expense and be allowed a two-cent fare at all hours.

The third plan is the one now being considered by the Rapid Transit Commission. The plan covers not only the streets but also bridge territory. Mayor Low requested that separate plans be submitted, which has been done. The Rapid Transit Commission has submitted the whole subject to a sub-committee to ascertain and report at an early date on the third plan. The syndicate interested consists of Stuyvesant Fish, George W. Young, Cornelius Vanderbilt and others.

The Daft and Williams System of Electrical Prospecting for Mineral Ores.

Messrs. Leo Daft and Alfred Williams for the past several years have collaborated in working on the problem of locating bodies of metallic ore beneath the earth's surface by means of electricity, and a system devised for this purpose has recently had some successful trials in England in prospecting for lead and zinc ores in Wales, and for hematite in Cumberland. Former systems for this purpose have, as a rule, been merely based on tests of the local resistance of the earth by means of constant currents, and too frequently the variations caused by the earth's connections have led to wholly erroneous conclusions.

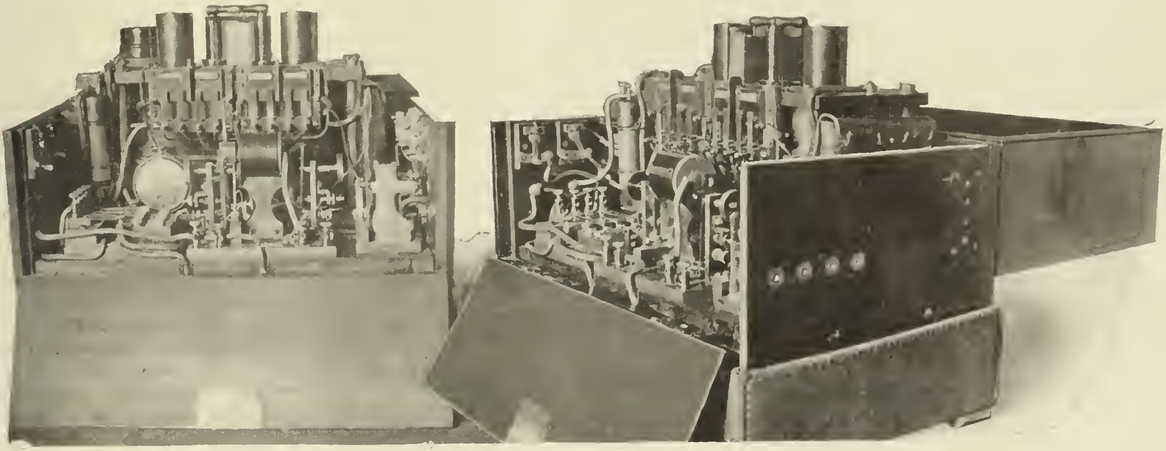
The present system employs the discharge from the secondary of an induction coil to set up an electrical disturbance between two electrodes driven into the earth at a considerable distance apart. For instance, in commencing a survey, 200 yards is a common distance between these two electrodes. With, say, 150,000 volts on the secondary of the induction coil, the effect produced as an earth disturbance can be traced quite a mile away from the electrode. The procedure is then as follows: Two other electrodes, with a telephone connected between them, are used to ascertain the direction of the oscillating currents in the surrounding district. If the earth were homogeneous, the lines of maximum effect, with a given distance between the exporing electrodes, would be as laid down by theory. The presence of a vein of ore, or of a pocket of metallic material, causes disturbance in the symmetrical distribution of the current streams, and these can be traced and located.

The engineer of the Ewmystyth mines in Cardeganshire, Wales, reports that by the use of this system he was able to locate a paying lode of lead and blende ore. These mines have been worked for centuries, and a number of good paying lodes were found to cease suddenly in one direction owing to faults in the formation. Costly attempts to discover these lodes beyond the fault have usually been unsuccessful. In the case mentioned, the two electrodes were placed at a considerable distance away from the broken lode, in unmined ground, and in such a position that a perpendicular through the center of the line joining the two electrodes would coincide with the run of the lode as worked out. The current streams from the one electrode to the other would thus, under normal conditions of homogeneity, pass at right angles through the extension of the lode if it existed beyond the fault. Exploring with the telephone, as explained above, it was found that on the hillside the line of normal current flow was in several places rotated through a very considerable angle. After careful mapping out of the results obtained, the lode was located, and reached after driving through about three fathoms of rock. The old headings were then found to be receding in a direction which was practically an asymptote to the lode, and hence would not have cut it, although very near to it.

In the ordinary way, when exploring a new field, the telephone gives the note of the induction coil, and the lines of flow are determined by moving one of the exploring electrodes round a circle until this note is loudest. Besides this effect, however, the telephone gives evidence of condenser-like discharges betwen large bodies of ore more or less insulated by the surrounding strata. These condenser discharges can be heard when the distance from the induction coil electrodes is so great that the ordinary note is not heard, and they form a great assistance in prospecting. The influence of water in the ground is not such as to prevent the method being employed, and in practically all cases it has been worked in what might be termed water logged strata.

The apparatus used, shown in Figs. 1 and 2, are, with the exception of the induction coil, exceedingly simple in character, and can be moved about by a few able-bodied laborers. The induction coil is especially arranged for the purpose, and has provision made for inserting condensers either in series or parallel with the electrodes. The condensers, which are used at both transmitting and receiving ends, are designed so that their capacity can be rapidly adjusted. As a rule, the current required is obtained from storage batteries, and the number of watts used in the primary of the induction coil may be as high as 120.

The illustrations show the series-parallel switches, adjustable spark-gap, ammeter, primary circuit-breaks, cut-outs (both fusible and magnetic) and the usual primary adjustable condenser in addition to secondary condensers, which latter are made of "cristoleum" immersed in oil. The poles of the U-core project at the top and a pivoted laminated armature enables the operator to vary the reluctances as required, this latter feature being brought into play when the instrument is used as a simple ratio transformer with the primary condenser cut-out. With the latter cut in for secondary static effects, the air-gap is, of course, left open. The primary break shown is only auxiliary, an independent break of high efficiency being also used. While a considerable energy is used in preliminary surveys, the final determinations are usually made with small quantity, so that delicate differences can be appreciated in the telephone. With the latter forms of apparatus the trembler break of the induction coil is replaced by a motor-driven interrupter designed by Mr. Leo Daft, in which the current is interrupted between two contacts under methylated spirits.



Figs. 1 and 2.—Apparatus for Electrical Prospecting for Mineral Ores.

It is stated that the system is singularly accurate in defining the outlines of mineral deposits of what might be called the grosser kind, such as galena, copper pyrites, zinc blende, calamine, nearly all the stannous ores, and even hematite, as established from tests in Wales, Cumberland and Northumberland. With quartz reef gold and similar deposits, the personal equation enters largely into the case, as might be expected.

A Long Electric Road.

The Milwaukee & Southern Railway Company has filed articles of incorporation with the Secretary of State of Wisconsin, its purpose being to construct and operate a railway from Milwaukee to East St. Louis. The motive power is not specified in the articles, but it is understood that an electric line is proposed. The company is capitalized at $50,000.

General Meeting of the American Electrochemical Society.

THE third general meeting of the American Electrochemical Society, held at New York April 16 to 18, was an unqualified success from a social as well as from a scientific and engineering point of view. In every respect it brought out the correctness of Dr. J. W. Richards' closing remarks in his presidential address: "Does not each of us go away from these meetings feeling that he has been sharing in the views of all his electrochemical brothers, and with his mind so filled with suggestions, thoughts and ideas of what may, can and will be done in the near future, that he wishes he had a dozen lifetimes at his command in order to work out to realization this plentitude of ideas? Such is the zeal and ardor which our meetings engender in a high degree, from listening to papers and discussions, by conversations, by simple hand shakes and seeing our friends, and by breathing the invigorating atmosphere of our assemblies."

It will be remembered that the American Electrochemical Society just enters the second year of its life. The New York meeting was, therefore, the second annual business meeting. From the reports presented by the secretary and by the treasurer, it appears that the society is well situated financially in spite of the comparatively low membership fee, and that the membership is steadily increasing, the number being 492 at present, and applications now on file to be acted upon at the next meeting of the board of directors will increase this by another score.

The election of officers did not change the present constitution of the board of directors. Dr. J. W. Richards was re-elected president, Mr. C. J. Reed secretary, Mr. P. G. Salom treasurer; Dr. W. D. Bancroft, Dr. C. A. Doremus and Dr. W. R. Whitney vice-presidents, and Col. S. Reber, Dr. S. T. Sadtler and Mr. C. O. Mailloux managers.

That the good work of the society is recognized by non-members, was evident in different ways, notably from the generous offer made by Mr. A. B. Frenzel, of Denver, Colorado, who proposed the award of $250 for the best paper on the treatment of rare metals, such as molybdenum, varadium, thorium, tungsten, etc. Mr. Frenzel, whose offer was accepted by the board of directors, will supply engineers who intend to take up this problem, with any reasonable amount of ore necessary for the investigation. The award of the prize will be made by the board of directors of the society.

Among the foreign guests of the society at the meeting were Dr. Walther Nernst, the distinguished professor of electrochemistry at the University of Göttingen, Germany, and inventor of the Nernst lamp; Dr. Bussmann, director of the Nernst lamp department of the Allgemeine Electricitäts Gesellschaft, of Berlin, Germany, and Dr. Reisnegger, of Auzsburg, Germany, as representative of the well-known firm of Meister, Lucius & Bruning.

The last edition of the printed list of members and guests who registered at the meeting showed 193 present, but subsequently the number of registered members and guests increased to somewhat over 250.

For the afternoons of April 17 and 18 various visits had been arranged, and the number of places visited including the Sawyer-Man Electric Company, a special exhibit of electrochemical apparatus by Eimer & Amend, the laboratories of Cooper Union, the Willyoung & Gibson Company, the Crocker-Wheeler Electric Works, a galvanizing plant installed at the Brooklyn Navy Yard by the United States Electro-Galvanizing Company, the Edison station at Thirty-eighth Street, the Manhattan Railway Company's power house at Seventy-fourth Street, the Metropolitan Street Railway Company's power house at Ninety-sixth Street, the new Rapid Transit Tunnel at Fifty-ninth Street and Broadway, Columbia College and the New Jersey Zinc Works.

On the evening of April 16 a subscription banquet was held in the hall of the German Liederkranz Society, which was handsomely decorated for the occasioin. It was well attended and an extremely enjoyable affair. Dr. C. A. Doremus acted as toastmaster and the following toasts were responded to: "America, the Electrochemical Center of the World," by Dr. J. W. Richards; "Development of Electrochemical Theories," by Dr. Walther Nernst; "The American Institute of Electrical Engineers," by Mr. C. F. Scott, President of the Institute; "The American Chemical Society," by Dr. C. F. Chandler, of Columbia University, and "Kitchen Chemistry," by Dr. H. W. Wiley, of the United States Department of Agriculture.

On the evening of April 17, the society was the guest of the American Institute of Electrical Engineers, at a meeting held in the College of the City of New York. Over the entrance of the building electric lamps showed the initials, "A. I. E. E." and "A. E. S." An account of this meeting will be found elsewhere in this issue. On the evening of April 18, after the presidential address of Dr. Richards, Mr. Thomas exhibited the Cooper Hewitt rectifier and Dr. M. von Recklinghausen lectured on the mercury vapor lamp. Afterwards an extremely enjoyable German American "smoker" ended this highly successful convention.

The scientific and engineering value of the convention must be judged from the papers and discussions, a concise but complete report of which follows. All the meetings were held in the large assembly hall of the Chemists' Club.

CONSTANT VOLTAGE AND CONSTANT CURRENT SEPARATIONS.

Dr. W. D. Bancroft, of Cornell, pointed out in this paper a general rule of classification for the numerous methods given in text-books on electro-analysis. He called attention to the fact that there are used in practice two essentially different methods for separating metals from other metals; according to one method it is the voltage which is kept constant, while by the other it is the current. The object of Dr. Bancroft's paper was to show why in each case the one or the other method is to be used.

Since the electrolytic separation of two metals depends on the fact that one precipitates at a lower voltage than the other, it would seem as though the proper way to effect a separation is to hold the voltage at a value such that the second metal cannot precipitate. This method has the advantage that the current drops to a very low value as soon as the first metal is completely precipitated, thus giving an automatic indication of the degree of precipitation. As a matter of fact, however, this constant-voltage method is not used in most of the standard separations, which are rather to be classed as constant-current separations, even though the current may not be held absolutely constant. If in such a constant-current method the second metal contained in the solution be prevented from being separated, it is of course necessary that at the end of the separation when the solution gets poor in the first metal, something else is deposited from the solution together with the first metal instead of the second metal; this "something else," which should not change the results, is in practice, hydrogen. The essential supposition, therefore, under which a constant-current separation becomes possible is that the decomposition voltage for hydrogen in the solution used shall lie below the decomposition voltage of one of the two metals. Since most separations were originally made without a voltmeter in circuit, no satisfactory results were obtained until a solution was found which permitted of a constant-current separation, and for this reason all except some of the most recent separations are constant-current separations.

The order in which the different metals and hydrogen are deposited from a solution with increasing voltage, is, therefore, of the greatest importance. Dr. Bancroft gave tables showing the order of the metals deposited from solutions of sulphates or chlorides, cyanides, oxalates, phosphates and tartrates. In another set of tables he gave a summary of the majority of the separations for silver, mercury, copper, bismuth, tin, lead, nickel, iron, cadmium and zinc. If hydrogen is evolved before the second metal, the constant-current method is feasible and is used in practice; otherwise constant voltage must be used. From Dr. Bancroft's tables it appears that this rule is generally correct (with a few exceptions which are explained in the paper) and that the overwhelming majority of the usual electro-analytic separations can be run at constant current without reference to the voltage. Some special points of Dr. Bancroft's paper were discussed by Messrs. Keith, Bigelow, Hering, Reed and Carhart.

EXPERIMENTAL STUDY OF SOME ELECTRODE EFFECTS.

In the absence of the author, Dr. H. T. Barnes, of Montreal, this paper was read by Dr. Bancroft. The author points out that in electrolytic experiments two apparently equal platinum electrodes never behave alike; the same is the case with other metals. The disturbing factor appears to he the air, which is dissolved in the solution, and the presence of air dissolved in the solution seems to be of greater importance even than any air dissolved in the electrodes. Various experimental facts are quoted in support of this view. The paper was not discussed.

THE ELECTROLYSIS OF WATER.

Dr. J. W. Richards and Mr. W. S. Landis gave in this paper the results of a rather extended series of experiments. One of their most interesting experiments was made with a closed vessel, completely filled with the electrolyte. A very thick, strong thermometer tube was used, filled with dilute sulphuric acid, which had been carefully boiled before in order to get rid of the gases. The ends through which the platinum wire electrodes were introduced were carefully sealed. Although an e.m.f. of 3.3 volts was applied, no current whatever was found to pass through the solution, but as soon as the seal was broken the current passed.

The authors then described several experiments made to test Thomson's rule. In one the e.m.f. and current were carefully measured and at the same time the Joulean heat was determined by the rise of temperature, measured with a thermometer. From these data the decomposition voltage was found to be 1.49, in accordance with Thomson's rule. In another set of experiments the cathode was observed by a microscope in order to detect the formation of gas bubbles, while the voltage was gradually raised in steps of 0.05 volt. At 1.45 volt no gas bubbles could be detected, while they appeared at 1.5 volt.

The authors finally investigated the so-called residuary current (Reststrom). Current passes with any applied voltage below the proper decomposition e.m.f., the amount of the current increasing with the voltage. The concentration of the sulphuric acid used makes very little difference, but the amount of the current depends largely upon the quantity of the gases dissolved in the electrolyte. The limit is reached when these gases (which act like depolarizers) are used up; then the proper residual current sets in. The authors further made experiments with the electrodes 8¾ meters apart, and in another case a small fraction of a millimeter apart; in the first case there was absolute conformity with Ohm's law, but not in the latter case.

The paper was discussed at length by Messrs. MacNutt, Hering, Reed, Bigelow, Cowles, Bancroft and Burgess. Mr. Hering doubted the suitability of platinum electrodes for such experiments and would have preferred gold electrodes. Mr. Reed referred to some old experiments of Faraday from which he concluded that above a certain voltage there is electrochemical decomposition, while below this voltage there is metallic conduction. Prof. Burgess gave an account of experiments made by him on the influence of the pressure on the e.m.f. Dr. Bancroft doubted if the experiments of the authors were exact enough to say that Thomson's rule is strictly correct, and added that we have absolute evidence that it is not exact.

EXPERIMENTS WITH METALLIC DIAPHRAGMS.

In this paper Dr. Bancroft describes some experiments in which metallic plates were interposed between the anode and the cathode in a solution. In this case one can have anything between the two extremes, if all, or practically all, of the current passing through the diaphragm and practically none of the current passing. When the diaphragm fills the cross-section completely, all the current must pass through it, and in order to pass a current, an excess voltage, is necessary due to polarization, if the diaphragm does not behave as an absolutely reversible electrode. If the diaphragm does not divide the electrolyte into two detached compartments, no current will flow through it, unless it requires a smaller expenditure of energy than to make the current flow through the electrolyte. Since the resistance of a metal plate is practically always less than the resistance of an equal thickness of electrolyte, current will always pass through an interposed plate unless prevented by polarization. If the thickness of the interposed plate be sufficiently great, the fall of potential in the plate plus the polarization may be made less than the fall of potential in the liquid, and current will then pass through the diaphragm. He experimented with a thick carbon plate interposed between anode and cathode in a copper sulphate solution, in order to find the exact conditions under which there is precipitation of copper on the side facing the anode. When the fall of potential between the ends of the carbon plate, as measured on copper wires dipped in the electrolyte, is less than one volt, there is no precipitation of copper. When the fall of potential exceeds 1.4 volt, there is a rapid precipitation of copper on the end of the carbon plate nearest the copper anode. On passing a current for a long time, there was a slight deposit of copper even when the difference of potential was only 1.1 volts, i. e., below the decomposition value. He then experimented with platinum, and in order to avoid plates of great thickness, he used two movable platinum electrodes connected metallically outside the solution; he had expected that this would be equivalent to a massive platinum bar, but this proved not to be the case. Instead of one electrode being anode and the other cathode, each electrode behaved to a certain extent both as anode and as cathode. The paper was not discussed.

THE PROTECTIVE ACTION OF ZINC CHLORIDE ON METALLIC IRON.

In this paper Mr. C. J. Reed related some facts which he thinks are not in agreement with the dissociation theory. It is now generally recognized that the rusting or oxidation of metallic iron in the presence of water and saline solutions is an electrochemical process, the water or saline solution being the electrolyte and the metallic iron the anode. Small particles of garphitic carbon and other impurities or alloys serve as cathode to form local voltaic circuits. According to the dissociation theory this attack of iron in a chloride solution would be due to the chlorine ions and should take place in a zinc chloride solution in the same manner as in a sodium chloride solution. He found that iron nails placed in a zinc chloride solution did not rust in any case; in strong zinc chloride solutions which had been boiled with metallic zinc and contained no free acid, there was not the slightest action of any kind upon the iron. This paper was the last read at the morning session of April 16. The first paper of the afternoon session dealt with

INSULATING MATERIALS, A FIELD FOR CHEMISTS.

The author, Dr. M. von Recklinghausen, pointed out that chemists are indebted to electrical engineers for the great advantages of the use of electric power and should show their gratitude by studying the problem of devising an electrical insulating material which is good all around. Chemists sometimes offer materials for insulation which may have *one* good property; for instance, may have enormous resistance to the passage of a current, but may be so highly inflammable or may have such a low melting point as to be utterly useless for the purpose intended. The author gave a systematic review of the desirable and undesirable qualities of the prominent insulating materials used nowadays; the desiderata are good insulation resistance, high disruptive strength, and good mechanical properties, especially workability; faults are combustibility, a low melting point, and changes of the electric and mechanical properties, with rise of temperature or with age, and, of course, high price. He briefly reviews the different materials which come into consideration. Of liquid organic compounds oils are the most important; their disadvantage is their combustibility. It has been proposed to use halozen carbon compounds, instead of hydrocarbon compounds. Among the organic compounds used in a solid and more or less plastic state there are varnishes, lacquers, drying oils, rubber, cellulose materials, etc. Most of them have very undesirable qualities. The pure cellulose compounds are probably very good in most respects, and seem to be less affected by heat and less inflammable than other materials of this group; but up to now they are fairly difficult to get into the desired dense mechanical shape. Mixtures of asbestos or mica with varnishes, rubber or similar materials mostly lack flexibility and mechanical strength. Inorganic solid materials, like slate, marble, asbestos, porcelain and glass, lack flexibility. Progress is probable in the line of cements that can be molded, although up to now they seem to be too hygroscopic. A tremendous step forwards would be a material of the flexibility of asbestos and the ideal high insulating and dielectric strength of mica. The paper was not discussed.

A HISTORICAL REVIEW OF THE STORAGE BATTERY.

A paper on this subject was read by Mr. H. B. Coho. As it was a review of the development of the storage battery industry, with brief and concise references to its various phases, it is impossible to give a brief abstract of the paper. In the discussion which followed, Dr. H. S. Carhart related that in 1881 Planté told him he had tried to apply by mechanical means the active material on the plates, but had found such plates did not give as good results as plates formed electrochemically.

THE USE OF PYROXYLINE IN ELECTRIC STORAGE BATTERIES.

A paper on this subject was presented by Mr. Elmer A. Sperry. After some general remarks on the inherent weakness of the positive plates of the lead storage cell, he discussed the use of a pyroxyline envelope which is wound around the plate, passing down one side.

under the bottom of the plate and up the other side. If any active material should be loosened accidentally, it is thus prevented from dropping off, being held in its position by the pyroxyline envelope. This cover is made of open mesh cotton cloth, such as cheese-cloth, which is chemically treated, forming a cellulose nitrate, termed "pyroxyline," of the same general character as gun cotton. Batteries with pyroxyline envelopes have been in continual use for three years and proven entirely satisfactory. The initial difficulties which were experienced in the manufacture of the pyroxyline envelope have been entirely overcome. The paper was briefly discussed by Mr. C. J. Reed. Mr. Sperry remarked that the pyroxyline cannot be used on the negative plate.

THE CONCENTRATION CHANGES IN THE ELECTROLYSIS OF BRINE.

In a paper on this subject, Dr. W. H. Walker discussed the results of experiments recently published by C. T. Townsend in *Electrochemical Industry*. Dr. Walker showed that the results observed by Mr. Townsend can be simply explained by means of the migration of ions, and that the resulting concentration changes can be calculated from Hittorp's transport numbers. At the beginning of the test only the sodium and the chlorine ions travel; but afterwards, when sodium hydroxide has been formed, the HO ions participate in the conduction of the current, and for the numerical calculation it is necessary to take them into account. Mr. Townsend stated that he is not at liberty at present to discuss the whole matter freely, but will do so in future.

THERMO E.M.F. WITHOUT DIFFERENCE OF TEMPERATURE.

In this paper Prof. H. S. Carhart presented a very clear and simple thermodynamical theory of concentration cells and of galvanic cells in general. The Peltier effect is a single example of a very general law; if a current passes through a junction, energy is either given to the circuit or taken from it. The flow of the current produces a difference of temperature. These temperature changes have nothing whatever to do with the Joulean heat. Prof. Carhart pointed out the essential difference in the behavior of a circuit, consisting of metals only, and of a circuit consisting of both metals and electrolytes. He then showed how the Carnot-Clausius thermodynamical cycle can be applied to the theory of a galvanic cell.

THE CORROSION OF METALS BY ELECTROLYSIS.

A long paper on this subject was read by Mr. A. A. Knudson, a portion of which is reprinted elsewhere in this issue. He first took up the subject of electric currents generated in the earth by local circuits formed by different metals in contact with another and with the damp earth acting as electrolyte. An analogous case is the corrosion which often takes place in vessels, due to galvanic action. If, when repairs become necessary, iron patches are bolted over the copper-plated hull of a vessel, corrosion is bound to follow. A still more important case of sea water corrosion due to placing together dissimilar metals, is sometimes found on the propeller shafts of steamers. The author then discussed the electrolytic action of the return currents of electric railways upon gas and water pipes, as well as upon metallic structures, such as bridges, which portion of the paper will be found elsewhere.

The paper was discussed at some length by Mr. Carl Hering, who pointed out that the corrosive effect on pipes depends upon the current flowing in them, and that in very many cases it is absolutely wrong to judge from voltmeter measurements what this current may be. He suggests to measure the current in a pipe as follows: Connect two points of the pipe selected with an ammeter as well as with a voltmeter and take a reading of the ammeter and of the voltmeter; disconnect the ammeter and take another reading of the voltmeter; then the current in the pipe is given by a very simple formula, which may be easily found by using Ohm's law. Mr. Hering suggested to apply the following remedy at such points of iron pipes where electric currents are tending to leave them and thus to destroy them by corrosion. Connect at such places the iron pipes with a block or plate of zinc; then the currents will not pass from the iron directly into the earth, but first into the zinc and the corrosion of the iron is thus prevented; the zinc is of course gradually eaten up. It may pay to prevent the corrosion of iron docks in the same way, by connecting them with a block of zinc. Mr. C. J. Reed mentioned that the same remedy of the use of zinc is being applied and has proven very satisfactory on steamships to prevent the destruction of condenser tubes.

The first paper of the session on April 17 was entitled—

NOTE ON THE COMPOSITION OF ELECTROPLATING SOLUTIONS.

The author, Dr. N. S. Keith, said that in electroplating and electrotyping the anodes should be of the pure metals; otherwise if the impurities be metals electropositive to that which is transferred, they will either enter the electrolyte, thus changing its constitution by the introduction of undesirable salts; or they may, if insoluble, form crusts on the anode, consisting of insoluble and non-conductive salts. The ideal electrolyte wherein metal is to be transferred is a solution of that metal which has no corroding effect on either the anode or the cathode when no current is flowing through the cell. Such a solution may possibly be made; but in operation, when current passes, it can be maintained only with difficulty. The author suggests the use of strong solutions with abundant solvent of the salt formed at the anode and rapid circulation; under such conditions high current densities may be used and deposits are rapidly obtained. The author discusses especially gold and silver plating and finally refers to his process of refining lead base bullion, separating its contents of gold and silver by electrolysis. The general tendency in electroplating solutions in operation is to form oxy salts at the anode. This is undesirable and, if avoided, either by suitably composing the solution, or by properly operating it, the best results will be attained.

In the discussion which followed Mr. H. E. Heath spoke on the use of unipolar machines for electroplating. Mr. C. O. Mailloux then gave an extended and very interesting account of experiments made by him some years ago in the electroplating line; he pictured the metal inertia of the average electroplates. He described how he had developed a plating process by careful and systematic laboratory work and how it became an easy matter to get very good deposits with a current density of 500 amp. per square foot, thus shortening the time of the process very considerably. The paper was also discussed by Messrs. Eddy, Reed, Johnson and Hering.

DETERMINATION OF VAPOR DENSITIES IN THE ELECTRIC FURNACE.

A highly interesting paper on this subject was read by Dr. Walther Nernst, of the University of Göttingen, Germany. The method employed is the classic one of Victor Meyer, which heretofore could not be used at temperatures higher than about 1800° C. It is now possible to use the same method for temperatures of about 2000°, by using apparatus of iridium, which has a melting point of somewhat over 2200°. Heræus of Hanau succeeded in making a small but expensive apparatus. The reading is taken by measuring the motion of a mercury meniscus. Small egg-shaped vessels of iridium are used to contain the substance and the weighings are made on a specially devised torsion balance. From some examples, quoted by Dr. Nernst, it appears that the method is surprisingly accurate. The author's achievement was highly commended in the discussion by Messrs. Bancroft, Backeland and Richards.

NOTE ON ELECTRICAL ENDOSMOSE.

A brief paper was then read by Dr. W. D. Bancroft on electrical endosmose or cataphoresis. The author pointed out the great importance of this phenomenon for scientific as well as technical work. It should not be neglected, as is generally done; it may in some cases be even more important than the effect of the true migration velocities of the ions. It is of importance to know that it is possible by proper choice of the diaphragm to obtain the degree of endosmosis wanted for the special purpose. The paper was not discussed.

IONS AND ELECTRONS.

Dr. Louis A. Parsons, of Johns Hopkins, read a paper in which he gave a review of the work of various investigators, especially J. J. Thomson, which led to the modern conception of electrons, and discussed the relation between electrons and ions. As the first part of the paper was a concise summary of the historical development of the electron theory, and as the second part was highly mathematical, it is impossible to give a brief abstract of the paper. It was not discussed.

UNIFORMITY IN ELECTROCHEMICAL EQUIVALENTS.

A brief paper on this subject was read by Mr. Carl Hering, who suggested that, for the sake of uniformity, electrochemists should adopt a combination of certain values already adopted by authoritative bodies. They are the electrochemical equivalent of silver 0.001118 gramme per coulomb, and the table of atomic weights issued by the American Chemical Society. This leads to a change of a univalent grain ion of 96,538.5 coulombs, or approximately 96,540 coulombs, which is already widely in use. The paper was discussed by Messrs. Bancroft, Cowles and Richards. Dr. Bancroft remarked that from recent measurements of T. W. Richards it seems that 96,000 coulombs is more correct than 96,540.

E.M.F. OF ALLOYS.

A brief note on this subject was then presented by Dr. W. D. Bancroft on the e.m.f. of alloys with respect to one of the two metals. He pointed out an apparent anomaly and explained it by showing that it was due to the fact that in such abnormal cases there is no chemical equilibrium. The paper was not discussed. This was the last paper read at the Friday session.

ELECTROLYTIC PRODUCTION OF METALLIC COMPOUNDS.

A long paper by Prof. C. F. Burgess and Mr. Carl Hambüshen, of the University of Wisconsin, was then read by Prof. Burgess. The authors point out the limitation of the methods at present available and deal with some of the difficulties which must be encountered in large scale working. The suitable design of electrolytic apparatus requires special ingenuity and skill of the designer. The advantages of electrochemical methods over purely chemical methods are pointed out in various special cases. The authors then give an account of an extended series of experiments in which they tested various processes for the production of white lead; they reach the conclusion that there is little chance for the electrolytic process replacing the chemical methods at present. In the production of various other lead compounds, however, there seems to be greater opportunity for commercial application of the electrolytic method, and lead acetate, lead chloride and lead chromate may be produced to advantage by electrolytic methods.

Officers and Guests of the American Electrochemical Society.
(Photographs taken by Cooper Hewitt Light—Three Seconds' Exposure.)

THE ELECTRO-DEPOSITION OF METALS UPON A ROTATING CATHODE.

A paper on this subject by J. G. Zimmerman was read by Prof. Burgess. The result of the investigation is that the use of high-current densities in depositing metals is made possible by the use of rapidly rotating cathodes. The critical current density, i. e., that at which a powdery deposit occurs, is approximately proportional to the speed of rotation. In the case of nickel plating, particularly, this method has great advantages, as it is possible to obtain a much thicker coating of nickel when the cathode is rotated than when stationary. Zinc behaves quite differently from nickel. Increase of current density by means of rotating cathodes is also possible in the case of iron, lead, antimony and silver. The paper was discussed at some length by Messrs. Burgess, Hering, Eddy, Bancroft, Heath and Mott. Mr. Hering suggested that a strong circulation of the electrolyte would have the same effect as rotating the cathode.

ELECTROLYTIC CONDUCTION WITHOUT ELECTRODES.

A paper on this subject was read by Mr. A. B. Marvin. He described several arrangements based upon the principles of dynamo construction and designed to detect electrolytic conduction without any electrodes. The best results were obtained with an apparatus consisting essentially of two alternating-current transformers of somewhat peculiar construction. The primary of the first was excited from a 125-cycle alternating-current power circuit. Its secondary winding, which consisted of a tube of electrolyte, served also as the primary of the second transformer, and the secondary of this second transformer was connected to a telephone receiver. Thus the impulses induced in the core of the first transformer were transmitted through the electrolyte to the core of the second and thence to the telephone. Whether decomposition of the electrolyte takes place is not definitely determined, but probably it does not.

POTENTIALS OF ZINC IN AQUEOUS SOLUTIONS.

A joint paper by Dr. H. E. Tatten and Mr. W. R. Mott, illustrated by a great many diagrams, was read by Mr. Mott. The first part of the paper dealt with single potentials of zinc in various aqueous solutions and one conclusion reached by the authors is that the so-called solution tension of zinc seems to be a "rather elastic quantity." The second part of the paper deals with decomposition points and various methods are discussed.

NOTES ON THE ELECTRO-DEPOSITION OF NICKEL.

A paper on this subject was read by Mr. Woolsey McA. Johnson. The author gives in this paper some extensions of his notes given in a recent number of *Electrochemical Industry*. He discusses at some length the reasons why hot solutions are used in processes. It is quite possible to obtain good deposits from cold solutions, but for certain commercial reasons which are explained by the author, the use of a hot solution is advantageous. In the second part of his paper the author discusses why the use of a hot electrolyte prevents the curling of nickel deposited at high-current density. He suggests that this fact is directly connected with the formation of nickel-hydrogen alloys.

NOTES ON MODERN ELECTROLYTIC COPPER REFINING.

A paper on this subject by Mr. Titus Ulke was read, in the absence of the author, by Dr. J. W. Richards. Mr. Ulke suggests that the managers of copper refineries might profitably adopt the methods of the American iron and steel makers and allow engineers free access to all parts of their plants and thereby encourage a free exchange of ideas and the obtaining of mutual benefits. All the so-called mysteries of electrolytic copper refining may be resolved into certain more or less well-known simple rules of practice. The material at present subjected to profitable electrolytic treatment in electrolytic refineries is invariably a precious metal bearing crude copper cast into anodes, assaying at least 96 per cent. copper and generally refined by fire methods up to 98 or 99 per cent. The initial cathode sheets are invariably thin sheets of electrolytic copper, obtained by deposition upon and stripping from greased, oiled plates of copper or lead. The constantly decreasing acidity and the constantly increasing copper contents of the electrolyte must be maintained within certain limits. Heating the electrolyte up to 40° or 50° C. is advantageous. The author enumerates the various improvements in details made in recent years in American copper refineries. He also gives some statistical data.

NEW APPARATUS.

Mr. A. Eimer exhibited and explained some improved electrochemical apparatus, especially several new forms of electric furnaces.

Two papers, by Mr. P. G. Salom and by Mr. A. H. Cowles, were withdrawn and will be presented at the next meeting. The papers by Dr. J. W. Walker on the influence of some impurities in salt upon the yield of soda by the amalgam process, and Dr. C. W. Volney on the formation of nitric acid under electric influences, were read in title in the absence of the authors.

CONDITIONS OF PROGRESS IN ELECTROCHEMISTRY

The presidential address of Dr. J. W. Richards dealt with this subject. The speaker discussed the subject under the following headings: Discovery of new facts; better understanding of the laws of co-relating facts; more rational theories of the why and wherefore; increasing application of the facts to the welfare of mankind; increasing dissemination of scientific literature, and an increasing vision on the part of the scientist of the possibilities of scientific achievement. The address was received with much applause.

After the presidential address, Mr. Thomas made an excellent presentation of the new Cooper Hewitt static converter described recently in these pages, and showed it in operation transforming three-phase current into direct to run lamps, motor, etc. After this Dr. Recklinghausen made a demonstration of the Hewitt mercury vapor lamp with special regard to its actinic qualities. As an illustration of its use in photography, Electrical World and Engineer then took some photographs. Those shown on page 697 were of 3 seconds' exposure. Others of 8 and 10 seconds were decidedly over-exposed and have not been reproduced here, although in some of them the individual likenesses are superb. The evening closed with a Kneipe given by the Chemists' Club and participated in by about 200 persons.

Lecture of Mr. W. J. Hammer.

On Friday evening Mr. William J. Hammer delivered at the College of the City of New York a lecture before a joint meeting of the American Institute of Electrical Engineers and the American Electrochemical Society, the title being "Radium and Other Radio-Active Substances, with a Consideration of Phosphorescent and Fluorescent Substances; the Properties and Application of Selenium, and the Treatment of Disease by Ultra-Violet Light." The attendance was very large and the greatest of interest was shown in the numerous experiments which Mr. Hammer had devised for the occasion. Since the lecture as issued in printed form by the Institute would cover, with the cuts, about 16 of these pages, only a brief summary of it can here be given.

In opening the meeting, President Scott referred to the American Electrochemical Society as indicating by its name the intimate connection between two branches of sciences and of industry. Electricity and chemistry in many of their aspects may have little in common; but the mystery of electricity and the secret of chemical affinity are not far apart. There is an overlapping field in which there is a new science, a new industry and a new society. He contrasted the slow development of the dynamo, reaching over the span of a lifetime, with the recent development following the announcement of the discovery of Prof. Röntgen. Immediately in laboratories all over the world extended experiments and investigations were begun, apparatus was forthcoming for practical use and within a twelvemonth the Röntgen ray was an important adjunct in many a hospital. This difference is due to a change in the method of doing things, in the method of scientific observation and of scientific generalization on the one hand, and in the facility of the inventor and the engineer to develop and utilize the new material which is put at their disposal. To this must be added as a factor in modern development the attitude of the general public. The scientific observer and the inventor are no longer wizards to be shunned or executed. Science and engineering have done so much in the past that there has come to be a wonderful faith in the future.

On the one hand we marvel at the advance which has been made in science, invention and engineering. On the other hand, we find that in every direction we have only entered upon the fields of nature, which lies before us promising and unexplored. In the production of light and mechanical energy, for example, we are wonderfully in advance of our forefathers, but our present methods are crude and inefficient compared with what we know to be theoretically possible in the transformation of energy if we had but the means. It is, therefore, with a peculiar interest when attention is directed to an unfamiliar subject; that we learn of the wonderful properties of a rare element, and that we direct our thoughts to a new field laden with great possibilities.

Mr. Hammer opened his lecture by describing the Finsen method for the treatment of disease by ultra violet rays. His remarks were illustrated by views projected on a screen, of the apparatus employed by Dr. Finsen, and of portraits of patients before and after treatment, showing the marvelous curative effect of ultra violet rays in cases of lupus.

Next taking up the subject of selenium, Mr. Hammer, after giving a historical résumé, conducted a number of interesting experiments. He described the method of making selenium cells, and showed quite a number of different types. He also explained various methods in which selenium has been employed in talking over a beam of light and in wireless telephony, and the various methods suggested for the use of selenium in seeing at a distance. One of the experiments consisted in the transmission of speech by the aid of the selenium cell. By talking against a pig skin diaphragm, acetylene gas behind the diaphragm is made to vibrate and produce a manometric flame, the light of which when turned upon a selenium cell connected with a telephone reproduces the sound spoken into the gas transmitter. By means of a selenium cell in connection with a battery and relay, a motor was started, a horn blown, a bell rung, a cannon fired, and incandescent lamps lighted, merely by interposing the hand between the selenium cell and a ray of light falling upon it. A 3-hp motor driving a 2-kw generator supplying a bank of lamps was easily started and stopped in the manner described.

Referring to a suggestion that safes could be burglarized by electrical means, Mr. Hammer suggested placing a selenium cell in or near the safe so that the moment light was produced by the electrical or other means employed, an alarm would be sounded; he referred to the probable use of thermite in burglary, this consisting of an oxide of iron mixed with powdered aluminum, which gives rise to an extremely high temperature if magnesium be placed on the top and touched off by a match. He spoke of the use of selenium cells on buoys, by means of which the gas for lighting is turned on automatically at the approach of darkness, and vice versa. He also described the Ruhmer photo-graphophone, views of which were projected on a screen. A gelatin film driven at a high speed is subjected to the action of an electric arc, in the circuit of which is a telephone. Words spoken or sung into the telephone superimpose the telephone waves upon the current flowing in the arc, and cause a corresponding variation in the light of the arc, which affects the photographic film. The film may then be passed at the previous rate between an arc lamp and a selenium cell, whereupon a telephone in the circuit of the latter will reproduce the original sound. Numerous other applications of selenium were described. The cost of the material is said to be $1 per gramme for pure crystalized selenium, the ordinary commercial article costing about 10 cents per gramme.

APPARATUS USED FOR ILLUSTRATING LECTURE.

Mr. Hammer then took up the subjects of fluorescence and phosphorescence, which were illustrated by a large number of experiments, many of which were striking in their effects. The subject led to the consideration of cathode rays and Röntgen rays. In this portion of the lecture Mr. Hammer illustrated an interesting and important discovery which he has made, namely, the production of cathode rays from Röntgen rays, thus reversing the Röntgen ray cycle. By bombarding the outer surface of an Edison Röntgen ray tube, he caused cathode rays to pass within the tube. This was indicated by the tungstate of calcium within the tube becoming brightly phosphorescent, and the fact that the stream could be deflected by a magnet.

A considerable portion of the lecture was devoted to radium, which opened with a historical account of its discovery and of the investigations of its radio-active properties, together with a sketch of its relations with other mineral deposits. He also referred to the properties of various other substances related to radium, such as uranium, actinium, polonium and thorium. Referring to the cost of radium, he gave the figure $2,721,555 per pound as the market rate for the purest grade now obtainable; such a quantity, however, is not in existence, and the material thus far experimented with has been in extremely small quantities.

Mr. Hammer pointed out that polonium and uranium do not possess the power of exciting radio-activity, whereas there is an actual emanation from radium and thorium, which produce radio-activity in surrounding objects. He referred to the discrepancy between a statement of Heydweiller and statements of Becquerel, J. J. Thomson and others concerning the loss of weight of radium. The latter authorities have stated that there is no perceptible loss of weight, and this the former has contradicted. Mr. Hammer says that since Heydweiller printed his denial it has been found that an error during his experiments invalidated his results, and that later experiments he has undertaken point to the correctness of the accepted position of Thomson and others. He said that it is noteworthy that radium rays induce activity which persist, whereas that excited by Röntgen rays ceases immediately on the removal of the rays. He showed an interesting original experiment in which radio-activity imparted to cardboard and tin had been restimulated after it had become too faint to be appreciable to the eye, by burning magnesium wire before the object or exposing it to ultra-violet rays. Mr. Hammer projected on the screen a number of photographs which he has taken of objects by means of radium, which illustrated the penetrative character of the radium rays, the effect of a magnetic field upon certain of the rays, the Röntgen ray characteristics present, etc. Among other things, he showed a radium radiograph of a human hand. The account which Mr. Hammer in his lecture gave of radium and its properties is perhaps the most exhaustive that has yet been printed, and the same is true with respect to selenium. Indeed, the paper is a mine of information on the several subjects which it considers.

CURRENT NEWS AND NOTES.

NEW YORK ELECTRICAL SOCIETY.—The next meeting of the New York Electrical Society will be held at 19 West Forty-fourth Street, New York, April 29 at 8 P. M. Mr. Bion J. Arnold, consulting engineer of the New York Central Railroad, and also of the Chicago City Council, will lecture on "The Rapid Transit Problem in Chicago and Other Great Cities."

LIGHT FOR THE KAISER.—The Kaiser has decided to bring the old palace in Berlin and the new palace in Potsdam up to date as regards modern conveniences, heating and lighting. Hitherto lack of elevators and electric light has been frequently the cause of much discomfort. When the works now in progress are finished the Kaiser's palaces will have all the modern improvements, like a New York flat.

ROTARY CONVERTER CIRCUIT.—A patent issued April 14 to Mr. A. D. Lunt, relates to a means for supplying to the direct-current circuit of a rotary converter a third or neutral conductor. This consists of the application of the Dobrowolski method, but the neutral point instead of being an image on an inductive resistance of the neutral point of the machine, is the neutral point of the secondary of the transformer or transformers supplying the machine. That is to say, in the case of a single-phase converter this neutral point is the middle point of the transformer secondary; and in the case of a three-phase converter the point is the middle point of the combined secondaries of the three transformers.

ELECTRIC CURE OF CANCER.—Dispatches from Vienna say that the news published of the discovery of a new treatment for cancer by means of high-frequency electrical currents has attracted the attention of the Viennese medical and surgical profession, the members of which are always keenly alert for every new idea or fresh development in the science of healing. One of the most prominent clinical surgeons does not consider this latest method as of the first importance. In the course of conversation on the subject he stated that the form of cancer known as epithelioma in the skin had been experimentally treated with Röntgen rays for some little time past in Vienna. It was found that this method had certain beneficial effects in temporarily lessening the malignant swelling. At the same time, however, while the outward manifestation of the malady is alleviated by this treatment, the primary cause remains unaffected, inasmuch as the seat of the disease simply penetrated more deeply into the system.

ELECTRIC FREIGHT IN MASSACHUSETTS.—A bill has just been signed by Governor Bates, of Massachusetts permitting street railroads of the State to carry freight. The Massachusetts Electric Companies, which operates over 800 miles of street railways in the State, will no doubt in time be able to take advantage of this law. As an example of the possibilities in connection with the transportation of freight by street railways, Fall River or any of the large mill cities in which the Massachusetts Electric Companies operates, may be cited. The lines of the system touch all the large mills in these cities and are in a position to handle freight from these mills to Boston or some central point to great advantage at a time when the passenger traffic is light. There are great possibilities in connection with freight transportation by the street railways, but few of the street railway properties are as yet prepared to take advantage of the opportunities. Special plans of this nature have been outlined and attempted for some years past.

U. S. NAVY WIRELESS TELEGRAPHY.—It is stated from Washington that tests to determine the true value of wireless telegraphy as a medium of communication in naval warfare will soon be conducted by the Navy Department off Montauk Point. The exact utility of wireless for a fleet attacking New York City will be demonstrated. The auxiliary cruisers *Prairie* and *Topeka,* both of which have been equipped for wireless experiment work, will take their positions at sea off Montauk Point. At changing distances, invariable weather and with five different types of wireless instruments, they will communicate with each other. Efforts will be made by the land wireless station on Montauk Point to intercept the messages between the warships. The ability of a hostile station, either ashore or on another warship, to intercept, confuse or interpret the messages between warships operating together is the most vital problem in the application of wireless telegraphy to modern naval warfare. Captain Arnold expects to make a thorough exposition of this point.

GERMAN WIRELESS TELEGRAPH APPARATUS.—A special cable dispatch from Berlin states that within a few days the first consignment of portable wireless telegraph carriages will be shipped by the Siemens & Halske Company to Washington, to be employed by the United States Signal Corps for the army. Six carriages will be placed in operation at military forts near Washington, and will be employed in maneuvers. The wagons will be specially adapted for use in mountainous Western regions of the United States. The air wire, which is of fine steel, is elevated by means of a small captive balloon or by a kite, if the weather is favorable. The system employed is that invented by Prof. Braun and used in the last German maneuvers in the presence of Generals Corbin, Young and Wood. Fifteen carriages will be sent in all to the United States and several will be shipped likewise to the Philippines for active service. Two carts will be used, the first containing the wireless apparatus and a rear carriage with a benzine motor. It is proposed to carry wireless messages a distance of 100 km (63 miles). Herr Georg Seibt, director in charge of the wireless department of Siemens & Halske, stated that no greater distance is desired than from 50 to 60 miles in transmitting messages from one corps or point of military operations to another. In a short time all the big armies of the world will be equipped with wireless portable stations, as the firm have orders from France, England, Russia, Belgium, Sweden and many other countries.

WIRELESS TELEGRAPHY ON LONG ISLAND SOUND.—A wireless telegraph station is being constructed at Fort Schuyler, on Long Island Sound, and another will be erected at Fort Fisher, on Fisher's Island, at the northern entrance to the Sound. The towers for the stations are to be of steel and 200 ft. high. The stations are expected to be in working order by the beginning of summer, and when completed they will be operated by electricians in the army service.

ARC LAMP PHOTOMETRY.—The committee on photometric values of arc lamps of the National Electric Light Association, of which Mr. Henry L. Doherty is chairman, is making a very elaborate report of the tests that have been carried on during the past year at Purdue University under the direction of Professors Goldsborough and Matthew. The committee will present at the convention to be held at Chicago May 26, 27, 28 the results of comparative tests of arc, incandescent, Nernst and Welsbach lights, and some very interesting data are expected.

NOVEL MESSENGER SERVICE.—At Toledo, Ohio, Miss Mayme Hartzell, a twenty-year-old girl living with her parents, has opened an office in the Nasby Building and started what she calls the Toledo Messenger Service. She proposes to do business in competition with the American District Company, and her only difficulty thus far has been in securing a sufficient number of boys, so rapidly is her business growing, it is said, owing not only to the novelty of the institution, but to her clever business methods. She is a telegraph operator also. This knowledge she picked up when but thirteen years of age by visiting a railroad office, her father being an employee of the Ohio Central.

VARIABLE-POLE, ALTERNATING-CURRENT MOTORS.—A patent issued April 14 to R. Dahlander and K. A. Lindstrom, of Westeras, Sweden, describes a method of winding alternating-current motors, whereby the conductors may be coupled to vary the number of poles. The conductors or groups of conductors for the several phases follow each other in regular progression around the member on which they are wound, and are connected to form separate windings for separate phases. The winding for each phase is divided into two sections with a terminal connection so arranged that the several windings may be so connected to cause the current to flow in the same direction through both sections of each winding, or the direction of current flowing in one of the sections may be reversed. The claims apply to induction and synchronous motors having drum windings.

ALTERNATING-CURRENT RAILWAY MOTOR.—A double-circuit alternating-current railway motor is the subject of a patent granted April 14 to Sigvald Krohn, of Berlin, Germany, which has been designed to obviate the objection to the general employment of high voltages, owing to danger from a high-potential trolley line in the streets of a town or towns through which a railway passes. The patent describes a motor of special construction, the movable member being provided with both a high-potential and a low-potential winding. When the motor receives current from a low-potential trolley, the high-potential winding is closed upon a variable resistance. On the other hand, when the motor receives current at high potential, the low-potential winding is closed upon a variable resistance; the resistances in either case may be cut in or out to any extent desired or short-circuited. The claims apply to the use of the invention in connection with induction motors.

CONNECTICUT HIGH-SPEED TROLLEYS.—It is reported in New Haven, Conn., that the New York, New Haven & Hartford Railroad Company will convert its Harlem River branch into a high-power electric passenger line, and by connecting it with its trolley system running west from Stamford, Conn., form a fast electric route to compete with the New York & Port Chester Electric Road. Officials of the New Haven road will say only that the project is under consideration. It is expected that the new Port Chester line will make very fast time between Port Chester and New York, and if the New Haven system expects to compete for this local traffic it is said that it will have to put in a first-class electrical equipment along the lines indicated. The Union Railway Company, a trolley line which says it has cut into the New Haven's local traffic to New York from New Rochelle, now complains of the legislation against it at Albany, N. Y., and claims that it is inspired by the New Haven system.

ST. LOUIS EXPOSITION LIGHTING.—Plans for the illumination of the central tower of the Administration Building of the Exposition have been perfected by Chief Electrical Engineer Henry Rustin. The tower will stand out a blaze of light, produced by 6,000 incandescent lamps. The current for this will be drawn from the power plant on the University portion of the grounds. The vertical line of the two hexagonal turrets on the front of the tower will be marked out in lines of light. A line of light will also mark the archway. Between the two turrets a giant American flag, occupying the entire space, in red, white and blue, will wave in the breeze. This effect will be produced in what is known as the Elblight system, in which two heavy cables formed of very thin copper wires are woven into a rope and properly insulated, side by side and touching in parallel lines. The lamp used is provided with two sharp points, which are forced into the cable and form a contact by penetrating between the strands of the wire rope. The advantage of this is that a lamp can be located at any point in the cable without the necessity of a socket. The flag will be supported from an iron cable by rings so that even a slight wind will move it to and fro, giving it a curious effect. The entire composition will have the effect of a giant construction of light supporting the flag. It is the intention to operate this illumination during the entire dedication period.

PHASE TRANSFORMATION.—Among the patents of April 14 are two issued to Messrs. J. F. Kelly and C. C. Chesney, which relate to a method of phase transformation. By this method the circuits of, say, a three-phase generator or the three secondaries of three transformers supplied by three-phase currents can be combined to produce two currents in quarter-phase; or the circuits of a two-phase generator or the two secondaries of two transformers supplied with two-phase currents can be combined to produce three-phase currents. As applied, for example, to a star-wound three-phase generator, one of the three armature windings is separated into two parts, each being in length .366 of each of the two other generator circuits. By a suitable connection of the terminals of these several windings, two-phase currents are derived. It is also shown how in the same manner three-phase currents may be taken from a generator supplied with a two-phase winding. As applied to transformers, two of the three transformers on a three-phase circuit have the usual winding; the secondary of the third winding is divided into two sections, each equal in length to .366 of either of the other two secondaries. By means of switches, the two-phase circuits may be made to correspond to primary three-phase circuits fed either by star or delta-wound generators. A second patent relates to a means for regulation in connection with the above phase transforming method.

SELECTIVE WIRELESS TELEGRAPHY.—Among the patents of April 4 are four on systems of selective wireless telegraph, one being issued to Nikola Tesla and the others to John Stone Stone. There is much similarity between the inventions described, which in both cases have been the subjects of previous patents. In each case the principle consists in transmitting a signal in waves of two or more frequencies, which implies two or more antenna and transmitting circuits controlled simultaneously by the sending key; and the same number of receiving antenna and receptive circuits, each of the latter being tuned to one of the transmitting circuits. A relay connected in common to the two or more receiving circuits can only be actuated when these several circuits respond simultaneously to waves received. As a consequence, no signals will be received unless they are transmitted in multiple waves of the exact frequencies for which the multiple transmitting and receiving circuits are tuned, the result being that the chances of interference are infinitesimal as are also the chances of a message being read at any other wireless station than that for which it is destined. The Tesla patent is the earliest in date of application (July 16, 1900) and relates to means for transmitting simultaneously the waves of different frequencies and the means of completing the conjoint recording circuit of the receiving station. The Stone patents (the applications for which were filed in January and March of the present year) deal with the same subjects, but with much more elaboration with respect to the character of the signals.

NEWS BY WIRELESS TELEGRAPHY.—A special dispatch from London of April 18 says: The *Times*, which for several days past has printed no dispatches received by the wireless system of telegraphy, a service which was inaugurated a few weeks ago, announces that the service has been temporarily abandoned, owing to the breaking down of a subsidiary device employed in connection with one of the Marconi company's stations. The company announces that repairs will shortly be made.

N. E. L. A. SPECIAL TRAIN.—Mr. C. O. Baker, Jr., master of transportation of the National Electric Light Association, is now planning to run a special train from New York to Chicago for the convention in the latter city, beginning May 26; and as a given number of passengers must be guaranteed, it is earnestly requested that all prospective attendants from the East likely to go on the train will send in their names at once to 136 Liberty Street and also mention the matter to their friends.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Resonance Phenomena.—Some editorial notes on Field's recent paper on the study of resonance in the electric circuit, by the aid of oscillograms. He has examined the phenomena experimentally on a large scale, the tests being made in the plant of one of the largest English generating stations. He points out the possible danger of destructive resonance due to the high-frequency harmonics caused by uneven distribution of the armature conductors. The effects of resonance may become dangerous if their possibility is ignored, but in nearly all cases they can be easily avoided. While there is thus no reason for alarm, there is always good reason for making sure that the danger of resonance can be neglected. None of the extraordinary cases shown by Field occurred when there was any appreciable load on the circuit, but only when the generators were merely loaded with the transformers and the cables. The resonance was due to synchronism between the higher harmonics of the potential wave and the rapid oscillatory discharge current between the cable and transformer windings. The effects described by the author point to the desirability of giving preference to alternators whose voltage waves are smooth. The ripples caused by the uneven distribution of the armature conductors can be made negligible by choosing higher engine speeds. The alternators will then have fewer and larger poles, thus allowing a greater number of slots per pole and a better distribution of the armature bars.—Lond. *Elec.*, April 3.

Insulating Paints for Electric Machines.—FARRINGTON.—A paper in which he points out that the use of defective insulating paints or varnishes is the reason of most break-downs of electric machinery, occurring at the present time. An insulating varnish or paint is used for the sole purpose of keeping constant the initial insulation resistance of the cotton covering. He therefore discusses the various points of weakness of cotton covering. He describes a long series of tests which he has made to find a satisfactory insulating material which will preserve the insulating properly of the cotton, and he points out that it should never contain linseed oil, on account of the extreme rapidity with which it absorbs oxygen; it continues to oxidize until it becomes a brittle, cracked mass. Electrical engineers when claiming good ventilation for their machines, should not forget, that well ventilated may also mean well oxidized. No insulating material of acid composition should be used; users of shellac, copal varnish, and linseed oil varnish as insulation have frequently found that the cotton covering of their wire has been turned to a brilliant green, which is a sure indication that the copper has been attacked by the acid and that a radical change has gone on within precincts where chemical changes should be excluded with great care. It is feasible to get a good non-acid insulating material by working in the paraffin series.—*Electrochem. Ind.*, April.

LIGHTS AND LIGHTING.

Life Tests of Nernst Lamps.—STOTTNER, BAILEY, ROBINSON.—Several communications on the life of Nernst lamps in laboratory tests and in actual operation: the Nernst lamps referred to are those made by the General Electric Company of Berlin, which sells the lamps to customers. Stottner (who is an engineer of that company, and recently read a paper before the [Brit.] Inst. of Elec. Eng.), refers to laboratory tests made at the Faraday house; the average life of the Nernst lamp was found to be over 500 hours.—Lond. *Elec.*, March 13. BAILEY had tested Nernst lamps in the laboratory and found the life to average about 300 hours, which agrees with the results obtained by the Reichsanstalt and with the claims of the manufacturers; in these tests the lamps were run continuously. In practical use, however, he and others found the life to be much smaller; "something between 50 and 100 hours seems to be the outside average life that we are obtaining." In the latter commercial tests the regulation is good, never more than 5 volts too high, or under 3 per cent.; there was no considerable vibration. The only explanation which he finds for the shorter life in actual use is that the lamps are frequently turned on and off, whereas the laboratory tests were continuous runs. As the filament becomes completely crystalline after a few hours, it is naturally very brittle and the repeated heating and cooling causes it to snap; it usually breaks at the negative end of the filament. The lamps tested by him were all of the large type, nominally 1 amp., 230 volts, with vertical filament. He states that the small lamps with horizontal filament seem to be doing much better, but that his experience with them has not extended over so long a time.—Lond. *Elec.*, March 20. ROBINSON has found that the automatic cut-outs in the pattern of the Berlin General Electric Company are not sufficiently substantial, and that, generally when there is "no apparent cause" for the failure of the lamp, it is due to the faulty action of the cut-out; the cause being the fusing of the heating coil without the rupture of its protective covering, due to its being accidentally left in parallel with the glower. Another weak point is the resistance holder, which frequently breaks away from the porcelain base. The burner is the place where there is most room for improvements. He tested 186 burners at Harkney, 141 being of the ½-amp. type and the remainder of the 1-amp. type; the lamps are hung on springs from a swan's neck carrier fixed to old gas standards in a street where the traffic is moderate; they are run during ordinary lighting hours and are switched on and off once a day. The declared pressure is 240 volts direct current, and the variation does not exceed 3 per cent. above the declared pressure; the average life of the ½-amp. lamps was found to be 334 hours; that of the 1-amp. lamps 370 hours. He cannot yet state the full life of the regulating resistances. So far only five have failed and they have an aggregate life of 6,665 hours.—Lond. *Elec.*, March 20.

POWER.

Electricity in Mining.—A note on the Tredegar Iron & Coal Company's collieries, situated in the Sirhowy Valley, Monmouthshire, the whole of which are now equipped with electric haulage, the pumping being also done entirely by electric power. The generating plant consists of two 300-hp engines coupled to three-phase generators at Ty Trist Pits, with an overhead transmission line of 2,000 volts to the Bedwellty Pits, a distance of about 1¼ miles. The plant is the largest of its kind in England, and no accident has yet happened there, special precautions having been taken to insure safety, as these pits are somewhat fiery.—Lond. *Elec.*, March 13.

TRACTION.

Interurban Electric Railways.—GONZENBACH.—A continuation of his serial on engineering preliminaries for an interurban electric railway. He discusses the transmission line, the distributing system and the third rail. Two absolutely independent pole lines are recommended and it is proposed that each follow its own route to the end of the line. It is also recommended that the poles be spaced 132 ft. apart, 40 to the mile, and that the average height be 35 ft. In very few cases in cross-country roads they will be obliged to be as high as 50 ft. The practice of using wooden pins boiled in paraffin for their insulating properties, is being gradually abandoned and dependence placed entirely on the insulator itself, which is generally made of porcelain to stand a voltage as high as 33,000, although glass insulators have been used on lines carrying 40,000 volts. Instead of adopting a systematic spacing of sub-stations along the line, the writer proposes that they be placed regardless of any uniform distance and as near the center of towns as the limitation imposed by a high tension line and the extent of real estate will permit. The object of this arrangement is to employ them as electric light and power stations for the places in which they are located, as well as for passenger, express and freight depots, and also to permit the company to have a representative at each of these places to handle the business on practically the same lines as on steam roads. The plans for an interurban station along these lines is presented and its advantages explained. Shunt-wound rotaries having a considerable drop in their characteristic curves between full load and 100 per cent. over load, are recommended, as they can properly handle the load imposed where there are several cars near one station. As sub-stations will also act as distributing centers for lighting and power, a motor generator set should be added. This should consist of a 60-cycle, 2,200-volt, two or three-phase generator, directly connected to a synchronous motor. The conductivity of the third rail as compared with copper is discussed in determining the size of the rail and some of its details. At highway crossings the third rail has to be interrupted, and the car drifts across. The writer proposes that the third rail be extended into the public highway and protected by a high fence and an automatic cut-out, leaving it dead except when a car passes over it. A passageway for teams could be left 25 ft. wide, and this could be easily spanned by the shoes of the car so that the lights will remain burning.—*St. R'y Jour.*, March 28.

Economy of Rural Railways.—An editorial discussion, with reference to the report just issued by the railroad commissioners of one of the New England States, showing that the rural railways in that State were doing little more than paying fixed charges, and that no dividends had been earned. This is not considered necessarily an evidence either that the railways are badly managed or unwisely built. A considerable number of roads are built largely on the proceeds of the sale of their bonds, so that return on the capital stock is often pure profit. It is believed that the return on the cash investment would usually show a fair profit. In addition the editors refer to the fact that many roads are built for summer traffic only and that there is very little profit in such a business. Such a road should not only keep expenses down, but should endeavor to build up a freight, mail and express business.—*St. R'y Jour.*, April 4.

Interurban Map of Wisconsin.—A map showing the electric interurban lines already built and those under construction in the State of Wisconsin. The most important center of interurban communication in that section is Milwaukee. Lines extend from that city to Waukesha, Pewaukee Lake, Kenosha and thence to Waukegan. The next important district is in the Fox River country, while in the southern part of the State several roads centering in Rockford, constitute another field. There is also a line from Madison to Fond du Lac.—*St. R'y Jour.*, April 4.

London.—A note on a recently-opened extension of the London United Tramways Company. The new section is seven miles in length and is fed from a sub-station at Tulwell. Current is supplied to the sub-station from the powerhouse at Chiswick by means of three-core, three-phase cables with 5,000 volts on each phase; at the sub-station the voltage is reduced to between 410 and 450 and six-phase synchronous converters change the current to between 500 and 550, direct-current. There is also in the sub-station a booster in circuit with the insulated return from the rails, whose fields are excited by the positive feeder, and which is motor-driven. In the other sub-stations these boosters will be driven from the shafts of the synchronous converters. Current for lighting the sub-station is taken from a separate 10 to 1 transformer and the lamps are wired five 100-volt lamps in series, so that should the alternating current fail, they may be worked from the line. In the powerhouse a new 1,000-kw steam-driven, 5,000 volt star wound generator has been installed, the frequency being 25 periods per second.—*Lond. Elec.*, April 3.

Ilford.—A note on the new Ilford tramways. There are altogether 4 miles of double and 2½ miles of single track, forming three distinct routes. The gauge is 4 ft. 8½ in. and the rails 100 lbs. to the yard. The feeders consist of lead-covered cables drawn in pipes under the footpath and have a cross section of 0.35, 0.25 and 0.15 sq. in.; the 0.35 reduces down to 0.25 and then to 0.15 at different distances along its length. There is a 0.5 insulated return to which the rails are connected at frequent intervals. Power is supplied from the lighting generators, which are compound wound, and give 500 volts, but only 400 when the shunt winding alone is excited.—*Lond. Elec.*, March 13.

REFERENCES.

Multiple Unit Systems.—An editorial note on the subject of multiple unit systems operating on low voltages. Where the system depends upon the action of magnets, some difficulty may be experienced in operating with a low voltage and this should be guarded against.—*St. R'y Jour.*, April 4.

Handling Freight on Interurban Electric Lines.—HAWKS.—A communication contending that the idea of operating electric lines as competitors of steam railroads for handling freight, is entirely erroneous. He believes that the electric roads should occupy an entirely different field from the steam lines, and he points out where each has its advantages.—*St. R'y Jour.*, April 4.

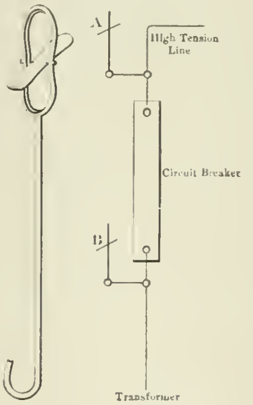
Freight Traffic.—An account of the methods employed by an agent of the Rockford Interurban Railway Company in developing freight and passenger business.—*St. R'y Jour.*, April 4.

Municipal Ownership in Germany.—HEYN.—An article on recent history of the municipal ownership of street railways in Germany. Of 133 German cities, 18 own their own street railway systems. A list of these cities is given. German cities are increasing the number of enterprises in which the municipality engages. A short sketch is given of the attempt of the city of Berlin to secure the system of the Grosse Berliner Strassenbahn.—*St. R'y Jour.*, March 14.

Canal Hauling.—A well-illustrated article on the three-phase system installed on the Miami & Erie Canal, which connects the Ohio River at Cincinnati with the Lake Erie at Toledo.—*St. R'y Rev.*, March.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Current Indicator.—An illustrated description of a simple device of Gavotti and Senni-Guidotti for always indicating whether a certain part of a line is under current or not. It is formed of nickel-plated iron wire with a hook at the lower end and an oval ring at the upper end; in the center of the latter a thin aluminum plate is mounted which can easily revolve around its axle, as shown in the figure. One-half of it is slightly heavier than the other half, so that in general the plate will be in a vertical position. If it is, however, placed at the side of a conductor through which a current flows, the plate tends to occupy a horizontal position, due to "electrostatic effects." The diagram shows two such devices mounted at the ends of a circuit-breaker. If the device, *A*, is in the horizontal position and *B* in the vertical position, it means that the circuit-breaker has acted. If both *A* and *B* are horizontal it means that the current passes through the circuit-breaker.—*L'Ind. Elec.*, March 25.



CURRENT INDICATOR.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity.—CURIE AND LABORDE.—A French Academy paper on the heat developed spontaneously and continuously by the salts of radium. A thermo-electric couple of iron and constantan, one of whose junctions is surrounded by radio-active barium chloride, indicates a difference of temperature between the two bodies. One gramme of radium discharges an amount of heat which is of the order of 100 gramme calories per hour (about 1-9th watt). One gramatom of radium (225 grammes) would discharge during every hour 22,500 calories, a number which is comparable to the heat produced by the combustion in oxygen of 1 gramatom of hydrogen. The continuous development of such an amount of heat cannot be explained by an ordinary chemical transformation. If we look for the origin of the production of heat in an internal transformation, this transformation must be of a more profound nature, and must be due to a modification of the radium atom itself; such a transformation, however, if it exists at all, takes place with extreme slowness. The hypothesis of a continuous modification of the atom is not the only one compatible with the disengagement of heat by the radium. This disengagement of heat may also be explained by supposing that radium utilizes an external energy of an unknown source.—*Comptes Rendus,* March 16; abstracted in Lond. *Elec.,* April 3.

Crookes.—A communication in which he suggests the following hypothesis on the origin of the energy given off by radio-active bodies. He draws attention to the large amount of energy locked up in the molecular motions of quiescent air at ordinary pressure and temperature, which, according to some calculations by Stoney, amounts to about 140,000 foot-pounds in each cubic yard of air. He conjectures that radio-active bodies of high atomic weight might draw upon this store of energy in somewhat the same manner as Maxwell imagined when he invented his celebrated "demons" to explain a similar problem. He suggests that the atomic structure of radio-active bodies is such as to enable them to throw off the slow-moving molecules of the air with little exchange of energy, while the quick-moving missiles would be arrested, with their energy reduced and that of the target correspondingly increased. The energy thus gained by the radio-active body would raise its temperature, while the surrounding air would get cooler. To a question of an anonymous correspondent asking whether sodium should not cease to display its peculiar properties in a vacuum, Crookes answers that what we call a high vacuum is only a vacuum by courtesy; a glass bulb, 5 in. in diameter and exhausted to the millionth of an atmosphere, still contains more than a trillion molecules.—Lond. *Times,* reprinted in Lond. *Elec.,* April 3.

Electric Properties of Gaseous Mixtures.—Bouty.—An account of an experimental investigation of the effect of the electric discharge or "effluvium" upon gases. It is incapable of changing the physical or chemical constitution of the gas through which it passes. It does not explode an explosive mixture, nor does it produce an appreciable change in the pressure of the gas. He has also investigated the dielectric strength of mixtures of hydrogen with various other gases, confining his experiments to pressures above several millimeters of mercury. In one class of mixtures the critical field is the exact mean of the critical fields of the gases taken separately at the pressure of the mixture. Another remarkable case is the decided reduction of the critical field in a mixture of hydrogen and carbon dioxide.—*Comptes Rendus,* March 16; abstracted in Lond. *Elec.,* April 3.

The Metals and Maxwell's Theory.—Hagen and Rubens.—Maxwell's theory has hitherto been in contradiction with the fact that the series of metals arranged according to transparency is not the same as the series arranged according to resistance. Hagen and Rubens have, however, now found that the theory is strictly verified in a region of wave lengths where the natural vibration of the metallic molecules does not influence the result. At the greater wave lengths, platinum becomes distinctly more transparent than gold and silver, and bismuth, which intercepts 99.9 per cent. of ordinary light, intercepts only 90 per cent. of waves 4,000 $\mu\mu$ long. The transparency of these metals for long waves, cannot easily be observed since no carrier exists sufficiently transparent to bear the thin metallic sheets without disturbing the result. The authors, therefore, studied the reflective power of the metals in the shape of cast concave mirrors, 30 cm in radius and 4 cm in aperture. They found that as soon as the wave length becomes as great as 12,000 $\mu\mu$, the molecular vibrations of the metals are without any influence, and the transparency series is the same as the resistivity series. The magnetism of iron and steel cannot follow a frequency of 2.5 x 10 to the thirteenth power, vibrations per second, and so these metals also fit into the series.—*Sitzungsber Akad., Berlin,* 13. 1903; abstracted in Lond. *Elec.,* April 3.

Dielectric Constants of Liquids.—Tangl.—An account of observations extended over a wide range of temperature. The Clausius-Mossoti formula depends upon the temperature, and the present author has, therefore, investigated whether the formula could be used as an index of chemical change, more especially in view of the parallelism between dielectric constant and degree of dissociation indicated by Nernst. The results show that Nernst's method is available for certain temperatures ranges and materials; others show an anomaly in their dielectric constant at the critical temperature, it being still much greater than the square of its refractive index for infinitely long waves.—*Ann. d. Phys.,* No. 4; abstracted in Lond. *Elec.,* April 3.

Magnetic Susceptibility of Water.—Stearns.—An account of an experimental investigation in which a new determination of the magnetic susceptibility of water at 22° C. was made. It was found to be between —0.000000715 and —0.000000750, C. G. S. units, while the results of former determinations vary between —0.00000066 and —0.00000086. The great discrepancies between the results of the different observers have not yet been explained.—*Phys. Rev.,* January.

ELECTRO-CHEMISTRY AND BATTERIES.

Artificial Graphite.—Fitzgerald.—A summary of the artificial graphite industry in 1902. The manufacture of graphite electrodes was not so large in 1902 as in the previous year, but the number of works in which the artificial graphite electrode is used has increased, as certain valuable properties have been recognized which were not fully appreciated before; among these are the resistance of graphite electrodes to oxidation when heated in the air, its high electrical conductivity, and the ease with which it can be machined. A new patented method for graphitizing electrodes is described in which most of the heat is developed in the higher resisting material placed in the spaces between the electrodes; the advantage of this method is that large furnaces can be used and yet the resistance kept sufficiently high to avoid the use of currents of very high amperage. A new patent process of making other forms of graphite is also described; it is based on metallic vapors acting upon amorphous carbon at the high temperature of the electric furnace; oxide of iron is reduced and the vapor of metallic iron acts upon the amorphous carbon, converting it into graphite. The manufacture of paint from artificial graphite has increased considerably, for it is now recognized that a greater purity and uniformity can be obtained than is possible with a natural product. The most marked increase has been found in the use of graphite for dry batteries. It is only within the last year that the problem of producing an artificial graphite lubricant for high-grade work has been successfully solved. The spontaneous ignition of high explosives is supposed to be caused occasionally by a static charge of electricity on the grains, thus causing a spark which detonates the powder; by coating the grains with graphite the formation of this static charge is prevented.—*Eng. & Min. Jour.,* March 28.

Use of Carbide of Silicon.—An article on the use of carbide of silicon, as a substitute for ferro-silicon, in the manufacture of steel. To insure solid castings, there should be a higher silicon content than can be secured from pig iron that comes within basic requirements. The addition of ferro-silicon causes difficulties, while carbide of silicon, containing 62 per cent. of available silicon can be added directly to the ladle during the process of tapping and without previous heating; uniform action is secured and complete solution generally takes place by the time the ladle is full. It is also used extensively in making steel for various purposes when it is first run into ingots, and in which there is much less silicon than in steel castings, amounting generally to but a trace. Manufacturers of tool steel have found that the freedom of carbide of silicon from phosphorus and sulphur offers great advantages, and it is, therefore, used in considerable quantities in the open hearth practice of such manufacturers and to some extent in crucibles. In the acid open hearth process carbide of silicon is also used for cleaning dirty furnace bottoms, as it readily reduces the residue to fluid slag, which is easily removed from the hearth.—Cleveland *Iron Trade Rev.; Eng. & Min. Jour.,* March 28.

Acetylene Dissolved in Acetone.—Hutton.—An article on a recent method introduced by a French company for storing acetylene gas so that there is no danger of an explosion. The acetylene is dissolved in acetone; but as this dissolution is accompanied by a considerable increase of volume, a free space would be formed in a cylinder containing acetylene dissolved in acetone when the gas is drawn off for use; this free space would then be filled by acetylene gas and there would again be danger of an explosion. This disadvantage is said to be entirely overcome by filling the cylinder with a porous material, such as porous bricks or specially prepared cement of a low density and of high porosity. The gas may then be stored under pressures without the least fear of an explosion.—*Electrochem. Ind.*, April.

Voltameters with Platinum Electrodes.—Bartorelli.—A study in detail of the polarization and resistance of voltametric cells consisting of platinum electrodes dipping into a more or less concentrated solution of sulphuric acid. He finds that the polarization increases with the current, but not in proportion to it. A maximum is attained and is maintained for all higher values, a result which is of importance, with regard to the ionic theory. The value of the maximum polarization varies from 2.7 to 2.9 volts from a concentration of 1 per cent. to a concentration of 15 per cent., and is, therefore, nearly constant. The conductivity also shows a very similar behavior, also with a constant maximum. In the case of platinum as well as aluminum electrodes, the resistance at high values depends almost exclusively upon the surface of the electrodes, and the variations are, therefore, properly of the surface of the electrodes, and may be called resistances of transition.—*Phys. Zeit.*, March 15; abstracted in Lond. *Elec.*, March 27.

Aluminum.—J. B. C. Kershaw.—A statistical article on the present state of the aluminum industry. The number of plants where aluminum is produced either by the Hall of by the Heroult process, is at present nine: America, 3; France, 2; Germany, Great Britain, Switzerland and Austria, each 1. The total power available in these is between 30,000 and 40,000 hp, all of which is water power. The total combined output is estimated as 7,240 tons in 1901 and 8,000 tons in 1902. Some information is given on the financial conditions of the various companies and the dividends paid by them.—Lond. *Elec. Rev.*, March 20.

REFERENCES.

American Automobile Batteries.—A continuation of the illustrated serial in which descriptions of the Madigin battery and of the Clare battery are given.—*Electrochem. Ind.*, April.

Concrete Tanks.—Browne.—An article on tanks suitable for use in the electrolysis of chloride solutions. While slate tanks are satisfactory, they are expensive and require much care in installing. He has found concrete to be an efficient substitute for slate and describes in detail how to make them.—*Electrochem. Ind.*, April.

Copper Process.—Johnson.—An illustrated detailed description of the plant of the International Copper Company, at Dorchester, Canada, and of the Carmichael process for producing copper from its ores, used at this plant.—*Electrochem. Ind.*, April.

Aluminum Bronze.—Sperry.—An article on the good forging properties of aluminum bronze.—*Metal. Ind.*, April.

Direct Combination of Chlorine with Carbon.—Bolton.—A brief note supplementing the results given in a former paper. If the carbon arc is formed in a chlorine atmosphere in a large space, C_2Cl_6 is formed; if, however, the reaction takes place in a confined space, C_6Cl_6 is formed.—*Zeit. f. Electrochem.*, March 5.

Antimony.—A description and critical discussion of the Izart and Thomas process for the production of antimony from the ore.—*L'Ind. Electrochimique*, March.

Metallurgy.—Schnabel.—A summary for the year 1902 of the progress made in various metallurgical processes, more especially for getting from their ores gold, silver, copper, lead, zinc and nickel. The descriptions are mostly brief and are taken either from articles in other journals or from patent specifications.—*Glueckauf*, February 28.

Calcium Carbide.—Caro.—A long critical discussion of the process patented by Diester.—*Zeit. f. Calciumcarb. Fab.*, March 20.

Electric Iron and Steel Processes.—Simpson.—An article in which he discusses, from a commercial standpoint, the electric reduction of iron ores and the conversion of iron into steel in the electric furnace. The conditions under which such a process may be a financial success, are pointed out.—*Electrochem. Ind.*, April.

Electric Steel Furnace.—Becker.—An illustrated description of the Kjellin electric furnace for making steel, in use in a Swedish plant.—*L'Ind. Electrochimique*, March.

Units, Measurements and Instruments.

Potentiometer for Thermocouple Measurements.—Lehfeldt.—An abstract of a Brit. Phys. Soc'y paper in which he describes the construction of a potentiometer for thermo-electric work. For such purposes it is essential that the potentiometer shall not introduce a high resistance in the circuit of the couple and galvanometer; most of the potentiometers in the market fail in this respect. In his apparatus the current flows from the positive terminal of an accumulator to a switch by means of which it can be sent through 100, 1,000 or 10,000 ohms, in order to get three grades of sensitiveness; it then passes through 20 coils of 0.1 ohm each, a slide wire of a little more than 0.1 ohm, and through an adjustable resistance back to the accumulator. The fixed resistance of 100, 1,000 or 10,000 ohms is shunted by a cadmium cell and a galvanometer, and the adjustable resistance is varied until balance is obtained. The thermocouple and the galvanometer are then just across any number of the tenth-ohm coils and any fraction of the slide wire. Great care has been taken to avoid accidental thermo-e.m.f's which are the chief trouble in using thermocouples. The only metals used in the measuring circuit are copper and manganin. The position of the sliding contact upon the bridge wire can be read by means of a vernier to one-fortieth of a millimeter, corresponding to one-four-thousandth of the unit used, which may be 1,000, 100 or 10 microvolts, according to the fixed resistance used.—Lond. *Elec. Rev.*, March 27.

Harker.—An abstract of a Brit. Phys. Soc'y paper in which he describes an instrument similar to that noticed in the above abstract. The main current from an accumulator flows through a series of resistances, any one of which can be short-circuited at will, and then through the balancing coils. By means of the adjustable resistance the standard cell employed can easily be made to cut off from the main circuit a resistance numerically equal to 100 times its e.m.f., and therefore 1 ohm on the potentiometer circuit is always equal to 0.01 volt. The balancing coils consist of 20 coils of 0.1 ohm each in series with 11 coils of 0.01 ohm each. Any two of these latter coils can be put in parallel with a slide wire of 0.02 ohm resistance. The slide wire is provided with a scale of 200 divisions, and as the fall along the wire is 100 microvolts, 0.1 microvolt can easily be estimated. The slide wire acts as a vernier to the small coils. Copper and manganin are the only metals used, and the connections are made by means of mercury cups. In the discussion, Price referred to the large number of coils requiring calibration in the instruments of Lehfeldt and Harker. In working with sliding contacts in a dusty workshop it is an advantage to immerse the bridge in paraffin oil. The contacts are then always good instead of uncertain and intermittent.—Lond. *Elec. Rev.*, March 27.

Resistance Comparator.—Lehfeldt.—An abstract of a Brit. Phys. Soc'y paper in which he objects to sliding contacts on account of the thermo-electric effects they tend to introduce, and on account of the irregularities which slide wires tend to show when used frequently. He has substituted for the slide wire two coils, each of 99 ohms, each one is connected with 20 coils of 0.1 ohm each. The latter are arranged circularly, so that a switch connected to the galvanometer may be set on any one of the intervening studs. The galvanometer deflections are taken for the two positions nearest to the balance, and he interpolates between these. In this way an accuracy of one part in 100,000 is attainable. He thinks there is a gain of accuracy as well as of convenience in using the interpolation method.—Lond. *Elec. Rev.*, March 27.

Miscellaneous.

The Mercury Vapor Lamp for Eye Investigations.—A note on some observations made by Mayou, who, by means of the Cooper Hewitt lamp, examined a number of fundi, both normal and diseased. When examining the fundus of the eye by ordinary light, the large number of red rays reflected from it tend to mask some of the detail, and this is especially the case in diseases of the retina and with the fine terminations of the arteries. In examining the fundus with the mercury vapor lamp, he found that the "back ground" appears pale green instead of the usual red, the vessels appear purple, standing out with unusual distinctness, and the arteries, being of the same color as the veins, can be traced to their finest ramifications. The choroidal vessels are of a deeper purple, and over the whole the retina can be seen glistening, being especially well marked along the arteries and veins. The optic disc appears with a white center and green edges. He thinks that the mercury vapor lamps should be of considerable utility in the differential diagnosis of retinal and choroidal disease, since the perspective of the retina, choroid and sclera is very clear.—Lond. *Elec.*, April 3.

Institution of Electrical Engineers (Brit.)—The new president to succeed James Swinburne, is R. K. Gray, the director of the Indian Rubber, Guttapercha & Telegraph Works Company. He will represent the Institution at the forthcoming International Telegraph Conference.—Lond. *Elec.*, April 3.

REFERENCE.

Electric Igniters.—Salomons.—The first part of a long article in which he discusses the various methods of electric ignition in gas engines.—Lond. *Elec. Rev.*, March 27.

The Cascade Water, Power & Light Co , Cascade, B. C., Canada.

By W. G. McConnon.

The Cascade Water, Power & Light Company, situated at Cascade, B. C., and owned by the London & British Columbia Goldfields Company, Limited, has recently completed a water power electrical plant representing an investment, in round numbers, of $500,000. Cascade is a small town on the Kettle River, twelve miles east of the town of Grand Forks, and about thirty miles directly west from Rossland, B. C. Flowing from the west the Kettle River descends 120 ft. in passing through a half mile of narrow rocky gorge in a series of rapids and falls. For the utilization of this natural power, the Cascade Water, Power & Light Company has built a large dam, waterway, pipe line, power house and transmission line from Cascade to Phoenix, where the largest and most productive copper mines in the "Boundary District" are situated.

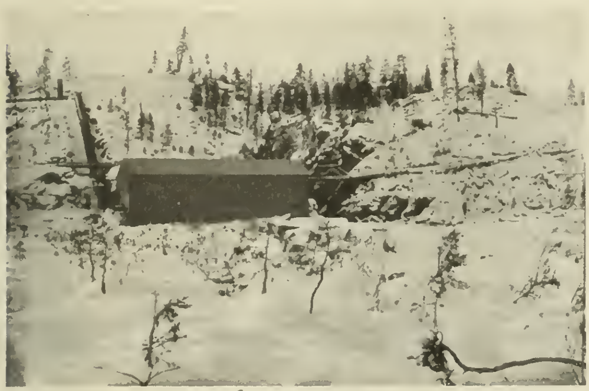


FIG. 1.—EXTERIOR OF POWER HOUSE, SHOWING PIPE LINE.

The dam, placed just above the entrance to the gorge, is of timber cribwork, with a 40-ft. base and 24-ft. top. The mid-section is 50 ft. high, tapering to 25 ft. at the sides, while the total length is 400 ft. This is built on a solid rock bed to which the foundation timbers are bolted, and filled with 10,000 cubic yards of rock. This dam raises the water 36 ft. above the natural level, giving an effective head at low water of 156 ft.

The permanent water level is 10 ft. below the top of the dam, being controlled during high water by twelve sluiceways, which can be opened to 12 ft. below the natural river level, giving a passway of about 2,000 sq. ft. These sluices are closed by means of 12-in. x 12-in. squared timbers in grooves, operated by a traveling winch running on a track over the top of the dam.

From dam to power house the water first passes through a 225-ft. open rock cut from which it enters a tunnel driven through 410 ft. of solid rock, passing under the track of the Canadian Pacific Railway, and then into another open rock cut 500 ft. in length, at the end of which the bulkheads and controlling gates are located. These cuts and tunnel, representing an excavation of about 35,000 cubic yards of rock, are of dimensions liberal enough to avoid any appreciable loss of head, delivering the water with a head almost equal to that at the dam level.

From the gates the water is conveyed through a wooden pipe 7 ft. in diameter, for about 1,400 ft. This pipe is constructed of Oregon fir tongued and grooved staves 2¾ in. x 7 in., cut in circular segments and machined to the radius of the pipe. The staves are hooped at 12-in. intervals, with ¾-in. round steel bands, with cast-iron connecting shoes for clamping. Provisions have been made at the bulkhead and in the width of the cut for the installation of a similar and additional pipe.

From the stave pipe the water is carried through 250 ft. of circular steel pipe, 7 ft. diameter, resting on concrete piers and anchored into solid rock to avoid end thrust. Where this pipe passes alongside of the power house, three 4-ft. pipes and one 2-ft. pipe are taken off below the floor level of the power house to supply three 36-in. turbines for generators and two 12-in. turbines for exciters.

Fig. 1 is a general view of the power house showing the stand pipe at the junction of the stave and steel pipes. This stand pipe relieves the pipe line from excessive water-ram strains, and incidentally voids any air taken into the pipes. About 10,000 cubic yards of rock were removed for the site of the power house, in a natural bay at the foot of the falls. This building is of substantial fire-proof construction, 150 ft. x 50 ft., with stone foundation 22 ft. deep on the lower side, and brick walls 30 ft. above floor level, the height to peak of roof being 45 ft. It has been designed with a view to lengthening it when required.

Figs. 2 and 3 show the interior of the power house, and the generating plant. The three generators are standard Westinghouse, three-phase, two-bearing, direct-coupled, 2,200-volt, 750-kw. at 80 per cent. power factor, or 940 kw at 100 per cent. power factor, 60 cycles per second, 300 r.p.m. The two exciters, each capable of exciting all three generators at one time, are 45-kw, 120-volt, shunt-wound dynamos, self-contained, two-bearing type, direct-coupled to independent turbines, with 500 r.p.m. The turbines are H. Morgan Smith wheels made at York, Pa., and the governors of the Escher-Wysse make, from Switzerland.

Fig. 3 shows the transformers, nine in all, three in each bank, which are the standard Westinghouse, self-cooling, oil-insulated type, having a capacity of 250 kw at 80 per cent. power factor, or 312½ kw at 100 per cent. power factor, star connection, and wound for a ratio of 2,000 to 20,000 volts, on both high and low-tension windings, with full load efficiency of 97.6 per cent. As the taps are brought out near the neutral point, which is grounded, it is impossible to maintain a dangerous voltage in the auxiliary circuit.

The current from the high-tension side of the transformers is carried to a row of high-tension fused circuit-breakers, situated alongside of the building behind the main switchboard. These switches are placed on independent marble slabs, with marble barriers between. The current leaving these switches enters a high-tension bus and is carried to the line switches at the rear of the building. These line switches are grouped switches opening all three wires at the same time. Each switch is furnished with a time limit tripping device, and reversed current tripping coils, so that overloads can be carried for a period of from one to ten seconds, as the local conditions call for, or either line can be cut out automatically in case of trouble.

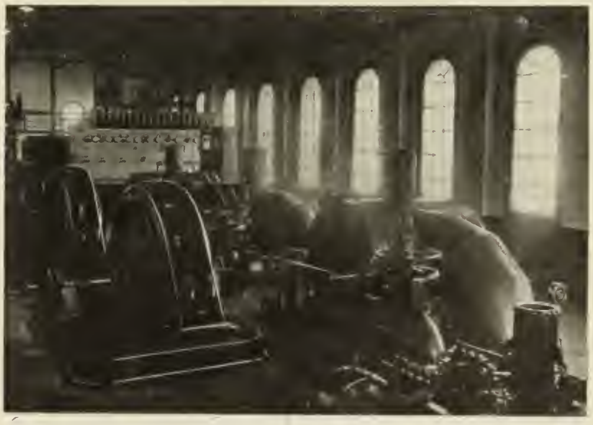


FIG. 2.—INTERIOR OF POWER HOUSE.

The switchboard for the low-pressure side consists of seven panels of blue Vermont marble, one panel for each generator, one for the two exciters, and a feeder panel for each group of transformers. The six lightning arresters, located just above the switches in the gable of the roof, are the "low-equivalent" style of Wurts arrester, giving protection against lightning discharges for transmission at 20,000 volts.

A right of way 132 ft. wide is cleared, and transmission lines erected from Cascade via Grand Forks to Phoenix, a distance slightly over 21 miles. The high tension circuit consists of two separate three-phase transmission lines, each carrying three No. 3 B. & S copper wires, with room on each line for another circuit. Throughout it is one of the most substantial and well constructed lines in the Dominion.

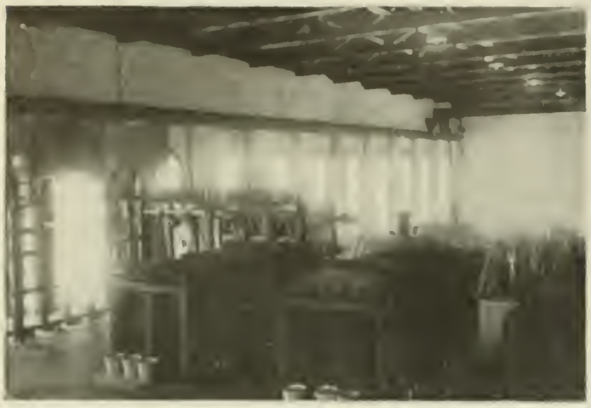


FIG. 3.—INTERIOR OF POWER HOUSE, SHOWING TRANSFORMERS.

The poles are heavy cedar, and on tangents are spaced not over 100 ft. apart, on curves at less distances, in some cases as low as 50 ft. No angles are turned, but all changes in direction of line made with easy curves. No side or head guys have been used except at extra heavy spans across rivers, etc. The work on this line, as well as all construction of the plant, is a decided credit to the company's local engineer, Mr. William Anderson, who has designed and executed the work.

A three-mile feeder is taken off at Grand Forks, 12 miles from Cascade, to the Granby Smelter of the Granby Mining & Smelting Company, where current is used for driving Westinghouse induction motors of sizes ranging from three to seven hundred horse-power, and of an aggregate capacity of 2,400 hp.

The sub-station at Phoenix, located at an altitude of about 3,500 ft. above the power house, is of brick, with one end left for future extension, and contains the transformers, line switches, fused circuit-breakers, switchboards, etc., substantially duplicating those at the power house. Fig. 4 shows the interior of this sub-station, which, for the immediate present, will be called upon to supply current for two 700-hp induction motors for driving two large compressors; a 100-hp motor for stone crusher, and a 150-hp motor for hoist as well as furnishing the current for lighting the town of Phoenix.

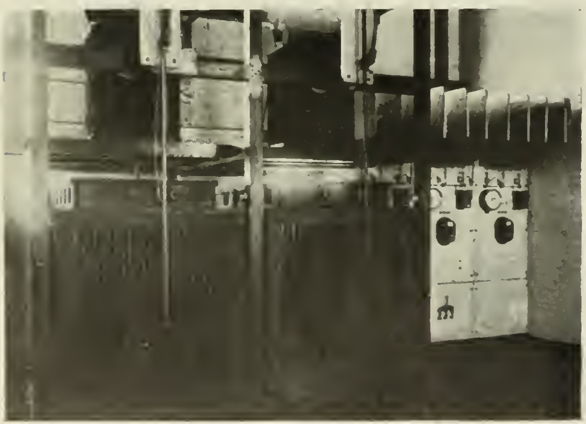


FIG. 4.—PHOENIX SUB-STATION.

The Cascade Water, Power & Light Company estimates that it will have a supply, at low water, for about 6,200 hp. This will enable the doubling of the present output. All the plans were made and carried out with the view of extending the plant to its full capacity, and from present indications it would seem that the company will have a demand for all the power it can furnish.

Development in Telephone Switchboard Equipment at Bloomington, Ill.

The telephone switchboard apparatus and instruments recently installed by the Equitable Construction Company, of Chicago, to enlarge and re-equip their plant at Bloomington, Ill., shows one of the most marked advancements that has been made lately in telephone systems. This exchange was one of the first plants in the independent telephone business. It was started early in 1895 with less than 100 subscribers. The outside lines were constructed with common return circuits and the plant was equipped with the old style individual generator call and local battery instruments, with a straight trunking switchboard.

The plant had a constant rapid growth and a year ago reached 700 subscribers, which was far more than at first calculated; and in order to accommodate additional subscribers who were rapidly applying for service, it was necessary to reconstruct the lines upon a much larger scale. In rebuilding the plant, the heavy aerial lines and all the lines in the main business district were replaced with an underground system. In the outlying districts a large amount of cable was substituted for open wires. The system was changed from the common return circuit to a full metallic circuit.

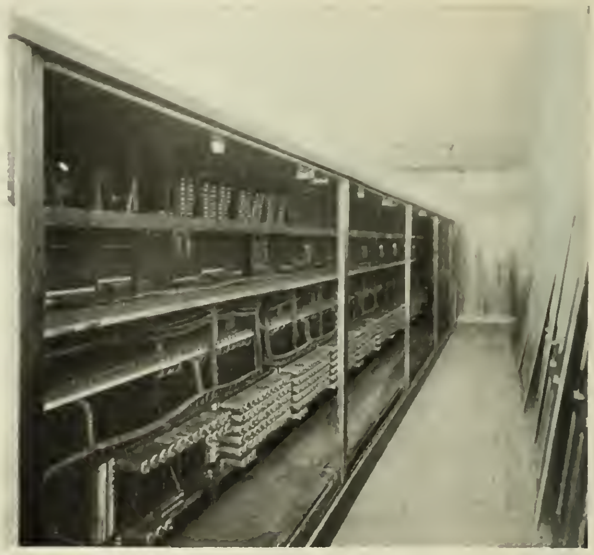


FIG. 1.—VIEW OF BACK OF TELEPHONE SWITCHBOARD.

After the outside lines had been practically rebuilt to an ultimate capacity for the accommodation of 2,500 subscribers, it was then necessary to increase their central office apparatus. After a thorough investigation and a careful consideration of estimates for increasing their old board and also for re-equipping their system, it was decided to install, as rapidly as possible, the new central energy system put on the market by the International Telephone Manufacturing Company, of Chicago. One of the features of the International system which made it especially adapted, and which was considered of vital importance, is that the board and central office apparatus may be installed first as a trunking system and the old telephones used as automatic signalling instruments and replaced gradually, at intervals,, with strictly central energy instruments as rapidly as required and the multiple jacks and wiring, etc., added to the board to make it a strictly multiple system at any time, without any material extra cost or interruption of service. This made it possible to equip the plant with a full lamp signal central energy board at once.

Fig. 2 shows the main switchboard. The present equipment consists of four sections of three operators' positions each, with a multiple capacity in each section for multiplying the 2,400 lines.

The board is arranged for 120 lines per position. The switchboard, as originally installed, is arranged with a trunking system between the operators' positions. The lamp line signals and answering jacks are placed at the bottom of the face of the board. The trunking jacks and order keys are placed in each position immediately above the line signals. The board is designed and fully wired for changing the system into a strictly multiple system by adding the necessary multiple jacks in each section and making the proper connection before cutting over the system. The multiple jacks are temporarily placed above the trunking equipment and are lowered into proper position after the system has been cut over and the trunking equipment removed. This change may be made without any interference with the service. The first position is equipped for 25 in-coming trunk or toll lines. Each operator's position is equipped with 15 pairs of connecting appliances with double supervisory clearing-out signals (party line keys), also a pilot lamp with line signals, one with the clearing-out signals and one with the ringing generator.

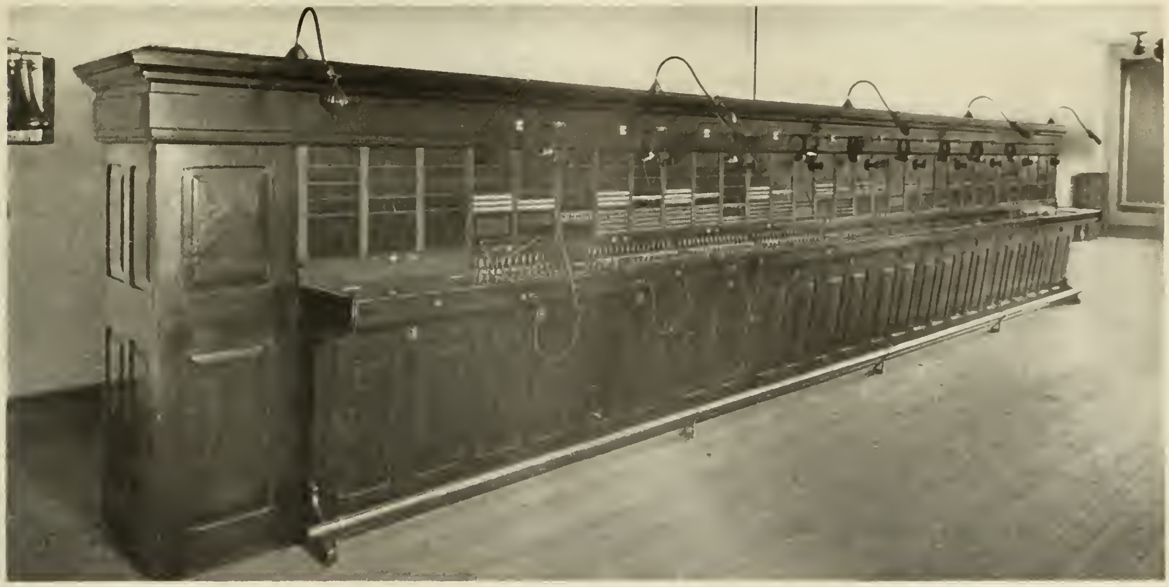


Fig. 2.—2,400-Line Capacity Lamp Signal Multiple Capacity Trunking Switchboard.

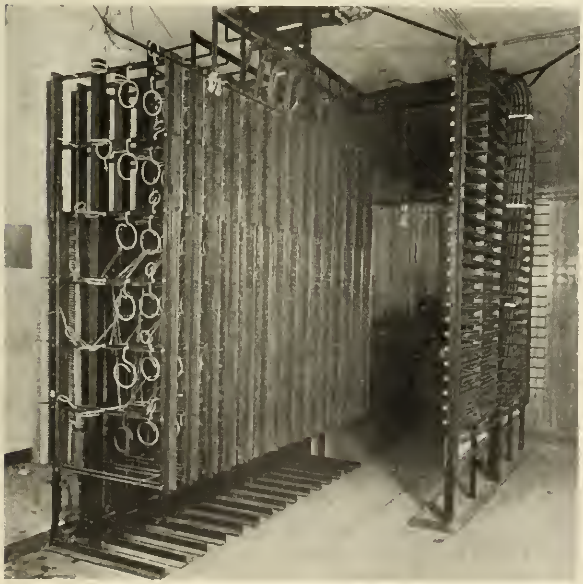


FIG. 3.—RELAY RACK AND MAIN AND INTERMEDIATE DISTRIBUTING BOARD.

Fig. 1 is a rear view of the switchboard. The switchboard frame is of heavy architectural iron, well braced and made strong and rigid. The supervisory and operator's set relays are mounted on an iron rack at the bottom of the switchboard frame. All working parts have every detail part made strong and durable and are mounted in a substantial manner and properly connected with No. 22 conductor, double silk, and single cotton insulated switchboard wire or cable.

Fig. 3 shows the terminal room. The lead-covered cables lead from the outside through the false floor to the rear of the distributing rack where they terminate in pot heads, at the bottom of the rack, and are properly connected with lightning arresters manufactured by the American Electric Fuse Company. These arresters are the new style Rolfe self-soldering heat coil and carbon protectors. The rack is a combination lightning arrester frame and intermediate distributing board, fully provided for complete multiple system. The relay rack is a large iron frame, built in two sections, each section accommodating the relays for 500 lines.

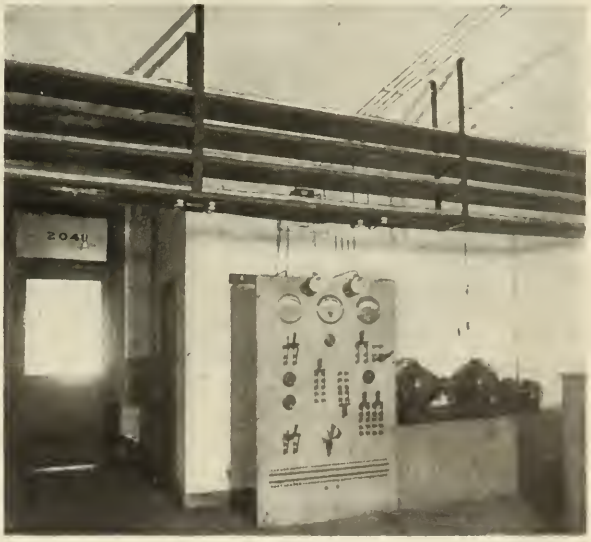


FIG. 4.—POWER EQUIPMENT.

Fig. 4 shows the power equipment. The power board is a heavy marble slab, fully equipped with Weston ammeters and voltmeter, voltmeter switch, proper knife switches for controlling the system, circuit-breaker, rheostat and starting boxes and the necessary busbars, etc. The Roth charging machine and ringing generators are mounted on a strongly constructed table, provided with a hard wood top, supported by heavy soft rubber balls, to take up all vibration. The front of the table is provided with a heavy marble slab to correspond with the power board. The storage battery plant consists of 12 cells of metal tank chloride accumulators.

All parts of the equipment are provided for an ultimate capacity of 2,500 subscribers. The instruments used in the increase of the exchange and for part of the instruments replaced, are of the International long-distance central energy type.

Alternating Current Long Scale Voltmeter and Ammeter.

The accompanying cut shows an improved form of voltmeter and ammeter of the induction type, which in principle of operation is closely allied to the integrating wattmeter made by the same company, the Westinghouse Electric & Manufacturing Company. These instruments, simple in design, are made in the pattern shown in Figs. 2 and also in the more familiar circular form, Fig. 1.

The scales begin at zero, and the divisions are absolutely proportioned and uniform above 20 per cent of the full capacity, with a length and openness which allows the readings to be made with perfect accuracy. As an additional aid to easy and correct reading from a distance, the dial of Fig. 2 is made of translucent material illumined from the rear, while the markings are distinct and the figures large and prominent. The lamps for illuminating this scale are enclosed in a compartment separate from the rest of the mechanism, giving perfect ventilation and not heating the working parts.

In this type an electromagnet produces a shifting magnetic field, in the air-gap of which is an aluminum disc in which currents are induced by the field, resulting in the disc's movement. This motion being opposed by a spring, the amount of deflection is shown by a pointer mounted on the shaft of the disc. When the pointer is at the zero position, the outline of the disc being spiral, the air-gap closes that portion of the disc having the longest radius. As the deflections increase the enclosed radii decrease, diminishing the pull on the disc until it becomes proportional directly to the current, resulting in a uniform scale of great length.

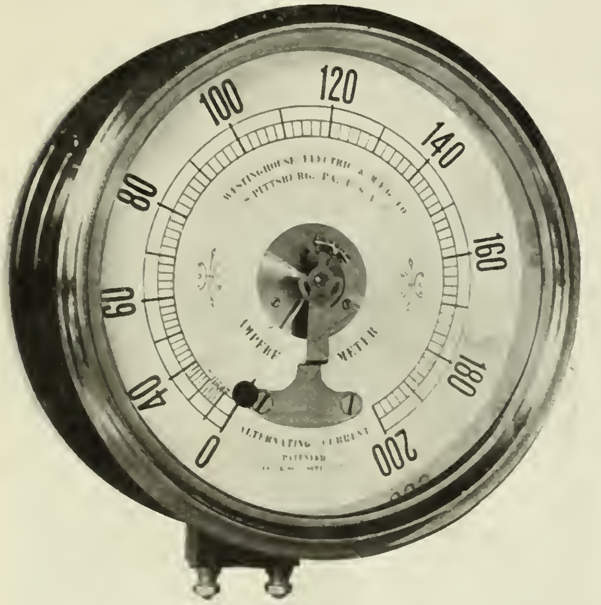


FIG. 1.—ALTERNATING-CURRENT AMMETER.

These instruments are unaffected by external fields, are totally dead-beat, and are compensated for changes in temperature and frequency. The moving elements being very light in weight, the bearings of finely ground jewels and the shaft carefully hardened and polished, render friction a negligible quantity. They are made to certified and legal standards, with extremely careful calibration. The parts are interchangeable, and the cases dust-proof and of neat appearance.

Instead of requiring the main current to be brought to the instrument, necessitating in some cases expensive bus-bar connections, this make of ammeter is arranged to operate from 5-amp. secondaries of series transformers, thus enabling the instrument to be mounted at any convenient point.

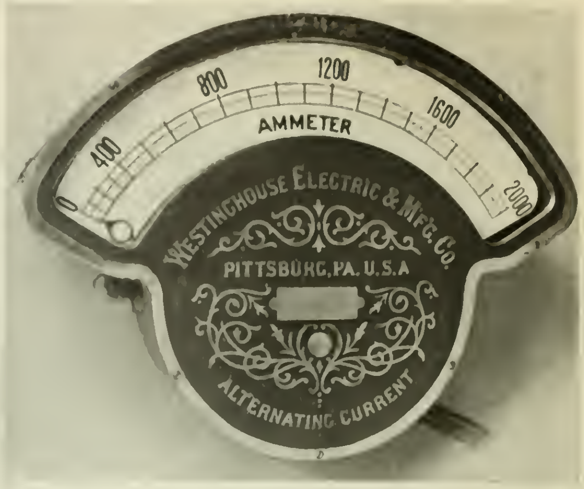


FIG. 2.—ALTERNATING CURRENT AMMETER.

Power Transmission in Connecticut.

The New Milford Power Company, incorporated under the laws of the State of Connecticut with a capital of $1,000,000, mostly furnished by New Yorkers, is to build two large water power plants on the Housatonic River for the purpose of generating current for electric lighting, railway and manufacturing consumption in various parts of Connecticut. A 15-ft. dam is to be constructed across the Housatonic River at the head of Bull's Falls. A canal 11,000 ft. in length will convey the water to a large reservoir whence a 13-ft. steel flume will be built to one of the power houses to be located at Bull's Bridge. The working head will be 115 ft. The contract for the construction of the canal has been awarded to David Emanuel, of Catasauqua, Pa. The steel flume is to be built by the Riter-Conley Manufacturing Company, of Pittsburg, Pa. The Bull's Bridge plant will have an initial capacity of 6,000 kw. The equipment will consist of six 1,000-kw generators of General Electric build. They will be revolving-field, three-phase, 60-cycle machines to operate at 400 r.p.m. These generators will be direct-connected to special high-head turbines of 1,850-hp capacity each. The turbine contract has been secured by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The machinery will generate at 1,150 volts and step up to 33,000 volts.

The other plant is to be situated at Gaylordsville, about four miles below the Bull's Bridge power house, with which it will be run in parallel. The capacity of the Gaylordsville plant will be 3,000 kw. The working head will be 33 ft. The contracts for the equipment have not yet been awarded. A double transmission line will be built almost straight across to Waterbury, a distance of 26 miles. At Waterbury, where the major portion of the power will be used, the Connecticut Railway & Lighting Company will construct a large receiving station for the distribution of power to operate its extensive railway, lighting and power interests. The station will take care of 6,000 kw and will be equipped with four 550-kw railway rotary converters and four 300-kw rotary converters for lighting use. The remainder will be utilized for arc lighting and general power purposes. All the rotary converters will be of six-phase, 60-cycle type, and will be of General Electric Company's manufacture. From Waterbury the transmission line will be continued to New Britain, 18 miles distant, by way of Southington. In the vicinity of Southington a transforming station will be built in which three General Electric six-phase, 60-cycle railway rotary converters will be installed for the purpose of operating the Meriden, Southington & Compounce Tramway Company and other lines controlled by the Connecticut Railway & Lighting Company in the locality. At New Britain a station is to be built which will be equipped with three railway rotary converters, six-phase, 60-cycle, of 300-kw capacity each, of General Electric type, also similar machinery to handle 1,500 kw for light and power purposes. The transmission line will be built by the New Milford Company. The contracts for wire, etc., have not yet been determined. The company has the contract for supplying power to the Connecticut Railway & Lighting Company for a period of 30 years. The power is to be delivered at the step-down transformers at all the latter concern's plants. The contracts for the rotaries and other equipment for the transforming stations are let by the Connecticut company. Among those primarily interested in the New Milford Power Company are R. N. King, some time president of the Stilwell-Bierce & Smith-Vaile Company. Charles F. Cutler, president New York Telephone Company; J. W. Ogden, banker, 1 Nassau Street, New York; Chas. Sooy-Smith, 71 Broadway, New York, one of the consulting engineers of the Rapid Transit Commission; Nicholas Staub, ex-Controller of the State of Connecticut; W. S. Morton, electrical engineer, St. Paul, Minn., and H. R. Leyden, electrical engineer, formerly of Hamilton, Ontario. The New York offices of the company are in the Atlantic Building, 49 Wall Street.

Core Type Transformers.

The General Electric Company began the manufacture of the core type transformer in 1896 and since then continuous improvements have been made in all the features that go to make up a good transformer. Some of these are enumerated below. The great reductions made in losses during the last three years will be readily appreciated by referring to the curves of Fig. 1, which show the reductions in coreless and regulation from 1899 to 1902. On the various sizes the average percentage reduction in core loss is 11.7 per cent. and in regulation is 8 per cent. Since transformers are usually energized 24 hours a day, low core loss is, of course, of great importance in its effect on the all-day efficiency. Minimum core loss has been made one of the leading features of General Electric transformers, the core loss being as low as is consistent with proper insulation, low temperature and good regulation.

It is essential that the regulation of a transformer be as low as is consistent with good characteristics in other respects, as this admits of the use of high-efficiency lamps, insures low cost for lamp renewals, and makes possible a small variation in voltage between the peak and light loads on the station and consequent uniform light throughout the 24 hours.

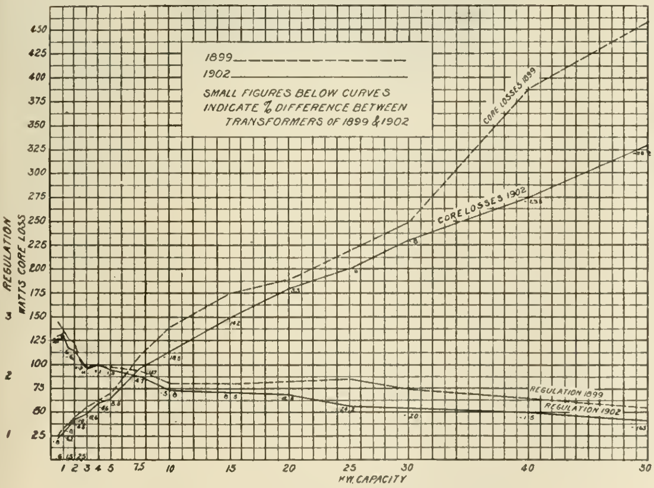


FIG. 1.—COMPARATIVE CURVES OF CORE LOSSES AND REGULATION.

Low uniform temperature is of importance in preserving the insulation and preventing deterioration of the iron which results in increase in core loss, commonly known as aging. The American Institute standard of 50° C. as the ultimate temperature rise for electrical apparatus has been adopted, as this is regarded by the most eminent engineers as a good safe figure. The ultimate temperature rise of the General Electric core type transformers will not exceed this amount, and because of the details of construction, the temperatures are uniform throughout. Every part of every coil has practically the same facility for passing off its heat.

Aging has been reduced to a minimum by the use of a specially-treated sheet steel and by processes of manufacture which have been developed in the course of 15 years' expeirence. Among the aids in regulating the properties of steel may be mentioned the microscopic examination of samples of steel. This method of investigation requires very skillful experts and a high grade of technical knowledge; but no expense has been spared to secure the best results. The effect of this work is shown by the result of a test which was made on 43 core type transformers taken indiscriminately from the lines of central stations. These were returned to the factory and were very carefully retested to show the amount of aging during their periods of operation. These transformers had been in service on an average for 2½ years, and showed the small average of 3.1 per cent.

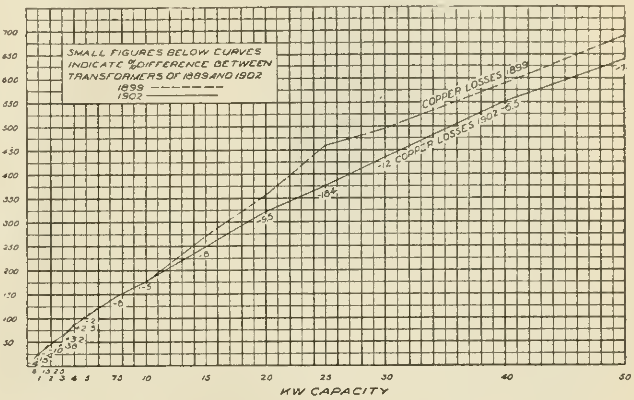


FIG. 2.—COMPARATIVE CURVES OF COPPER LOSSES.

Every transformer before shipment receives very careful tests as to its characteristics. An accurate record is kept of all these tests, so that at any time they can be readily compared with the result of subsequent tests.

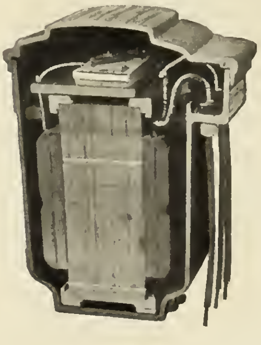


FIG. 3.—SECTIONAL VIEW OF TRANSFORMER.

FIG. 4.—MICA SHIELD.

Very careful attention is paid to the insulation which is used in these transformers. The method of manufacture of the various insulations used and methods of inspection employed, combined with the low uniform temperature maintained, have met with such success that during the last three years less than ⅓ of 1 per cent. of the total capacity of transformers sold have burned out from all causes, including lightning and overload. The percentage of burn-outs due to lightning alone is two-tenths of 1 per cent. In this connection, particular attention is called to the mica insulation shield shown in Fig. 4, which is placed between the primary and secondary coils and renders a cross between primary and secondary practically impossible, thus giving security to the customer.

The value of oil as a cooling and insulating medium has long been recognized, but this value is greatly reduced unless oil of the best properties is used. Although the oil used in the core type transformers is made especially for the purpose, has very high insulating qualities and is remarkable for its non-absorbent properties, it is subjected to very rigid inspection as to its characteristics and for the presence of moisture, and unless it passes this test satisfactorily, is rejected. The result is oil which gives the best results both as to cooling and insulation. Fig. 5 shows clearly spaces which are left for the circulation of oil in sizes of transformers constructed with cruciform cores.

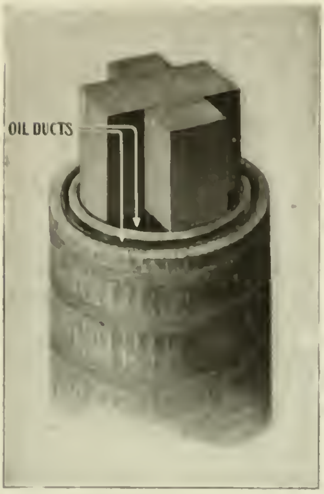


FIG. 5.—SPACES FOR OIL CIRCULATION.

This type of transformer is made in 10 sizes, from 600 watts to 50 kw inclusive, and in two lines, which, for convenience, are termed high and low frequency lines. Both of these lines have the well-known characteristics of the core type design, and both give perfectly satisfactory operation on either 60 or 125 cycles. The distinctive difference between the two lines of transformers from an operating standpoint is in their data, the high-frequency transformers being slightly less efficient than the low-frequency, and having a correspondingly lower cost. For 60-cycle operation the high-frequency line may be used when extremely low efficiency is not of great importance. The transformers made for three-wire service have the winding so distributed that the voltage on the two sides of a three-wire system will not differ more than the regulation drop of the transformer even with one-half the rated capacity of the transformers all on one side; with ordinary distribution of load the voltage will be practically equal on the two sides.

Automatic Motor Starter.

The Automatic Switch Company, 131 Liberty Street, New York, has designed a modification of its belt-driven type of motor-starter, in which the pawl and ratchet of the latter are replaced by a magnetic clutch, which operates the resistance arm. This clutch is energized only at the time of cutting out resistance, and releases its hold on the resistance arm when the motor reaches full speed. By this construction wear on the starter is eliminated except the slight friction of the bronze worm while driving the idle clutch, and the arrangement produces an absolutely silent form of starter, which is a decided advantage for use in connection with high-grade elevator service.

Referring to Figs. 1 and 2, it will be seen that the circular clutch magnet on the face of the starter is driven from the pulley by a heavy three-pitch gear, meshing into a bronze worm, which is adapted to operate the starter arm at the proper speed, when driven at about 300 r.p.m. The clutch magnet-winding is connected in series with the small retaining magnet shown at the top of the resistance segments, and the current to both clutch magnet and retaining magnet passes through a suitable dead resistance. When the resistance arm comes in contact with the retaining magnet it short-circuits the clutch magnet coil and releases the worm gear from any further work, except the free revolution of the clutch. The resistance contacts are stamped from copper, and the starting current is fed to them through a heavy graphite brush while bringing the motor up to speed, and the running current is carried by a substantial laminated copper contact shown near the retaining magnet.

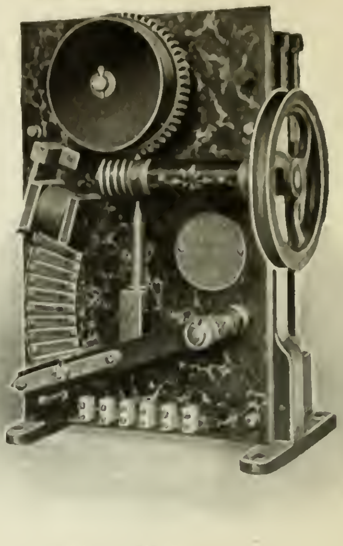


FIG. 1.—AUTOMATIC MOTOR STARTER.

The customary method of installing and driving the starter is shown in Fig. 2, but the position of the starter and switch may be varied to suit different conditions. The starters are adapted for connection to shunt, series and compound-wound motors, and to accommodate any desired number of series coils.

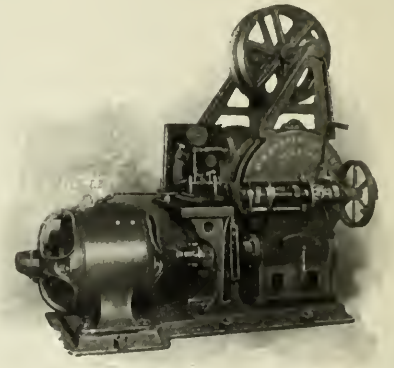
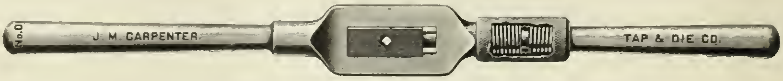


FIG. 2.—AUTOMATIC MOTOR STARTER.

Tap and Reamer.

The wrench illustrated herewith is an improvement on the ordinary form of machinist's wrench. The knurled sleeve, broken away, shows a right-hand thread on the outside of the neck of the stock and a left-hand thread on the handle, the two threads engaging corresponding interior threads of the sleeve. A right-hand turn of the sleeve closes the jaws and a left-hand turn opens them. The handle thus moving in and out without rotating motion avoids all tendency to unscrew while at work.

The advantages claimed for this wrench are that no pin, wire or other implement is required to tighten the jaws upon the tap or reamer, and it possesses extra strength at the point where wrenches are usually the weakest. It is made by the J. M. Carpenter Tap & Die Company, Pawtucket, R. I.



TAP AND REAMER.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was easier and at the close of the week was liberally offered at lower rates, closing at 5 a 5¼ per cent. for all periods from 60 days to six months. The stock market showed greater strength as compared with the previous week, but towards the end relapsed into a condition of dullness. The trading was more professional, with manipulation in specialties and particular stocks. Toward the close on Friday there was a break in Metropolitan Street Railway and its affiliated stocks, the former declining from 132⅜ to 127. The movement was accompanied by further indefinite but adverse reports about the Metropolitan's finances. The United States Steel stocks sold down in the general market, and the new bonds were also weak in the outside market. Later on, however, they all showed a disposition to recover. Strike rumors affected Manhattan and caused a decline from 138 to 135¼. The stock was well supported, however, and rallied on Friday on rumors that the strike might not occur. Since that time the differences between the men and the company have been practically settled and the threatened strike seems to have been averted. The sales of Metropolitan aggregated 88,200 shares, the price ranging between 127 and 135¼, closing at 132, this being a net loss of 1½ points. Manhattan made a gain of 1 point, closing at 139. Brooklyn Rapid Transit ranged between 64⅛ and 67⅛, closing at 66½, a net loss of ⅜. General Electric showed some activity and made a net gain of 5½, closing at 190½, the lowest figure being 179 and the highest 192⅛. Westinghouse common closed at 193½, being ½ point above the last previous quotation, and first preferred at 202. Western Union was steady, closing at 85. Following are the closing quotations of April 21:

NEW YORK.

	Apr. 14.	Apr. 21		Apr. 14.	Apr. 21
American Tel. & Cable	.	80	General Electric	182⅜	192
American Tel. & Tel.	152	158	Hudson River Tel.	..	..
American Dist. Tel.	30	30	Metropolitan St. Ry.	133⅜	131¾
Brooklyn Rapid Transit	66	66¾	N. E. Elec. Veh. Trns.	26	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	160	...
Electric Boat	23	20	N. Y. E. V. T. Co.	8	..
Electric Boat pfd.	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1	1	Western Union Tel.	85½	85⅝
Electric Vehicle	10	12	Westinghouse com	185	206
Electric Vehicle pfd	14	16	Westinghouse pfd	189½	206

BOSTON.

	Apr 14.	Apr. 21		Apr. 14	Apr. 21
American Tel. & Tel	154½	159	Western Tel. & Tel. pfd.	95*	96¾
Cumberland Telephone	..	..	Mexican Telephone	1⅞	1⅞
Edison Elec. Illum		..	New England Telephone	135	135
General Electric	181	..	Westinghouse	..	..
Western Tel. & Tel	19	20	Westinghouse pfd	..	..

PHILADELPHIA.

	Apr. 14	Apr 21		Apr. 14.	Apr. 21
American Railways	50	.	Phila. Traction	97	97⅜
Elec. Storage Battery	75*	70*	Phila. Electric	6⅞	7
Elec. Storage Battery pfd.	75*	70*	Pa. Electric Vehicle	..	..
Elec. Co. of America	8⅝	9	Pa. Electric Vehicle pfd	.	

CHICAGO.

	Apr. 14.	Apr. 21		Apr 14	Apr. 21
Central Union Tel.	..	..	National Carbon pfd.	97¼	97
Chicago Edison	..	.	Northwest Elev. com	..	..
Chicago City Ry.	205	..	Union Traction	7	7⅛
Chicago Tel. Co	..	..	Union Traction pfd.	37	37
National Carbon	24⅛	24¼			

*Asked.

DENVER GAS AND ELECTRIC COMPANY.—At a meeting of the stockholders of the Denver Gas and Electric Company, held in the office of Emerson McMillan & Co., last Saturday, the resolution was passed: That the plan of re-adjustment of reorganization proposed by the protective committee of the stock and bondholders of the Denver Gas and Electric Company, dated November 10, 1902, be ratified and confirmed. Under this agreement the company will make payment to the holders of the consolidated bonds of their eighteen months' back interest in scrip, exchangeable in $1,000 denominations for new general mortgage bonds. Also to issue prior lien bonds 6 per cent.—15-year—to the amount of $1,000,000, and to issue present treasury stock to the amount of $500,000; and in addition, to place a new 5 per cent. general mortgage of $8,000,000 upon the property, of which $2,580,000 will be issued in exchange for the present $2,400,000 consolidated mortgage bonds with the additional $180,000 for back interest; $3,270,000 reserved in the hands of the trustee to retire the underlying bonds (inclusive of the $1,000,000 prior lien bonds) and $2,150,000 held in the treasury for future extensions and other uses of the company under proper restrictions.

WESTERN TELEPHONE.—The Western Telephone Company report states that on December 31, 1902, the number of subscribers of four of its sub-companies, the Northwestern, Southwestern, Cleveland and Wisconsin was 111,036. On December 31, 1899, the close of the last year reported by the Erie Company, the number of subscribers of these four companies was 74,327. The following comparison shows the subscribers and capitalization of the Western Telephone Company as of December 31, 1902, and of the Erie Company as of December 31, 1899:

	West. Tel.	Erie Tel.	West. Tel. Per subscriber.	Erie Tel. Per subscriber.
Subscribers	111,036	74,327	....	....
Bonded debt	$9,835,966	$12,739,403	$88	$171
Capital	32,000,000	10,000,000	288	134
Total capital	$41,835,966	$22,739,403	$376	$305

The total authorized capital stock of Erie Company was $15,000,000. Of this amount only $5,000,000 was outstanding in 1899, but as $5,000,000 more was issued shortly after the close of the year, Erie's capital stock is taken at $10,000,000.

Income accounts compare as follows:

	West. Tel.	Erie Tel.
Divs., etc., received	$1,304,209	$966,039
Expense and interest	630,360	482,761
Net earnings	673,849	483,278
Dividends	640,000	225,000
Surplus	33,849	268,278

Erie's dividends paid were 4½ per cent. on the $5,000,000 stock outstanding in 1899. The comparison favors Western Telephone still more since Erie received dividends from Michigan Telephone, and no item from that is included for Western Telephone. The dividends paid by Western Telephone are much larger than those of Erie in 1899, but this policy may be warranted by the stronger position of the former company as to earnings, capitalization and treasury assets.

GENERAL ELECTRIC REPORT.—As we go to press, the General Electric Company issues its annual report for the year ending January 31, 1903. The total sales (amount billed to customers) during the past year were $36,685,598. The yearly orders and sales for the past five years are as follows:

Year end. Jan. 31.	Amount billed.	Orders received.	Yearly increase of orders received.
1899	$15,679,430	$17,431,327	21.8%
1900	22,379,463	26,323,626	51.1%
1901	28,783,275	27,969,541	6.3%
1902	32,338,036	34,350,840	22.7%
1903	36,685,598	39,944,454	16.4%

Since February 1, 1900, the reported orders received have not included the items of services of experts and labor, freight and transportation, supply material, boilers, engines, etc., of outside manufacture and bare copper wire, which items were included prior to 1900. These items amounted to $1,558,371 during the past year. Including these items the total orders received for 1902 aggregate $41,502,825. The company has 3,000,000 square feet of factory floor space, and has 18,000 factory employees. The profits for the year less $44,331 interest on debentures were $10,232,837, but the company only paid out $2,677,263 in dividends.

DIVIDENDS.—The Lowell Electric Light Company has declared a dividend of $4, payable May 1, stockholders of record April 21. The directors of the American Light and Traction Company have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable May 1. The directors of the Brooklyn City Railroad Company have declared the regular quarterly dividend of 2½ per cent. The Houghton County Electric Light Company will pay a dividend of 75 cents per share on the preferred stock (par $25) on May 1, to stockholders of record April 21. The Edison Electric Illuminating Company, of Brockton, will pay a dividend of $2.50 per share on May 1, to stockholders of record April 21.

STORAGE BATTERY STOCK.—Dispatches from Philadelphia announce that the stockholders of the Electric Storage Battery Company met and approved a proposition to permit holders of preferred stock to convert it into common, share for share. The preferred stock amounts to $4,500,000, all of which will probably be converted.

Commercial Intelligence.

THE WEEK IN TRADE.—Very satisfactory conditions exist generally, according to reports received by the mercantile agencies. The wet weather has retarded retail trade somewhat, but there is an improvement in collections nothwithstanding the bad weather. The agricultural outlook is of the best, and there is activity in farming work. Export trade is still expanding, cotton and corn being leaders, and manufactured products are also going abroad in larger volume. Iron production is surpassing all records, with improved transportation conditions and better supplies of coke. Finished products are in unprecedented demand, and foreign steel is arriving in increased volume to meet domestic needs. Despite widespread labor troubles, particularly in building lines, builders' hardware and structural steel are exceedingly active. Over-production is noted in very few lines of business, and manufacturers generally are pushed to keep up with orders. Premiums on quick delivery are disappearing, and imports of foreign iron are finding their field unrestricted. A feature in the more finished forms is the large demand for light rails for electric and street railways. Copper is slightly higher on the week, and other metals are steady. Copper advanced about ½ cent, nominally, through another arbitrary move of the large copper producers. The quotations are: 15 a 15¼c. for Lake and electrolytic; and 14½ to 14¾c. for casting stock. Railway earnings are the best ever recorded for this season, the gross receipts for March exceeding those of a year ago by about 14.5 per cent. The business failures for the week ending April 16, as reported by *Bradstreet's*, numbered 160 against 153 the week previous, and 193 the corresponding week last year.

BAY POWER, CAL., DEVELOPMENT.—Arrangements have been made at Oroville, Cal., to handle 350 carloads of freight for the Bay Power Company. This will be poles, wires and machinery for the plant on French Creek, twenty miles above Oroville. The company has had men working there for the past year and a half, preparing the grounds for a reservoir and dam. A tunnel is to be run three-quarters of a mile under the mountain to tap the little North Fork, and the waters of that stream will be added to those of French Creek. The surveyors of the Bay Power Company have just finished running a line from Sundale, six miles north of Oroville, to French Creek, on the east side of the North Fork. The object is to convey power and light to the big plant at French Creek. The company will send power from Centerville to be used in running the tunnel, working the derricks and lighting the place while this work is being carried on. When the plant is established, the same line will be used to transmit current from the new plant to towns and cities in the Sacramento Valley.

PUGET SOUND GENERATOR ORDER.—One of the very largest contracts for electrical generators ever placed for use west of the Rocky Mountains has been awarded by Stone & Webster, of Boston, managers of electric power, traction and lighting plants along Puget Sound, to the General Electric Company. It is for six machines, two to be furnished to the Tacoma Industrial Company, for use in its development of the White River, and four to the Pierce County Improvement Company for the work of developing the Puyallup River, including the flow from the Mount Rainier glaciers. The generators will be three-phase, 60-cycle, of 3,500 kw capacity each, at 2,300 volts and 225 revolutions. Deliveries will commence next September. Both of these developments are now being carried forward in accordance with the details that have been given of the work in these pages.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the Chloride accumulator, has recently installed and has in process of installation a number of large batteries for railway work. Among these may be mentioned two batteries contracted for by the United Traction Company, of Albany, each having a capacity of 700 kw. These will be located at Albany and Troy, and operated in connection with specially-wound boosters for regulating fluctuations. The Cleveland, Painesville and Eastern Railway Company are to install, about June 1, a battery having a capacity of 460 kw. This battery is to be operated in connection with a motor-driven differential booster, and is designed to relieve the station of fluctuations, to care for peaks, and allow the plant to be operated with fewer generators than are now in service.

PUYALLUP RIVER POWER.—The Risdon Iron Works, of San Francisco, have secured a contract for the construction of four million pounds of steel pipe for the new water power plant building on the Puyallup River, near Tacoma, by the Pierce Company Improvement Company. The order was placed by General Manager S. Z. Mitchell. This is the largest order for pipe ever placed on the Pacific Coast. At its head the pipe line will be forty-eight inches in diameter. The first section will be 1,700 feet long, and in that space will have a drop of 877 feet. The diameter is gradually reduced until it becomes thirty-six inches at the bottom. The delivery of pipe is to be made between October 1 and February 15 next. The power company has 500 men clearing the right of way and building reservoirs above Lake Kapousin.

BULLOCK ELECTRIC GROWTH.—The Bullock Electric Manufacturing Company, of Norwood, Ohio, have recently occupied a new building of brick and steel, 177 feet wide by 300 feet long, for testing large work, and equipped with 50-ton cranes in center aisle, 75 feet span, and 30-ton cranes in side aisle. One machine worthy of notice is a pit lathe with a 44-ft swing. It anticipates lengthening this building another 300 feet. The company has now under construction one 5,000-hp a.c. and one 5,000-hp d.c. machines for the Cincinnati Gas and Electric Company; also several 12 2,000-hp to 3,500 hp, five of them for the Pittsburg Reduction Company, at Massena, N. Y., while others are for Pacific Coast work, as noted lately in this column.

ENGINE SALES.—Among the engine sales of the Allis Chalmers Company, of Chicago, during the month of March, were the following: To the Carnegie Steel Company, Pittsburg, Pa., one 42 and 66 x 60 tandem roller mill engine; South Side Elevated Railway Company, Chicago, Ill., one 34 and 70 x 54 1800 horizontal cross-compound Reynolds Corliss engine; Illinois Steel Company, Chicago, Ill., two 46 and 66 x 84 and 84 x 60 vertical steeple cross compound blowing engines; the International Traction Company of New Jersey, Jersey City, two 34 and 68 x 48 1800 cross-compound condensing Reynolds-Corliss engines; the Pennsylvania Railroad Company, one cross compound Reidler air compressor 15 and 24 x 36.

THE SAN FRANCISCO & SAN JOAQUIN COAL COMPANY, of San Francisco, has decided to install machinery for the briquetting of coal dust, the high price of coal in California rendering this profitable. The briquetting presses will be driven by electric motors arranged to give any desired speed from 20 r.p.m. to 550 r.p.m. in about 15 steps. Two 40-hp, slow-speed, 500-volt, direct-current motors have recently been purchased for this purpose from the Westinghouse Electric & Manufacturing Company, together with speed-controlling rheostats designed to vary the speed of the motors within the above limits. The controllers will allow the motors to be operated continuously at any of the speeds.

EQUIPMENT FOR WINCHESTER (IND.) TRACTION PLANT.—The Union City, Winchester and Muncie Traction Company is now letting contracts for the equipment of its new power station, at Winchester, Ind. The engine contract has been awarded to the Buckeye Engine Company, of Salem, Ohio. It calls for two 21 in. and 42 in. by 48 in. compound direct-connected engines, and a similar number of exciter engines to operate at 200 pounds pressure. The generators and exciters will be General Electric.

EQUIPMENT FOR BIG CLEVELAND DEPARTMENT STORE.—The Westinghouse Electric and Manufacturing Company has secured the contract for the generators to be installed in the big department store and office building now under construction at Cleveland by J. Hartness Brown, Jr., of that Ohio city. The generators will be direct-connected to 11½ in. and 19 in. by 14 in., 15 in. and 25 in. by 18 in., and 20½ in. and 34 in. by 27 in. compound engines, of Buckeye build.

POWER HOUSE AT PAINESVILLE, O.—Contracts for the erection of a power house at Painesville, Ohio, for the Cleveland Painesville and Ashtabula Railway Company, of Cleveland, have been placed. The power equipment will include 900-hp Sterling water-tube boilers, two 600-hp compound condensing engines, to be built by the C. & G. Cooper Manufacturing Company, and two 360-kw alternating-current generators, etc., furnished by the General Electric Company.

MANUFACTURING ELECTRIC VEHICLES.—The Baker Motor Vehicle Company, of Cleveland, manufacturers of light electric vehicles, is to erect a large factory. It is preparing plans for a power plant and is securing estimates on a 250-hp cross compound engine, to be direct connected to a 150-kw alternating current generator. The Corlett Engineering Company is the engineer for the work.

EQUIPMENT FOR A. S. & W. NEW MACHINE SHOPS.—The American Steel and Wire Company's new machine shops, to be built at Worcester, Mass., will be equipped with three 20 in. and 38 in. by 30 in. Buckeye compound direct-connected engines. A 14¼ in. and 28½ in. by 21 in. engine has also been ordered. The generators will be Westinghouse.

THE STANLEY ELECTRIC MANUFACTURING COMPANY has sold thirty-two 38-hp and twenty 50-hp street railway motors to the Sheboygan Light, Power and Railway Company, of Sheboygan, Wis. A sale has also recently been made of a 750-kw engine type railway generator to the Trenton Street Railway Company.

GREAT FALLS, MONT.—The Boston and Great Falls Electric Company, of Great Falls, Mont., is now installing one 360-kw Westinghouse revolving field two-phase alternator 2,200 volts, and one 675-hp Victor turbine of the Stilwell-Bierce & Smith-Vaile Company's make. W. D. Dickinson is the manager of the plant.

GENERAL SPECIFICATIONS FOR THE CONSTRUCTION OF TELEPHONE AERIAL LINES.

NOTE.—The construction of aerial lines is rarely performed by contract, as each telephone company usually builds its own lines. For this reason no form of contract is embraced in the "*Specifications for Aerial Line Construction.*" If contract work is desired, the form of contract used, for either conduit or cable construction, can with slight modification be employed.

SECTION 1.

1
General Characteristics

Aerial lines shall be embraced in three types:

"A"—Bracket Lines.
"B"—Cross Arm Lines.
"C"—Aerial Cable Lines.

"A"—BRACKET LINES. Bracklet lines are those of small capacity, in which the circuits are carried on brackets placed on the side of the poles to which they are attached. Lines of this type shall be limited in capacity to six wires, three being placed upon each side of each pole.

"B"—CROSS ARM LINES. Cross arm lines are those using cross arms for the support of the circuits. The maximum capacity of cross arm lines shall be limited to ten arms of ten pins each; thus, the maximum capacity of a cross arm line is one hundred wires.

"C"—AERIAL CABLE LINES. Aerial cable lines shall be those which use dry core paper cables, suspended by messenger strands to the poles. The number of aerial cables shall be limited to four, and the maximum size of each cable one hundred and fifty pair.

SECTION 2.

2
Routes

Prior to commencing construction, a careful examination and general survey of all desirable routes shall be made. From this survey a sketch map shall be prepared for the use of the right-of-way agent. A sample of such sketch map is shown in Fig. 1. This shall indicate the route which it is considered, on the whole, most desirable to follow, and the approximate desired location of all poles, guy stubs, etc. Wherever it is feasible to select more than one location, all of the desirable locations shall be indicated, in order that the right-of-way agent may have alternative routes in securing permits. No construction shall be commenced until rights of way have been finally and formally secured by the authorized right-of-way agent, in definite written form, upon the approved blanks of the company.

SECTION 3.

3
Location

Aerial lines shall be located only on permanent rights of way. These rights of way shall include the necessary permission to erect all poles and guy stubs, to string necessary wires, and trim such trees and shrubbery as may be required to secure the proper working of the circuits. Rights of way shall be secured by the right-of-way agent, and shall be in accordance with all of the laws of the country traversed, and in conformity to all municipal regulations of all towns or villages traversed. The right-of-way contracts shall be examined and approved by the General Council of the company prior to the commencement of construction.

SECTION 4.

4
General Instructions to Foremen

1. WORK TO BE DONE ACCORDING TO RIGHT-OF-WAY CONTRACT.

Prior to commencement of any construction, each foreman shall be supplied with a blue-print map, showing the location of all rights of way, and copies of contracts with all property owners. The maps and contracts shall be sufficiently explicit so that the location for every pole, guys, guy stubs, or other attachment, and the permission to string wires and trim trees and shrubbery, shall be so specifically described that foremen shall have no difficulty in proceeding with construction in exact acordance with each permission received. Foremen shall be responsible to see that all poles, anchors, guy stubs, or other attachments, are placed in exact accordance with the contracts, and that the erection of wires, and trimming of trees and shrubbery, is done as the permissions specify.

2. OBJECTIONS.

In case any person shall offer any objections to the prosecution of any part of the work that seems to be clearly within the obtained permissions, or shall endeavor to hinder the erection of any poles, guy stubs, wires or other attachments, or the trimming of any trees or shrubbery, the foreman shall courteously call the attention of such objecter to the copies of the contract permissions which he holds. In case the objection is still persisted in, the foreman shall stop work on the portion of the line in question, and shall refer this objection at once to the General Manager or Superintendent, and wait for further instructions. All foremen shall be rigidly responsible to perform all operations exclusively within the written contracts of rights of way. Foremen must under all circumstances take particular pains that no contract is exceeded in any single particular, and they must be responsible to treat, and to see that all employees reporting to them, do treat all persons with the greatest politeness and courtesy, and that all work of construction is so prosecuted as to interfere with, damage, or inconvenience all persons in the smallest amount.

3. ACCIDENTS.

During the prosecution of all work herein called for, foremen shall conduct all operations with all possible care for the safety and security of the general public, that of all of their employees, and of all property. Foremen shall not assume any risks whatsoever of any nature, or description, not absolutely entailed by the nature and character of the work under construction. During the raising of poles, the stringing of wire, or the erection of cables, particular pains shall be taken to secure the public from injury. Poles, wire and cable shall not be raised during the passage of teams or pedestrians, without giving due warning by stationing a watchman, with a red flag, at both ends of the portion of the highway occupied, and no work shall be done in such manner as to endanger the safety or convenience of those using the highway, more than is absolutely necessary. All material shall be so distributed along the highway as to produce a minimum of inconvenience to the public, and shall be arranged in such a manner as not to become a source of danger. In all cases where material sensibly obstructs the highway, a lighted red lantern shall be placed as a warning each evening at sunset. Each lantern shall be capable of burning all night. As fast as construction is completed, all surplus material and tools or debris of whatsoever nature, shall be removed and the highway left in its normal and proper condition.

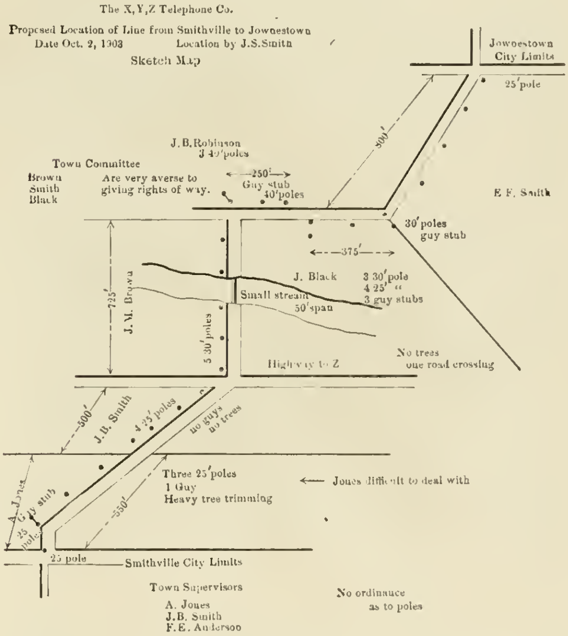


FIG. 1.

In all operations in any way connected with the work herein specified, foremen shall carefully observe and comply with all of the laws of the land, and with all municipal rules, ordinances or regulations of the towns traversed that shall in any way affect the conduct of those employed, or the method of doing work specified, or in the use of any materials, tools, appliances or machines. Particular pains shall be taken not to interfere with, or trespass in any respect upon the rights of way of any railway, telephone or telegraph company, whether such rights of way are upon the ground, or in the air, and in all cases foremen shall confine all operations strictly within the written rights of way contracts with which they are supplied.

In case of any accident, that can in any way be attributable to the prosecution of the work herein specified, the foreman shall immediately take the following steps:

"A"—ACCIDENTS TO PERSONS.

First.—Dispatch a messenger immediately for the nearest physician, and report the occurrence to the police if within corporate limits.

Second.—Take all possible local steps that will in any way conduce to the comfort of the injured.

Third.—As soon as practical make a written report to the company upon authorized blanks, stating the names and addresses of all injured, the nature and cause of the injury, the names and address of the attending physician, and of any or all witnesses of the accident.

"B"—ACCIDENTS TO PROPERTY.

First.—Take all possible local steps that shall prevent any extension of damage, and that shall in any way protect the property injured, and notify the police if within corporate limits.

Second.—Notify all owners that may be unaware of the occurrence of the character and probable amount of injury, and that a report will at once be sent to the company who will take immediate, proper action thereon.

Third.—Forward accident report to the company as under "A"—3.

SECTION 5

5
Inspection

All classes of material called for under these specifications shall be subject to inspection by an authorized inspector, duly appointed by the company. The company shall have liberty to select as the place of inspection, either the point of manufacture or shipment, or the point of delivery specified by the company of each class of goods. A reasonable number, or amount of samples of each kind of goods herein called for, shall be supplied to the inspector for the purpose of making such examinations as are herein called for. Any and all material which does not entirely fulfill the requirements of the specifications, all and singular, shall be rejected by the inspector. If any goods shall be rejected which the company elects to inspect at the point of delivery, the company shall notify the vendor as soon as the inspector completes the examination thereof, and, as soon as the notification is sent of the rejection of any goods, the vendor shall remove the same, and after such notification the company shall be no longer responsible in any way, shape or manner for the care or preservation of such rejected articles, and the vendor shall, under no circumstances, institute against the company any claim for injury or damage to such goods.

SECTION 6.

6
Shipments

Each of the various kinds of goods herein specified shall be properly and suitably packed for shipment by the vendor. The packing shall in all cases be such as is adequate to protect and guard each of the several classes of goods from the ordinary contingencies of transportation, and to enable them to be delivered to the company in proper order without loss or damage, or injury in any respect. Each individual package, box or bale, shall be properly and plainly marked with the name of the company, the destination to which the goods are to be forwarded, and the route they are to pursue, together with a statement and description of the kind of article, and number of pieces which each package is to contain. The vendor in all cases shall properly deliver the goods to the transportation company by which they are to be forwarded, and shall take the customary freight receipt and bill of lading, and shall forward to the company suitable evidence of proper shipment. In all cases the responsibility of the company for goods shall not commence until after the company shall have received them from the transportation company in good order, and in no case shall any vendor advance any claim for damages against the company until the company shall have received in good order the goods in question from the transportation company.

SECTION 7.

7
General Qualifications of Iron and Steel

All articles made of iron or steel under these specifications, except wire, shall be made of a first-class quality of wrought iron, or preferably of mild steel. The quality of the metal used shall in all cases be equal to that employed in bridge or structural iron work. All wrought iron shall have a tensil strength of not less than fifty thousand pounds per square inch of area, an elastic limit of not less than twenty-five thousand pounds per square inch, shall elongate not less than 15 per cent in a test piece of eight inches in length, and shall have a reduction in area of not less than 25 per cent. All mild steel shall have an ultimate strength of not less than fifty-five thousand pounds per square inch, an elastic limit of not less than thirty-two thousand pounds per square inch, an elongation of not less than 28 per cent in eight inches, and a reduction of area of not less than 45 per cent.

The fracture of wrought iron test pieces shall be fibrous, with not over 25 per cent of white or granular spots. The fracture of mild steel shall be cup shaped and silky, and absolutely homogeneous in texture. All pieces of wrought iron or steel shall be capable of being bent, cold 180 degrees, around a mandrel having a diameter not to exceed their least thickness.

SECTION 8.

8
Galvanizing

All iron and steel used in building open wire lines shall be galvanized, unless *distinctly specified* to the *contrary*, and all galvanizing for each specific case, shall be done in such a manner as to stand the following test:

From each shipment of each kind of goods, the inspector shall select such a reasonable number of samples as shall, in his judgment, fairly represent the consignment in question. Each sample shall be immersed in a saturated solution of sulphate of copper for one minute. At the expiration of this minute it shall be removed and wiped dry. This process shall be repeated four times. If after the fourth immersion and wiping any deposit of copper can be found upon the sample, or if any red spots can be detected, or if the galvanizing shall be seen to be corroded and removed, it shall be considered defective, and the goods represented by this sample shall be rejected. All galvanizing shall be smooth and clean. There shall be no superfluous spelter or drops of zinc, or rough places, or other imperfections. All holes, grooves, recesses and threads shall be entirely clean and free from zinc, and shall be fully up to the dimensions required of them, and in all cases galvanizing shall be so performed that the parts intended to fit together can be readily and easily assembled.

SECTION 9.

9
Material Specifications

The bulk of material required for the construction of aerial lines is comprised within the following schedule.

TABLE I.

SCHEDULE OF OPEN WIRE LINE MATERIAL.

Section 10—Poles.
Section 11—Creosoted Poles.
Section 12—Guy Stubs and Anchor Logs.
Section 13—Wooden Pole Braces.
Section 14—Brackets.
Section 15—Cross Arms.
Section 16—Pins.
Section 17—Insulators.
Section 18—Cross Arm Braces.
Section 19—Cross Arm Bolts.
Section 20—Carriage Bolts.
Section 21—Fetter Drive Screws.
Section 22—Double Arm Bolts.
Section 23—Pole Steps.
Section 24—Pole Rings.
Section 25—Pole Protection Strips.
Section 26—Pole Wheel Guards.
Section 27—Guy Rods.
Section 28—Guy Strands.
Section 29—Thimbles.
Section 30—Strand Clamps.
Section 31—Rock Eye-bolts.
Section 32—Staples.
Section 33—Fuses.
Section 34—Ground Rods.
Section 35—Connectors.
Section 36—Copper Line Wire.
Section 37—Iron Line Wire.
Section 38—Bridle Wire.
Section 39—Weather Proof Wire.
Section 40—Tie Wire.

SECTION 10.

10
Poles

All poles shall be of the best quality of live green timber, free from rot, sound and substantial in every respect. The grain of every pole shall be close and hard, with the annular rings closely pitched, and the heart sound and firm. Every pole shall be straight and well-grown, free from all objectionable bends. Each pole shall contain the natural butt of the tree, squarely sawn with no trimming to reduce size. Poles shall vary in length by increments of five feet from twenty to seventy feet, and shall have an approximately uniformly decreasing cross section from butt to top; shall be true and well-proportioned, and shall be cut and felled between the first of November and the first of March. From each pole all the bark and soft wood shall be carefully removed, all knots trimmed closely and smoothly, and the butts squared. The top of each pole shall be roofed and such a number of grains for cross arms cut in each pole as may be specifically directed for the pole in question. The first gain shall be cut ten inches from the top of the pole, and each subsequent gain shall be 24 in. below the preceding one. Each gain for standard cross arms shall be 4¼ ins. wide, and ½ in. deep; for light cross arms the gain shall be 3¾ ins. wide, and ½ in. deep. All gains shall be cut true and square with the axis of the pole, smoothly and evenly, in such a manner that all cross arms shall accurately fit the gains, and shall stand at right angles with the pole in all directions. Each gain shall be bored with two $^9/_{16}$ in. holes for two ½ in. bolts, or with $^{11}/_{16}$ in. hole for one ⅝ in. bolt, as may be directed. If two bolts are specified, the holes shall be spaced 1½ ins. on each side of the center of the gain. If one bolt be specified, the hole shall be bored directly through the center of the pole, all holes shall be at right angles to the gain and at the axis of the pole. The general appearance of all poles and pole tops shall be as in Figs. 2 and 3. Each pole shall be sound, strong, and free from objectionable cracks, rot or other defects, and shall be subject to inspection either at the point of shipment, or at the point of delivery, as the company may elect, and all poles which do not strictly conform to all requirements of the specifications shall be unqualifiedly rejected.

The sizes and dimensions of poles, and the price per pole of various dimensions, shall be in accordance with Table II.

TABLE II.

POLE DATA.

Length in feet.	Circumference in inches. At top.	Circumference in inches. 6 ft. from butt.	Price per pole.	Approximate weight. each.	Approximate No. per car.
20	12½	24	(To be filled in at time of purchase.)	100 pounds	200 1 car
20	16	25		130 pounds	175 1 car
25	12½	24		150 pounds	150 1 car
25	16	25		200 pounds	120 1 car
25	17½	26		250 pounds	110 1 car
25	19	27		350 pounds	100 1 car
25	22	30		350 pounds	100 1 car
25	25	34		275 pounds	100 1 car
30	19	30		275 pounds	100 1 car
30	22	34		350 pounds	100 1 car
30	25	37		450 pounds	80 1 car
35	22	37		450 pounds	120 2 cars
35	25	40		600 pounds	110 2 cars
40	22	40		625 pounds	100 2 cars
40	25	43		800 pounds	90 2 cars
45	22	43		835 pounds	82 2 cars
45	25	46		1,000 pounds	60 2 cars
50	22	46		1,035 pounds	40 2 cars
50	25	50		1,250 pounds	25 2 cars
55	22	50		1,300 pounds	30 2 cars
55	25	54		1,550 pounds	25 2 cars
60	22	54		2,000 pounds	20 2 cars
60	25	58		2,000 pounds	20 2 cars
65	25	58		2,700 pounds	15 2 cars
70	22	64		3,400 pounds	12 2 cars

SECTION 11.

11
Creosoted Poles

The process of creosoting poles and cross arms shall be in accordance with the following requirements. Prior to treating, all mill work shall be done, and all holes bored, so that subsequent to the completion of the preservative process there shall be no cutting of timber. Creosoting shall be done by placing the lumber to be treated in a closed tank and steaming it with steam at a pressure of not less than forty-five pounds gauge, for a period of not less than four hours. At the end of the steaming a vacuum of not less than twenty inches of mercury shall be applied to the tank, and all drainage from the timber pumped away. The vacuum shall be continued so long as there is any sensible discharge of sap or moisture from the timber. Pure dead oil of tar shall be then pumped into the tank, and an hydraulic pressure shall be applied sufficient to force into the timber at least twelve pounds of oil per cubic foot of timber treated. The absorption of oil by the timber shall be determined by measuring the total quantity of oil pumped into the tank, and comparing this with the known volume of the timber and the known volume of the tank. All oil used shall be pure dead oil of tar, and, if required, shall be subjected to a chemical analysis, and shall possess the following characteristics: It shall be liquid at 100° Fahr. It shall contain at least 25 per cent. of constituents that do not volatilize at a temperature of 600° Fahr. It shall not contain over 5 per cent. of tar acids. It shall contain no admixture of any substance not derived from the distillation of coal tar.

After the process of creosoting is completed, all timber shall be stacked at least six inches away from the ground, shall be so piled as to permit a free circulation of air around all pieces, and shall be allowed to season in this manner for not less than three months prior to being used.

Prior to setting, the butts of all *untreated* poles, guy stubs and anchor logs shall be charred and tarred. Each pole shall be placed on a skid and slowly revolved over a hot fire until the entire butt, to about one foot above where the ground surface will intersect the pole, is thoroughly charred. While hot the butt shall be thoroughly painted with melted first-class coal tar, rubbed into the charging with a stiff brush.

SECTION 12.

12
Guy Stubs and Anchor Logs

The timber used for guy stubs and anchor logs shall correspond in all respects with the specifications for poles, and shall be creosoted whenever creosoted poles are employed. Anchor logs shall not be less than twenty-five inches in circumference at the smallest point, and shall be at least four feet in length.

Guy stubs shall not be less than twenty-two inches in circumference at the smallest end, and of such a length as shall enable the stub to extend six feet into the earth, and at the same time support the top of the guy at such a point as may be required above the ground. Untreated guy stubs and anchor logs shall be tarred as specified in Section 11.

SECTION 13.

13
Wooden Pole Braces

The timber to be used for wood pole braces shall fall under the same specifications as given for poles. No pole brace shall be less than eighteen inches in circumference at the smallest end, and of such length as may enable the brace to be set six feet in the ground, and to extend to the proper point required for supporting the pole. At the point at which the brace is attached the pole shall not be mortised more than three-fourths of an inch, but the brace shall be trimmed to fit the pole. Wherever creosoted poles are used, pole braces shall be creosoted; if untreated they shall be tarred as specified in Section 11.

SECTION 14.

14
Brackets

Brackets shall be of two kinds:

"A"—Wood Brackets.

"B"—Iron Brackets.

"A" WOODEN BRACKETS. Wooden brackets shall be of the general form and dimensions as shown in Fig. 4. They shall be made of the best quality of oak; sound and perfect in every respect; fully up to the dimensions specified; neatly and carefully machined, with the bolt holes accurately spaced, carefully bored with sharp tools and with the insulator thread perfectly and truly cut, and a good fit for standard telephone insulators.

"B"—IRON BRACKETS. Where more than two wires are to be placed on one pole, an iron bracket shall be used. There shall be two styles of iron brackets, namely, two-pin and four-pin brackets, as shown in Fig. 5. The bracket strip shall be of a first-class quality of flat-iron, or steel, to which the pins shall be solidly and substantially attached, as shown, and the pins shall in all respects correspond to the specifications for wooden pins—Section 16—otherwise iron brackets shall have the form and dimensions of Fig. 5.

SECTION 15.

15
Cross Arms

There shall be four kinds of cross arms:

"A"—Standard Arms.

"B"—Light Arms.

"C"—Alley Arms.

"D"—Cable Arms.

"A"—STANDARD CROSS ARMS. All cross arms, except cable arms, shall be made of thoroughly seasoned, straight-grained wood—either Norway pine or Southern pine, as may be directed. The timber used shall be free from sap wood, and from any knots which may weaken it. Every arm shall be solid, sound and substantial, free from bad cracks, dry rot, or any other imperfections whatsoever, shall be smoothly and accurately milled, with all dimensions full, as hereinafter specified. All holes shall be bored of the sizes specified, and at right angles to the respective faces of the cross arms, true and straight, and with sharp tools to avoid tearing or injuring the wood. All sides of every cross arm shall be straight and true, and at right angles to each other, and without warp or wind. Cross arms ordered creosoted shall be treated as specified in Section 11. In case cross arms are not treated, each arm shall be thoroughly painted with a brush, and given two coats of Prince's metallic paint, color red, mixed in the ratio of two pounds of dry paint to one gallon of linseed oil. A drawing of the standard ten pin cross is shown in Fig. 6. The dimensions for standard cross arms, containing less than ten pins, shall be as in Table III.

TABLE III.

STANDARD CROSS ARMS.

Finished size, 3¼ in. x 4¼ in.

* Bored for 1½ in. or 1¼ in. pins, two ⅜ in. carriage bolts and one ⅝ in. or two ½ in. bolts, as may be directed.

Length.	No. pins.	Pin Spacing. Ends.	Pin Spacing. Sides.	Pin Spacing. Centers.	Approximate weight.
3 ft.	2	4 in.		28 in.	10 lbs.
4 ft.	4	4 in.	12 in.	16 in.	14 lbs.
5 ft.	4	4 in.	15 in.	22 in.	17 lbs.
6 ft.	4	4 in.	21 in.	22 in.	21 lbs.
6 ft.	6	4 in.	12 in.	16 in.	21 lbs.
8 ft.	6	4 in.	16½ in.	22 in.	28 lbs.
8 ft.	8	4 in.	12 in.	16 in.	28 lbs.
8½ ft.	10	3 in.	10 in.	16 in.	29¼ lbs.
10 ft.	8	4 in.	15 in.	22 in.	35 lbs.
10 ft.	10	4 in.	12 in.	16 in.	35 lbs.
10 ft.	12	4 in.	9⅔ in.	16 in.	35 lbs.

"B"—LIGHT CROSS ARMS. For light lines or those which are to be erected in particularly protected and inexposed situations, it is permissible to use a slightly lighter arm. The dimensions for light cross arms shall be as in Table IV.

"C"—ALLEY CROSS ARMS. Where pole lines are erected in alleys, a special arm is required, as it is usually impossible to center the arm upon the pole, but it must be placed as shown in Fig. 7. This requires that the square portion of the arm, fitting the gain, shall be in the center between the second and third pin holes from the end of the arm; that the holes for the arm braces shall be bored between the first and second pins, and the fourth and fifth pins, and that a special hole $^9/_{16}$ in. in diameter, for a vertical brace, shall be bored between the seventh and eighth pin on each arm, as shown in Fig. 7. In other respects the dimensions of the arm, of the pin holes, and bolt holes, shall be as already specified for standard arms. Arms for terminal poles or corners and all exposed locations shall be bored for 1½ in. insulator pins. Cross arms to be used with iron pins shall have all pin holes bored for ⅝ in. bolts, driving fit, but in all other respects shall have the same dimensions as above specified.

"D"—CABLE CROSS ARMS. The cross arms for supporting aerial cable shall be made of angle iron. Each arm shall be fitted to receive four cables,

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* Pin holes shall be a driving fit; carriage bolt holes $^7/_{16}$ in. diameter; ½ in. machine bolt holes $^9/_{16}$ in. diameter; ⅝ in. machine bolt holes $^{11}/_{16}$ in. diameter.

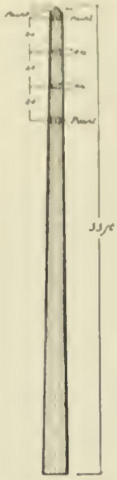


FIG. 2.—POLE ELEVATION.

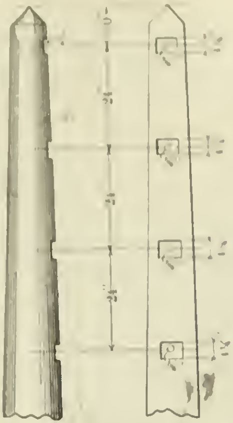


FIG. 3.—POLE TOP.

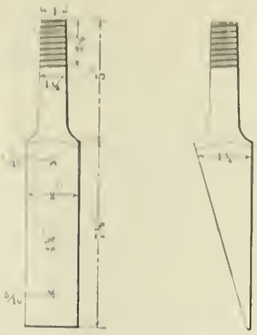


FIG. 4.—WOOD BRACKET.

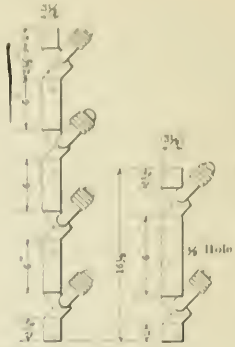


FIG. 5.—IRON BRACKETS.

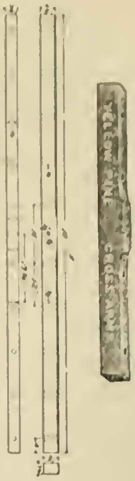


FIG. 6.—YELLOW PINE CROSS ARMS.

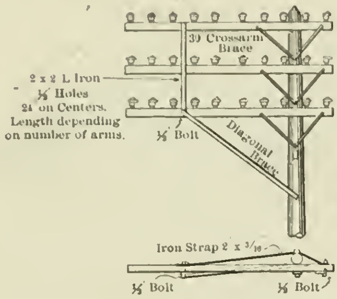


FIG. 7.—ALLEY ARM LOCATION.

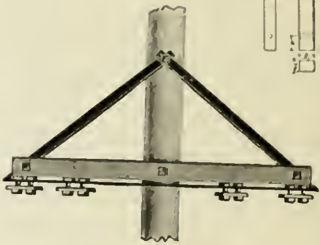


FIG. 8.—CABLE ARM.

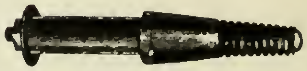


FIG. 12.—CORNER PINS.

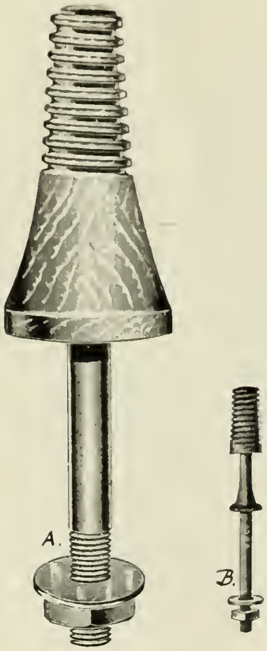


FIG. 13.—IRON PINS.

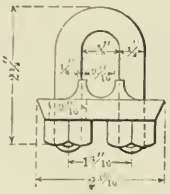


FIG. 10.—CABLE STRAND U-BOLT.

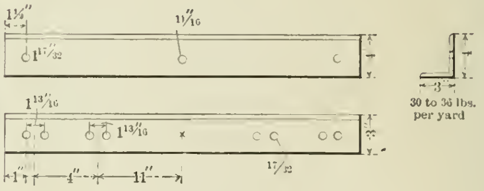


FIG. 9.—CABLE CROSS ARM.

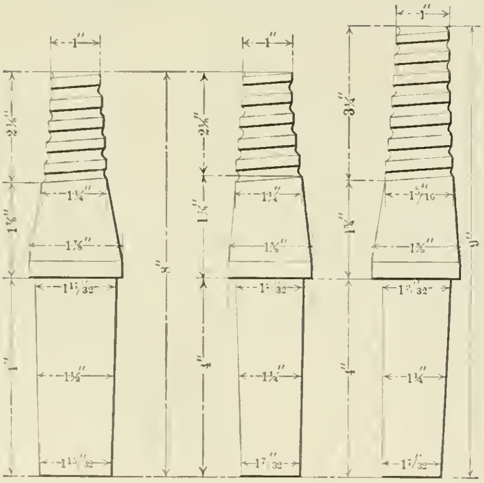
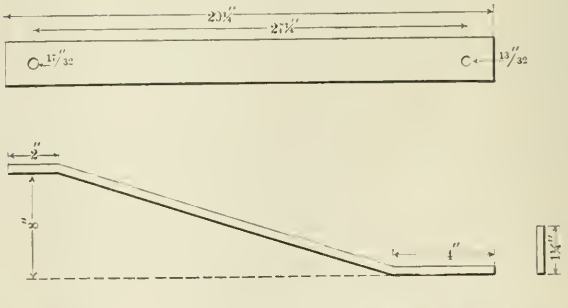


FIG. 11.—WOODEN PINS.



FIGS. 15 AND 16.—BACK AND FRONT CROSS ARM.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.

and shall be attached to the pole one foot below the lowest open wire arm, as shown in Fig. 8. Cable arms shall consist of a piece of angle iron, weighing not less than twelve pounds to the foot, thirty-six inches in length,—shown in detail in Fig. 9. The angle shall have a $^{11}/_{16}$ in. hole bored in the center thereof, for the purpose of attaching the same to the pole. On either side of the center, respectively at eleven inches and fifteen inches away from the center, the fixtures for supporting the aerial cables shall be placed, which shall consist of steel U-bolts, as shown in Fig. 10. At a distance of 1½ ins. from each end of the cross arm, a $^{17}/_{32}$ in. hole shall be bored for the purpose of attaching the cross arm brace. Each cross arm shall be furnished with four steel U-bolts, as shown in detail in Fig. 10.

TABLE IV.

LIGHT CROSS ARMS.

Finished size, 2¾ in. x 3¾ in. (See note preceding page.)

Arms bored for 1¼ in. pins, two ⅜ in. carriage bolts, and one ⅝ in. or two ½ in. bolts, as may be directed.

		Pin Spacing			
Length.	No. pins.	Ends.	Sides.	Centers.	Approximate weight.
24 in.	2	3 in.		18 in.	5 lbs.
30 in.	2	3 in.		24 in.	7 lbs.
42 in.	4	3 in.	10 in.	16 in.	9½ lbs.
62 in.	6	3 in.	10 in.	16 in.	14 lbs.
82 in.	8	3 in.	10 in.	16 in.	18 lbs.
102 in.	10	3 in.	10 in.	16 in.	23½ lbs.
4 ft.	4	3 in.	13 in.	16 in.	11 lbs.
6 ft.	6	3 in.	12½ in.	16 in.	16½ lbs.
8 ft.	8	3 in.	12½ in.	16 in.	22 lbs.
10 ft.	12	3 in.	10 in.	14 in.	27½ lbs.

(NOTE.—For additional specifications for aerial cable lines see Specifications for Aerial Cables.)

SECTION 16.

16
Pins

There shall be two kinds of pins:

1—Wooden Pins.
2—Iron Pins.

1.—WOODEN PINS.

There shall be three kinds of wooden pins, respectively known as (A) Line Pines, (B) Transportation Pins, and (C) Terminal Pins.

"A"—LINE PINS. The general form and dimensions of the Line Pin is as shown at A—Fig 11. The shank shall be four inches long, and have an average diameter of 1¼ ins., being $1^{9}/_{32}$ ins. under the shoulder, and $1^{7}/_{32}$ ins. at the bottom of pin. The insulator thread shall be 2⅛ ins. long, 1 in. in diameter at bottom, with a pitch of four threads per inch, and shall fit a standard Pony insulator. In all respects the Line Pin shall correspond to the dimensions of Fig. 11.

"B"—TRANSPOSITION PINS. The transposition pin shall be of the form and have the dimensions shown in Fig. 11—B. It shall differ from the Line Pin only in having the insulator thread 3¼ ins. long instead of 2⅛ ins.

"C"—TERMINAL PINS. The Terminal Pin shall be of the form and have the dimensions shown in Fig. 11—C. It shall differ from the line pin only in the diameter of the shank, which shall be $1^{17}/_{32}$ ins. under the shoulder, $1^{15}/_{32}$ ins. at the bottom of the pin, and average 1½ ins. In particularly exposed locations the shank of Terminal Pins shall be supplied with an iron bolt, nut and washer, as shown in Fig. 12. This bolt shall be ¼ in. in diameter, 1½ ins. long outside the pin shank, and shall be secured in the shank firmly and solidly. The thread of the bolt and the nut shall be U. S. standard. The washer shall be ⅛ in. thick, 3 ins. in diameter, and closely fit the bolt. All pins shall be made of the very best quality of thoroughly seasoned locust wood, sound, clear, free from knots and sap wood, subsequently boiled in paraffin or oil. All pins shall be cut of exactly the dimensions specifieu in Fig. 11 in all respects. They shall be solid, substantial, free from all cracks, shakes, soft wood or other defects, and shall be machined with sharp tools, smooth and fully up to all the dimensions specified.

2.—IRON PINS. The general style and method of making iron pins is shown in Figs. 13—"A" and "B". Each pin shall consist of an iron or steel bolt, not less than ⅝ in. in diameter, supplied with a U. S. standard thread, nut and washer. The thread shall be at least 1¼ ins. long. The bolt shall be securely fastened into a cap, made of locust wood, which in all respects shall conform to all the requirements and match all the dimensions, specified in "A" and "B" of this section, for wooden pins. There shall be two sizes of wood caps—one with an insulator thread 2⅛ ins. long, to correspond to the line pin, and one 3¼ ins. long, to correspond to the transposition pin. The distance between the shoulder of the iron pin, and the inner face of the washer, when the nut is so screwed on the bolt as to allow two full threads to project outside of the nut, shall not be less than 4 ins.

SECTION 17.

17
Insulators

1—GLASS INSULATORS. Insulators shall be of two kinds: "A"—Line Insulators, "B"—Transposition Insulators.

"A"—Line Insulators. Line insulators shall be used for ordinary line work, and shall he of the type known the trade as the "Standard Pony" insulator. The general form of the Pony Insulator is illustrated in Fig. 14—A, and a section and dimensions are given in Fig. 14—B.

"B"—Transposition Insulators. The transposition insulators shall only be used where transpositions are to be made. There are four varieties of transposition insulators on the market, either one of which will answer the purpose, and are illustrated in Figs. 14—C, D, E and F, standing in the same order of excellency. At G a section, with dimensions of F, is given, and that portion of all transposition insulators which receives the pin shall have the dimensions of Fig. 14—G. All insulators shall be made of standard white or green glass—which shall not decompose under the weather—carefully and accurately finished with smooth surfaces, free from cracks, seams, flaws, sand spots, flat places, or any other imperfections whatsoever. They shall be moulded full and true, and shall show a minimum die-seam. Screw threads shall be carefully and accurately moulded, and shall be free from fins or sharp edges, and shall accurately fit the threads of the standard pins.

2.—PORCELAIN INSULATORS. Insulators may be made of porcelain, the porcelain line Pony being shown at Fig. 14—H. Porcelain is somewhat stronger than glass, is a little less likely to crack in handling, and has somewhat better insulating characteristics, so is preferable on these accounts. The porcelain insulators shall be made of a first-class quality of highly glazed, brown porcelain, and shall in all respects possess all of the characteristics specified for glass insulators. Porcelain insulators shall be fully and thoroughly glazed; and hard burnt, and the enamel shall show no cracks, and shall be insoluble in any of the mineral acids.

SECTION 18.

18
Cross Arm Braces

There shall be three kinds of cross arm braces, made of iron or mild steel:

"A"—Front Braces.
"B"—Rear Braces.
"C"—Alley Arm Braces.

"A"—Front Braces. Front Braces are those which shall be placed on the same side of the pole as the cross arm. Front braces are shown in Fig. 15. They shall be made of flat iron, 28 ins. long, 1¼ ins. wide, ¼ in. thick, and shall have one $^{17}/_{32}$ in. hole drilled 1 in. from one end, and one hole $^{13}/_{32}$ in., drilled 1 in. from the other end.

Braces for cable arms shall have belt holes drilled $^{17}/_{32}$ in. in diameter.

"B"—Rear Braces. Rear braces are those which shall be placed on the opposite side of the pole from the cross arm. Rear braces are shown in Fig. 16. They shall be made of flat iron, 1¼ ins. wide, ¼ in. thick, 29¼ ins. long, and shall have one hole $^{17}/_{32}$ in., drilled 1 in. from one end, and one hole $^{13}/_{32}$ in., drilled 1 in. from the other end. Each rear brace shall have an offset, as shown in Fig. 16.

"C"—Alley Arm Braces.

1.—*Vertical Brace.* The vertical alley arm brace is shown in Fig. 17—A. It shall consist of a piece of 2½ in. x 2½ in. angle, weighing 2½ lbs. per foot. One inch from each end of the brace a hole $^{13}/_{32}$ in. in diameter shall be drilled. The length of this brace will depend on the number of cross arms for which it is to be used, and an allowance of 24 ins. in length for each arm shall be made, and for each arm one hole $^{13}/_{32}$ in. shall be drilled, as shown.

2.—*Diagonal Alley Arm Brace.* The diagonal alley arm brace, Fig. 17—B, shall be 38 ins. long over all, and shall be made of a piece of 2½ in. x 2½ in. angle, 2½ lbs. per foot. For a space of 4 ins. on each end, the flange of the angle shall be removed. One inch from one end a hole $^{17}/_{32}$ in. in diameter shall be drilled, and one inch from the other end a hole $^{13}/_{32}$ in. in diameter.

SECTION 19.

19
Cross Arm Bolts

Cross arm bolts shall be of steel, and supplied in two sizes, ½ in. and ⅝ in. in diameter, and of each size there shall be five lengths of bolts, measured under the head, respectively, 12 ins., 13 ins., 15 ins., 18 ins. and 20 ins. long. Each bolt shall have a thread 4 ins. long, cut on its end, supplied with a nut and square washer. All threads and nuts shall be U. S. standard. Fig. 18 shows the details of the ⅝ in. bolt and washer. The ½ in. bolt and washer shall be the same in all respects, except that the diameter of the bolt shall be ½ in., and that of the hole in the washer $^{17}/_{32}$.

SECTION 20.

20
Carriage Bolts

All carriage bolts shall be standard trade iron carriage bolts, ⅜ in. in diameter, 4½ ins. long under head, and having a nut and washer as shown in Fig. 19.

SECTION 21.

21
Fetter Drive Screws or Lag Bolts

All fetter drive screws shall be standard trade fetter bolts, made of iron, ½ in. in diameter, and 5 ins. long over all. They shall correspond to the dimensions of Fig. 20.

SECTION 22.

22
Double Arm Bolts

Double arm bolts shall be made of ½ in. steel rod. There shall be four sizes, respectively, 17 ins., 20 ins., 23 ins. and 26 ins. over all. On each end of each bolt a U. S. standard thread shall be cut for 12 ins. Each bolt shall be supplied with four U. S. standard nuts, threaded to fit the bolt, and four steel washers, ¼ in. thick, and 2½

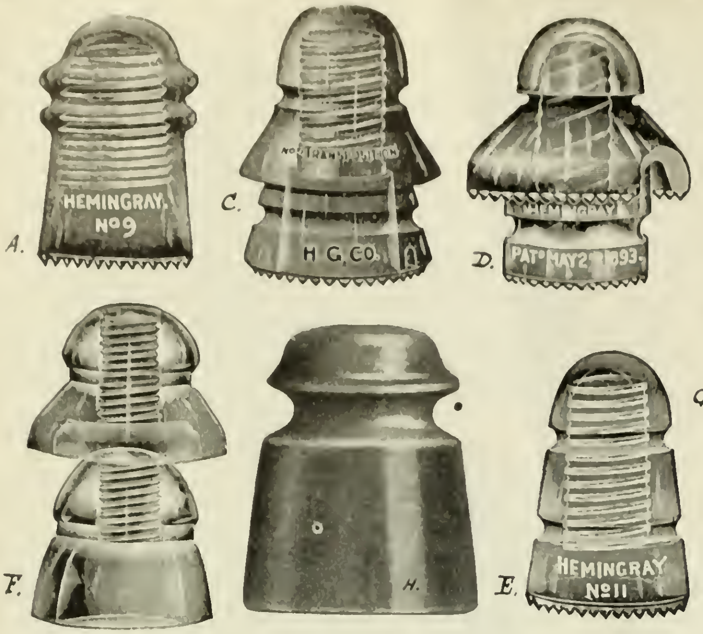
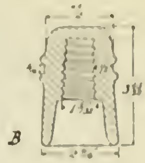


FIG. 14A TO H—INSULATORS.



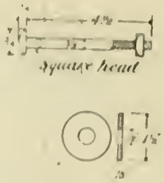
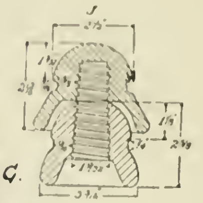


FIG. 19.—CARRIAGE BOLT.



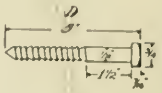


FIG. 20.—DRIVE SCREW OR LAG BOLT.

FIG. 22.—POLE STEP.

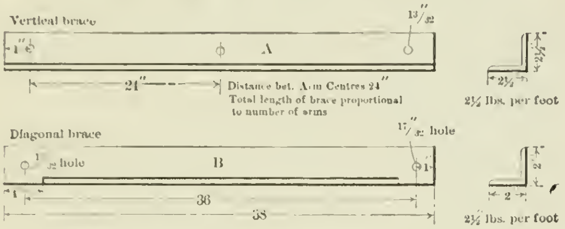


FIG. 17.—ALLEY ARM BRACES.

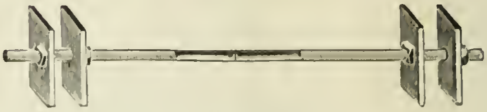


FIG. 21.—DOUBLE-ARM BOLT.

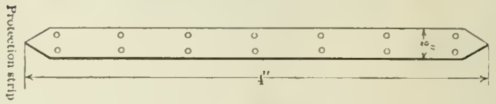


FIG. 24.—PROTECTION STRIP.

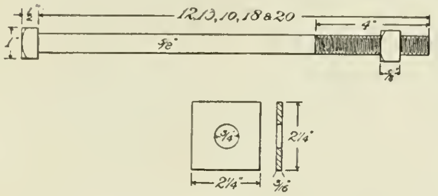


FIG. 18.—CROSS ARM BOLTS.

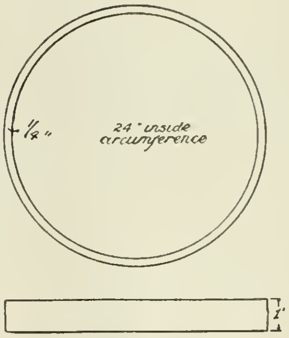
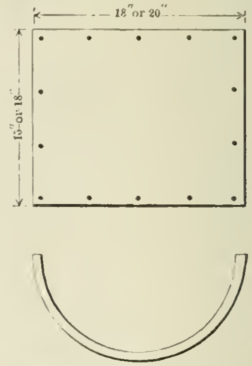


FIG. 23.—POLE RINGS.



Wheel Guard
FIG. 25.—WHEEL GUARD.

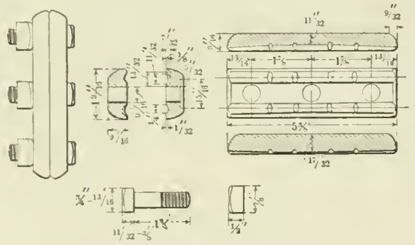
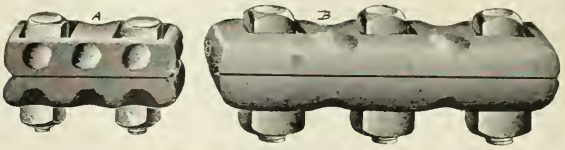


FIG. 28C.—STRAND CLAMP.



FIGS. 28A AND 28B.—STRAND CLAMP.

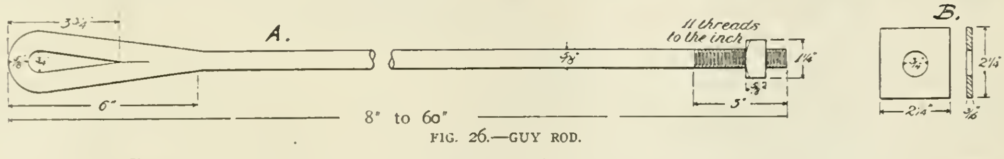


FIG. 26.—GUY ROD.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.

ins. square, each drilled with one $^{17}/_{32}$ in. hole in the center. The double arm bolt is shown in Fig. 21, and each bolt shall be shipped assembled in accordance therewith.

SECTION 23.

23
Pole Steps

Pole steps shall be of steel, as shown in Fig. 22, ⅝ in. diameter, 10 ins. long over all, turned up for 1½ins. at the end, and provided with a lag bolt thread for 3 ins. on the end.

SECTION 24.

24
Pole Rings

Pole rings shall be of iron or mild steel. They shall be 24 ins. in circumference inside, 1 in. wide, ¼ in. thick, made of ¼ in. by 1 in. bar, and otherwise according to Fig. 23.

SECTION 25.

25
Pole Protection Strips

Protection strips are shown in Fig. 24, and shall be made of sheet iron or steel, not less than 18 B. & S. gauge, 2 ins, wide, by 24 ins. long, and shall be punched with fourteen holes for tenpenny wire nails. All strips shall be concaved longitudinally to approximately fit the pole.

SECTION 26.

26
Wheel Guards

Wheel guards are shown in Fig. 25. They shall be made of $^{3}/_{16}$ in. iron or steel plate, of two sizes, respectively, 15 ins. x 18 ins., and 18 ins. x 20 ins., and shall be bent to a radius of 7 ins. Each plate shall be punched with fourteen holes, ¼ in. in diameter, or for twentypenny nails.

SECTION 27.

27
Guy Rods

Guy rods shall be made of wrought iron or mild steel. They shall be ⅝ in. in diameter, 18 ins. to 60 ins. by increments of 6 ins. long over all, furnished with an eye welded at one end, and a U. S. standard thread, and nut at the other end, and shall be of the dimensions and according to Fig. 26—A. Each guy rod shall be supplied with one iron washer of the style and dimensions shown by Fig. 26—B.

SECTION 28.

28
Guy Strands

All guys, from the end of the guy rod to the pole, shall be made of a first-class quality of wire rope. The wire used in making guy strands shall be the best quality of Bessemer or Sieman-Martin steel. It shall be uniform in quality, of an even cylindrical section, free from all die marks, scales, splits, flaws or other imperfections. Each wire shall be double galvanized. Every strand shall contain at least seven wires, and in case wires are spliced the tensil strength of the strand shall not be reduced thereby. All strands shall have the physical characteristics given in Table 5.

TABLE V.

PROPERTIES OF GUY STRANDS.

Diameter in inches of Wire.	Strand.	Lay in inches.	Ultimate strength—lbs. Bessemer.	Sieman-Martin.
.072	¼	3	2500	3050
.109	$^{5}/_{16}$	3½	4200	4860
.120	⅜	3¾	5700	6800
.134	$^{7}/_{16}$	4	7600	7000
.165	½	4½	9800	11000

SECTION 29.

29
Thimbles

Thimbles shall be made of wrought iron or mild steel, and shall correspond in all respects to the form and dimensions of Fig. 27.

SECTION 30.

30
Strand Clamps

Strand clamps shall be of two sizes; the two-bolt and three-bolt clamp. Two-bolt clamps shall be used for ¼ in. strands only; three-bolt clamps for all strands over ¼ in. The general appearance of strand clamps is shown in Fig. 28A and B, detail dimensions of a three-bolt clamp at C, to which all three-bolt clamps shall correspond. Two-bolt clamps may be proportionately smaller. The clamp grooves shall accurately match the strand specified in Section 28. All clamps shall be of the best quality of malleable iron or soft steel casting. The bolts shall be special steel, having a breaking strength of not less than 80,000 pounds per square inch. All castings shall be smooth, fully formed and carefully finished.

SECTION 31.

31
Rock Eye Bolts

Eye bolts for rock guying shall be of the style, dimensions and construction, as shown in Fig. 29. The sides shall be made of the best quality of commercial wrought iron or mild steel. Bolts shall be steel and shall have a breaking strength of not less than 70,000 pounds per square inch. Bolts for rock guying shall be made accurately to the dimensions shown, shall be carefully finished and shall correspond to all dimensions given. Rock eye bolts shall be assembled and wired together in sets, and then shipped either in boxes, barrels or bags.

SECTION 32.

32
Staples

Staples shall be made of galvanized wire, approximately No. 6 B. W. G. They shall be 2⅛ ins., and otherwise of the style and dimensions as shown in Fig. 30. All staples shall be galvanized, and shall be packed and shipped in boxes.

SECTION 33.

33
Fuses

Line fuses shall be of the general style shown in Fig. 31. Clamps shall be capable of being attached to any wire between Nos. 5 and 12 B. & S., as shall be specified. Fuses shall blow at three, five or seven amperes, as may be specified in each case, and each fuse shall be plainly marked with its capacity. The fuse gap shall be not less than 3 ins. The fuse case shall be of waterproof material, and each terminal provided with lock nuts.

SECTION 34.

34
Ground Rods

Ground rods shall consist of ½ in. steel or iron rods, 6 ins. long. Each rod shall have one end drawn to a point, and the other cut suqare. One inch (1 in.) from end that is squared, a $^{3}/_{16}$ in. hole shall be drilled through the rod perpendicular to its axis.

SECTION 35.

35
Connectors

Connectors shall be made of copper, and designed according to Fig. 32. Each connector shall be not less than 1¼ ins. long, and provided with two bolts, each not less than ¼ in. in diameter. Each bolt shall have a lock nut or other approved method of securing the nut. Connectors shall be designed for wire from No. 5 to 12 B. & S.

SECTION 36.

36
Copper Line Wire

All copper line wire shall be hard drawn. It shall be cylindrical in section, uniform in quality, with smooth surface, free from all die marks, scales, splints, flaws, fractory joints or other imperfections of whatsoever nature. The inspection of all wire shall be done at the factory of the manufacturer, who shall at all times afford the authorized inspector of the company full and free access to all processes of manufacture through which the wire, to be delivered under these specifications, shall pass. The manufacturer shall also provide adequate testing machines for making any and all of the mechancial tests hereinafter provided. The inspector shall have the privilege of inspecting all of raw material from which the wire is made. The inspector shall cut a sufficient length from each end of each coil of wire to make all of the mechanical tests hereinafter specified. Each coil of wire shall be drawn from one bar in one continuous length, and shall be free from all joints or splices. The diameter of the eye of each coil shall not be less than 20 ins. or more than 22 ins. When shipped, each coil shall be bound with four lashings of twine, and shall be so protected by burlap that there may be no danger of mechanical injury during transportation. Each coil shall be plainly and indelibly marked by two tags, one of which shall be attached inside of the burlap, and the other on the outside. These tags shall state the weight and length of the coil in question. The mechanical and electrical properties of hard drawn copper wire shall be as in Table VI:

All samples of hard drawn copper shall elongate not less than 1 per cent. or more than 2 per cent. in test pieces five feet long. Samples of No. 5 hard drawn copper wire, 6 ins. in length, when tested for torsion, shall show not less than twenty twists in a length of 6 ins. Each successive smaller gauge shall show at least five additional twists.

All wire shall be full in section, and shall not vary more than .001 in. on either side of the diameters specified in Table VI., and the weights per mile of wire shall not vary more than 3½ per cent. on either side of the weights specified in Table VI. The conductivity of all wire shall be at least 97 per cent. of Matthieson's standard.

TABLE VI.

PROPERTIES OF HARD DRAWN COPPER WIRE.

Numbers B. & S. gauge.	Diameters in mils.	Areas in circular mils.	Weights per 1000 ft.	Weights per Mile.	Resistances in international ohms at 68° F. Per 1000 ft.	Resistances in international ohms at 68° F. Per mile.	Tensile strength—lbs.
5	182.	33102.	100.	529.	.3199	1.689	1550
6	162.	26251.	79.	419.	.4013	2.130	1235
7	144.	20818.	63.	332.	.5085	2.685	980
8	128.	16510.	50.	264.	.6413	3.386	778
9	114.	13093.	40.	209.	.8088	4.277	617
10	102.	10383.	32.	166.	1.0199	5.384	489
11	91.	8234.	25.	132.	1.2854	6.787	388
12	81.	6529.	20.	104.	1.6218	8.563	307
13	72.	5178.	15.7	83.	2.0443	10.794	244
14	64.	4106.	14.4	76.	2.5779	13.612	193
15	57.	3257.	9.9	52.	3.251	17.165	153
16	51.	2582.	7.8	41.	4.099	21.646	133
17	45.	2048.	6.2	33.	5.055	27.694	97
18	40.	1624.	4.9	21.6	6.518	34.416	77

SECTION 37.

37
Galvanized Iron Wire

Iron wire shall in all qualifications, regarding size, finish method of manufacture, inspection, etc., correspond to the specifications in Section 36, given for copper wire. There shall be three kinds of iron wire, respectively known as E.B., B.B.B. and Steel. The properties of the various kinds of wire are given in Table VII.

Samples of iron wire shall elongate not less than 15 per cent. in lengths of one foot, and when tested for torsion there shall be at least fifteen twists in pieces 6 ins. long. All wire shall be thoroughly and carefully annealed and double galvanized.

TABLE VII.

PROPERTIES OF GALVANIZED IRON WIRE.

Numbers B. W. G.	Diameters in mils.	Weights, lb., per 1000 ft.	Weights, lb., per Mile.	Breaking strengths, lbs. Iron.	Breaking strengths, lbs. Steel.	Resistance per mile in ohms. E. B. B.	Resistance per mile in ohms. B. B.	Resistance per mile in ohms. Steel.
2	284	212	1121	3363	6335	4.19	4.91	5.8
3	259	177	932	2796	5268	5.04	5.9	6.97
4	238	149	787	2361	4449	5.97	6.99	8.26
5	220	127	673	2019	3801	6.99	8.18	9.66
6	203	109	573	1719	3237	8.21	9.6	11.35
7	180	85	450	1350	2545	10.44	12.21	14.43
8	165	72	378	1134	2138	12.42	14.53	17.18
9	148	58	305	915	1720	15.44	18.06	21.35
10	134	47	250	750	1410	18.83	22.04	26.04
11	120	38	200	600	1131	23.48	27.48	32.47
12	109	31	165	495	933	28.46	33.3	39.36
13	95	24	125	375	709	37.47	43.85	51.82
14	83	18	96	288	541	49.08	57.44	67.88

SECTION 38.

38
Bridle Wire

Bridle wire shall be of No. 19 B. & S. gauge (36 mils in diameter), copper, insulated with okonite. The wire shall be first tinned, and then thoroughly and uniformly covered with rubber compound to a thickness of $^3/_{32}$ in. The composition shall be homogeneous in composition, and shall be evenly applied to a uniform thickness, and concentrically with the wire, and shall have the following electrical properties: After forty-eight hours immersion in water at a temperature of 60° Fahr., all wire shall show an insulation resistance of not less than 250 megohms per mile, when tested with the negative pole of a 100 volts battery to the wire, after an electrification of one minute. The dielectric strength of the insulation shall be tested by immersing a sample of the insulated wire in water for seventy-two hours, and then placing it in a conducting liquid in a metal trough. All wire shall under these conditions be capable of withstanding an alternating current of 18,000 volts with a frequency of 133 per second, applied to the test sample for five minutes.

SECTION 39.

39
Weather Proof Wire

Weather proof wire shall be made of thoroughly tinned copper wire, insulated with three separate, closely-woven braids of cotton. Each braiding, as applied, shall be completely saturated with a dense moisture-repellant compound, applied in such a manner as to drive from the cotton any moisture contained. The thickness of the finished insulation shall not be less than $^1/_{16}$ in., and the surface shall be hard and smooth. The covering shall retain its elasticity at a temperature of ten degrees below zero, Fahrenheit ,and shall not drip at any temperature below 180 degrees Fahr.

SECTION 40.

40
Tie Wire

Tie wires shall be of same size and material as the line wires they are to secure, and shall be made of wire that is carefully annealed, and is as soft as possible. The length of the wire shall be as follows:

Size of Line Wire.	Length of the Wire. Ins.
.080	16
.104	19
.165	22

SECTION 41.

41
Construction Specifications

For the purpose of description, it is convenient to subdivide the work of building open wire lines into the following sections:

Section 42—Location of Poles:
  A—Country Lines.
  B—City Lines.
Section 43—Distribution of Poles.
Section 44—Fitting of Poles:
  A—Gaining and Roofing.
  B—Stepping.
  C—Ringing.
  D—Protecting.
  E—Lightning Rods.
Section 45—Setting Poles:
  A—Foundations.
  B—Erection.
Section 46—Cross Arming:
  A—Straight Line Work—Single Bracing.
  B—Straight Line Work—Double Bracing.
  C—Double Arming.
  D—Alley Arms.
  E—Cable Arms.
Section 47—Setting of Pins.
Section 48—Painting.
Section 49—Guying.
Section 50—Bracing.
Section 51—Curves and Corners.
Section 52—Highway Crossings.
Section 53—Erection of Wire.
Section 54—Tension of Wire.
Section 55—Location of Wire on Pins.
Section 56—Tying of Wire.
Section 57—Wire Joints.
Section 58—Dead Ending.
Section 59—Transposition.
Section 60—Distribution.
Section 61—Protection.
Section 62—Prevention of Humming.
Section 63—House Top Line:
  A—Right of Way.
  B—Construction:
    1—Connection to Main Wire Plant.
    2—Fixtures and Circuits.

SECTION 42.

42
Location of Poles

"A"—COUNTRY LINES. Prior to the commencement of actual work, all pole locations shall be fixed by measuring off the proper distances along the route selected, to be in all cases within the limits granted in the rights of way contracts. At the points thus indicated stakes shall be set to mark the location of poles; in ordinary level country poles shall be set at uniformly equal distances of 130 ft., or in other words, there shall be forty poles per mile of line. Stakes shall be planted irrespective of obstacles, and poles set as near each stake as possible. Wherever guying or bracing is necessary, a stake shall be planted, indicating the location of the guy or brace, which shall be carefully arranged in such a manner as to completely absorb the horizontal stresses inflicted upon the poles by the circuits. On curves, at corners and other exposed locations, such a number of poles shall be placed as is necessary to secure proper strength, and the best alignment of the work. Heavy lines of seven to ten arms need more poles than light ones of two or three arms, and city lines must have more than country lines. It is rarely necessary to set poles closer together than 100 ft., and seldom expedient to build spans of more than 150 ft. These are the limits for good regular work, but as it

is impossible to specify the arrangement of poles to meet all contingencies, the design and location of the various portions within the above limits shall be left to the discretion of the foreman. If special obstacles arise, a careful sketch showing all the details (with dimensions) of the portion of the route in question, shall be submitted to the manager with request for instructions.

In lines constructed along railway rights of way, no poles shall be set at a distance of less than twelve feet from the edge of the nearest rail, unless the lowest cross arm that the line shall ever carry shall be more than twenty-two feet from the top of the rail. In such cases, with the consent of the railway company, the pole may be set to within seven feet of the edge of the rail. Along all railway rights of way all wires, cables, strands or other fixtures shall be placed so that the lowest portion of the line shall be at least twenty-two feet from the top of the rail.

Poles shall be located upon the edge of the highway in such a manner as to interfere with its use as little as possible. Whenever any portion of the line is vertically over any road or highway, all wires, strands, fixtures or cables shall be placed so that there shall in all cases be at least eighteen feet head room between the lowest portion of the line and every part of the highway.

Wherever a route shall intersect the lines or property of other telephone or telegraph company, or when two companies shall occupy the same poles, such a design shall be made as to allow the lowest wires of the line running over to clear the highest wire of the line running under by a space of at least four feet. This rule shall also apply to the clearance of all obstacles of whatsoever nature except trees.

"B"—CITY LINES. The location of poles for city lines shall be made in all respects as specified in "A". In addition, care shall be taken to place poles on the corners of streets to render guying easy. Poles shall be located just at the edge of the curb line, and as far as possible the center of each pole shall be set on a dividing property line, thus interfering with each owner as little as possible. All poles shall be placed away from driveways, gates, entrances, crosswalks, and the like.

SECTION 43.

43
Distribution of Poles

The heaviest and most substantial poles shall be placed at corners and curves, and the straightest and best poles shall be selected for city work, and of these the best appearing shall be placed in front of residences. As far as possible, poles shall be selected for length in such a manner as to balance the changes in contour of the country, and to keep the lines as nearly level as may be. Thus, short poles shall be used upon high ground, and tall poles in the valleys. It is essential to always so proportion poles that the circuits shall not pull upwards, tending to lift the insulators from their pins.

SECTION 44.

44
Fitting of Poles

A—Gaining and Roofing.
B—Stepping.
C—Ringing.
D—Protection.
E—Lightning Rods.

"A"—GAINING AND ROOFING. All poles shall be roofed, gained and bored for cross arms as specified in Section 10. The required number of gains shall be specified for each pole separately. If poles are not treated, the roof and each gain shall be painted with two thick coats of Prince's metallic paint, mixed in the proportion of 7 lb. dry paint to 1 gal. pure linseed oil.

"B"—STEPPING. Each cable pole, all painted poles in towns or in cities, and all poles fifty feet in height and over, shall be equipped with galvanized pole steps, as is illustrated in Section 23. These pole steps shall be driven on alternate sides of the pole in line with the cross arms. Poles that are less than 63 ins. in circumference shall have steps spaced 18 ins. between centers on each side; poles which exceed 63 ins. in circumference shall have the pole steps spaced 12 ins. on each side.

"C"—RINGING. Corner poles, or those in exposed locations, shall be ringed if in the judgment of the foreman this is desirable. Pole rings are specified in Section 24. Ringing shall be accomplished by shaving the top of the pole so that the ring can be driven on to the pole to 1 in. below the base of the roof. The ring shall be secured by four sixpenny galvanized wire nails driven on top of the ring spaced equally around its circumference.

"D"—PROTECTION. On all the principal streets of towns and cities, at all street corners, and in other exposed locations, where in the opinion of the foreman protection is desirable, poles shall be supplied with protection strips, or wheel guards, or both, as the foreman may deem necessary. Protection strips and wheels guards are described in Sections 25 and 26. Protection strips shall be applied to the base of the pole and secured thereto as shown in Fig. 33, with twelvepenny galvanized wire nails. Wheel guards shall be applied as shown in Fig. 33, but shall be secured with sixpenny galvanized wire nails.

"E"—LIGHTNING RODS. Every tenth pole of country lines only shall be equipped with a lightning rod. This lightning rod shall consist of a piece of No. 6 galvanized iron wire, which shall extend not less than 12 ins. above the top of the roof of the pole, and shall be attached to the sides thereof by means of galvanized steel staples (Section 32), spaced 1 ft. apart. Each lightning rod shall extend the entire length of the pole, and shall be soldered to a ground rod, driven into the earth below the surface at the base of the pole. The lightning rod shall be kept as straight as possible, and in no case shall any turns or coils be introduced therein.

SECTION 45.

45
Setting of Poles

A—Foundations.
B—Erection.

"A"—FOUNDATIONS. Under ordinary circumstances, where the ground is of normal consistency, poles shall be set to the following depths:

Poles 30 ft. or less, 5½ ft. on straight lines and 6 ft. on corners and curves.
35 ft. poles, 6 ft.
40 ft. poles, 6 ft.
45 ft. poles, 6½ ft.
50 ft. poles, 7 ft.
Poles 50 ft. or over, 8 ft.

All poles on straight lines shall be set perpendicularly. Poles on curves shall incline slightly outward, enough so that the tension of the circuits shall pull them nearly perpendicular. All holes shall be dug large enough to admit the pole without stabbing or hewing, and shall be full size at the bottom, to permit the use of iron tampers. After the pole is placed in position, only one (1) shovel shall be used in filling the hole. Three (3) tampers shall be employed to pack in the filling continuously until the hole is completely filled. Soil shall then be piled up above the surface and firmly packed around the pole. In filling in holes, use the coarse soil or gravel at the top of the hole. Where the ground is sandy or marshy, additional precautions are necessary to keep the pole from settling out of line. Where the soil is fairly firm a sand-barrel may be used. The sand-barrel is a strong barrel or cask, which shall be set at the bottom of the hole, and into which the pole shall be placed, and the barrel packed with firm loam, clay, gravel or sand, the barrel serving to distribute the pressure of the pole over a greater area of soil. When soil is only slightly soft a temporary sand-barrel may be used. This is an iron cylinder, about 3 ft. in diameter, and 4 ft. or 5 ft. in length, split longitudinally and provided with hinges and clasps. The cylinder is set at the bottom of the pole hole, the pole placed inside of it, and loam or clay rammed in place until the pole is solidly supported. The cylinder is then drawn from the excavation by a fall on the pole, and can be opened and removed. With a weaker soil the best method is to surround the pole with 6 ins. or 8 ins. of concrete, made of one part of Rosendale cement mixed with two of sand, and five of broken stone. In such cases, place a layer of concrete, 8 ins. thick, on the bottom of the hole. The concrete pole foundation is shown in Fig. 34. As the object of the concrete is to give a larger bearing surface against the soft soil, as much concrete may, within reasonable limits, be used as is necessary. Where concrete is not available, or the soil seems so soft to require an excessive amount, a foundation may be secured by bolting the transverse logs to the pole butt, as shown in Fig. 35. Such logs shall be from 4 ft. to 6 ft. long, not less than 6 ins. in diameter at the smallest end, and secured to the pole by one ⅝ in. bolt. When the soil is a veritable bog or marsh, poles shall be set on a platform, Fig. 36, or a platform and piles, Fig. 37. These methods are so obvious from the illustrations that further specification is unnecessary. The construction of Fig. 36 shall be used for 30 ft. pole, and that of Fig. 37 for larger and heavier lines, or when the ground is very soft. If hard pan or rock shall be encountered, the only precaution to be observed is to make holes large enough to receive the butt without hewing, and to excavate the hole so that the pole can stand perpendicularly. If it shall be necessary to blast pole hole, this part of the the work shall only be entrusted to those who are skilled in the use of explosives.

"B"—THE ERECTION OF POLES. Poles which are 45 ft. or less, may be erected with pike staves, as shown in Fig. 38. Care shall be taken to distribute the gang on each side of the pole, so that it may be held securely while in the air, yet so that in case of an accident no one shall be injured. To raise poles over 50 ft. a tripod derrick may be employed, as shown in Fig. 39. The derrick shall be built of three 30 ft. poles. The top of the derrick spars may be equipped with a universal swivel hinge and ring, to which the fall may be hung, or a simple lashing may be used. In the butt of each pole a solid spike, not less than 1 in. in diameter and 3 ins. long, shall be placed to prevent the butt from slipping. A four part 3 in. fall is sufficient for hoisting. For heavy poles, a winch clamped to one leg of the derrick, can be employed. The pole should be slung just above its center of gravity, so that the butt will drag on the ground and slide into the hole. As soon as the butt has entered the hole, the sling can be shifted and the pole hoisted upright. Better than either of the preceding methods is the use of a derrick wagon for all pole setting. A heavy two-horse truck is equipped with a small derrick, having a capacity of two tons, and a reach of 20 ft. in all directions. The mast is hinged at its base on the truck, so that it can be laid down for transportation. Power is best supplied by a gasoline or electric motor. With such an apparatus, poles can be set as fast as the wagon can drive.

Prior to raising, a guide cross arm shall be placed on each pole, to show which way the gains set. Before the refill is rammed about each pole, it shall be turned to bring all gains to their proper positions. On straight lines gains shall be perpendicular to the line; and on curves and corners set radially.

SECTION 46.

46
Cross Arming

A—Straight Line Work.—Single Bracing.
B—Straight Line Work.—Double Bracing.
C—Double Arming.
D—Alley Arms.
E—Cable Arms.

All cross arms shall be bolted to the pole, either with one ⅝ in. machine bolt, or two ½ in. machine bolts (Section 19), as may be specified in each case.

"A"—STRAIGHT LINE WORK—SINGLE BRACING. In straight-a-way work each cross arm shall be braced with two galvanized mild steel braces of the style and dimensions shown in Section 18—A. Each brace shall be attached to its arm by one 4 in. carriage bolt (Section 20). Both braces shall be secured to the pole by one ⅝ in. fetter drive screw (Section 21). The method and dimensions for cross arming are shown in Fig. 40.

"B"—DOUBLE BRACING. Whenever the line is exposed more than under normal conditions, back cross arm braces shall be used in addition, unless double cross arms are specified. The back cross arm brace shall be of the style and dimensions as shown in Section 18—B. Each pair of back cross arm braces shall be fastened to the pole by one 5 in. fetter drive screw (Section 21). Each brace shall be attached to the cross arms by one carriage bolt, Section 20. The method and dimensions for double bracing are shown in Fig. 41.

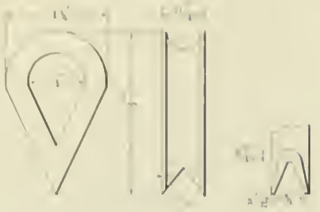


FIG. 27.—THIMBLE.

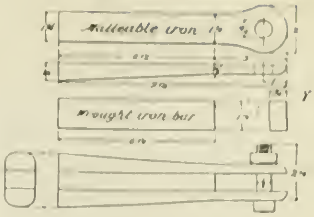


FIG. 29.—ROCK EYE BOLT.

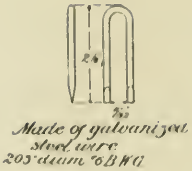


FIG. 30.—STAPLE.

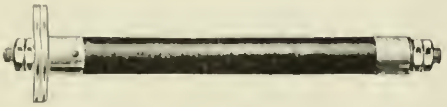


FIG. 31.—FUSE.

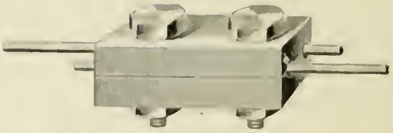


FIG. 32.—CONNNECTOR.

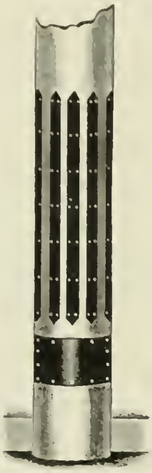


FIG. 33.—POLE PROTECTION.

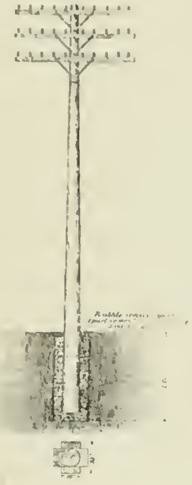


FIG. 34.—CONCRETE FOUNDATION.

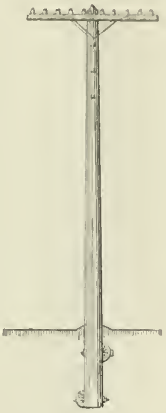


FIG. 35.—LOG FOUNDATION.

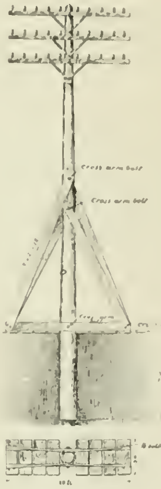


FIG. 36.—PLATFORM FOUNDATION.

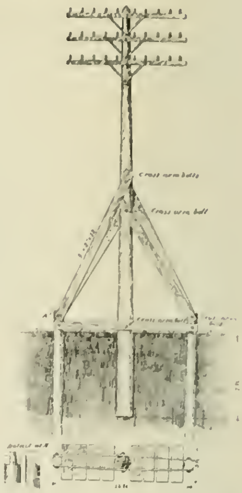


FIG. 37.—PLATFORM AND PILES.

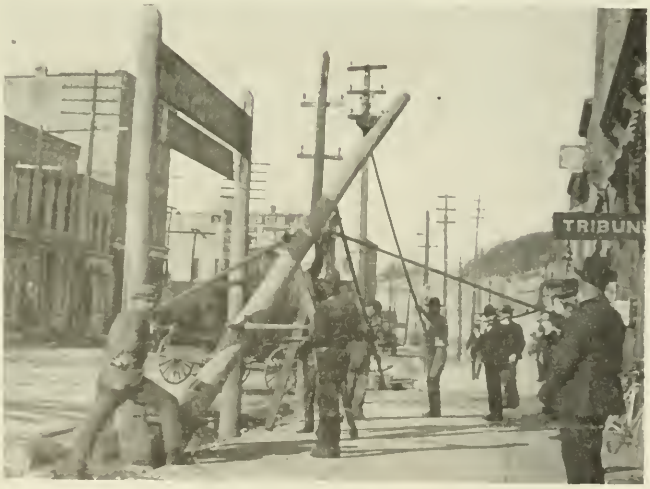


FIG. 38.—POLE RAISING.

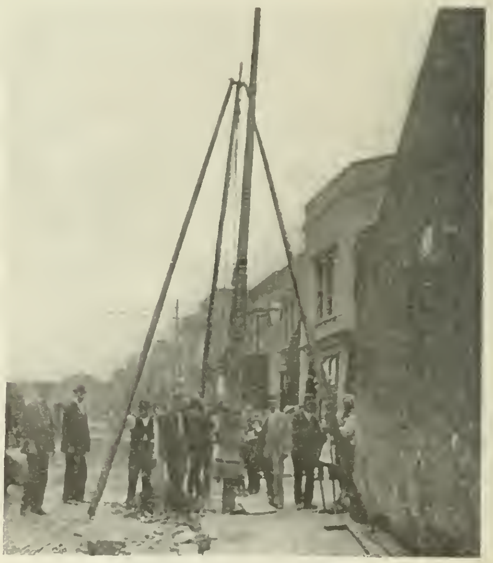


FIG. 39.—POLE DERRICK.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.

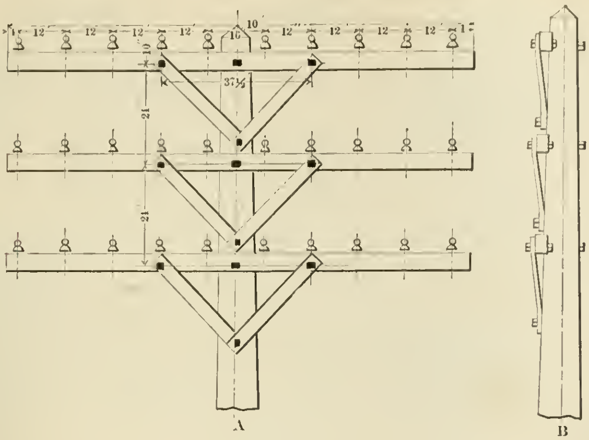


FIG. 40.—ATTACHMENT OF FRONT BRACES.

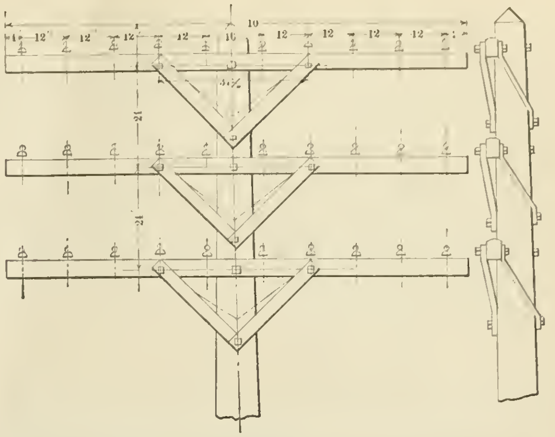


FIG. 41.—ATTACHMENT OF REAR BRACES.

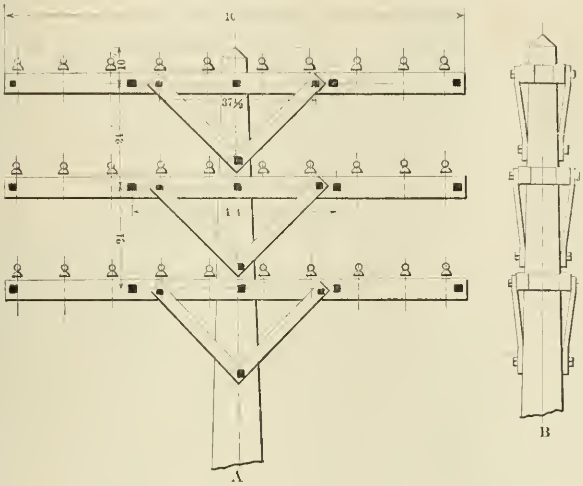


FIG. 42A AND B.—DOUBLE ARMING.

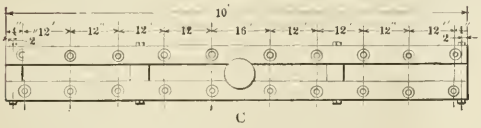


FIG. 42C.—DOUBLE ARMING.

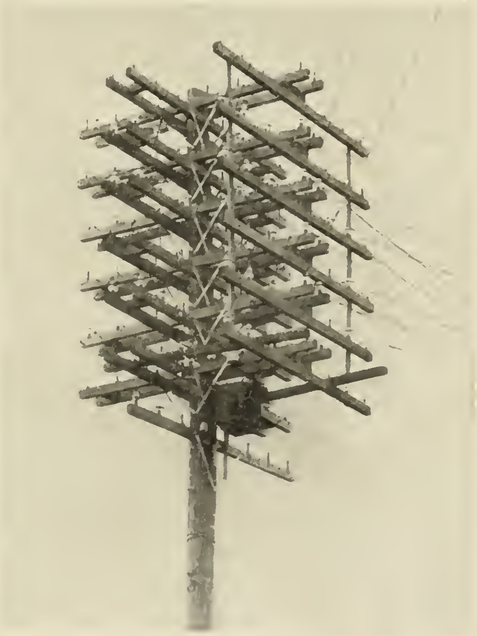


FIG. 43.—DOUBLE ARMING.

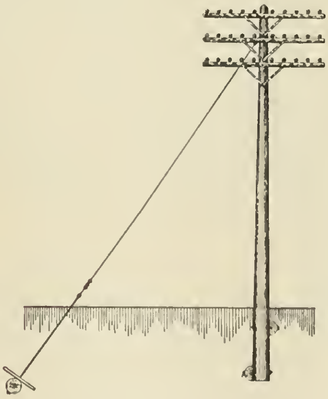


FIG. 44.—PLAIN GUY.

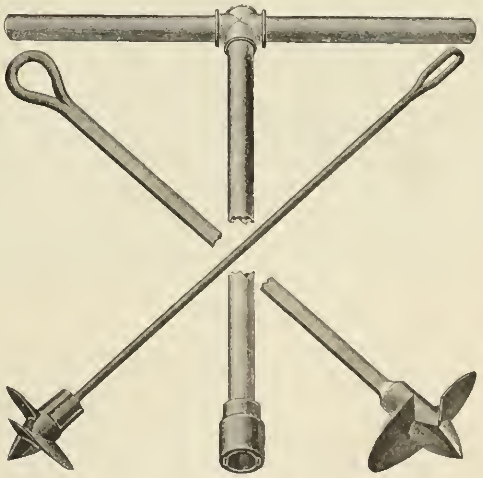


FIG. 44A.—GUY ANCHOR.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.

"C"—*DOUBLE ARMING.* Where many circuits are dead ended, on all bad corners, in particularly exposed locations, when circuits run in several directions from a distributing pole; and at such other points as the foreman shall deem necessary,—poles shall be double armed. Double arms shall consist of two arms, one placed on each side of the pole in the manner already specified in "A", of this section. In addition, each ten pin double arm shall be secured by four blocks and double arm bolts (Section 22). The blocks shall be of pine 4 ins. x 4 ins., and of such thickness as may be necessary to fill between the arms. The double arm bolts shall be placed, and double arming done in accordance with Fig. 42—A and B. An example of double arming is given in Fig. 43.

"D"—ALLEY ARMS. Alley arms shall be erected as specified for straight line work, and in addition, the two special braces shall be attached, as shown in Section 18—C, Fig. 7. The vertical braces shall be attached to each arm with one carriage bolt (Section 20). The diagonal brace shall be attached to the pole with one fetter drive screw (Section 21), and to the arm with the same carriage bolt used for the vertical brace.

"E"—*CABLE ARMS.* Shall be attached to the pole and braced as specified in "A" of this Section, and according to Fig. 8.

SECTION 47.

47
The Setting of Pins

Wooden pins shall be placed at the time the cross arms are erected. Each pin shall be driven firmly into its hole in the arm, and nailed with one galvanized sixpenny wire nail, driven through the arm in the center between the top and bottom.

Iron pins shall not be erected till the line wires are strung.

SECTION 48.

48
Painting

In cities and larger towns poles shall be painted after the line is completed. Each pole shall receive two coats of first-class lead and linseed oil paint, of such a color as may be directed by the company. After painting, the butt of each pole shall receive two coats of black paint for a distance of 6½ ft. above the ground.

SECTION 49.

49
Guying

The various methods of guying are illustrated in Figs. 44 to 51, inclusive. Wherever possible, guying shall be done as shown in Fig. 44. The butt of the pole to be guyed shall be reinforced by two logs, 4 ft. to 6 ft. in length, and not less than 8 ins. in diameter at the smallest end. These logs shall be bolted to the butt of the pole, as shown. A guy rod (Section 27) shall then be planted at an appropriate distance from the pole; the greater the distance of the foot of the guy from the pole, the more valuable it is. The anchor log shall not be less than 8 ins. in diameter at the smallest end, and from 4 ft. to 6 ft. in length. Through the center of the log the guy rod shall be set and bolted. In place of the anchor log and rod, a guy anchor, as shown in Fig. 44—A, may be used, but can only be employed in loamy or clayey soils, where no rock or coarse gravel is encountered.

The guy shall be made of strand, as specified in Section 28. It shall run from a thimble in the eye of the rod to the pole, and be secured by two hitches around the pole, and a strand clamp, both at the pole and at the thimble. Where obstacles prevent running the guy, as shown in Fig. 44, guy stubs shall be used, as shown in Figs. 49 and 50. Of the two methods indicated for guy stubs, the one in Fig. 49 is the preferable one, and should be used wherever possible. In all cases guy stubs shall be reinforced by two logs, as shown. Sometimes it is possible to use trees as anchors for guys. Wherever this can be done, under private right of way authority, the methods used in Figs. 45 and 46 shall be adopted, the one shown in Fig. 45 being the preferable one. Guys shall not be attached to limbs of trees, unless the limbs are at least 5 in. in diameter. In all cases, trees shall be protected with proper lagging, as shown. Where rock exists, guying shall be accomplished as shown in Figs. 47 and 48. Guys shall be secured to the rock by means of a rock eye-bolt (Section 31). A taper hole shall be drilled in the rock and the rock and eye-bolt set as shown in Fig. 48. From the rock eye-bolt the guy strand shall be extended to the pole. All attachments shall be made with strand clamps. As often as once in each mile in straight country lines—wherever turns, crossings or corners occur—and as often as may be considered advisable in city lines, poles shall be head-guyed and double head-guyed, as shown in Fig. 51.

SECTION 50.

50
Bracing

To counteract side strain upon poles, braces may be used wherever it appears preferable, either from economy or convenience, to use a brace instead of a guy. The various forms of braces are illustrated in Figs. 52, 53 and 54. The single brace is shown in Fig. 52, and the double brace in Fig 53. These figures are self-explanatory. In Fig. 54 the Double Pole is shown. This is an exceedingly economical and desirable form, and should be employed in all exposed locations, where right of way conditions will permit. An extension of this design, making a tripod pole, may be used at particularly bad corners, and will provide a strut that will successfully withstand any gale.

SECTION 51.

51
Curves, Corners and Crossings

Where it is necessary to make any change in direction in a line, care shall be taken to make such change as gradual as possible, or, in other words, to spread the curve over as many poles as may be. Where sharp bends are unavoidable, proper guys or braces, or both, must be provided to receive all the horizontal stresses of the circuits. Figs. 55 and 56 are examples of methods of curve and corner work. Fig. 55—A is the method of making a gradual bend, which should be adopted wherever possible. At Fig. 55—B, a right angle corner, with side guys is shown. In Fig. 56—B a similar corner is shown, but this design is much stronger than Fig. 55—B, as there are two more head guys, and a brace suitable for poles, which are double armed. Fig. 55—C is a corner without guys, suitable only for light lines where guying is impractical. Poles 3 and 4 should be double poles if possible. Fig. 56—A illustrates a design suitable for the sharpest kind of a corner. At Fig. 56—D, a corner is shown made by dead-ending on the terminal poles, and cutting the circuits into cable over the corner itself. Fig. 5 "C", shows a design for two intersecting lines. As it is impracticable to specify details for all curves, corners and crossings, foremen shall build all ordinary cases as herein specified, and shall submit to the manager, for approval, a sketch with full dimensions and all other information of all cases which are not here under comprised.

SECTION 52.

52
Highway Crossings

Whenever a line must change from one side of a road or street to the other, the crossing shall be made so that the circuits make as near a 45° angle with the highway as possible. Pains shall be taken to select locations where the crossing can be made as in Fig. 57 A, with side guys at each terminal pole, as shown. If it is impossible to realize the condition, the crossing shall be made as in Fig. 57 B or 57 C. If the line contains more than two cross arms the head guys shall be carried three poles from the end of each line, and the first two poles shall be double head guyed.

SECTION 53.

53
Erection of Wire

"A"—COUNTRY LINES. In open country, or in thoroughfares not densely crowded—where a number of wires are to be strung simultaneously, a cart shall be provided, on which shall be placed as many reels as there are pins upon each cross arm. A good form of reel is shown in Fig. 58, while Fig. 59 shows the reel cart in use stringing wire. A running board shall be provided, as shown in Fig 60. This is a piece of tough timber 4 ins. x 6 ins. as long as the cross arm, having holes bored as shown, spaced the same distance apart as the cross arm pins. Where there is more than one arm, a split running board shall be used. A running rope shall then be carried over the cross arms of the poles for 1,500 ft. or 2,000 ft., and the running board attached to the end thereof. A team of horses shall then be attached to the rope, and the running board, with the wire attached, hauled over the cross arms. At each pole a lineman shall be stationed, whose business it is to guide the running board and wires over the cross arms. As soon as the running board arrives at the last pole over which the running rope passes the wires shall be temporarily secured, and the process repeated until the line is completely strung. After the wires are in their places, they may be drawn up by the method shown in Fig. 61, and the sags adjusted in the center of each span to the amounts prescribed in Section 54. A better method is to adjust the final tension on each wire by means of a come-along and dynamometer, shown in Fig. 62. The dynamometer is attached to the cross arm by its fall, and the wire gripped by the come-along. By means of the fall the wire may be drawn in or paid out till the dynamometer shows the tension specified in Section 54. When the wires are finally in their places, and adjusted to the proper tension and sag, they shall be tied to the insulators, as specified in Section 56.

"B"—CITY LINES. In crowded city streets, it is rarely practical to employ the running board and erect a number of wires simultaneously, and it is usually only possible to erect a single wire at a time. The method of erection consists in stringing a running rope over the cross arms of as many poles as possible, without seriously interfering with city traffic. A reel, containing the wire, shall be mounted at the beginning of the line, to which the running rope is attached, and then the wire, by means of the rope, hauled over the cross arms and lifted into place. At each cross arm the wire shall then be adjusted in proper tension and sag, as specified in "A", and tied to its insulators. This method may also be employed in country lines where but one or two wires are to be strung, and the use of the running board is inexpedient.

SECTION 54.

54
The Sag and Tension of Wires

Before wires are tied to their insulators, they shall be adjusted for tension. The proper tension depends on the length of the span, the temperature of the wire at the time of erection, and the size of the wire. There are two methods of adjusting wire; one is by means of a dynamometer, as specified in Section 53; the other is by adjusting the deflection of the wire in the center of each span below a horizontal line. In cold weather the wire contracts and the tension increases. All wire shall be so adjusted that in the coldest weather the tension shall not exceed one-third of the breaking strength. The relation between the deflection of any wire, the span between the poles, and the tension produced on the wire, is given by the following expression:

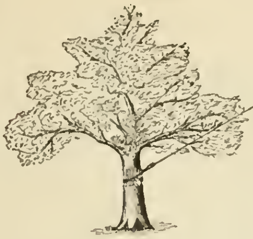


FIG. 45.—GUY TO TREE TRUNK.

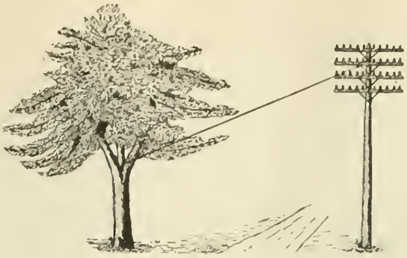


FIG. 46.—GUY TO TREE BRANCH.

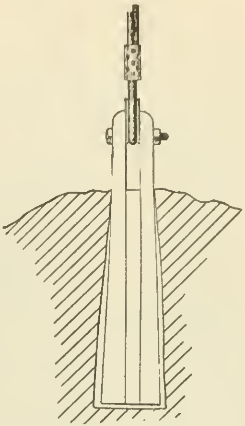


FIG. 48.—ROCK EYE BOLT.

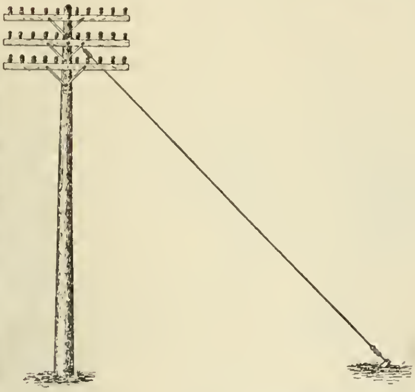


FIG. 47.—ROCK GUY.

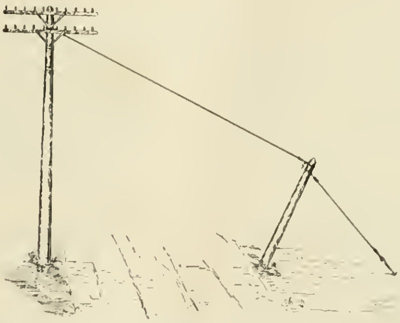


FIG. 49.—GUYS OVER OBSTACLES.

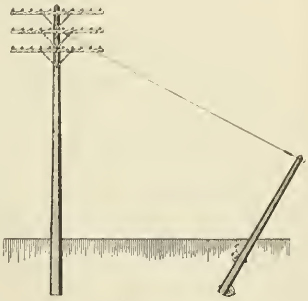


FIG. 50.—UNANCHORED GUY STUB.

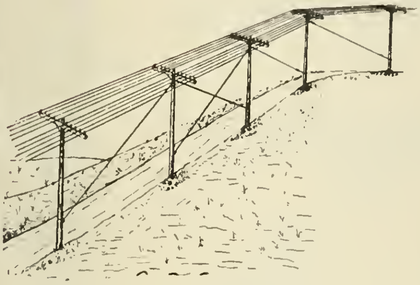


FIG. 51.—HEAD GUYING TO LINE.

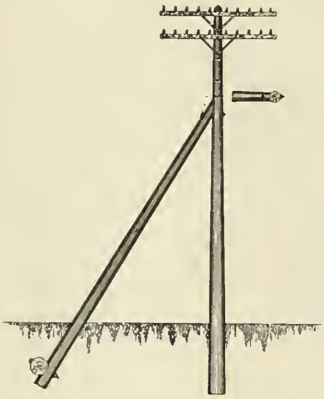


FIG. 52.—SINGLE BRACE.

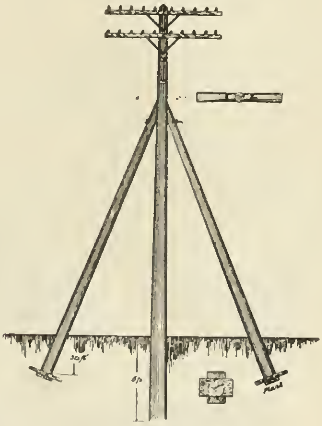


FIG. 53.—DOUBLE BRACE.

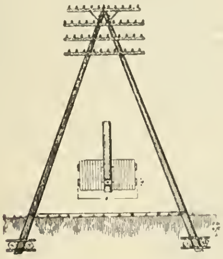


FIG. 54.—DOUBLE POLE.

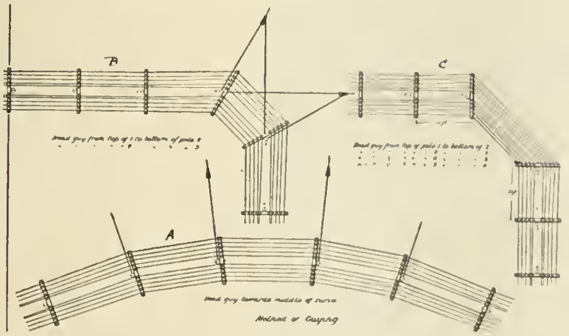

B
C
Head guy from top of 1 to bottom of pole 2
Head guy from top of pole 1 to bottom of 2
A
Head guy towards middle of curve
Method of Guying

FIG. 55 CURVES AND CORNERS.

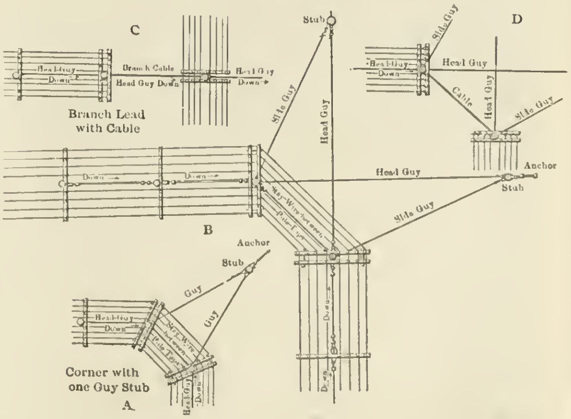


FIG. 56.—CURVE AND CORNER DETAILS.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.

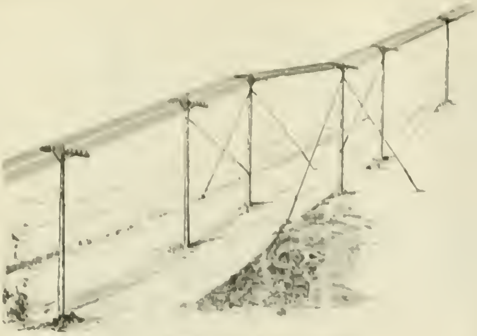


FIG. 57A.—CURVES AND CORNERS

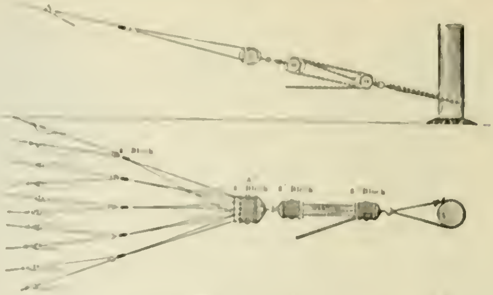


FIG. 61.—PULLING UP WIRE.

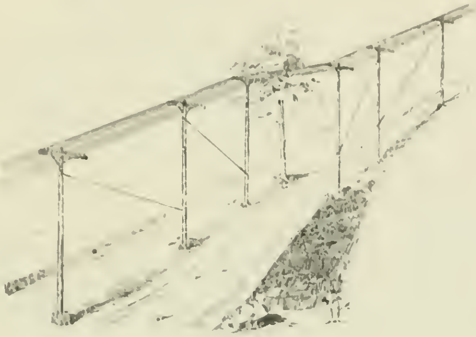


FIG. 57B—CORNERS AND CROSSINGS.

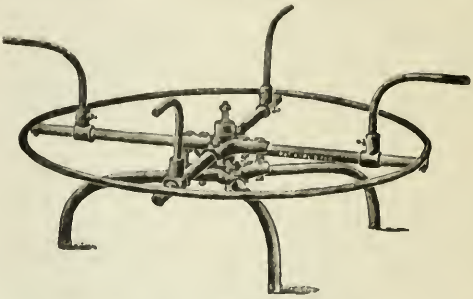
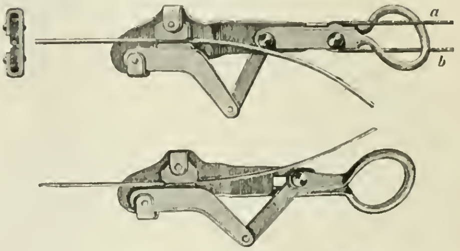


FIG. 58.—WIRE REEL.



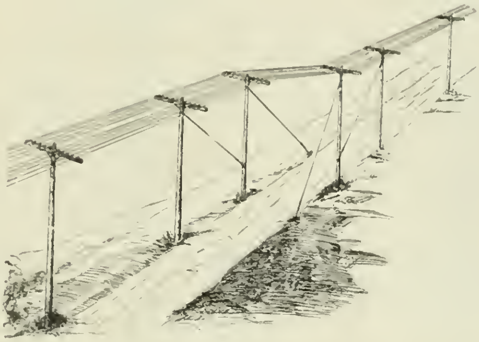


FIG. 57C—HIGHWAY CROSSING WITH SIDE GUYS.

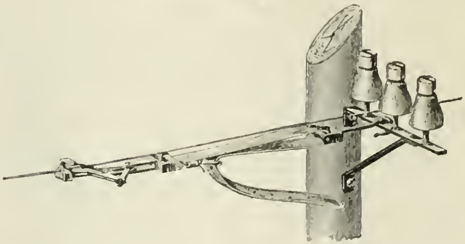
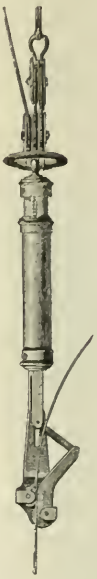


FIG. 62.—LINE DYNAMOMETER.



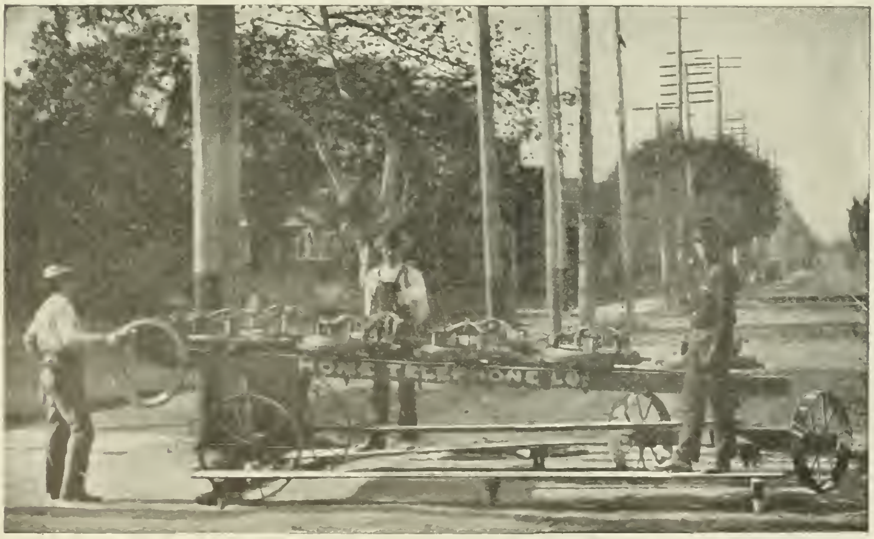


FIG. 59.—REEL CART AT WORK.

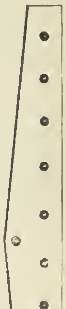


FIG. 60.—RUNNING BOARD.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.

$$\text{The tension} = \frac{\text{Span}^2 \times \text{weight per foot}}{8 \times \text{the deflection.}}$$

In this formula the span and deflection are measured in feet, and the weight of the wire in pounds per foot. In Fig. 63 a table is prepared from this formula, giving all requisite information regarding sags and tensions.

First.—If wire is erected by dynamometer the proper tension is found by referring to curves "A", "B" and "C". Curve "A" is for .080 copper wire, curve "B" .104 copper, and curve "C" .165 copper. Curves "B" and "C" may be used for iron wire of similar or nearly similar sizes. Find on the lower scale the temperature at which the wire is being strung, follow a vertical line up to the curve of the proper size of wire, then a horizontal to the left-hand scale, finding the tension to which the wire shall be strung. *Example.*—A No. 12 wire is to be strung at 60° Fahr., what is the tension? From 60 follow a vertical to curve "B", thence a horizontal to the left, finding 124 pounds, and with the dynamometer the wire should be pulled to 124 pounds, no matter what the span between the poles may be.

Second.—If wire is strung by center deflection, turn the table over to the corner marked "D", find on the lower scale the span between the poles, follow a vertical line to the curve marked with the temperature at which the wire is being strung, thence a horizontal to the left-hand scale, finding the deflection in inches at the center of the span. *Example.*—What deflection shall be given to any wire strung at 60° Fahr. between poles 100 ft. apart? From 100 ft. on the lower scale follow a vertical to the curve headed + 60° Fahr., thence a horizontal to the left-hand scale, finding 4.15 ins. the proper deflection at the center of the span.

SECTION 55.

55
Location of Wire on Pins

In all straight lines, wires shall be placed on the insulators as shown in Fig. 64—A. At all corners, curves, or whenever the line is not perfectly straight, wires shall be located as shown at "B", Fig. 64.

SECTION 56.

56
Tying Wire

Each wire shall be secured to its insulator by means of a tie wire of the same metal as the line wire. The qualities and dimensions of the tie wires are as specified in Section 40, and the method of applying the tie wire shown in Fig. 65.

SECTION 57.

57
Wire Joints

"A"—COPPER WIRE. All joints shall be made, in copper wire, with McIntire sleeves. There are two forms of the sleeve—the double form, illustrated in Fig. 66, and the single form, illustrated in Fig. 67—A. There is little choice between these forms, though the single one is less likely to split. All sleeves shall be drawn of a single piece of the best annealed copper. Sleeves shall be supplied for each different size of wire, and no sleeve shall be more than .01 in. larger than the wire to which it is to be applied. Joints shall be made by slipping the ends of the wires to be joined into their respective halves of the sleeve, so that the end of each wire shall project ¼ in. through the sleeve. This end shall then be turned over, as shown in Fig. 67—B, and by means of the special McIntire plyers, illustrated in Fig. 66, the joints shall be twisted as shown in Fig. 67—B.

"B"—IRON WIRE. All joints of iron wire shall be made with what is known as the Standard Western Union joint, as illustrated in Fig. 68.

SECTION 58.

58
Dead Ending

In every case where a wire shall be terminated on a pin the method adopted at the last insulator shall be that shown in Fig. 69. A half McIntire joint shall be slipped over the wire. The wire shall then be turned around the insulator, the end slipped into the McIntire, and the joint made up all as shown in Fig. 69.

SECTION 59.

59
Transpositions

"A"—LOCATION OF TRANSPOSITIONS. Transportations are introduced into the line at frequent intervals, in order to avoid inductive disturbances. The location of transpositions on twenty-wire lines shall be made in accordance with the diagram of Fig. 70. To locate transpositions poles, proceed as follows: Measure a distance of 1,300 ft. from the first open wire pole, and mark the pole nearest the point so located as "A". Measure a second distance of 1,300 ft. from the first 1,300 ft. pole, mark the nearest pole "B". Proceed in the same manner to measure off poles at intervals of 1,300 ft. for the entire length of line. Poles so marked are designated respectively, "A", "B", "C", etc., in the diagrams, and are the poles upon which the wires shall be transposed, as shown by Figs. 70, 71 and 72. The diagram of Fig. 71 indicates the method of making transpositions on a twelve-wire line, consisting of two six-pin cross arms. Diagram in Fig. 72 indicates another method of arranging transpositions on a four-arm forty-wire line. These diagrams may be extended to any number of six-pin or ten-pin arm lines.

"B"—TRANSPOSITION DETAILS. There are two methods in common use for making transpositions. Each method requires the use of two transposition pins and two transposition insulators for each pair of wires to be transposed.

The first and older method is illustrated in Fig. 73 at "Y" and "Z", "Y" showing a plan of the lines transposed, and "Z" a perspective view, including the cross arm. This diagram is self-explanatory. It is impractical to use this form of transposition between the two circuits nearest the pole, as the cross wires from one line to another would intersect in the middle of the pole. For the two circuits nearest the pole transposition shall be made as shown in Fig. 73 at "U" and "V". The only difference is that the line wires are bent backward around the back of the insulator to avoid the pole.

STOCK LIST FOR TRANSPOSITION SHOWN IN FIG. 73.

- 2 Transposition pins,
- 2 Transposition insulators,
- 2 Whole McIntire joints,
- 6 Half McIntire joints.

The more modern method of making transpositions are shown in Fig. 74. To make this transposition, cut the wires "A" and "C" of such a length as to enable them to be dead-ended on their insulators, slip over each wire a McIntire sleeve, and run it back about 2 ft; carry each wire to its insulator and dead-end it with a half sleeve. Cut the wires "B" and "D" about 5 ft. longer than is necessary to reach their insulators, carry each to its insulator, turn it around the insulator, and dead-end it with a half McIntire; then carry the slack over the wires "A" or "C", introduce it in the McIntire joints previously specified, and twist the same into a joint.

STOCK LIST.

- 2 Transposition pins,
- 2 Transposition insulators,
- 2 Whole McIntire joints,
- 4 Half McIntire joints.

SECTION 60.

60
Distribution

Where distributing poles are used to reach subscribers' sub-stations, the open wire lines shall be terminated on their appropriate insulators upon the pole ring. From this point the drop wires shall be swung to the sub-stations. Drop wires shall either consist of twisted pair of okonite or weather-proof wire, as specified in Sections 38 and 39.

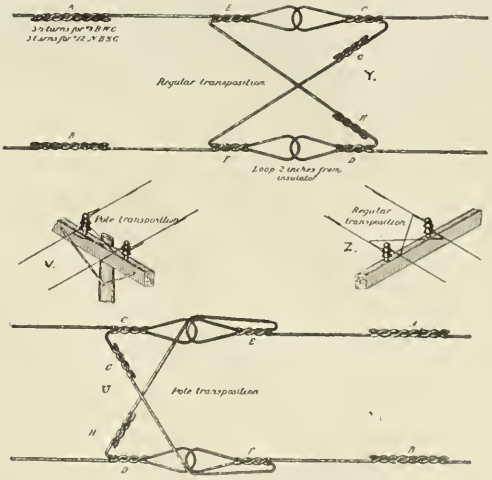


FIG. 73.—DETAILS OF TRANSPOSITION.

Where the distribution is made from open wire cross arm lines the methods shown in Fig. 75 shall be used. In all cases the wires shall be dead-ended on their appropriate insulators, as shown. A pair of knobs shall then be attached to the cross arms, directly beneath the circuits, to which the drop wires shall be attached. The drop wire may be either a pair of open wires, as at "A", or a twisted pair of okonite or weather-proof, as shown at "B". The attachment on the open wire to the open wire circuit may be made by McIntires or connectors, as at "B" or "C".

SECTION 61.

61
Protection

Whenever open wire lines run into a building or a cable, each wire shall be protected by a fuse. If the sub-station is supplied with any one of the approved forms of protection, having fuse, heat coil and spark gap, and if the cable is terminated in a similarly protected head at the open wire, no further protection shall be introduced. But in case either the cable or the sub-station is unprotected, a fuse such as is specified in Section 32, shall be introduced at the unprotected end of the line. At

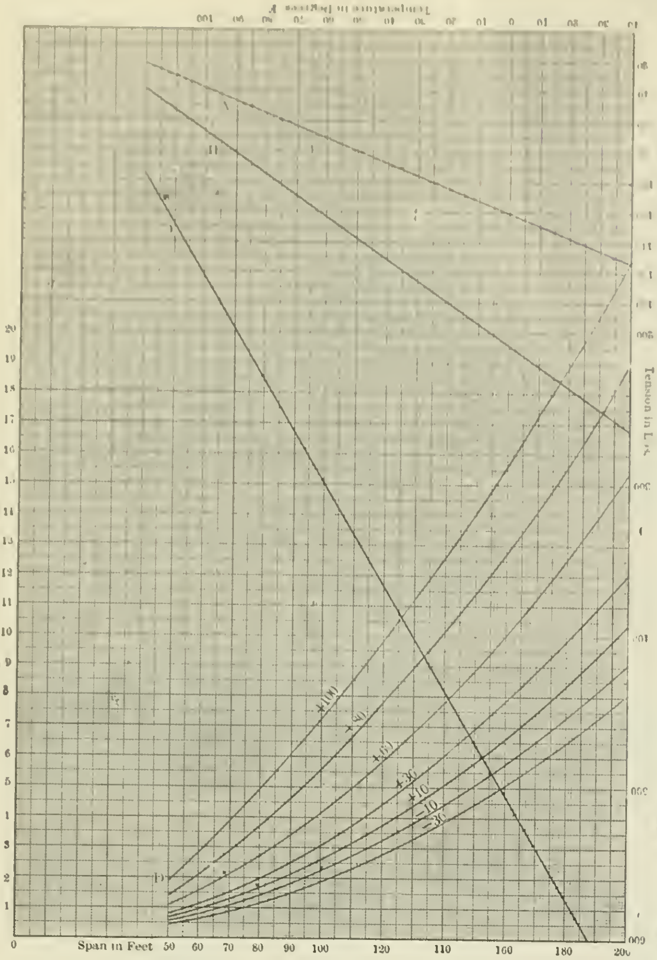


FIG. 63.—SAGS AND TENSIONS.

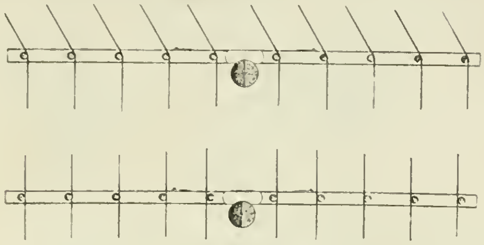


FIG. 64.—LOCATION OF WIRE ON PINS.

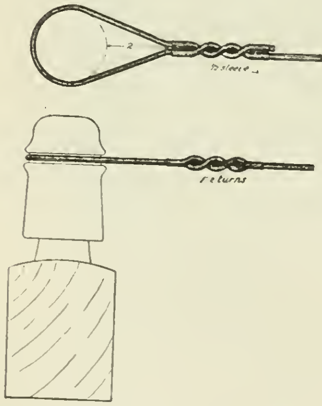


FIG. 69.—METHOD OF DEAD-ENDING.

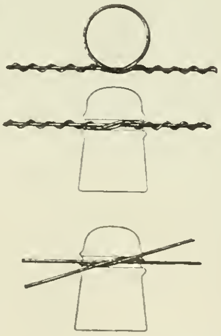


FIG. 65.—TYING OF WIRE.

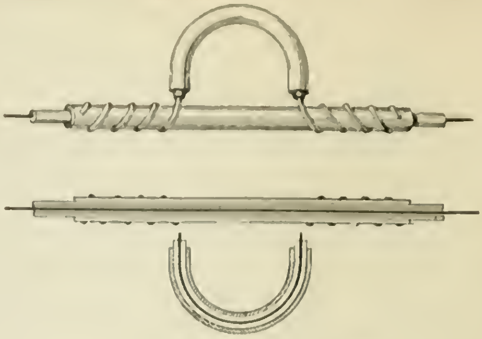


FIG. 76.—"ANTI-HUM" DEVICE.

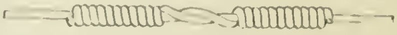


FIG. 68.—WESTERN UNION JOINT.

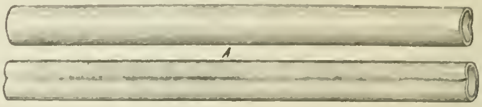


FIG. 67.—SINGLE M'INTIRE SLEEVES.

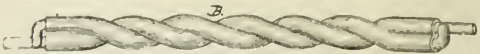


FIG. 67A.—COMPLETED JOINT.

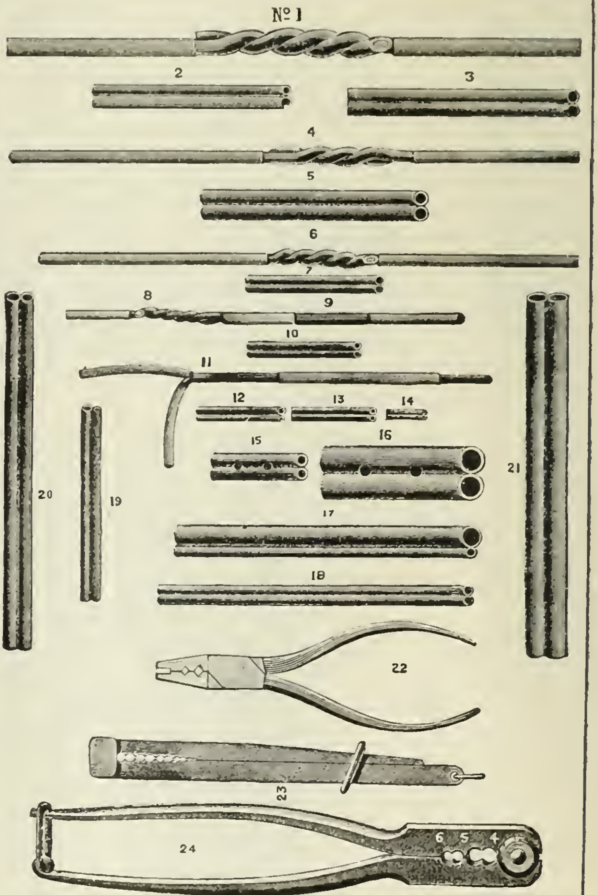
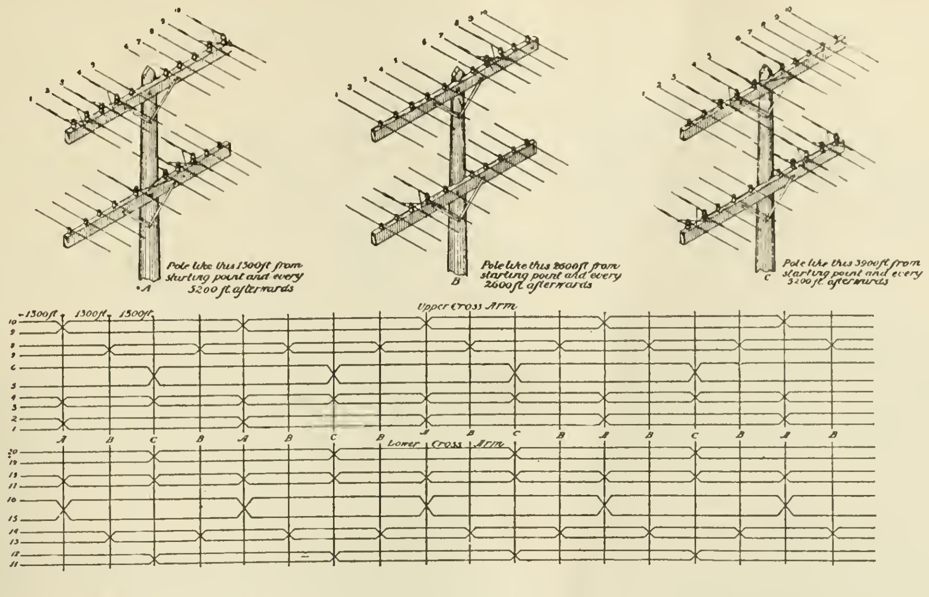


FIG. 66.—MCINTIRE JOINTS.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.


Pole like this 1300ft from starting point and every 5200 ft afterwards
A
Pole like this 2600ft from starting point and every 2600ft afterwards
B
Pole like this 3900ft from starting point and every 5200 ft afterwards
C
1300ft 1300ft 1300ft
Upper Cross Arm
A B C B A B C B A B C B A B C B A B
Lower Cross Arm

Note When the Pole line contains more than two Cross Arms, transpose the 3rd, 5th, 7th, etc. cross arms like the 1st & transpose the 4th, 6th, 8th, 10th, etc. like the second cross arm.

FIG. 70.—TRANSPOSITIONS OF TWENTY-WIRE LINE.

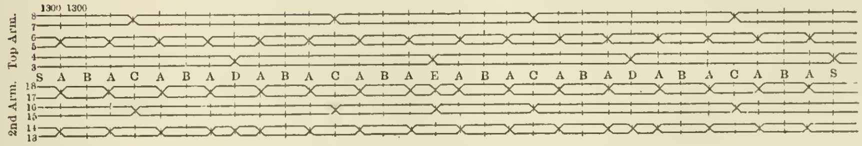

1300 1300
Top Arm.
S A B A C A B A D A B A C A B A E A B A C A B A D A B A C A B A S
2nd Arm.

FIG. 71.—TRANSPOSITIONS FOR TWELVE-WIRE LINE.

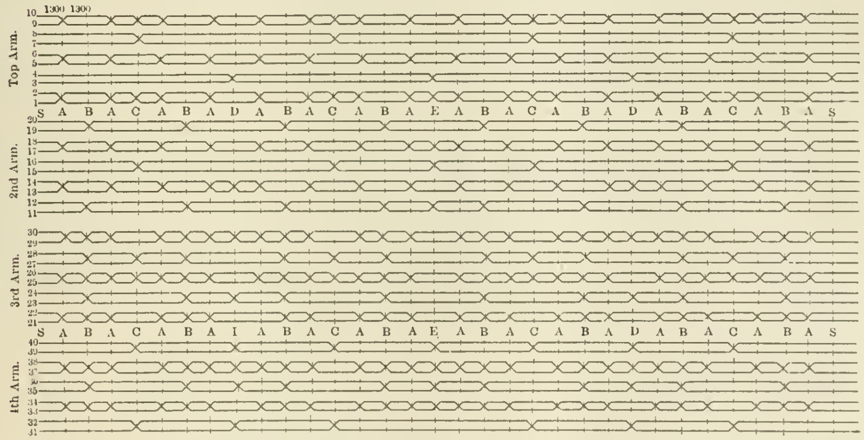

1300 1300
Top Arm.
S A B A C A B A D A B A C A B A E A B A C A B A D A B A C A B A S
2nd Arm.
3rd Arm.
S A B A C A B A D A B A C A B A E A B A C A B A D A B A C A B A S
4th Arm.

FIG. 72.—TRANSPOSITIONS FOR FORTY-WIRE LINE.

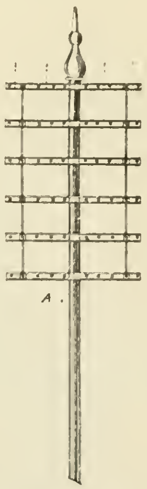


FIG. 77.—FIXTURE A.

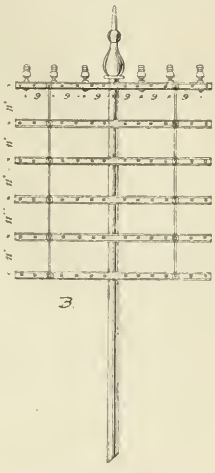


FIG. 78.—FIXTURE B.

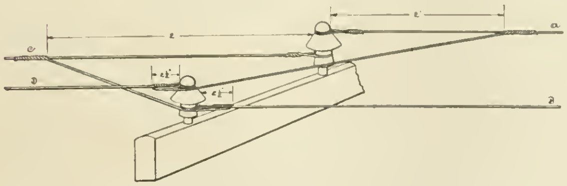


FIG. 74.—RECENT METHOD OF MAKING TRANSPOSITIONS.

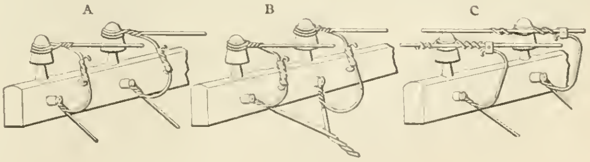


FIG. 75.—SUBSCRIBER DROP WIRES.

CONSTRUCTION AND EQUIPMENT OF AERIAL TELEPHONE LINES.

the cable pole the fuse shall be clamped to the open wire close to the insulator, and the bridle wire attached to the other end of the fuse. At the sub-staion the fuse shall be attached as close to the wall brackets as possible.

SECTION 62.

62 Prevention of Humming

In case of difficulty with humming, the wires causing complaint shall be tied to their insulators, as shown in Fig 76. The line wires shall be wrapped with a piece of soft rubber about 8 ins. long, and then enclosed with a piece of sheet lead. The tie wire shall be treated in a similar manner, and then the wrapped line secured to the insulator with the wrapped tie.

SECTION 63.

63 House Top Lines

"A"—*RIGHT OF WAY.* House top lines shall be confined to accomplishing distribution, and only be used for extended circuits when it is impractical to reach sub-stations by regular routes. Prior to the construction of any house top lines, all necessary rights of way shall be obtained in writing upon the regular blank forms provided by the company. Before rights of way are negotiated a careful examination shall be

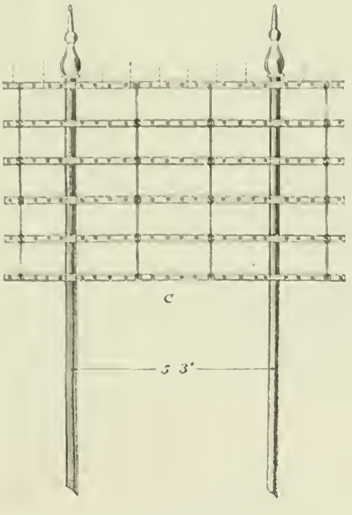


FIG. 79.—FIXTURE C.

made of each building to ascertain that its construction is amply sufficient to carry all the weight and stress that the contemplated line will impose. Rights of way contracts shall comprise a permission from the owner of each building to erect the necessary fixtures, guys, attachments, cables and wire; shall state the amount of compensation to be paid therefor, and the length of time for which the permission is granted. Whenever buildings are not occupied by the owners,

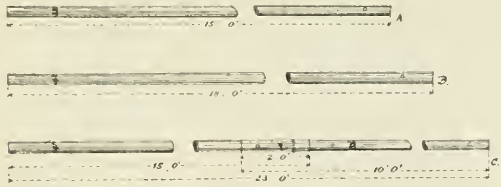


FIG. 80.—FIXTURE POLES.

an additional permission in writing shall be obtained from each and any tenant whose premises shall in any way be affected, either by the placing of any fixtures, wires, cables, etc., or during the process of construction. Such permissions shall be on authorized forms, and shall grant to the company leave to pass through and occupy such portions of the premises of the tenant as may

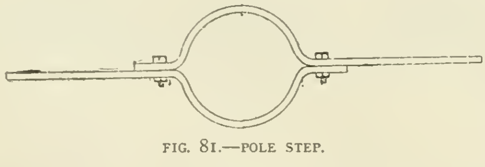


FIG. 81.—POLE STEP.

be necessary for the purpose of construction and repairs, and shall state any compensation to be made therefor. Rights of way shall include and describe the methods, locations and means of extending cables or other circuits from such manholes or distributing poles in the general wire plant system of the company, as may be required to reach and serve the house-top line under consideration, and shall cover permission to occupy and use the premises of the grantor of the right of way for this purpose.

"B"—*CONSTRUCTION.* The actual construction of house-top lines shall consist of two parts.

1.—The Connection to the Main Wire Plant.
2.—The Fixtures and Circuits.

1. —*CONNECTION TO THE MAIN WIRE PLANT SYSTEM.* The connection to the main wire plant system shall consist in running a cable from the

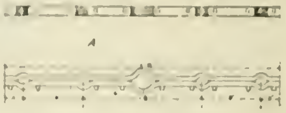


FIG. 82.—CROSS ARM FOR FIXTURE A.

nearest wire plant route of the company, to the point selected for the commencement of the house top line. For this purpose a standard cable, having a sufficient number of pairs to supply the house-top line in question, shall be run from the selected manhole or distributing pole to the roof of the building on which the house-top line shall commence. If connection is to be made with the underground a lateral shall be extended to the building, and either enter the cellar, or run upward along the outer wall to a sufficient height to protect the cable from external interference. If the lateral ends in the basement, the cable shall from

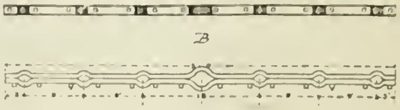


FIG. 83.—CROSS ARM FOR FIXTURE B.

its end extend to the roof through a light or elevator shaft, or such other passage-way in the building as may be found suitable for the purpose. If the cable is to run along the outside wall, it shall be placed near a leader, down spout, cornice, or moulding, so as to be as inconspicuous and protected as far as possible. In all cases the cable shall be fastened carefully and securely, as often as once in 18 ins. All fastenings shall be so made as to prevent any injury to the sheath, and to support the cable in such a manner, that the sheath shall not be unduly strained. On the roof of the building, where the house-top lines commence, the cable shall be terminated in a pot-head, or cable-head, as may be directed for each case, and by means of bridle wire each cable conductor shall be carried to its specified pin on the house-top fixtures. (See Specification for Aerial Cables.)

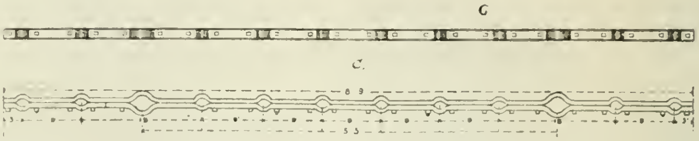


FIG. 84.—CROSS ARM FOR FIXTURE C.

2.—*FIXTURES AND CIRCUITS.* House-top lines shall be carried on house-top fixtures, which shall consist of support built of iron pipe, constructed as shown in Figs. 77, 78 and 79, specified as Fixture "A", Fixture "B" and Fixture "C". Each fixture shall consist of wrought iron pipe set in a socket placed on the building roof, and carrying one or more cross arms. There shall be three standard sizes of pipe poles, as shown in Fig. 80, at A, B and C. Pole "A" shall be made of 3 in. lap-welded tube, from 10 ft. to 15 ft. long, and shall be used for single pole fixtures "A" and "B," as shown in Figs. 77 and 78, when no more than three arms are needed. Pole "B" shall be made of 4 in. pipe,

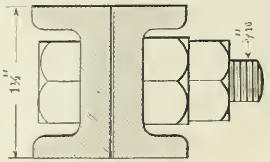


FIG. 85.—SECTION OF CROSS ARM.

from 12 ft. to 18 ft. long, and shall be used for fixtures, "A" and "B", Figs. 77 and 78, when more than four arms are needed, and always when Fixture "C", shown in Fig. 79, is used. Pole "C" may be used for any fixture, in case conditions are such as to imperatively demand the use of a very high pole, and shall be made of one piece of 3½ in. pipe, 10 ft. long, telescoped and welded into one piece of 4 in. pipe, 15 ft. long, making a pole 23 ft. over all. Fixtures "A" and "B" should be limited to five cross arms, and Fixture "C" used when no more than 30 wires are needed. Fixture "C" can be used to carry 100 wires when built with pole "C", but it is never expedient to build house-top lines of this capacity. Poles shall be secured in their bases either by leading, or by calking into place with a rust joint, made by calking around the end of the pole a freshly-made mixture of fine iron turnings, or filings, and salammoniac in the proportion of one part of salammoniac to two parts of iron. Pole steps shall be made of ¼ in. x 3 in. flat iron bent to fit each size of pole, as shown in Fig. 81. All poles shall be made of standard lap-welded ordinary iron pipe. All pipes shall be of regular sizes and thicknesses, and shall be first-class merchantable quality in all respects.

CROSS ARMS. For each of the respective fixtures the cross arms shall consist of two 1½ in. channels set back to back, and fastened by $^5/_{16}$ in. bolts. To secure the arms to the pole and to hold the insulator pins in position, each channel shall be bent into an approximate semi-circle of 3 ins. diameter for the pole, and 1 in. diameter for the pins. The channels shall be formed by heating and forging in a die. One $^5/_{16}$ in. bolt shall be placed on each side of each pole, and on each side of each pin. The details and dimensions of each arm are given in Figs. 82, 83 and 84, while a cross section is shown in Fig. 85.

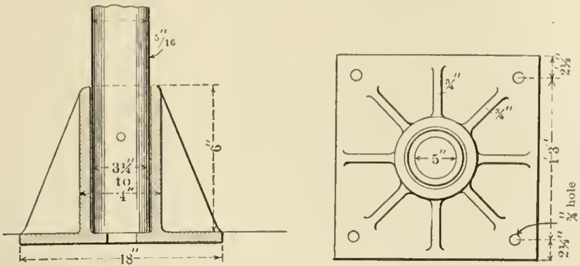


FIG. 86.—POLE BASE FOR WOOD ROOFS.

PINS AND INSULATORS. Shall be standard pins and insulators as specified in Sections 16 and 17.

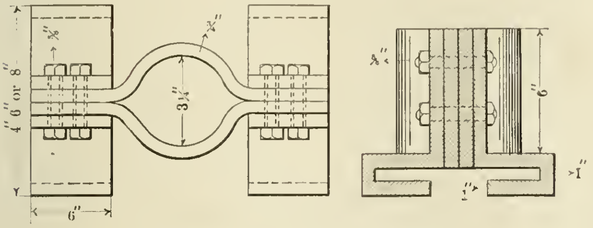


FIG. 87.—POLE BASE FOR IRON ROOF.

ATTACHMENT TO ROOF. Each pole shall be set in an iron base placed on the roof. In case of a wooden roof, the base shown in Fig. 86 shall be used, and each pole shall be set over the principal roof timbers, so that no weight shall fall on mere rafters or boarding. If necessary, a supplementary timber foundation shall be built to carry the load to the main timbers. The base shall be placed on not less than four layers of roofing felt, and secured by four ⅝ in. lag bolts. For iron roofs the base shown in Fig. 87 shall be used. This base shall be made to fit 4 in., 6 in. or 8 in. eye-beams, and shall be clamped on to the flanges of the beams of the principal roof system. By placing shims between the casting and the pole pieces, both the pole and the beam can be clamped tightly. After each fixture is in place the roof shall be made tight by flashing around the base, rubber packing or in any other manner satisfactory to the building owner.

GUYS. Each fixture shall be stayed by not less than four guys, and as many more as may be required in special cases, each made of ¼ in. steel strand. At the pole each guy shall be secured by a round turn and lashed eye, as shown in Fig. 88. Guys should be located as near the middle of the cross arms as possible. At the roof the guy shall, whenever possible, be fastened as shown in Fig. 89. A ¼ in. turn buckle or strand clamp shall be used, and the tension on all guys so adjusted to brace the pole equally in all directions. Care shall be observed to so locate the guys on each roof as to best protect the fixtures from the severest winds. If it is impossible to secure guys to the roof, they may be attached to other portions of the building. The main wall, several feet below the cornice, is the next best place, and the guys secured by driving a wall iron into the brick work. In this case the turn buckle or clamp must be placed above the roof and out of sight. Attachment to chimneys and cornices should be avoided as dangerous.

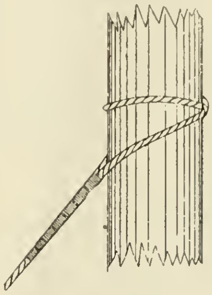


FIG. 88.—GUY AT POLE.

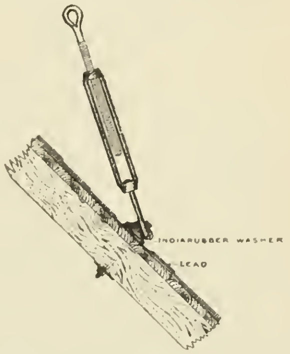


FIG. 89.—GUY ATTACHMENT TO ROOF.

FINISHING. After the fixture is complete, all the metal work shall receive two good coats of best metallic paint, slate color or light brown. All debris, tools or material shall be removed, the roof carefully examined and left in perfect and neat condition. In all other respects house-top lines shall be constructed of the same materials, and in the same manner as specified for regular open wire construction.

General News.

THE TELEPHONE.

SAN BERNARDINO, CAL.—The Home Telephone Company has filed articles of incorporation in the County Clerk's office here under two separate names—the San Bernardino Telephone and Telegraph Company and the Redlands Home Telegraph Company. In addition to the usual business of such companies it will establish a burglar-alarm system and a messenger service. The directorate is the same for both corporations, as follows: Arthur Wright, John Van Liew, F. F. Graves, C. L. Zahn and F. W. Wachter, all of Los Angeles. The telephone system will be built to Banning, Beaumont, Pomona, Ontario, Corona and ultimately to San Diego. The contract for installing the system is in the hands of the Cleveland Construction Company.

MAHER, COLO.—The Maher, Crawford & Hotchkiss Telephone Company, with a capital stock of $5,000, has been incorporated by G. H. Graham, W. L. Savage, A. W. Morrow and others.

WASHINGTON, D. C.—The District Commissioners have directed that the contract for furnishing underground signal and telephone cable be awarded to the Chesapeake & Potomac Telephone Company for the fiscal year beginning July 1. The company's bid was $35,636.36.

ATLANTA, GA.—C. J. Simmons has purchased a site in Atlanta which will probably be used for the erection of an exchange for the Standard Telephone Company when this corporation shall have been re-organized.

ATLANTA, GA.—Damage suits against the Southern Bell Telephone Company, aggregating $40,000 in Atlanta, have been dismissed. The suits grew out of the explosion in a manhole in the city of Atlanta.

EUREKA, ILL.—The Eureka Telephone Exchange contemplates increasing its capital stock to $5,000.

MT. OLIVE, ILL.—The Mt. Olive Telephone & Electric Company has been organized with a capital stock of $5,000. The incorporators are Gustav Schrier, W. J. Burns and G. A. Simpson.

WABASH, IND.—A complete system of rural telephones will be built in the country around Wabash this spring by the Home Telephone Company.

INDIANAPOLIS, IND.—The Patriot & North Telephone Company, of Ohio and Switzerland counties, has been incorporated with a capital stock of $5,000.

CRYSTAL, IND.—The Crystal Telephone Company has been incorporated with a capital stock of $1,000, by William A. Line, Walker Mickler and J. M. Sivilage.

FONTANET, IND.—The Merchants' Telephone Company, of Fontanet, has been incorporated with a capital stock of $5,000. The incorporators are H. J. Lambert, W. J. Randall, J. J. King and Edward King.

GREENFIELD, IND.—The Carrollton Telephone Company has increased its capital stock $3,000 and will make improvements and extend its lines. The Carrollton is a farmers' company and is giving good service.

DANVILLE, IND.—James M. Griest, of New Haven, Conn., has closed a deal with president Spencer, of the Danville Telephone Company, which gives Griest control of many telephone lines over Hendricks County. This and other deals gives Mr. Griest the local system and a dozen small exchanges and many toll lines in all directions. The price paid for the Danville company's property was $35,000. Mr. Griest had previously purchased the Plainfield system, nine miles south.

INDIANAPOLIS, IND.—The New Telephone Company, of this city, is making extensive improvements and adding new rooms to its main exchange building in order to accommodate its rapidly increasing business. The switchboard is being enlarged and changed from an old drop into a lamp signal board. New cut-off relays are also being put in. The company is also putting in a number of private branch exchanges. Similar improvements and additions are being made to the company's branch exchange on 24th Street and Talbott Avenue.

EVANSVILLE, IND.—The preliminary steps in the organization of the Municipal Telephone Company in this city were taken in a meeting held by the stockholders a few days ago, when Alexander Gilchrist, Fred Peterschein, A. F. Karges, Jas. R. Goodwin, A. P. Lahr, R. K. Dunkerson and James Gray were elected directors. In a few days the directors will decide upon what plan is best to pursue in regard to launching the municipal plant. A. J. Rouseau, representing the Stromberg-Carlson Construction Company was present, and invited the directors and city officials to go on a tour of inspection to the cities where his company has installed plants. K. McMurray, of the American Electric Telephone Company, was also present. The ordinance making the company possible provides that the amount to be raised shall be $190,000. Of this amount $135,000 has been subscribed. Any one of the numerous construction companies endeavoring to secure the contract is willing to take the remaining $55,000 worth of stock. Mayor Covert is desirous that the stock all be held by local people. Thus the Evansville telephone question is in the hands of the directors. The injunction suit to test the right of the Cumberland Company to longer occupy the streets will not be heard until June.

DES MOINES, IA.—The Ocheyedan Automatic Telephone Company has been incorporated with a capital stock of $6,000.

COUNCIL BLUFFS, IA.—C. B. McBride, president of the Honey Creek Farmers' Mutual Telephone Company has been granted the right to establish a telephone system here.

OTTUMWA, IA.—The Ottumwa Telephone Company has elected officers for the ensuing years as follows: President, Frank S. Turner; vice-president, Henry S. Herr; secretary, George S. Cowdery; treasurer, I. F. Hubbard.

LE MARS, IA.—The directors of the Le Mars Telephone Company have let a contract for the construction of their telephone system to Mark Babcock of Avoca. Stromberg-Carlson apparatus will be used. The contract calls for a system of 600 telephones.

DES MOINES, IA.—The finance committee of the Board of Directors of the Mutual Telephone Company has submitted a plan for the reorganization and financing of the company, the rebuilding of the property and readjustment of its relations to the city. The improvements contemplated will cost from $75,000 to $100,000, exclusive of the building, which will cost $50,000 more. Additional common stock will be issued instead of preferred stock and bonds, for the purpose of defraying the cost of the improvements.

KINGMAN, KAN.—The People's Telephone Company will extend its line from Leavenworth to Kansas City, Mo.

TOPEKA, KAN.—The Dewey-Wareham Telephone Company has been organized to do business in central Kansas and has been granted a charter. The capital stock is $50,000, the greater part of which is held by C. P. Dewey, of Chicago, and H. P. Wareham, of Manhattan, Kan. The company's place of business will be Junction City and Manhattan.

LUDLOW, KY.—The Ludlow Telephone Company has applied for a franchise to establish a telephone system throughout Campbell County. The company has already asked for rights in Newport, Bellevue and Dayton.

FRANKFORT, KY.—The London Telephone Company, of Laurel County, has been incorporated by the Secretary of State. The company, which has a capital stock of $10,000, will build lines to connect London with East Bernstadt, McWharter, Benge, Pittsburg and Manchester, in Clay County.

GALESBURG, MICH.—The village council has granted a franchise to the Citizens' Telephone Company.

MARQUETTE, MICH.—The Michigan Bell Telephone Company has decided to extend its long distance service to Manistique.

DULUTH, MINN.—The switchboard at the central office of the Zenith Telephone Company was burned out a few days ago as a result of the crossing of telephone wires with an arc light wire. Little damage was done to the building.

BINGHAMTON, N. Y.—It is proposed to install a police telephone system in this city.

WOLCOTT, N. Y.—The Wolcott Rural Telephone Company will construct a line from this village to South Butler, Butler Center and Red Creek.

SENECA FALLS, N. Y.—The village trustees are considering the advisability of ordering the various telephone, telegraph and other electric wires placed underground in the main business streets of this place.

BUFFALO, N. Y.—The International Railway Company is installing a telephone system for the direction of the operation of cars on its various lines. The Bell Telephone Company has secured the contract to furnish 250 telephones for this service.

ELBA, N. Y.—A. G. Small, of Rochester, who is connected with the Bell Telephone Company, is making arrangements to establish an exchange in this place. It is proposed to organize a local company to be operated in connection with the Bell system. Forty telephones will be connected with the service.

BROCKPORT, N. Y.—It is reported that the Bell Telephone Company will make application to the village trustees for a franchise to establish an exchange and system in this place. There is already a local company here with a service of 300 instruments, and there does not seem to be much sentiment in favor of the Bell Company's coming in.

CLEVELAND, OHIO.—The Standard Telephone Company has changed its location from Cleveland to Logan. Mr. W. H. Fledderjohann is president.

SPRINGFIELD, OHIO.—The Springfield & Xenia Telephone Company has been granted permission to erect an exchange building on Centre Street in this city to cost $8,000.

WEBSTER, OHIO.—The Webster Telephone Company, of Webster, Wood County, has been incorporated with a capital stock of $10,000. The names of the incorporators are Milan Jameson, J. A. Stebel, L. C. Fish, C. D. Hagerty, L. E. Philo and Anthony Seifert.

TIFFIN, OHIO.—The new Farmers' Mutual Telephone Company, of Attica,, will conduct business in Seneca, Huron and Wyandot Counties. The following-named officers have been elected: President, J. W. Walkers; secretary, Jacob Zellers; treasurer, Henry Deuchley.

WILLIAMSPORT, PA.—Farmers of the Loyalsock Valley are organizing a telephone company to build a line from Williamsport to Warrenville, a distance of 12 miles.

BROOKINGS, S. D.—The city has voted bonds to purchase the telephone system.

LE DELLE, S. D.—The South Dakota Farmers' Mutual Telephone Company, of Le Delle, has been incorporated with a capital stock of $6,000.

BEAUMONT, TEX.—The Beaumont Telephone Company has increased its capital stock from $120,000 to $200,000.

SMITHVILLE, TEX.—The Smithville Telephone Company has been organized with a capital stock of $20,000. The new company has purchased the old local system and will extend and improve the same. The officers of the new company are as follows: President, E. H. Eagleston; vice-president, W. R. Searcy; secretary and treasurer, V. S. Robb.

SALTILLO, MEX.—It is stated that John Woessner, of Saltillo, who is building a long distance telephone line between Monterey, Mex., and Torreon, a distance of 300 miles, will extend the system to a number of the other larger cities of that country.

ELECTRIC LIGHT AND POWER.

NORTH BIRMINGHAM, ALA.—The citizens have voted to issue $15,000 bonds for an electric light plant.

STOCKTON, CAL.—The City Council is making arrangements to hold a special election on a proposition to bond the city for $160,000 for the purpose of constructing a municipal electric lighting plant. Professor C. L. Cory, of the Engineering Offices, prepared plans and estimates for the use of the city authorities.

SAN FRANCISCO, CAL.—The Pacific Portland Cement Company, of San Francisco, which has its factory in Suisun, recently closed a contract with the General Electric Company for two large induction motors of 300-hp and 320 hp. respectively and a number of smaller motors aggregating 100 hp in capacity. The capacity of the plant is to be increased from 600 barrels to 1,400 barrels per day. Geo. Stone is president, N. L. Bell, vice-president, and Morris Kind, superintendent.

WEST PALM BEACH, FLA.—Joseph Jefferson, the famous actor, will be president of a new $50,000 electric light and power company to be organized at West Palm Beach.

GREEN CASTLE, IND.—A new electric light plant is contemplated for Depaw University in this city.

MUNCIE, IND.—The local electric lighting plant, belonging to C. M. Kimbrough, H. C. Hammond and others, has been sold to Muncie capitalists who will enlarge the plant and install new machinery. The purchase price is $75,000.

TAYLORVILLE, IND.—Prominent electric light men have secured options on the stock of the Citizens' Gas Company and the Taylorville Electric Company, and on April 6 the stock of the two companies was practically sold to a New York company.

MISHAWAKA, IND.—The council has sold the city water and lighting plants to the Public Utility Company for $100,000. The action was taken to avert foreclosure sales by holders of unpaid bonds. Under the deed the city reserves the privilege of buying back the plant after five years.

COLUMBIA CITY, IND.—The municipal electric light plant operated by this city in connection with a municipal water plant is proving highly satisfactory. The plant was purchased of a private company while the city was paying it $80 per lamp and it is claimed that the same are now being operated at a cost of $28 per lamp per year. The plant will be enlarged so as to accommodate the demand made upon it.

ASHBURNHAM, MASS.—The Green Electric Light, Power & Manufacturing Company, of Ashburnham, has been incorporated with a capital stock of $16,000. The names of the incorporators are Charles H. Greene, Alonzo A. Carr, Cecil F. Heyward, Edwin A. Hubbard, William O. Loveland and Henry Allison.

LESTER PRAIRIE, MINN.—W. F. Volkenant is reported interested in the construction of an electric light plant.

SOUTH STILLWATER, MINN.—Prof. J. J. Flather, of Minneapolis, is stated to have been engaged to prepare plans for an electric light plant and water works, to cost about $23,000.

STILLWATER, MINN.—The Western Gas & Electric Company is reported to have absorbed the Stillwater Gas & Electric Company and the Apple River Power Company, and will develop the power at Apple River still further for transmission to this city.

HUNTSVILLE, MO.—The Huntsville Gas & Electric Company of Huntsville, has been incorporated; capital $15,000. Incorporators: W. C. Knight and J. T. McClanahan.

MANCHESTER, N. H.—The Manchester Traction, Light & Power Co., controlled by Tucker, Anthony & Co., of Boston, has been awarded a five-year contract for lighting the city of Manchester, N. H., at $90 per light. This is a reduction of $25 per light from the previous contract.

CAMDEN, N. J.—The New Jersey Southern Gas & Electric Company recently incorporated, has taken over the properties of the Wenonah, Glassboro & Clayton Electric Company; the Electric Light, Heat & Power Company of Hammonton; The Egg Harbor Electric Lighting Company; the Swedesboro Gas Company and a water power at Weymouth, N. J.

GREENE, N. Y.—The Water Commissioners of Greene expect soon to have plans prepared for water works and an electric light plant. Address J. E. Bartoo for further information.

ATHENS, OHIO.—A proposition to issue $15,000 worth of bonds for a municipal lighting plant was carried at the recent election.

OBERLIN, OHIO.—The Council has granted L. B. Fauver and A. E. Hay, of Elyria, a franchise for a heating and electric light plant.

DEFIANCE, OHIO.—The Council has granted John F. Frost and Martin W. Steinberger, a franchise for an electric light and heating plant.

CLEVELAND, OHIO.—The Cuyahoga County Commissioners are again figuring on installing a lighting plant to supply the county buildings with light. Light costs the county over $10,000 per year and it is thought that a suitable plant could be erected for about that much money.

SOUTH BETHLEHEM, PA.—The Consumers' Heat & Power Company, of South Bethlehem, has been incorporated with a capital of $5,000.

NORRISTOWN, PA.—The town council has granted permission to the Montgomery Subway Company to lay conduits in the streets of Norristown. These conduits will accommodate electric light, telephone and telegraph wires.

READING, PA.—It is reported that the Schuylkill Navigation Company will construct an electric plant at Kissingers Dam. It will furnish lighting for the Reading shops, the shifting and freight yards, stations, etc., and for the various plants of the Reading Iron Company. The plant will use the power of the Schuylkill by means of a large turbine wheel.

CUSTER, S. D. R. M. Fuller and Fred Beardshear, it is reported, have secured a franchise for an electric light, power and heating plant, telephone and telegraph system.

TRENTON, TENN.—The Senate has passed the bill authorizing the city to issue $15,000 electric light bonds.

COLUMBIA, TENN.—The Board of Aldermen has granted to John H. Carpenter a franchise for an electric light plant.

SPRINGFIELD, TENN.—The House has passed the bill authorizing the city to issue $35,000 bonds for an electric light plant and water works.

MEMPHIS, TENN.—The Memphis Consolidated Gas & Electric Company will expend about $93,000 in extending its conduit system in Memphis.

SPOKANE, WASH.—The City Council has granted the Spokane Light & Power Company a franchise.

CHESTER, W. VA.—The village is considering establishing a municipal lighting plant.

GRANTSBURG, WIS.—The citizens have voted for water works and an electric light plant.

SAUK CITY, WIS.—Preliminary steps are being taken to ascertain the cost of a municipal electric light plant at a probable cost of $8,500.

MADISON, WIS.—It was voted on April 7 to construct a municipal power, heating and lighting plant; a garbage disposal and sewage disposal plant and a pumping station.

WAUPACA, WIS.—The Waupaca Electric Light & Railway Co. has secured a contract for 27 or more 2,000-cp arc lights, every night from dusk until dawn, at $6.36 per light per month.

SHEBOYGAN FALLS, WIS.—The directors of the Sheboygan & Elkhart Lake Ry. & Electric Company have decided to equip the Elkhart Lake substation with apparatus for lighting and power.

DE PERE, WIS.—The Burns Boiler Company will install in its new factory a system of electric power. Each machine will be equipped with an independent motor and power will be supplied by a General Electric generator driven by a 100-hp "Ideal" engine.

TEHUACAN, MEX.—Inocente Sanchez and Ramon de la Fuente, of this city, will install an electric light plant here.

THE ELECTRIC RAILWAY.

HUNTINGTON, ARK.—The Huntington, Sugar Loaf & Rapid Transit Company has been organized with a capital stock of $100,000 to build an electric railway to connect Huntington, Prairie Creek, Montreal, Burmah and other mining towns. The officers are Bennett Brown, president; Dr. J. W. McConnell, vice-president; O. M. Harwell, secretary and treasurer.

SAN FRANCISCO, CAL.—The Board of Public Works has appointed J. C. Stut to make the estimates as to the cost of changing the present Geary Park & Ocean Railroad into an electric line.

SANTA BARBARA, CAL.—It is reported that the Santa Barbara Electric Railway, together with its power plant, has been acquired by the Huntington-Hellman interests of Los Angeles, to form a terminal for electric lines from Ventura to Santa Barbara.

DENVER, COLO.—Fred C. Adams, of Denver, is interested in a project to build an electric railway to connect Colorado Springs with Denver and Pueblo.

LOCKVILLE, CONN.—The Stafford Springs Street Railway Company, is seeking authority to increase its capital stock from $700,000 to $1,500,000. The new road will form part of the Hartford-Worcester-Boston line, promoted principally by Boston interests.

BRISTOL, CONN.—The directors of the Bristol & Plainville Tramway Company have authorized the construction of the line between Bristol and Plainville.

MADISON, IND.—The Jefferson County commissioners have granted a franchise to Hubbard, Yoder & Co., of Indianapolis, for an electric railway from Madison to Hanover.

ELKHART, IND.—The Ft. Wayne, Elkhart & Chicago Traction Company has been incorporated with $10,000 capital stock by A. H. Beardsley, S. L. Beardsley, Charles Burhaus and others.

ELKHART, IND.—The St. Joseph Valley Traction Company has elected these officers: H. E. Bucklen, president; W. B. Pratt and R. Ellison, vice-presidents; C. H. Winchester, treasurer, and S. Maxon, secretary.

INDIANAPOLIS, IND.—The Madison, Greenburg & Indianapolis Railway Company has been incorporated with $50,000. The promoters are Richard Johnson, Nicholas Horuss, W. D. Wilson, L. V. Cravens and David Johnson.

WABASH, IND.—Negotiations are on for the sale of the Wabash River Traction Company to the Union Traction Company of Indiana. The Wabash road extends from Wabash to Logansport, 34 miles. The property is owned chiefly by Charles Blakelee and the price is understood to be $850,000.

SOUTH BEND, IND.—The Indiana Western Railway, recently incorporated, will build an electric railway from South Bend to Michigan City, a distance of about 36 miles. The line will be built for high-speed interurban service. The engineering corps is now locating the line. J. McM. Smith, general manager of the Indiana Railway Company at South Bend, is interested.

TOPEKA, KAN.—Official announcement has been made of the consolidation of the Topeka City Railway and the Vinewood Park Street Railway Company. Many prominent Eastern and Western street railway men are interested in the deal, among the names of those connected with it being L. E. Myers, of Chicago; Walton H. Holmes and Conway F. Holmes, of Kansas City; Isaac T. Burr, of Boston; E. W. Wilson, Pekin, Ill. An effort is to be made to secure a blanket franchise to cover both properties, and then the reconstruction and improvement of the system will be begun.

CUMBERLAND, MD.—The Westernport & Keyser Traction Company has been incorporated. The capital is $20,000, and the incorporators are James L. Luke, of Luke, Md.; N. U. Bond, of Bond, Md.; David P. Miller, of Cumberland, Md.; Zadock T. Kalbaugh, of Piedmont, W. Va., and James C. Watson, of Keyser, W. Va.

FALMOUTH, MASS.—The Railroad Commissioners have issued an order authorizing the Cape Cod Street Railway Company to construct its proposed road in Falmouth.

SPRINGFIELD, MASS.—The Springfield Street Railway Company will make extensive improvements and additions to its power plant, the proceeds of the sale of $250,000 of the new stock just authorized by the Massachusetts Railroad Commissioners being intended for this purpose.

DUNSTABLE, MASS.—Steps are being taken to organize and to build an electric railway to connect Tyngsboro and Lunenburg. The proposed route is about eighteen miles in length. It is proposed to capitalize the company at $200,000, and the proposed name is the Pepperell & Townsend Street Railway Company.

GRAND RAPIDS, MICH.—The Grand Rapids, Grand Haven & Muskegon Electric Railway will, it is reported, build a branch this summer from Coopersville to Ravenna, a distance of 12½ miles.

SAGINAW, MICH.—D. M. Farson, 115 Devon Street, Chicago, and G. N. Pannell, secretary Trowbridge & Niver Company, Boston, are interested in the proposed electric railway from Saginaw to Flint.

ST. LOUIS, MO.—The announcement is made that the St. Louis Transit Company has in contemplation the erection of a new power house in East St. Louis.

GREAT FALLS, MONT.—The City Council has passed a resolution to submit to a vote of the people the proposition to grant a twenty-five-year franchise to John D. Ryan and others, who recently acquired a controlling interest in the Boston & Great Falls Electric Light Company, for the operation of an electric light plant and a street railway system in this city.

TRENTON, N. J.—Active preparations have been started by Wilbur F. Saddler, Jr., for the construction of an electric railway to connect Trenton and Lambertville and intermediate points.

CAMDEN, N. J.—Contracts for the construction of the extension of the Camden & Suburban Railway from Palmyra to Riverton have been awarded to the Latta & Terry Company, of Philadelphia. The company has also awarded a contract for the construction of its line on Union Avenue and Park Avenue, Pensauken, to T. S. Drake & Company, of Philadelphia.

UTICA, N. Y.—It is understood that the increase in the capital stock of the Utica & Mohawk Valley Railway Company from $3,100,000 to $6,300,000 is to furnish funds for the construction of important extensions to the company's lines.

HOOSICK FALLS, N. Y.—A charter has been granted by the Vermont Legislature for an electric railway from Bennington, Vt., to the Massachusetts State line at Williamstown, where a short extension of the Hoosac Valley Street Railway would connect the line with North Adams and Pittsfield. Terminals will be at Great Barrington, Mass., and Bennington, a distance of sixty miles, principally through the Berkshires. Among the incorporators are C. H. Cutting, H. H. Hanley, H. W. Clark and C. Q. Richmond, of North Adams, Mass.

GREENSBORO, N. C.—It is reported that the electric street railway company of Greensboro may build a twelve mile extension.

BUCYRUS, OHIO.—The Crawford County commissioners have granted a franchise to C. A. Linn and others for an electric railway from Marion to Bucyrus.

COLUMBUS, OHIO.—The Springfield, Piqua & Troy Railway Company has been incorporated with $700,000 capital stock by Asa S. Bushnell, J. L. Bushnell, Dr. H. C. Diamond, W. G. Bowman and Fred J. Green.

CLEVELAND, OHIO.—The Northern Ohio Traction & Light Company has sold the $500,000 of 4 per cent. bonds and $500,000 of common stock which was set aside at the recent reorganization for immediate sale for improvements.

CLEVELAND, OHIO.—The directors of the Muncie, Hartford & Ft. Wayne Railway Company have elected these officers: S. M. Hexter, president; A. L. Johnson, vice-president; J. C. Gilchrist, treasurer; F. M. Osborn, secretary. The board authorized the immediate extension of the line to Bluffton, Ind., a distance of 15 miles.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway Company has purchased the property of the Marion Street Railway Company and the Marion Electric Light & Power Company, of Marion. The price paid for the properties is said to have been $181,000. The Columbus, Delaware & Marion Railway Company will spend a large amount of money in improving both the railway and lighting systems.

PITTSBURG, PA.—The Philadelphia Company, owning the capital stock of the Sycame Street Railway Company and the Mt. Washington Street Railway, has formally consolidated those companies as the Mt. Washington Street Railway Company.

STROUDSBURG, PA.—A company has been organized to build an electric railway from Mt. Pocono to La Anna, a distance of twelve miles. The officers are J. B. Williams, president; John Houck, of La Anna, treasurer; E. D. Dunning, of South Sterling, secretary.

UNIONTOWN, PA.—The Webster, Monessen, Belleverton & Fayette City Street Railway Company has decided to extend its lines to Uniontown, and will issue $300,000 worth of bonds secured by mortgage, the Fayette Title & Trust Company being trustee.

PITTSBURG, PA.—The rapid transit committee of the Pittsburg Chamber of Commerce, in order to secure adequate transportation facilities for Pittsburg and vicinity, will, it is said, recommend that subways be constructed and leased to traction companies at a fixed rental.

NEW INDUSTRIAL COMPANIES.

THE BEN F. BARBOUR PLUMBING & ELECTRIC COMPANY has been incorporated at Birmingham, Ala., with a capital stock of $15,000. The incorporators are Ben F. Barbour, B. C. Rickman and Charles B. Barnitz.

THE WILLIAMS ELECTRIC TELEPHONE COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000. The incorporators are Philip F. Hintz, Louis B. Spanner, E. P. Kern, C. M. White and H. H. Hammond.

THE INTERMOUNTAIN ELECTRIC COMPANY has been incorporated at Salt Lake City, Utah. The capital stock is $50,000. The officers are Samuel F. Fenton, president, F. A. Tripp, vice-president, G. C. Fenton, secretary; Louis H. Farnsworth, treasurer.

THE MOUNT OLIVE TELEPHONE AND ELECTRIC COMPANY, of Mount Olive, Ill., has been incorporated with a capital of $5,000, to manufacture and deal in electrical and other machinery, supplies, etc. Incorporators: Gustav Schreier, William J. Bruns, George A. Simpson.

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LEGAL.

THEFT OF CURRENT. George Block, a prominent merchant of Union Hill, N. J., was sentenced last week by Judge Blair in the General Sessions Court at Jersey City to sixty days' imprisonment in the county jail and to pay a fine of $250. He was convicted of defrauding the North Hudson Electric Light and Power Company by falsifying the meter supplying the electricity with which his store is lighted. His defense was a general denial. Block expected to be punished by fine only. He was greatly surprised when sentenced to imprisonment also. He was at once removed to the county jail to enter upon his term.

CONTACT WITH LIVE WIRE. The Supreme Court of Pennsylvania, in deciding the case of Elliott vs. Allegheny County Light Company, held that in an action by a painter to recover for injuries received, where the evidence shows that he fell from a ladder and clutched at a live electric wire, and was shocked thereby, he is not entitled to recover from the electric light company, which left the wire uninsulated, the fall from the ladder being the proximate cause of the injury. The court said in part: "It is undisputed that the defendant was in nowise responsible for the slipping of the ladder, which was the originating cause of the plaintiff's fall. It would be speculative in the extreme to attempt to differentiate between the extent of the injury which he would probably have received if he had not come in contact with the electric light wire in the course of his fall. It is quite possible that the wire helped to break the fall, and thus lessen the extent of the injury. But even if the presence of the wire, in the condition in which it was, made the consequences of the fall more serious, yet it did not bring about the accident, nor was it in any sense the efficient responsible cause of the injury."

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OBITUARY.

DR. JOHN HOYT LILLIE, who died in Los Angeles, Cal., on April 6, was one of the early inventors of the electric motor and electric railway in this country. Fitting it was that a modern electric street railway funeral car bore him to his last resting place. He was almost 90 years of age at his passing away. Born at Montrose, Susquehanna County, Pa., April 13, 1813, he became incidentally an electrician and inventor, finally seeing one of the toys of his youth grow into a mighty industrial utility. Contemporary with the experiments of Morse in telegraphy, Dr. Lillie, then residing in Joliet, Ill., was deeply engaged in electrical experiment, the most satisfactory of which was an electrical traction motor. It was not, however, until 1850, that the Patent Office issued the papers which recorded as "No. 7287" the improvement in "electro-magnetic engines." The text of the patent states that Lillie had invented "a new and useful machine for the generation of electro-magnetic power." The claim of "newness" made was: First, the employment of induced electricity, inducing electricity in the secondary electro-magnets, to be used as motive power, in connection with the prime mover, and to neutralize the secondary currents of the principal magnets formed by the direct current from the battery. In Martin & Wetzler's pioneer work on "The Electric Motor and Its Applications," Dr. Lillie's work is duly recorded and illustrated. Note is also made there of the traveling exhibition of Messrs. Lillie and Colton of a model electric railway, shown around 1847 and later, one notable feature of which was the use of the track as part of the return circuit. The model was discovered in a scrap heap some years ago, and was exhibited in operation at the New York Electrical Exhibition of 1896.

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PERSONAL.

MR. HENRY V. A. PARSELL, the electrical engineer and designer, is sailing on April 29 for England and will not return to New York before the end of August.

DR. LEE DE FOREST has been visiting Seattle, Wash., with the object of establishing wireless telegraph stations along the Pacific coast and possibly across to Asia.

MR. SAMUEL INSULL, president of the Chicago Edison Company, will, it is announced, be re-elected a director in the American Marconi Wireless Telegraph Company.

MESSRS. DODGE & DAY, the modernizing engineers of Philadelphia, are installing a new shop management system in the works of the Link-Belt Engineering Company.

MR. W. F. D. CRANE.—The many friends of Mr. Crane will regret to hear that this well known electrical engineer is quite ill with pneumonia and will express hopes for his early recovery.

HON. W. MURRAY CRANE has been added to the executive committee of the American Telephone & Telegraph Company. He has been associated with the Bell system for some time.

MR. W. S. LAYCOCK, of the well known firm at Sheffield, England, bearing his name and engaged in electric car fitting, equipment, etc., is a visitor to New York and has been staying at the Waldorf Astoria.

PROF. W. E. GOLDSBOROUGH reports that the telephone companies that have their headquarters in Chicago will occupy about 20,000 square feet of space with their exhibits in the Electricity Building, at the St. Louis Exposition.

DR. WALTHER NERNST, the distinguished German chemist, made but a brief stay in this country, to the disappointment of a host of friends and admirers. After participating actively in the Electrochemical convention last week, he sailed for home on Saturday.

DR. W. M. HABIRSHAW, of the India Rubber & Gutta Percha Insulating Company, has returned home to New York from a long trip through the West Indies and the far Southern States. The end of the winter found the veteran expert in rather poor health, but his holiday has done him considerable good.

MR. HANS PAETOW, of the firm of Paetow Brothers, of Dusseldorf, Germany, was a caller at the office of ELECTRICAL WORLD AND ENGINEER this week. Mr. Paetow is in this country placing orders for mill supplies and arranging with American manufacturers of such supplies to represent them in Germany.

MR. R. M. PATRICK is manager of the new concern started at Syracuse, N. Y., called the R. M. Patrick Electric Contracting Company. It has established general offices in the Kirk Block and with a full staff is bidding on all important contracts in its vicinity for power, telephone, lighting and railway work.

DR. AD. FRANKE, associate director of the Berlin factories of the Siemens & Halske Company, of Germany, is now visiting this country and will spend about a month here. Last week he attended the electrochemical convention, and he will now visit various stations and manufacturing establishments, going as far west as Chicago at least.

DR. R. OGDEN DOREMUS, who for fifty-one years past has been professor of chemistry at the College of the City of New York, has just resigned. His interest from the first was keen in electricity, and a number of able men in the electrical and chemical fields have been his students during fifty brilliant and eventful years of instruction.

MR. H. G. STOTT, electrical engineer of power plants, etc., for the Manhattan Elevated Company, while watching some mechanical work lately was unfortunate enough to get some chips of steel in one of his eyes. A severe surgical operation was necessary to get them out. We are glad to state that Mr. Stott has been able to resume his duties, however.

MR. GEORGE H. DAY. Mr. George H. Day has resigned the presidency of the Electric Vehicle Company, of Hartford, to become general manager of the Association of Licensed Automobile Manufacturers, a new combination of leading factories. Ex-Gov. M. G. Bulkeley, of Hartford, vice-president of the Electric Vehicle Company, succeeds Mr. Day.

MR. FRANK C. WRIGHT has recently left the electric light plant at Dover, N. J., to become the superintendent of the Edison Electric Illuminating Company, at Lebanon, Pa. The plant at Lebanon is a large and progressive one giving 24 hours' service 365 days in the year for light and power and furnishing current to the Lebanon Valley Street Railway system.

MR. JOHN H. VAN DEN WALL BAKE, of Amsterdam, Holland, accompanied by Mr. Willem C. Mulhaus, Jr., consulting engineer for the firm, has returned home this week after a long and successful trip through the country, during which arrangements were made with several leading American electrical and mechanical concerns to represent them in the Low Countries. They sailed well pleased with the reception extended to them in the United States.

MR. ISAAC MI HUTCHISON, of Mexico City, who represents the Mexican interests of the St. Louis Car Works, and other prominent U. S. manufacturing concerns, has left for Mexico after a short visit to the United States, where he came principally regarding the perfecting of financial arrangements in connection with the extensive car building plant to be built in a new Mexico city in which he is primarily interested. The shops will turn out cars both for both for steam and electric roads.

MR. E. W. BUCKLEY, works superintendent of the British engineering firm of Mather & Platt, who has been on this side for some weeks past, has left for England for the purpose of conferring with his directors regarding the placing of some important contracts for electrical equipment, machine tools, etc., for installation in an additional plant which is about to be built by the firm. Mr. Buckley expects to return to the United States in about a month with a view to closing the contracts which it is anticipated will represent an expenditure not far short of a quarter of a million dollars.

MR. F. E. DRAKE, U. S. Director of Machinery and Electricity at the Paris Exposition of 1900, and for two years past manager of the works of the Union Elektricitäts Gesellschaft, at Berlin, Germany, which he remodeled on the latest modern lines of practice, has been offered and has accepted the presidency of the Lanyon Zinc Company with headquarters in St. Louis, whither he will proceed at once. The recognition of Mr. Drake's great executive ability is shown in his appointment to manage this large metallurgic enterprise, but it is a misfortune to the electrical industry that even for a time his services should be lost to it. He will be followed in his new sphere of work by the good wishes of a host of friends in the electrical field in Europe as well as the United States.

MR. H. E. O'BRIEN, one of the electrical experts of the Lancashire & Yorkshire Railway, arrived here this week on the White Star liner *Celtic* for the purpose of studying American electric traction methods. The British railway has already adopted electricity as a means for operating part of its suburban traffic, pointers as to the handling of which were secured some time ago by Mr. John F. Aspinwall, the general manager of the Lancashire & Yorkshire system, who paid an extended visit to this side for the purpose. It is proposed to convert electrically further lines now operated by steam. Accompanying Mr. O'Brien on this visit are Messrs. J. Wharton, freight traffic manager; G. Banks, freight traffic superintendent and assistant passenger traffic manager; J. T. Tatlow, locomotive accountant, and F. Dale, the accountant of the company. These gentlemen will make a somewhat long visit on this side. They intend to go as far west as Chicago.

MR. W. B. HALE, chief of the Chicago laboratory of the Western Electric Company has been visiting New York and making a tour through the Eastern cities with the object of inspecting the laboratories of the educational institutions in this part of the country. During the past week Mr. Hale had the pleasure of attending the sessions of the American Electrochemical Society and meeting a great many experts and engineers there engaged in lines of work of interest to him or his company.

MR. W. WHEELER.—It is stated from Chicago that President Fish, of the American Telephone & Telegraph Company has nominated two members of the Illinois bar to succeed Gen. Sabin in the telephone field, Wm. Wheeler, of Holt & Wheeler, for president of the Chicago Telephone Company, and Mr. Richardson, now general counsel of the company, to be president of the Central Union Telephone Company. This might almost be said to smack of nepotism. The bar is evidently no bar to Mr. Fish, where real ability is concerned.

MR. JAMES ROSS, president of the Mexican Light & Power Company, and also president of the Dominion Iron & Steel and Dominion Coal Companies, has been in London, England, during the present month, and has concluded arrangements for the purchase of the City of Mexico Electric Light Company, owned by the firm of Siemens & Halske, the German bankers. In his announcement to the directors of the Mexican Power Company, most of whom are directors of the Bank of Montreal and Canadian Bank of Commerce, Mr. James Ross states that the purchase was made by an exchange of stock whereby the Mexican Power Company secures a controlling interest in the electric light company. Mr. Ross will sail from England on April 23.

MR. GEORG KIRKEGAARD, the expert model maker and electrician, was tendered a testimonial banquet on April 14, the eve of his departure for Europe. The affair was arranged by Mr. Kirkegaard's Danish friends in New York and was in recognition of his services in the promotion of the interests of Danish people in the United States. Mr. Kirkegaard has been president of the leading Danish society in New York and was the leading spirit in collecting the fund to erect the statue of Thorvaldsen now standing in Central Park. The dinner was given at Terrace Garden and was attended by some two hundred of the most prominent Danes in America. A notable feature of the occasion was the presentation to Mr. Kirkegaard of a handsome watch and chain.

Trade Notes.

PAWLING & HARNISCHFEGER, of Milwaukee, Wis., report that the recent fire at their works was confined to one building, so that the delay in production would be at worst but temporary. The works are very extensive and the other buildings ample to take care of all contracts and prospective orders.

FORD, BACON & DAVIS, electric railway engineers, etc., New York City, will remove their offices on May 1 from 140 Broadway to the Blair Building, 24 Broad Street.

LARGE OIL FILTER.—A very large Cross oil filter has just been ordered by the B. F. Goodrich Co., Akron, Ohio, to be used in connection with a Westinghouse steam turbine. The Burt Mfg. Co. makes the Cross oil filter.

"COLUMBIA" CARBONS.—The National Carbon Company, Cleveland, Ohio, in a neat folder recently issued under the title "There is Light Within," gives some facts regarding Columbia carbons for enclosed arc light service.

"FLEXDUCT."—The Osborn Flexible Conduit Company, 19 Park Row, New York City, in its two latest folders illustrates and describes some of the principal qualities and features of "Flexiduct," and much other information regarding these goods is given.

FORT WAYNE BULLETINS.—Bulletins 1039 and 1041 of the Fort Wayne Electric Works have for their respective subjects small direct-current generators, motor-starting rheostats and direct-current belted motors. Two recent "Flyers" of the same company are on fan motors and commutator truing devices.

STERLING SPECIAL LAMP.—The Sterling Electrical Mfg. Company, Warren, Ohio, has issued a booklet pointing out the merits of the Sterling special lamp. The booklet is entitled, "Sixteen All-ways," and has two meanings, one to the lamp itself and the other to the picture of a young girl shown on the cover.

HOLTZER-CABOT ELECTRIC COMPANY, of Brookline, Mass., has just added to its handy trade literature circulars, illustrated, dealing with its electric lathe motors and with its enclosed types of small direct current power motors. These are described in detail, with tables of dimensions, speeds, etc., and diagrams of base, frame, etc.

THE ELECTRIC CONTRACT COMPANY will henceforth be located in new quarters at 202-204 Centre St., New York. It has moved from its old address to a location which gives it larger and better facilities than it has possessed hitherto. The company is a well-known manufacturer of electrical novelties including the "Evening Star" flash lamp.

"THEY SAY."—Under this title the Eureka Electric Company, of Chicago, has issued an artistic booklet containing a few expressions of appreciation recently received from users of Eureka telephone equipment. The pamphlet contains 24 pages and is gotten up in a very attractive manner. The writers of the letters express great satisfaction with the apparatus.

THE TELEPHONE DEPARTMENT of the Electric Appliance Company, Chicago, has more than doubled its capacity in floor space, machinery and employees. The steady increase in the demand for the "Eaco" line of telephones and switchboards has made this necessary. The company has many new circulars describing these telephone specialties which will be sent upon request.

THE WILLARD STORAGE BATTERY COMPANY, of Cleveland, is meeting with considerable success in the introduction of a new storage battery for automobiles lately placed on the market. The company is said to be supplying batteries to nearly all the leading manufacturers of electric vehicles in the country. Unusually high efficiency and long life are claimed for the battery.

CARL G. M. MILLER & COMPANY have opened an office at 141 Pearl Street, Boston, Mass., for the purpose of dealing in electrical machinery and specialties. They will be glad to hear from manufacturers desirous of active New England representation. Their Mr. Miller was for nine years connected with the Chase-Shawmut Company and is well known in the New England states.

DATA ON INSULATING MATERIALS.—A small pamphlet containing some curves on the dielectric strength of some of the commonly-used insulating materials has been recently issued by the Dielectric Manufacturing Company, of St. Louis, Mo. Eight curves are given, showing the dielectric strength of dry air, solid mica and "dielectrol." These curves will be valuable to all electrical engineers for reference.

"AS COOL AS A CUCUMBER."—The Emerson Electric Mfg. Company, St. Louis, Mo., has discovered a new relationship between cucumbers and electric fans, and under the title of "As Cool as a Cucumber," it has recently issued a booklet giving some cool facts regarding its Emerson fans. The facts are presented in a very catchy manner and their perusal will very likely leave in the mind of the reader a strong desire to possess an Emerson fan in view of the approaching warm season.

DYNAMO FIELD REGULATORS.—The Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., has just issued a price-list and descriptive bulletin covering its new C-H dynamo field regulators. These new field regulators, like all C-H apparatus, are built to wear, and embody many improvements. The bulletin sets forth their many desirable features. The company, in anticipation of a heavy demand for these instruments, has stocked 2,000 of them and is therefore in a position to make prompt shipment.

TELEPHONE MOUTH PIECES.—The Dickinson Hard Rubber Company, Springfield, Mass., is making telephone mouth-pieces that possess several properties of value in such goods. They are made of a composition that is light in weight and has great strength, and they are finished in an excellent manner. These mouthpieces have been subjected to severe tests at the factory and have proven to be exceedingly strong and tough. They may be dropped on the floor and otherwise thrown around without sustaining any damage. The company reports that it has made a hit with them and is making them in large quantities for the trade.

"MORE LIGHT."—The Columbia Incandescent Light Company, of St. Louis, Mo., recently issued a booklet, of vest pocket size, giving some interesting facts about the Columbia lamp. Reference is made to our late friend, Mr. Aladdin, of Arabia, and the ease with which he did things with his famous lamp. The lamp business now-a-days, however, as the Columbia Company points out, is not so easily carried on. The modern lamps must have intrinsic merit, and the only way to make an electric lamp produce money is to make it produce light in every direction. The Columbia Company has just completed a new factory.

AKRON GENERATORS.—The Akron Electrical Mfg. Company, of Akron, Ohio, has recently issued an excellent 16-page illustrated bulletin in regard to its engine type generators. These are built in sizes from 1-kw up to 300-kw. The same progressive concern also makes belted generators, in regard to which it issues a bulletin; and it has a line of motors that are also treated in fully descriptive literature. The generators and motors are solidly built on good lines of design, with the best material and workmanship, and special attention is paid to such parts and details as brush rings and holders, etc. The company issues a long list of purchasers, and will be glad to answer inquiries for any of its apparatus.

HYDRA BATTERY.—In a recent comparative test of dry cells to determine their "telephone life," the Hydra cell, manufactured by the Hydra Battery Company, 70 Reade Street, New York, it is reported, came out victorious with a "telephone life" of 3.55 years to its credit, the next best showing a useful life of 2.48 years, tested under the same conditions. The Hydra is a semi-dry battery and is adapted to all uses to which batteries are applied, such as the operation of automobiles, gas engines, gasoline launches, motor cycles, telephone service, etc. The Company states that its battery is meeting with a highly satisfactory reception in the trade, and its producing facilities are taxed to the utmost to supply the demand.

A 20-FOOT LIST.—Pawling & Harnischfeger, of Milwaukee, Wis., have just issued a list of users of their cranes and hoists, in the form of a strip 20 feet long and so folded as to be readily accessible for reference. The list shows that this concern has sold machines to a very large portion of the representative concerns of this country and has a very creditable showing of foreign business besides. Their cranes and hoists in service number nearly 1,000, and the firm has an excellent representation in most every line of industry needing crane and hoist service. The list is arranged alphabetically to permit of easy reference and the types of machines are classified to show the exact service to which each machine is given, the capacity of each machine being also given. The list folds up into a small package measuring 3x4 inches in size.

THE CENTRAL ELECTRIC & MANUFACTURING COMPANY recently organized at Youngstown, Ohio, will establish a plant at Struthers, Ohio, where it will manufacture motors of small capacity besides a number of electrical specialties. The company has recently purchased from Edward McGarvey, of Bellefonte, Pa., a number of valuable patents on devices which it proposes to manufacture. One of these patents covers a selective call and lockout system for party line telephones; another is a selective annunciator system which can be used with a single circuit, and another is a recording ammeter, voltmeter and wattmeter. The most important invention is a device whereby moving cars passing over a scales can be weighed automatically and the figures indicated at a distant office. The invention makes it possible to weigh moving grain in elevators and while grain is being transferred to cars or elevators. One of these devices has been installed by the Republic Iron & Steel Company, at Youngstown, and the manufacturers will push this invention.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 14, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

725,044. INSULATOR, Charles Claydon, Searcy, Tex. App. filed Sept. 19, 1902. (See page 692.)

725,061. CIGAR LIGHTER, James J. Fleming, Elk Garden, W. Va. App. filed May 27, 1902. A small pocket case contains a lamp in the body portion and a battery and spark coil in the lid. The opening of the box creates a spark which lights the lamp.

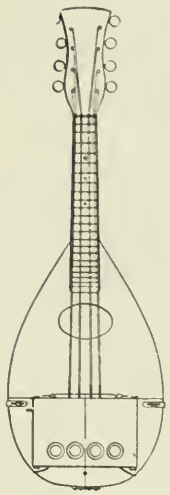
725,067. STORAGE BATTERY; William Gardiner, Chicago, Ill. App. filed Jan. 31, 1902. Details.

725,133. ELECTRIC INCANDESCENT LAMP SOCKET; Guy H. Proctor, Somerville, Mass. App. filed Feb. 3, 1902. Details.

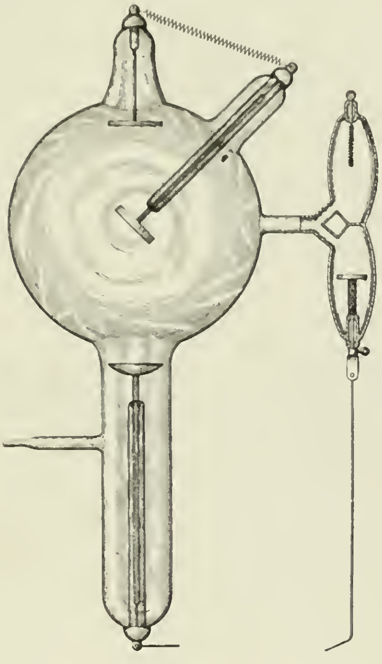
725,140. DEVICE FOR MAINTAINING CONSTANT SPEED IN ELECTRIC MOTORS; John G. Roberts, Detroit, Mich. App. filed Jan. 2, 1902. A direct current motor having a short circuit connecting opposite points of its windings and a timed circuit controller in the short circuit to keep the motor at uniform speed.

725,177. ATTACHMENT FOR MANDOLINS OR SIMILAR INSTRUMENTS; Joseph M. Timmons, New York, N. Y. App. filed Aug. 7, 1902. The strings are picked by electromagnets operated by push buttons and the fretting is done in the usual way.

725,195. CIRCUIT CLOSING DEVICE; Henry P. Ball, New York, N. Y. App. filed Jan. 29, 1903. The position of the contacts with respect to the magnet is adjustable to compensate for various positions of the core when adjusted for different loads.



725,177.—Attachment for Mandolins or Similar Instruments.



725,331.—X-Ray Tube.

725,196. RHEOSTAT; Joseph P. Ball, Frankfort, Pa. App. filed April 7, 1902. A rheostat comprising a plate of insulating material having a series of radial slots, resistance located in the slots and detachable means for holding the resistance in place.

725,208. ELECTROLYTIC COATING APPARATUS; Heinrich W. Botz, Ludwigs-hafen-on-the-Rhine, Germany. App. filed Aug. 6, 1902. Relates to the distant pieces for retaining an irregular sheet of metal in proper position in the bath.

725,214. TELEGRAPH INSTRUMENT; Carey E. Bunker, Oregon, Mo. App. filed May 23, 1901. The line circuit is open when the key is depressed instead of being closed as usual and the sounder gives out its loudest sound when released by the magnet.

725,215. TELEGRAPH KEY; Carey E. Bunker, Oregon, Mo. App. filed Aug. 31, 1901. A self-closing key having two contacts normally holding the line closed and movable on the depression of the key to successively break contact.

725,218. STORAGE BATTERY; Rufus N. Chamberlain, Depew, N. Y. App. filed Aug. 13, 1902. A cover for the cell arranged to shed moisture and direct it back into the cell, so as to prevent waste of liquid.

725,221. ELECTRIC SWITCH; Troy Cope, New Waterford, Ohio. App. filed May 6, 1902. A railway switch in which the magnets are energized by two contacts on the car engaging with two corresponding contacts in the road.

725,225. INDUCTION MOTOR; Abe L. Cushman, Concord, N. H. App. filed Oct. 13, 1902. A modification of the preceding patent.

725,239. BRUSH HOLDER FOR DYNAMOS; Eugene Gaud, Asnieres, France. App. filed Aug. 6, 1901. An arrangement by which the spring acting on the carbon works perpendicularly to the surface of the commutator.

725,244. TELEPHONE CALL REGISTER; William Gray, Hartford, Conn. App. filed September 17, 1898. (See page 692.)

725,259. AUTOMATIC CUT OUT; Isidor Kitsee, Philadelphia, Pa. App. filed May 20, 1897. An electro magnetic device having its coils connected in multiple and its core connected in series with the current carrying circuit, in connection with a movable member coacting with the core to close the circuit therethrough.

725,331. X RAY TUBE; Theodor Friedlander, Chicago, Ill. App. filed June 23, 1902. As a means for varying the degree of vacuum an auxiliary anode terminal is provided capable of absorbing the gaseous atmosphere of the tube.

725,334. THERMOSTAT; Henry W. Germner, New Boston, Ohio. App. filed Nov. 5, 1902. Details

725,355. RESISTANCE COIL; Edwin F. Northrup, Philadelphia, Pa. App. filed Feb. 4, 1903. The coils are suspended from a plate by their terminals which are reinforced for this purpose.

725,386. BELLOWS MOTOR CONTROLLER; Frank E. Whitney, Augusta, Ga. App. filed July 29, 1902. The starting rheostat is controlled by the movement of the bellows.

725,416. DEVICE FOR SHIFTING THE FIELD MAGNET FRAMES OF DYNAMO-ELECTRIC MACHINES; Wm. F. Dawson, Schenectady, N. Y. App. filed June 28, 1901. A carriage is arranged under each supporting foot of the frame, on which the frame is moved by means of suitable jack-screws.

725,436. TROLLEY WIRE CLAMP; Henry Geisenhoner, Schenectady, N. Y. App. filed July 28, 1902. A wire clamp comprising a holding member having an eye and a pair of arc-shaped clamps passing through the eye.

725,450. AIR COMPRESSOR AND HEATER; Charles R. Keller, Dayton, Ohio. App. filed Feb. 9, 1901. Compressed air is heated by an electrical heating resistance located in the tank.

725,476. TELEPHONE SYSTEM; Thomas Paul, Yorkton, Can. App. filed June 14, 1901. (See page 692.)

725,485. TROLLEY WHEEL; E. C. Rolfe, Belleville, Ill. App. filed July 8, 1902. The harp rotates on ball bearings at the upper end of the pole.

725,499. DESK FOR X-RAY APPARATUS OR THE LIKE; Horace R. Smith, Altoona, Pa. App. filed July 10, 1902. The cover of a roll top desk in which x-ray apparatus is placed, establishes the circuit when it is opened.

725,520. METHOD OF REDUCING METALLIC OXIDS WITH METALLIC ALUMINUM; Frederick C. Weber, Chicago, Ill. App. filed Aug. 6, 1902. The method of treating metallic oxids with aluminum in the production of metals and alloys which consists in subjecting the to-be-treated charge comprising aluminum in admixture with a metallic oxid reducible by aluminum, to a drying by steam heat for removal of the hygroscopic or ordinarily present moisture as a treatment preparatory to reduction.

725,523. ELECTRIC ARC LAMP; Harlan P. Wellman, Ashland, Ky. App. filed Dec. 3, 1902. Means for automatically connecting the carbon to the lamp circuit and allowing of the ready adjustment of the carbon either under the action of a clutch or when freed therefrom.

725,558. ELECTRICALLY DRIVEN CENTRIFUGAL BLAST FAN; Herman K. Grull, Vienna, Austria-Hungary. App. filed Jan. 28, 1902. A direct driven fan is adapted to utilize the entire surface of the wings for producing the draft, so that the inner diameter of the ring-shaped armature and the outer diameter of the wing are of nearly equal size.

725,592. ART OF TELEGRAPHY; Henry A. Rowland, Baltimore, Md. App. filed Nov. 23, 1897. The invention consists in transmitting over an alternating circuit by modifying the impulses for each character by cutting out the impulses in combination and so adjusting the times of current-modification that such times shall commence at the point of zero current.

725,596. ALTERNATING CURRENT MOTOR; A. W. Schramm, Philadelphia, Pa. App. filed Jan. 9, 1903. An inductance coil having a constant number of its convolutions connected with the field winding and means for connecting the brushes at will to different convolutions of the coil to thereby control the speed.

725,598. ELECTRIC CIRCUIT CLOSING MECHANISM FOR KEYED MUSICAL INSTRUMENTS; Ernest M. Skinner, Dorchester, Mass. App. filed Oct. 1, 1902. Circuit closing devices so arranged that only slight pressure on the keys will be required to close the circuit with certainty.

725,602. CIRCUIT BREAKER FOR FIRE ALARM SYSTEMS; Daniel T. Spring, Andrew Lond and Geo. H. Ebeling, Wheeling, W. Va. App. filed June 23, 1902. A box constructed so that when once pulled successive "pumpings" cannot interfere with the transmission of the signal.

725,603. REGULATOR FOR FIRE ALARM SYSTEMS; Daniel T. Spring, Andrew Long and Geo. H. Ebeling, Wheeling, W. Va. App. filed June 23, 1902. A regulator for the train in the transmitter box.

725,618. TROLLEY HEAD; Samuel Fierbaugh, Huntington, W. Va. App. filed Dec. 6, 1902. The wheel is afforded certain movement independent of the pole.

725,622. GUARD FOR THIRD RAILS; Charles W. Hornung, Jersey City, N. J. App. filed Dec. 22, 1902. A sheet metal covering shaped with a flange which fits one of the side guards to which it is fastened.

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CONTENTS.

Editorial 737
Annual Report of the General Electric Company 740
The New Brussels Telephone Exchange 741
Blondel Oscillograph. By Henry Hale 743
Resistance of Oil as Affected by Temperature and Impurities. By Prof. John W. Langley 745
Electric Canal Towage in Germany 745
Division of Labor in Mexico 746
Electrical Progress in Spain. By Henry L. Geissel 746
Economical and Safe Limits in the Size of Central Stations 747
Death of Prof. J. Willard Gibbs 749
April Meeting of the American Institute of Electrical Engineers 750
New Home of the New York Stock Exchange 751
Smoke and the Determination of its Density 752
Recent Electrochemical Developments. By Clinton Paul Townsend.... 753
New Telephone Patents 753
Current News and Notes 754
LETTERS TO THE EDITORS:
  A Theory of Magnetism. By Joh. Zacharias 755
  Stress on Frames of Alternating Current Generators. By Fred'k W. Knopfe 755
  Sweden and Electric Railway Development. By H. Ward Leonard.. 756
Digest of Current Electrical Literature 757
New Books 761
Heating and Ventilation of Railway and other Shops 763
Automobile Charging Outfits 764
Queen's Engineering Works, Bedford, England 765
New "Star" Screw-Cutting Engine Lathe 765
An English Photometer 766
Fan Motor and Battery 766
The Robb-Mumford Boiler 767
New Combination Ohmmeter 768
New Desk Telephone Set 768
The New Works of P. & B. 768
News of the Week 769

THE GENERAL ELECTRIC REPORT.

Last week a brief abstract was given in these pages of the annual report of the General Electric Company, and on page 740 we supplement those data with further statistics of interest to everyone connected with the development of electrical industries in the United States. Evidence as to the rapid extension of electrical production and the large share of it due to the company is shown by the fact that the amount billed has increased over 50 per cent from the figure of 1900; in other words, the amount has risen from slightly over $22,000,000 to $36,685,000. Great as this may seem, and undoubtedly is, it is interesting to note that it is barely 25 per cent. of the total annual product of electrical apparatus and supplies in this country, the amount reaching without question between $140,000,000 and $150,000,000. At the same time the fact remains that in its own chosen fields of effort the figures of the company are largely preponderant. In spite of active competition, the net profits shown on this business reached over $10,000,000, while the conservatism of the management is indicated by the fact that only about a quarter of this was paid out in the shape of dividends.

The question often arises as to the extent to which the electrical industries can maintain the rate of development exhibited by such a report, but if the subject is seriously studied, it will be agreed that there is no department of the art in which a steady growth is not to be anticipated, even should trade slacken, and through periods of depression. The fact is undeniable that the supercession of other methods by electricity has not yet gone far. It is not to be forgotten, for example, that in the census year less than 5 per cent. of the power in manufacturing establishments in this country was electrical, and here alone is a field of enormous and indefinite consuming ability for generators and motors, as well as for lights. As to electric traction, while it might seem that most of the large cities were pretty well filled up with trolley cars, a little further investigation would show that there is not a city in the United States where the rolling stock could not well be doubled in capacity without very great relief to the congested conditions. As to the heavier work that is looming up, such as that outlined by the New York Central and the Pennsylvania Railroads, it is simply infinite in its scope, and the chief thing to be desired is that it will not come all of a rush. Telephony is in a splendid state of growth, but is still far from having reached the completed period where normal rates of increase would begin to apply; and telegraphy is certainly in a state of underdevelopment.

All things considered and looking the field over broadly, we regard the General Electric report as a splendid indication of the possibilities embraced in the electrical arts, and in saying this we take the opportunity of congratulating the officials upon the clearness, fullness and minute detail of the statement. There was a time when the General Electric report was not a particularly copious or illuminating document. To-day we think it can be held up as an exemplar for every large corporation in the industrial world.

* * *

EXPORT TRADE AND ST. LOUIS.

The fact that the St. Louis Exposition is to be dedicated this week under favorable and promising circumstances gives special emphasis to the efforts which are now being made to induce the other civilized countries of the world to participate in the great show to be held next year. It is particularly hoped that foreign manufacturers and engineers will be numerously represented among us in 1904, and, as our readers are aware, special efforts are being made to organize congresses whose work shall have a lasting value. Already our English friends of the Institution of Electrical Engineers have notified their intention to participate, and if a programme of sufficient importance is laid out, we have no doubt that other countries and other engineering bodies will give official recognition to this part of the work. So far as manufactures are concerned, it may be well to point out that high as some items in our tariff may be, and strenuously as Americans may be pushing forward export trade, there remains and always will remain in this country a very large market for the productions of other countries. In the admirable speech of the Prince of Wales this week to the British Commission, of which he is chairman, the remark was made, "It should, however, be remembered that there is a considerable market for high-class goods in the United States, and also that the exhibition will afford an opportunity for showing our manufactures to customers in South America, Canada and other countries." This is an enlightened way of looking at it and is confirmed by the remarkable figures which appear in our commercial columns from time to time, showing the great and growing bulk of our importations.

Looking at the other aspect of the St. Louis Exposition, there is good reason to hope and believe that the assemblage of the best American fabrics, machinery, etc., will serve to develop a new demand for them in various parts of the world which they have not hitherto reached or where they are not adequately known. The population of the world is growing, the wealth of the world is increasing, the interchange of products will be larger and larger as years go by, and the only way to share in the commercial intercourse is to know and be known. It is true that our own exports have been somewhat restricted by the great prosperity of the country, and Mr. Thomas A. Eddy, returning recently from South America, stated that the exportation of American manufactured goods in that region has been reduced 30 per cent. since the year 1900, owing to the fact that American prices had become high and delivery slow, while the packing of exportable articles had also been inferior, so that the goods often could not be transported in safety. But, as our own commercial columns this week show so forcibly there are possibilities for electrical and machinery export the world over.

SAFETY DEVICES IN CENTRAL STATIONS.

The recent Institute paper of Mr. Philip Torchio, on station safety devices, though relating particularly to the systems employed in New York City, contains a number of useful rules which, while admitting of differences of opinion, will commend themselves to constructing and operating engineers generally. A moot question is the extent to which fuses should be used in a general lighting or power system. There can be no doubt of the necessity for using reliable fuses in the wires and fixtures of consumers. Unless some form of automatic cut-out is employed on the premises of the customer, there can be no security against fire. No cut-out has yet been found which is so cheap and so generally reliable as the ordinary fuse link or fuse strip. It can always be depended upon to melt when its current-carrying limit has been exceeded, although the exact limit may not always be accurately foretold. We shall print the paper next week.

The difficulty with fuses, from the station manager's standpoint, is that they may melt at an unduly low current, owing to unsuspected weakness, and thus interrupt the service. If there are, say, five sets of feeders between the central station and the load in a certain district, then, if all the feeders are adequately fused, so as to prevent them from carrying a dangerously strong current, the consequences of an accidental melting of a fuse may be serious. In such a case, the load previously carried by the feeder thrown off, is distributed among the four remaining feeders, thus tending to overload them, and bring their fuses to the danger point. If this causes another fuse to melt, the whole load will be thrown upon three feeders, and the chance of their being overloaded is rendered still greater. Cases have been known where an accident to the fuse or one feeder has soon effected the destruction of a number, thus interrupting the service.

The result of such experiences has been the abandonment of fuses outside buildings, and the solid connection of all mains and feeders through copper strips at junction boxes. If a short circuit occurs in a main or feeder, it becomes the business of the generators, with or without the assistance of a storage battery, to burn off the offending "short." This is usually preferred to the chance of accidentally cutting off conducting mains or feeders by over-sensitive fuses. As a rule, a central station can burn out any underground short-circuit without more than a momentary flicker; but in bygone days a whole central station would occasionally groan and wrestle for minutes with a distant short-circuit.

THE CENTRAL STATION STEAM PLANT.

The process of increasing the size and output capacity of central station units has steadily advanced since the inception of electric lighting. The first electric lighting dynamos were little machines of two or three horse-power that would seem like toys at the present time. As soon as the system was found to be practicable, the demand arose for a large unit in place of an equivalent aggregation of small ones. As fast as the larger unit was built, the demand for yet larger sizes outstripped it. This advance has gone on steadily, until of late the difficulty has been to get suitable steam engines of sufficient power to drive the size of dynamos which could be constructed. As pointed out by Mr. Lardner in his recent Institute paper, the largest marine engines are still more powerful than the largest engines installed in electric lighting stations. But the conditions of regulation in speed and in uniformity of rotation involved in central station operation, are more severe than in marine engines. Moreover, the cost of construction and installation in the largest sizes of engines does not show much advantage to the engineer in their adoption over existing sizes, as found in New York central stations. If any repair has to be effected in a very large engine, the delay in removing and replacing the part is apt to increase disproportionately after a certain large size of engine has been adopted.

If, however, the steam turbine proves an unqualified success, we may expect a change in the existing order of dimensions. In the first place, the sizes will be so much reduced that an engine the size of the present type of 5,000-kw will be perhaps of 20,000-kw capacity. Moreover, the simplicity of the steam turbine as compared with a reciprocating engine, should enable a turbine of that capacity to work very steadily and reliably. Unless the reliability of an engine increases at least in proportion to the size, engineers will be loth to build on a larger scale, since it means putting too many eggs in one basket. If then, the steam turbine is successful, there will be no constructive limit in the near future to the size of units. But it is doubtful, however, whether any plant at the present date would care to tie up as much as 20,000 kw in a single unit. A well-designed large central station should probably retain not less than five units, no matter how large the machines that may be economically constructed. If stations continue to grow in total capacity, we may expect to see the power divided among about five units, if there is economical advantage in the full size thus reached. There seems to be no reason why a 50,000-kw turbo-generator might not be constructed some day; but it is doubtful if such a size of reciprocating engine could be built and operated under commercially satisfactory conditions.

There can be no doubt that the increase in the size of central station units has materially reduced the cost of producing the kilowatt-hour at the switchboard, though the rate of reduction decreases as the size increases. So long as the construction is reliable, however, the cost of attendance per kilowatt diminishes steadily with the size, and promises to diminish still further with turbo-generators. The ideal large central station would have automatic stokers feeding large boilers working directly into a few large turbo-generators. The few men required would then merely have to superintend and control.

CENTRAL STATION DESIGN.

The Institute is to be congratulated on the excellent character of the papers read at the recent meeting, as well as on the strength of the following discussion. Since all members do not have general access to trade bulletins and catalogues, it may possibly be desirable to devote a meeting occasionally to papers descriptive of the latest wares in a selected branch; the success, however, of the March and April meetings indicate that the old-time Institute programme dealing with the broader questions of electrical engineering has not lost in interest to members. No small share of the credit of the success of these two meetings is due to Messrs. Ralph D. Mershon and Henry G. Stott, the former having been given charge of the programme for the transmission meeting and the latter that of the meeting on Friday of last week. As remarked by President Scott, in opening the meeting, the papers of the evening were notable in that they dealt with fundamental and broad questions of central station design, and it may be added that they reflected a shifting of engineering opinion which, though until the present receiving little or no public expression, has for sometime been apparent to those who have closely watched present-day central station conditions. In this respect the papers and discussion promise to have no small influence through directing attention generally to the fact that central station development along later lines has about run its course, and that in the case of large systems the time has arrived when account must be taken of the many new factors strongly affecting central station equipment and operation and consequently central station design.

The papers by Messrs. Junkersfeld and Lardner respectively deal from the standpoint of the practical operating engineer, with some of the difficulties which are associated with the colossal central stations which have been the fashion within the past few years. The advantages of centralization have been dinned into our ears over and over again, but after all there is something to be said for local self-government in central station operation as in politics. Mr. Junkersfeld's paper deals with some of the curious complications arising in the operation of a modern central station with its polyphase transmissions, sub-stations, batteries and switching systems. He holds, and we think correctly, that there are times when the operation of the network as a whole becomes a practical disadvantage, and the load can be worked with greater ease and safety in independent sections. This is almost self-evident when one fully grasps the nature of the network as a whole, and it is equally clear that there are times when operation as a whole is highly desirable. The point of the matter is that when trouble like a short circuit occurs, it will injuriously affect just so much of the whole system as is tributary to it. If every generator is on the same bus-bars and connected to the whole network, the voltage of the whole system will fluctuate; while if the fault be on an isolated circuit, only that circuit will suffer. The moral is that whether the normal mode of operation is as a single network or several, it should be possible to cut off and isolate a faulty section very promptly. The problem of doing this has never been properly worked out, and until it is there is something to be said for operating in sections.

The troubles to which Mr. Junkersfeld refers are undoubtedly aggravated when the system includes high-voltage transmission to sub-stations with rotaries. In case of a fault the transmission system enables enormous amounts of energy to be poured into it, which in a simple direct-current distribution would be limited by drop in the feeders and mains. But we think Mr. Junkersfeld errs in ascribing any peculiar relations in this particular to synchronous operation as such. The real trouble is that the very characteristics that enable the system or any systems to run with small loss in the distribution render faults the more disastrous. To an alternating transmission system all faults act as if they were close to the station, and that is all there is to it. The central station manager is perpetually between the devil and the deep sea—if his distribution is highly efficient and gives the best of regulation when in perfect order, it will be subject to specially violent and destructive action when anything goes wrong. And incidentally the concentration of the generating units involves some danger of a single accident involving a large part of the total plant capacity. Of course, a system of partition walls and remotely controlled valves and switches lessens this danger, but it also greatly reduces the incentive to centralization. By the time a huge plant is thus subdivided, from an operative standpoint it may, and in our judgment generally will, become quite as costly to build and to operate as if its units were grouped in several plants judiciously scattered over the load area. And if as sometimes happens, the colossus is reinforced by prime-movers installed at some of the sub-stations, the safety precautions are a confession of defeat.

And this brings us to Mr. Lardner's paper. Mr. Lardner points out very clearly both the dangers of putting all one's eggs in one basket, and the uselessness of the procedure after the number of eggs becomes large. It is all very well to advise watching the basket, but the point has been already reached where the necessary amount of watching can be just as effectively distributed between several baskets. It is often urged that by building a single station, the best point with respect to coal and water supply can be utilized; but when the cost of transmission is considered, and the system is designed for minimum cost of energy at the center of load, the case takes on a very different aspect. It is true that very large generating units secure a certain amount of economy in first cost and operation. If, however, the plant be reckoned on the basis of first cost and final cost per kilowatt-hour delivered at the center of distribution, as we have just suggested, the very large units may not appear to so great advantage. Taking for instance Mr. Lardner's figures for guaranteed steam per kilowatt-hour in steam turbines, and we find that the gain in passing from 500 kw to 5,000 kw in size is not enough to equal the losses in transformers and feeders to the sub-stations of a transmission plant. As between a 1,500-kw and a 5,000-kw size, the gain in steam consumption will barely balance the energy lost in the transformers alone. Of course, the floor space may be better utilized in the larger unit, but the difference amounts to only a small fraction of a square foot per kilowatt capacity. There is only one great system in this country, that of the Boston Elevated Railway Company, which has systematically held to separate stations of moderate capacity. Its power expense has never been fully made public, but we are very strongly of the opinion that it will compare favorably with the costs obtained in the huge stations erected elsewhere. It takes a large gain from concentration to offset the losses in distribution to sub-stations, and the operating expenses and cost of the latter. When all these things are taken into consideration, we think the station of maximum economy will be of much less output than has sometimes been supposed. The subject is one that needs investigation on its merits—it cannot be settled on purely hypothetical data.

Annual Report of the General Electric Company.

Last week we presented a brief abstract of the annual report of the General Electric Company, issued on Wednesday. We can now supplement that data with some further figures from the interesting statements of President Coffin and his associates. As noted last week, the report shows gross sales of well over $30,000,000, net profits of $10,277,169, and dividends paid of $2,721,594, altogether a splendid manifestation of the possibilities of well directed industry in the electrical field.

The balance sheet as of January 31, 1903, compares as follows:

Assets	1903.	1902.	1901.
Patent	$2,000,000	$2,000,000	$2,000,000
Plants	5,000,000	4,000,000	3,400,002
Real estate	431,456	464,195	522,453
Stocks and bonds	12,682,214	9,825,820	6,012,300
Accounts receivable	12,816,608	11,364,345	9,596,940
Inventories	11,561,216	8,876,883	7,990,980
Work in progress	1,769,456	1,338,258	1,054,650
Cash	3,632,556	4,058,448	2,373,683
Total	$49,893,507	$41,927,251	$32,951,017
Liabilities	**1903.**	**1902.**	**1901.**
Common stock	$41,880,733	$24,910,900	$21,400,300
Preferred stock	....	....	2,551,200
Debentures	2,148,400	372,000	1,534,000
Accrued interest	825	3,100	16,533
Accounts payable	1,378,961	1,349,335	820,450
Unclaimed dividends	1,886	4,775	....
Profit and loss surplus	4,482,702	15,287,140	6,628,534
Total	$49,893,507	$41,927,251	$32,951,017

The income account of the General Electric Company for the past four years compares as follows:

	1903.	1902.	1901.	1900.
Net profits	$10,277,169	$8,598,241	$6,243,792	$5,479,131
Dividends and interest	2,721,594	1,997,966	1,968,289	1,282,670
Balance	7,555,575	6,600,274	4,275,502	4,196,461
Pat. acct. Sprague Elec. Co.	1,613,879	....	....	....
Balance	5,941,696	6,600,274	4,275,502	4,196,461
Inc. val. sec.	....	2,057,685	....	....
Total	5,941,696	8,657,960	4,275,502	4,196,461
Previous surplus	15,287,140	6,629,180	2,353,030	156,570
Total surplus	21,228,835	15,287,140	6,629,180	*2,353,030
Stock issued	16,746,133	....	....	....
Surplus	4,482,701	15,287,140	6,629,180	2,353,030

* $2,000,000 written off.

The various sources from which profit were derived compare for the past four years as follows:

	1903.	1902.	1901.	1900.
Sales	$36,685,598	$32,338,036	$28,783,276	$22,379,463
Royalties	814,958	141,391	298,366	868,706
Dividends	393,961	434,350	232,041	309,428
Profits on sales st'ks & bds	973,649	938,584	419,067	838,857
Inc. val. sec.	....	2,057,685	....	....
Interest and discount	253,882	....	96,902	70,710
Total	$39,122,050	$35,910,049	$29,829,652	$24,406,068
Cost of sales	28,844,881	25,254,122	23,585,860	18,926,937
Net profit	$10,277,169	$10,655,927	$6,243,792	$5,479,131

A comparison of the balance sheet as of January 31, 1903, with the three preceding years, follows:

Assets:	1903.	1902.	1901.	1900.
Patents, franchises	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Factory plants	5,000,000	4,000,000	3,400,002	3,400,002
Real estate	431,455	464,195	522,453	563,643
Stocks and bonds	12,682,214	9,825,120	6,012,300	6,132,268
Accounts received	12,816,607	11,364,345	9,596,940	6,978,002
Inventories	11,561,216	8,876,883	7,990,980	8,047,581
Work in progress	1,769,456	1,338,258	1,054,659	874,128
Cash	3,632,556	4,058,448	2,373,683	1,537,072
Total	$49,893,507	$41,927,251	$32,951,017	$29,532,697
Common stock	$41,880,733	$24,910,900	$21,400,300	$18,276,000
Preferred stock	....	....	2,551,200	2,551,200
Debentures	2,148,400	372,000	1,534,000	5,300,000
Accrued interest	825	3,100	16,533	44,166
Accounts payable	1,380,846	1,354,110	820,450	1,008,299
Profit and loss surplus	4,482,701	15,287,140	6,628,534	2,353,030
Total	$49,893,507	$41,927,251	$32,951,017	$29,532,697

The amounts written off factory plant and patent accounts exceed the amounts written off those accounts last year by about $2,500,000. The present condition of the business of the company is satisfactory and indicates a considerable increase in volume for the current year over that of last. The total sales (amount billed to customers) during the past year were $36,685,598. The yearly orders and sales for the past four years are as follows:

Year ending Jan. 31	Amt billed	Orders rec'd.	Yearly inc. of Orders rec'd.
1900	$22,379,463	$26,323,626	51.1%
1901	28,783,276	27,969,011	6.3%
1902	32,338,036	34,350,840	22.7%
1903	36,685,598	39,944,454	16.4%

Since February 1, 1900, the reported orders received have not included the times of service of experts and labor, freight and transportation, supply material, boilers, engines, etc., of outside manufacture and bare copper wire, which items were included prior to 1900. These items amounted to $1,558,371 during the past year. Including these items the total orders received for 1902 aggregate $41,502,825.

With regard to the acquisition of the Sprague Electric Company, the following reference is made by vice-president General Eugene Griffin: "By the purchase of the Sprague patents we have come into possession of the only fundamental and detailed patents, outside of those already owned by our company, covering a successful and satisfactory form of multiple-unit control. This system, now known as the Sprague-General Electric System, is in successful operation on many roads." A list is given of 31 roads with 2,081 cars on which the multiple-unit system has already been adopted.

General Griffin also remarks: "My report of June 28, 1897, states: 'Since the organization of the company in 1892, we have sold 30,912 railway motors, having a total capacity of 795,120 hp. Since that date we have sold 54,344 motors, having a total capacity of 2,304,986 hp. The grand total of railway motor sales in the past eleven years is 85,256 motors, having a total capacity of 3,100,106 hp. These motors are in operation in all parts of the world. The growth of water power enterprises is shown by the fact that 221 plants are now in operation with 428,269 hp in General Electric generators. We received about 162,000 separate orders during the year (not including contracts), an average of 541 per day.'"

Vice-president E. W. Rice, Jr., in his report, says: Expenditures aggregating about $2,500,000, exclusive of the cost of patterns, small tools, etc., have been made during the year for real estate, extensions to existing buildings and the erection of new ones, and for additional machinery; all required to take care of the increased business. The following table shows approximately the increase in floor space and in the number of employees during the past five years:

	Factory floor space in square feet.	Factory Employees.
1899	1,800,000	8,000
1900	2,000,000	11,000
1901	2,300,000	12,000
1902	2,500,000	15,000
1903	3,000,000	18,000

As to electric drive, Mr. Rice states that such applications by the General Electric Company show an increase of 40 per cent. in 1902. As to mining work, he mentions one coal company that operates some 50 General Electric locomotives over some 200 miles of track, mostly underground. As to methods of generation and distribution, Mr. Rice says: "The demand for direct-current generators of large size, 2,000 kw and over, has fallen off. This has been due to the increasing use of alternating current in the generating station and its conversion, where needed, into direct current at sub-stations through the medium of rotary converters. This system, which has been mentioned in previous reports, has now become standard for all large undertakings in this country and is being rapidly introduced abroad. Its great economy and flexibility has undoubtedly contributed largely to the successful and extended use of electricity for all purposes. It is interesting to note that the capacity of some of these sub-stations is much greater than that of the largest generating stations that were in existence a few years ago."

The company reports some 14,500 regular customers on its books.

◆

New York Lighting Plant

The proposal to establish a municipal lighting plant for New York City has been lost in both the Senate and Assembly, so that the scheme is dead, or at least in abeyance, for the present. The proposition received wide attention.

The New Brussels Telephone Exchange.

OWING to the continuous increase in the number of subscribers and the necessity of reducing to a minimum the cost of operation, the Belgian Government some time since appointed a commission to investigate the several modern telephone systems and designate that which they considered the best. The transformation of a telephone system is a matter of very large cost, and in this case the decision involved the telephone service of the entire kingdom. After having visited most of the countries of Europe and America and giving the most careful thought to the subject, the commission made the following recommendation:

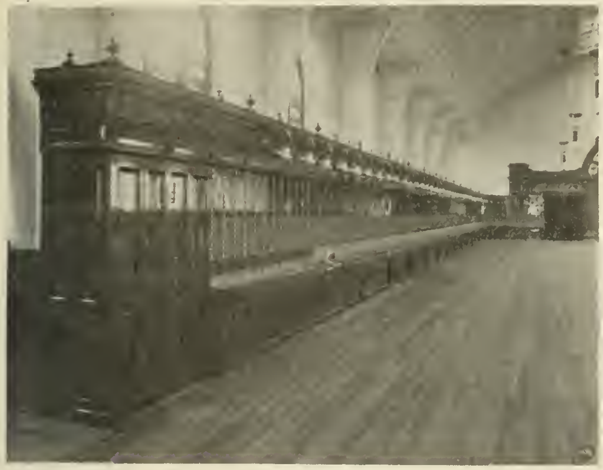


FIG. 1.—GENERAL VIEW BRUSSELS EXCHANGE.

All grounded circuits should be transformed to metallic circuits and in large cities the conductors be placed underground. The common battery system should be adopted and new exchanges be so constructed as to provide so far as possible for the growth of the service, and assure the comfort and health of the personnel.

It was in accordance with this recommendation of the committee that the new central exchange at Brussels was designed, a description of which follows.

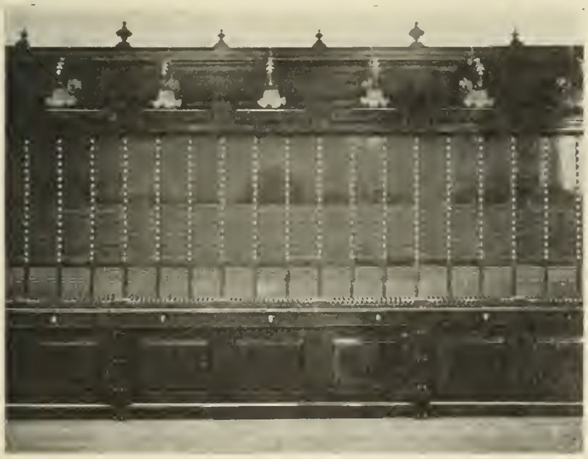


FIG. 2.—SECTION OF SWITCHBOARD.

The building is 197 ft. long, 65 ft. wide, and is 106 ft. high, measured from the street level. It comprises a basement at the level of an interior court and four stories. The third, or principal story, is entirely reserved for the operating room, which is 33 ft. high in the middle and 26 ft. high at the walls. This room, a view of which is given in Fig. 1, is both light and airy, thus conducing both to the health of the employees and the quality of the service. At the left of the hall is the multiple switchboard, which is equipped for 6,300 subscribers and 43 operators, its total final capacity being for 14,400 subscribers.

Fig. 2 shows the last section of the board for three operators' positions, there being nine panels of jacks in a length of 6 ft. Fig 3 gives a view behind the board, the shutters being removed. This shows the disposition of the general jack cables and the supervising relays which control small lamps in connection with 17 pairs of plugs for each operator's position. All the parts of the switchboard are very accessible, and, moreover, offer no difficulty in making extensions, which can be provided for without in any manner interfering with the existing sections and the service. The cables from the intermediate distributing board, which serve local jacks, are in a channel immediately behind the board; the successive groups of these cables for each operator's position pass through small openings in the floor underneath the supervising relays. These groups of cables then pass vertically between two successive groups of supervising relays to the corresponding local jacks.

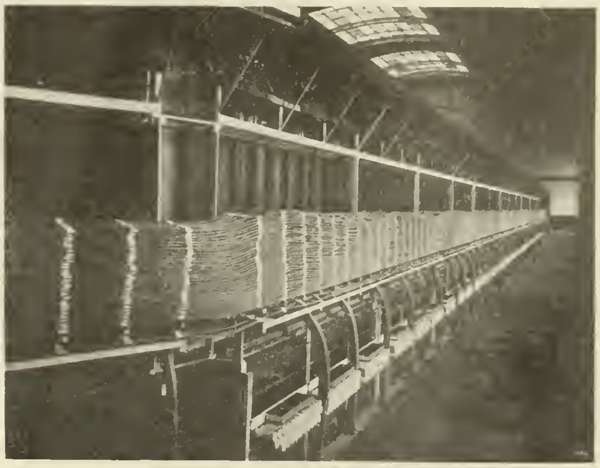


FIG. 3.—REAR VIEW OF SWITCHBOARD.

Fig. 4 gives a view of the interurban tables. A calculagraph is placed between each two adjacent operators for the automatic stamping on the tickets of the time of the commencement and close of each interurban connection. The night service can, by means of a simple commutator, be entirely switched on to the last section to the right of the interurban board.

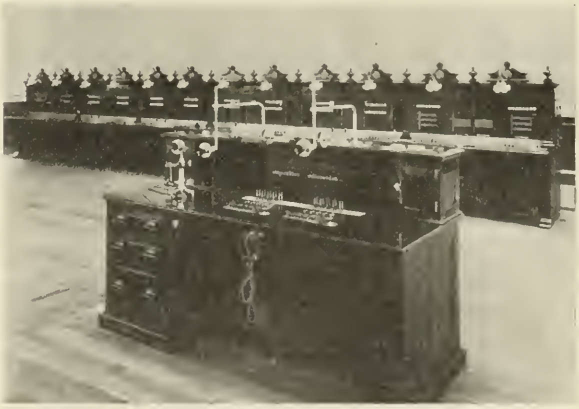


FIG. 4.—INTERURBAN SWITCHBOARD AND TOLL TABLE.

The employees at this table receive all calls for interurban connection and prepare the tickets relating thereto. The auxiliary lines which connect the interurban and local service are provided with automatic signals represented by small lamps, which system permits the reduction to a minimum of the manipulations for connections and at the same time facilitates supervision.

Very complete means are provided for protection against fire, both with respect to security to the personnel in case of actual fire and in preventive means. Of all these, the best and at the same time the least expensive, is that furnished by protective fuses and lightning arresters which are placed on the intermediate distributing board in the story below the operating room. The exterior lines entering the exchange offer the greatest hazard from fire, and in the new exchange each line aerial or underground is provided with a lightning arrester so adjusted as to protect the wiring and apparatus of the multiple switchboard.

The cables, which are paper insulated and lead encased, are carried from where they enter the building in a wall channel to the second floor, where they terminate in cable heads, from which the interior cables start, as shown in Fig. 5. This principal distributing board is shown to the right of Fig. 5, the center of which is occupied by the intermediate distributing board; to the left are the calling relays and in the background the translator board. Fig. 6 shows in the background the details of the latter. Figs. 5 and 6 together enable an idea to be obtained of the connecting cables which unite these boards together and with the switchboard. The cables are carefully disposed in a simple order, and there are no crossings.

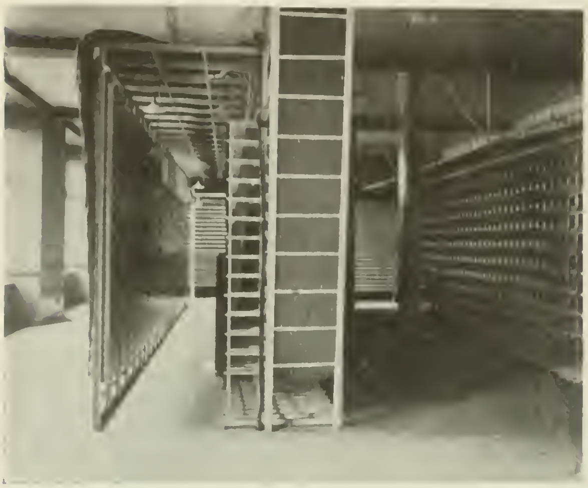


FIG. 5.—CABLE LEADS AND DISTRIBUTORS.

The second story also contains the plant furnishing current for the common battery system, including a storage battery of eleven cells, a portion of which is shown in Fig. 8. The 110-voltage current required for operating the two motor-generators may be obtained from the street service or supplied by two gas engine units in the basement. The 110-volt current is transformed to 24 volts for charging the storage battery, the capacity of which is sufficient to operate the exchange for 24 hours. One of the motor-generators is kept in reserve. The motor-generators have been so designed with such care that it is possible to charge the accumulator during the hours of service without affecting in the slightest the service at either the switchboard or at the subscriber's telephone. Should an accident happen to the storage battery, it is even possible to supply the service directly from the motor generator, and it is for this reason that there is no reserve storage battery. The generators supplying calling current are shown in Fig. 7 to the right of the motor generators; two of these are installed, one being in reserve. The first calling generator is operated by current from the storage battery, while the second is connected with the street circuit. The secondary current furnished by these generators is an alternating current of 75 volts. The generating apparatus shown in Figs. 6 and 7 supplies all the electrical energy for the entire service of Brussels, not only for calling and the operation of all signals, but for the transmission of speech.

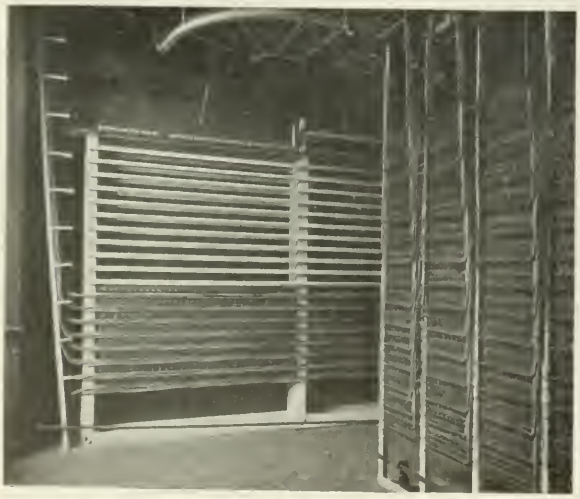


FIG. 6.—REAR OF DISTRIBUTING BOARD

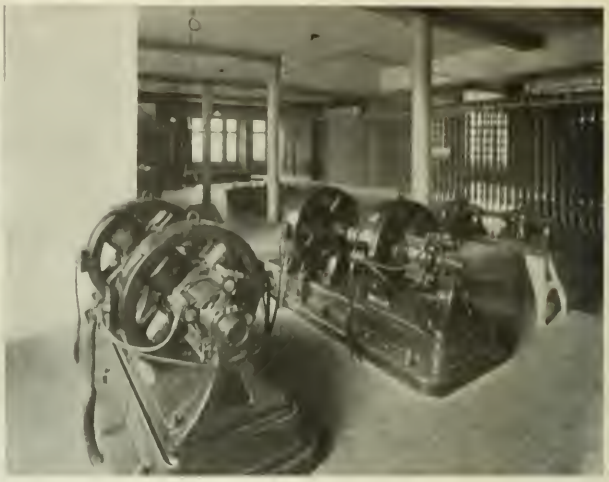


FIG. 7.—GENERATING PLANT

The second story contains also all the apparatus which plays an intermediate rôle between the exterior circuits and the switchboard on the third floor. On this floor also is concentrated the trouble-finding and testing service. Owing to the use of the intermediate independent distributing board, faults may be quickly located and repaired.

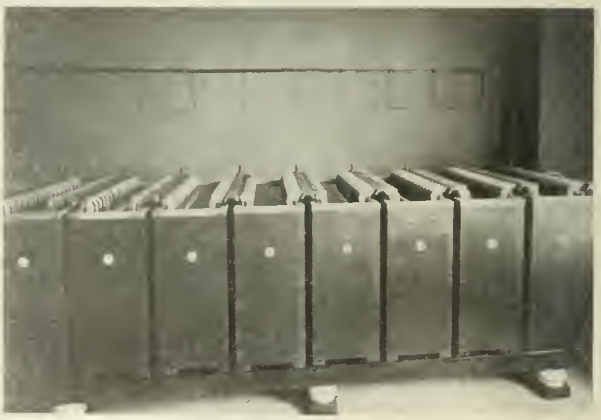
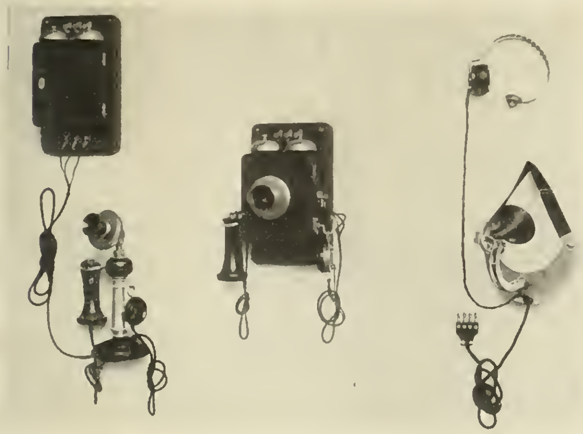


FIG. 8.—STORAGE BATTERY PLANT.

The other stories of the building are assigned to the several departments of the State Telegraph administration. In the cellar are the gas engine generating sets, the apparatus for heating and ventilation, etc. A high-speed elevator is at the service of the operators, and on the upper floor are a number of rooms for their convenience, including cloak rooms, library and reading rooms, baths, and kitchen, which latter supplies at cost meals to the personnel. There is also a doctor's office and rooms are provided for cases of illness. It is well known that the duties of operators are very trying, and it is, therefore, proper that their comfort should be thus provided for. The new switchboard adopted is, however, a great advantage in their work and reduces to a minimum the number of words to be spoken to subscribers. The automatic signal system enables an operator to follow the course of a call without listening in, which latter was necessary in the system displaced. Moreover, since the operator is enabled to know the precise moment when a conversation is finished, she can immediately disconnect and thus increase considerably the efficiency of the subscribers' lines as compared with the old system. Moreover, the common battery system also lightens the subscriber's share in telephonic connection. It is only necessary for him to take his receiver off the hook in order to call, and returning it to the hook signals the close of conversation. The connection for a call can be made at once, for the operator has merely to inquire the number of the subscriber called and make calling connection with him without being obliged to wait until he answers.

Figs. 9, 10 and 11 show the types of telephone instruments that have been adopted for Belgium. Fig. 10 represents the wall type, which is extremely simple. This set consists of a solid-back transmitter, a commutating hook, two receivers, a call bell, an induction coil and a condenser. No local source of electricity is necessary, the current for the station being supplied from the exchange. Fig. 9 shows a set which consists of two independent parts connected by a flexible cable; one part consists of a solid-back transmitter mounted on a column supporting the two receivers; the second comprises a bell, an induction coil and a condenser in a box. The apparatus for operators is shown in Fig. 11. The exchange has been equipped on the Bell system by the European interests of the Western Electric Company.


FIGS. 9, 10 AND 11.—TYPES OF TELEPHONES.

Stockton Municipal Plant Report.

A movement at Stockton, Cal., for a municipal lighting plant appears to have got a quietus from the report to the city council by Prof. C. L. Cory. He stated that with the plant contemplated, running 200 arc lights on a moonlight schedule, the engines going twenty-four hours daily and operating also the incandescent system for commercial and residence lighting, the cost to the city for each arc light per month would be $7.45. The present cost to the city per arc light monthly is $6.90. Prof. Cory explained that the plant contemplated was considerably larger than the present needs of the city demanded, but he believed it better to put in a larger plant than required at the outset than to have to add to the plant when the city grew and there was a greater demand for power. He thought the city should build with a view to the future. Prof. Cory presented plans for the lighting plant complete, with a map of the city showing the location of the poles of the distributing system, and he also presented a mass of figures and statistics regarding municipal lighting. He said the plant contemplated by his plans was the best that could be got and such a one as the city should have. The price given, moreover, was based on overhead circuits and the consumption of fuel oil at 70 cents a barrel.

Blondel Oscillograph.

By HENRY HALE.

ONE of the striking exhibits at the 1900 Paris Electrical Congress was the Blondel oscillograph, which gives a visual representation of alternating-current waves that formerly were plotted from laborious determinations by contact methods of successive points of the curves. The latest form of that apparatus is illustrated herewith and among its practical uses is the taking of curves of alternators, motors and transformers in studies of design and operation. The arrangement is such that two different wave forms may be taken at a time, corresponding, for instance, to e.m.f. and current, and these are superposed in their relative position. The waves are thrown on a ground-glass screen about 4 by 6 in. and are traced by a spot of light. For the accomplishment of this a small iron piece is free to oscillate between the poles of a horseshoe magnet and carries a small mirror. The coil carrying the current acts upon the mirror and the latter vibrates according to the variations of the current. The small mirror sends a beam of light on to an inclined mirror, which is oscillated by a synchronous motor, and the combined action traces the wave form upon the screen, as will be further indicated.

In order to respond exactly to a wave form of a high-frequency period, it is essential that the mirror should follow the variation of the wave at every point, and the vibration period of the mirror itself must be reduced to a minimum in order that its vibrations will not conflict with the impulses it receives from the current. M. Blondel has succeeded in carrying this out by using a very narrow and thin iron band for the vibrating piece, which is stretched between two bridge-pieces, and carries a small and light mirror in the center. In this way he obtains a band whose rate of vibration is as high as 50,000 periods per second, and can thus follow the variations of even the most irregular waves. In practice the band is mounted on a support which protects it and also allows it to be adjusted with reference to the poles. This arrangement is shown in Fig. 1 on the left. The cylindrical supporting rod, *R*, has a groove running from top to bottom. In the upper part of the groove is a sliding piece, *S*, which may be regulated by the milled nut, *N*, at the top. The vibrating band, *B*, is attached to a bridge, *b*, below, and above to the end of the sliding piece at *a*. By turning the screw the band, carrying the mirror, *M*, is given the necessary tension. The rod carrying the mirror is mounted in an outer protecting tube, *T*, which is filled with oil to prevent the oxidation of the band. The tube has an opening, *O*, opposite the mirror, carrying a lens; the two soft iron pieces, *I*, are inserted in the tube to concentrate the magnetic effect of the poles upon the band at this point. The upper milled screw, A, allows the tube to be turned in its support so as to adjust the mirror.

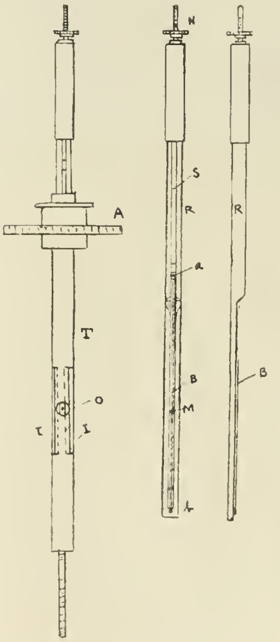
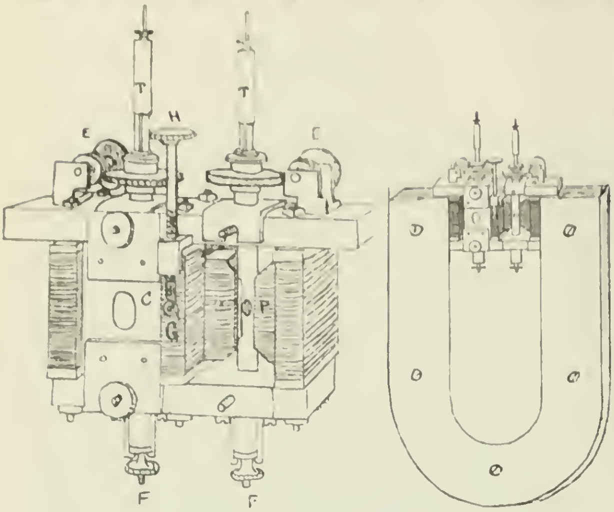


FIG. 1.—BLONDEL OSCILLOGRAPH.

The vibrating band is mounted so as to bring it between the poles of a powerful horseshoe magnet. In practice there are two bands, forming a double oscillograph, which are inserted between the poles of an inverted horseshoe as will be noticed on the left of the general view. The double form is useful in taking current and e.m.f. waves at the same time. The tubes, *T*, are mounted, as shown in Fig. 2, between the laminated pole pieces, *P*, which are inserted between the poles of the magnet and form a compact ensemble. The current whose wave form is to be taken is sent into a coil of fine wire or flat strip which is inserted at *C* on each side of the pole pieces, *P P*; the coil has an opening in the center to allow the light to fall on the mirror. The tube is adjusted horizontally by the endless screw, *E*, which turns it about, and by the lower screw, *F*, which slides it up and down. In the center is a small mirror, *G*, adjusted by the screw, *H*, which gives the permanent strip of light forming the zero line of the curves. The



FIGS. 2 AND 2A.—OSCILLOGRAPH.

vibrating band has proved far superior to the system of pivots or wire suspension. Owing to the effect of torsional vibration the oscillating period is very high and is still further increased by the tension and the strength of the magnetic field. The number of vibrations proper to the band is in fact the square root of the sum of the squares of the numbers of vibration due respectively to the elasticity of torsion, to the tension and to the magnetic field. Experiment has shown that the band works best when it is saturated, and it is for this purpose that the magnetic field is concentrated as much as possible. It is also very sensitive to the influence of the current in the coil, as the effect accumulates from the ends toward the middle. The iron band is made as small as possible and is now only 0.03 in. wide and 0.002 thick; the mirror which it carries is correspondingly small, being 0.01 in. wide, 0.02 high and from 0.005 to 0.003 thick. It is made of thin glass or mica, which is silvered by deposition from a bath and is attached to the band by shellac.

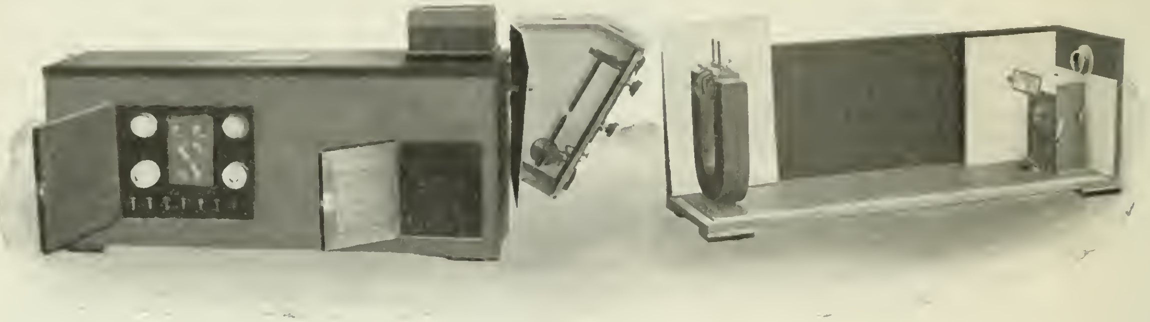


FIG. 4.—EXTERIOR AND INTERIOR VIEWS OF OSCILLOGRAPH.

The variable wave traversing the coils causes the spot of light reflected from the mirror to vibrate to and fro with an amplitude corresponding to the intensity of the current. To produce the wave form the spot must be displaced in a direction perpendicular to the former and proportionally to the time of vibration. For this the spot is reflected from an oscillating mirror placed at 45°, which is operated by a small synchronous motor. The method of mounting is shown in Fig. 3, where *O* is the oscillograph mirror which receives light from a source, *A*, through the lens, *B*. From the mirror the light is reflected through the lens, *C*, upon the oscillating mirror, *M*, and thence to the ground-glass screen, *S*, above, where it is concentrated to a point. The mirror is made to oscillate by a cam, *D*, on the shaft of a small synchronous motor; the cam has a profile adapted to give a uniform movement of the image on the screen during the forward stroke of the mirror, which is proportional to the wave period, and then allows it to drop back quickly so as to recommence the forward stroke. The formation of the wave under these conditions is easily understood. A small fixed mirror between the two oscillographs sends a spot of light on the oscillating mirror and the continuous image of this spot forms a straight line from right to left for the base line of the wave. The oscillograph mirror under the action of the current would, if acting alone, cause the spot to oscillate across the base line at an equal distance on each side, forming a straight line, but the oscillating mirror distributes the light from the spot in a direction parallel to the base line, so as to form a continuous wave. In practice the oscillating mirror swings on the forward stroke so as to allow the spot to form two complete waves. At the end of the period the cam causes the return or back stroke, which takes place very quickly, and during this period the light is cut off by an electrically-operated shutter, *E*, placed in front of the light. The eye does not perceive this movement.

The lens, *C*, is of semi-cylindrical form and thus the rays coming from the oscillograph mirror may be concentrated vertically, while at the same time they are free to move in a horizontal direction. The source of light is a vertical slit, whose image is thus concentrated to a point in front of the lens, *C* (or in this case on the screen above). In this way a brilliant image is obtained, while still using a very small mirror.

A valuable feature of the oscillograph as now constructed is that all the parts are mounted together in a compact case and there are no difficult adjustments to be made. The interior (Fig. 4) contains the oscillograph proper on the right with double mirror and on the left is the oscillating mirror with its motor and starting crank. A convenient form of synchronous motor has been devised which has no moving contacts. A horizontal fixed armature is wound with a six-pole winding and around it turns a horseshoe magnet upon a pivot support with a shaft projecting at the top, which carries the cam. The exterior view of the box shows a hand-regulated arc lamp on the right, mounted in a sheet-iron box, which can be taken off. Above is a ground-glass screen upon which the wave is observed. To photograph the waves a plate holder can be inserted in place of the screen. The oscillograph can be used for lecture demonstration by taking off the screen and substituting a mirror inclined at

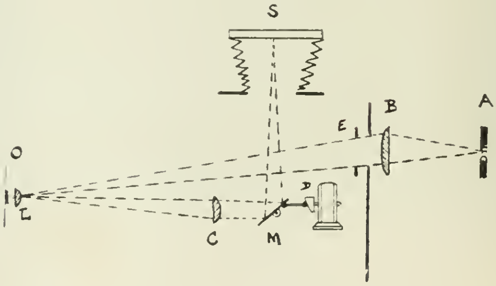


FIG. 3.—DIAGRAM SHOWING ARRANGEMENT OF APPARATUS.

45°, which sends the wave upon a screen a yard square placed at 3 or 4 yards distance. At the same time the cylindrical lens is replaced by a second of longer focus and the mirror tube is exchanged for another carrying a larger mirror of 0.04 in. diameter. This increases the brilliancy of the luminous point at the expense of the frequency, which falls to 4,000 or 5,000 per second, but the latter is sufficient for the purpose.

Resistance of Oil as Affected by Temperature and Impurities.

By Prof. John W. Langley.

DURING the year 1902 a research on the electrical resistance of oils, as affected by temperature and impurities, was conducted in the electrical laboratory of Case School of Applied Science by two students, Messrs. C. E. Cochran and H. E. Fetzer. A steady pressure of 2,400 volts, derived from a storage battery, was applied through two copper electrodes in a metallic tank which could be heated.

The tank to hold the oil was made of a rectangular sheet of copper, so formed and folded at the corners that it was not necessary to make brazed joints. To the upper edge of two of the sides was fitted a small brass rod to facilitate handling. The tank was three inches by four and a half inches on the bottom, three and one-half inches by five inches on the top, and three inches deep. In order to protect the tank from sudden changes of temperature, it was enclosed in a sheet-iron oven lined with asbestos. The heat was applied by a Bunsen burner, which projected upward through the bottom of the oven.

The electrodes were made of sheet copper, two inches square and covered with mica on the back, but having the mica continued as a border on the front face around the edge, so as to reduce the area of the latter face to three square inches. This device prevented the current from passing by way of the edges, and compelled it to pass from the central portions of the electrodes in parallel lines through the oil.

The electrodes were suspended by small brass rods fastened to movable collars which were clamped to a glass insulating rod by means of thumb screws. The glass rod was supported by two small steel rods, one at each end, and secured by thumb screws.

1. LIGHT ENGINE OIL.

30	1780
60	1243
90	506
120	209
150	78
180	60

2. CYLINDER OIL.

30	803
60	65
90	30
120	8
150	5.2
180	5

3. COTTON SEED OIL.

30	5110
60	1500
90	910
120	580
150	435
180	277
210	260

4. FISH OIL.

30	1400
60	700
90	420
120	315
150	238
180	215
210	188

5. RAW LINSEED OIL.

30	36.4
60	10.6
90	7
120	4.6
150	4
180	3.87
210	3.3

6. BOILED LINSEED OIL.

30	5.9
60	4.44
90	3.1
120	2.32
150	2.1
180	1.75
210	1.3

7. LARD OIL WITH 1% BUTYRIC ACID.

30	6120
60	2310
90	1000
120	610
150	302
180	59
210	54

8. ENGINE OIL WITH ¼% OF SOAP.

30	5110
60	1000
90	220
120	70
150	40
180	16
210	9

9. PARAFFIN WAX.

30	Infinite
60	4773
90	1000
120	575
150	310
180	217
210	158

10. LARD.

30	6390
60	3100
90	1840
120	990
150	755
180	810
210	532

As the temperature of decomposition of oil is above the range of a mercurial thermometer, a pyrometer of the Siemens type was carefully calibrated and kept inserted in the oil during all the observations of resistance. A sensitive galvanometer was used to measure the current passing through the oil.

The oil being in the tank, the current and voltage at the electrodes are read, then the temperature is slowly raised about ten degrees Centigrade with constant stirring, and another reading of the galvanometer and voltmeter taken. These were continued by ten degree steps till the decomposition temperature of the oil was reached.

The current was very small, as was to be expected, ranging from .000001125 to .0003. The distance between the electrodes was constant at one-half an inch. In the tables given below the first column gives the temperature in Centigrade degrees and the second the resistance in megohms.

The effect of temperature in lowering resistance is apparent in all the experiments; also, that its influence becomes very marked above 90°, showing that incipient decomposition begins at this point. The action of impurities, such as acid and soap, is well shown by comparing tables 7 and 8 with 1 and 10 at temperatures of 60° and higher.

The resistance of linseed oil is exceptionally low, but the boiled oil is still lower, showing the effect of previous high temperature, and perhaps of the dissolved lead oxide which it contained. The low resistance of table 2, cylinder oil, would indicate that it had been adulterated with animal or vegetable oils, or, perhaps, soap to give it "body," which is known to be often done.

The high resistance of paraffin at low temperatures is in marked contrast with its failure as an insulator when heated above 120°. The resistances in the above tables are relative, not absolute, for they did not vary proportionally when the area or the distance between the electrodes was changed.

From the above, and numerous other measurements made on some twenty-five specimens of oil, pure and adulterated, the following conclusions seem warranted:

First. That at ordinary temperatures the resistance of oils is extremely high.

Second. That in order to have a high resistance the oil must be pure.

Third. That the resistance grows less with the per cent of impurity.

Fourth. That, within the limits of these experiments, the resistance is mainly of the nature of a contact resistance, and varies but slightly with change of distance between electrodes.

Fifth. That the resistance is not a direct function of the temperature, though it varies inversely with it in a general sense.

Sixth. That for temperatures above that at which marked decomposition of the oil sets in (150° C.) the resistance is practically constant, or approaches a constant.

Electric Canal Towage in Germany.

Mr. Frank H. Mason, United States Consul General at Berlin, Germany, writes to the State Department as follows about electrical canal work in the Empire: It is perhaps one of the compensations incident to Government ownership of railways, that it does not exclude or prevent due consideration of other methods of transportation. Notwithstanding the overshadowing interest of Prussia in her State railways, there is, especially in Imperial Government circles at Berlin, a keen and intelligent interest in all that relates to the improvement of internal water routes, for it is recognized that under existing conditions really cheap freights for raw materials and other coarse, heavy merchandise can only come from canal and river transportation. In deference to the general demand for improvement in this direction, the Government, early last year, formulated a plan for the employment of electric traction engines for towing boats on the Teltow Canal, a new work now in process of construction, which will connect the Havel with the River Spree just south of Berlin. The canal is to be 23 miles in length, with one lock, and passes for a short distance through a lake, where tugs instead of towing engines will have to be used. It is to be completed some time during next year, and is expected to have an annual traffic of about 1,500,000 tons. For obvious reasons, this new canal will offer an admirable opportunity for the employment of the most improved method of towing, and accordingly bids were solicited for an electric installation to comply with certain prescribed conditions, the motors being adapted to towing boats ranging from 175 to 600 tons loaded to [illegible] per cent of their capacity, and to be worked with a three-phase current of 8,000 volts and 50 periods. Twenty firms in all sent in tenders, of which the best known were Messrs. Siemens & Halske, Messrs. Ganz & Co., Messrs. Feldmann & Zehme, and the Société de Touage at Kiel. With characteristic forethought, the Government placed at the disposal of the competitors for preliminary experiments a section of the Finow Canal, which connects the Havel and the Oder rivers at Oderberg, some distance north of Berlin, and there during the summer of 1902 a series of tests were made which attracted great attention from engineers and traction experts throughout Europe. The system of Messrs. Siemens & Halske appears to have been similar in general design to that of Mr. Richard Lamb, which was tested several years ago on the Delaware and Raritan Canal and later on the Erie Canal in the United States. The motor—which was little more than a working model—weighed 900 kilograms (1,890 pounds), and with a continuous current of 500 volts developed 5 hp. The stretch chosen for the tests included a curved channel, bridge crossings, and the usual difficulties that would be encountered in actual practice. It was found that in rounding a curve the light motor was derailed, and the experiment showed that for actual service the motor should be large and heavy enough to have at least 8 to 10 hp. To enable the towline to clear moored boats and other obstructions along the shore, the line was attached to the top of a mast 15 to 20 ft. high, and located centrally in the forward section of the boat.

Another example of the several proposed installations was the one submitted by Messrs. Ganz & Co., which is thus described: The locomotive is relatively light and has two pairs of wheels, which are set at a convergent angle, so that both pairs run on the same rail, the balance of the machine being maintained by a pair of trail wheels running along the adjacent roadway. Almost the entire weight, however, is borne by the inclined wheels on the single rail, and the arrangement is such that the heavier the resistance load created by the boat, the tighter the grip of the wheels upon the rail.

For an estimated annual traffic of 1,500,000 tons, it is proposed to equip one shore of the canal, and the service will require 53 locomotives capable of towing one boat of 600 tons or two of 200 tons each, besides six tugs to tow the boats across the lake. Whichever of the various competing systems may be adopted, it is certain that the Teltow Canal, when completed and equipped, will furnish a convenient object lesson of the latest and most improved application of electric traction to canal navigation.

Division of Labor in Mexico.

The principle of the division of labor may sometimes be misapplied. The London newspapers have lately been pointing out a wrong application in that city, where work on the streets has been divided up among as many trade unions as there are castes in India; with the result of exasperating slowness in getting the work finished. The picture shown herewith is a kindred illustration from Mexico, witnessed and captured by a well-known electrical engineer and reader of this journal. The process going on in the foreground is that of trimming an arc lamp, and it takes three persons to perform the operation. The lamp trimmer discharges his ordinary function, but here he requires two assistants. One of them carries and holds the ladder. The other totes the bag of carbons, pliers and other tools and passes them up to the chief electrician in proper order and with due ceremoniousness. The performance is here shown done to slow music, the onlookers in the background being engaged in endeavoring to determine the difference between a string orchestra and a rubber band.

MEXICAN LAMP TRIMMER AND TWO ASSISTANTS.

Electrical Progress in Spain.

By Henry L. [illegible]

In Madrid last year, a prominent Spanish importer of American machinery remarked to the writer: "It is a blessing to our country that we have finally disposed of our colonies. For years, the best of our youth perished in the tropical climate of far-away possessions. The agricultural districts at home were suffering from the loss of our very best labor. Conscriptions took the boys away from our farms, and taxes upon taxes nearly destroyed our finances. We are now recovering. The Government is paying more attention to the development of our rich natural resources than ever before in the history of Spain, and municipal and private enterprises are making progress all over the country. Our finances are being strengthened, and confidence in our industrial undertakings is returning." I can but endorse every word of these remarks. I went through Spain in 1901, and again visited every province and all the industrial centers of the Iberian Peninsula last year.

Spain is making slow but steady progress in all her branches of industrial life. This is especially the case in electricity.

The improvements in electric tramways have given fresh impulse to the companies interested in them. During the last few years the increase in electric tramways in Spain has been very rapid, and the various lines already cover upwards of 200 miles. In the Province of Viscaya there were last year 68 miles of electric tramways, in Madrid, 26 miles; in Seville, 10 miles; in San Sebastian, the famous sea-resort on the Bay of Biscay, 12 miles; with lines in Barcelone and quite a number of other cities. Long lines were under construction from San Sebastian to Tolosa; from Cadiz to San Fernando; from Coruña to Burgo-Santiago, and from Arriandas to Covadonga. Further concessions for electric tramways were granted for the cities of Madrid, Valencia, Seville, Zaragoza, Coruña, San Sebastian, Barcelone, Cadiz, Oviedo, Almeria, Carthagena, etc. A number of these lines have already been completed and others are under way of construction.

The general use of electricity is causing the introduction of many valuable industries into practically deserted districts. Electricity generated by water power is beginning to play a very important part in the industrial development of Spain. Many of the smaller towns and country villages are lighted by electricity so obtained. In the district of Barcelone alone there are now more than 800 turbines in operation, representing 35,000 hp. Whenever water is found, factories spring up.

Until a few years ago the streets and houses of most of the small towns and villages which are now well lighted with electricity, were dependent on a few oil lamps and the lanterns of the night-watchmen. Once an electrical plant has been put in a village it becomes necessary to employ skilled labor. The residence of a few people of superior education in a village soon puts new life and energy into all its undertakings, and other improvements generally follow.

To what extent electricity has made strides ahead throughout Spain may best be seen by glancing at some figures. According to official returns there were in Spain, in 1901, altogether 639 cities and towns with electric central power stations. These plants were distributed among the 47 provinces on the mainland, and the two insular provinces—the Canaries and the Balearic Islands—as follows: The province leading in number of cities with electric central stations was Asturias, with 33, followed closely by Viscaya, with 31; Badajos, with 28, and Madrid with 26. Then came in order of importance, the provinces of Jaen, with 23; Seville, 21; Santander, 20; Cordoba, 20; Barcelone, 18; Navarra, 18; Valencia, 17; Guipuzcoa, 17; Ciudad Real, 17; Zaragoza, 16; Gerona, 16; Logroño, 16; Murcia, 15; Cadiz, 13; Malaga, 13; Alicante, 12; Albacele, 11; Leon, 11; Pontevedra, 11; Avila, 10; Coruna, 10; Castellon, 9; Lerida, 9; Granada, 9; Lugo, 9; Soria, 8; Salamanca, 8; Caceres, 8; Cuenca, 8; Huesca, 8; Tarragona, 7; Burgos, 7; Guadalajara, 6; Huelva, 6; Orense, 6; Palencia, 6; Valladolid, 6; Balearic Islands, 5; Toledo, 5; Segovia, 4; Almeria, 4; Alava, 3; Canary Islands, 3; Ternel, 3, and Zamora, 3.

Of cities and towns with a population of more than 4,000 souls, there were 430 in Spain last year where electricity had not as yet penetrated. In the provinces of Gerona, Huesca, Santander, Palencia, Zamora and Zaragoza there is but one town left in each of them without electricity, while in Coruña there are 53; in Lugo, 43; in Pontevedra, 37; in Orense, 32; in Asturias, 19, and in Valencia, 19 without electric power stations.

The largest and most powerful plants are, of course, in the big cities. In many of them there are several power stations, as is the case in Madrid, Barcelone, Linares, Lugo, Malaga, Salamanca, Seville, Valencia, Bilbao, Zaragoza and others. The most prominent plant in Madrid is that of Compañia General Madrileña de Electricidad, equipped with ten steam engines of 6,600 hp total capacity, continuous current, of 115 volts. The price charged by this company is 11 centimos, or about 1¾ cents per kilowatt-hour for light and 5 centimos (0.8 cents) per kilowatt-hour for power. The plant of the Compañia Barcelonesa de Electricidad in Barcelone has 5 steam engines of 1,000 hp each, and the dynamos are from the General Electric Company of Berlin. The electric power station of San Sebastian was equipped by the Oerlikon Company (8 dynamos), that of Seville by the General Electric Company of Berlin, and one of the Malaga plants by Siemens & Halske.

The electric business in Spain is largely in the hands of German manufacturers ,and most of the installations have been built by the General Electric Company, of Berlin; Siemens & Halske, Berlin; Schuckert Company, of Nuremberg, and the Spanish branch of the Lahmeyer Company.

It cannot too much be regretted that our electrical manufacturers have neglected the Spanish market to such a large extent. In business and industrial circles in Spain, there is no feeling whatever against the United States, while there are splendid opportunities for the sale of our goods. Last year the imports of machinery into Spain exceeded in value $8,000,000, of which very little came from this country.

In many country villages the extremely moderate charge of two pesetas (about 30 cents at present rate of exchange) is made per month for one lamp of 10 candle-power per night, a fact which is largely responsible for the steadily increasing application of electricity. This small charge enables the poorest to have electric light in their houses.

Another consequence of the development of electricity is the formation of powerful companies in Spain. The German firm of J. Lahmeyer & Co., which has been established in the north of Spain for some years, has amalgamated with the Hispania Company, and bought the business of the Sociedad Bilbaina de Electricidad. The capital of the new company amounts to 30,000,000 pesetas ($4,500,000). Apart from its local business, it has secured important contracts, such as the lighting of the city of Carthagena and the supply of electrical power in the neighborhood of that town.

Several other companies were recently formed for the supply of current the two most important being the Sociedad Hidro-Electrica Iberica, which disposes of a capital of 20,000,000 pesetas ($3,000,000), and has secured water rights in various provinces throughout Spain. This company proposes to furnish power to Bilbao, Santander, Valencia and Alicante. It has begun work on the Ebro River, and expects to be in a position to supply 7,000 hp to Bilbao by the month of March of this year. The force is to be applied in various industries, such as corn and paper mills, tramways, tin plate works, etc. The other company is called the Sociedad del Salto del Ter, and has bought water rights for a sum of $150,000, with a view to furnish power to Gerona. The larger mining companies are also installing electric plants all over the country. The magnificent steel pier of the Rio Tinto Company, at Huelva, has been provided with an installation of arc lamps, whereby night work has been greatly facilitated, and their large depot within about a mile of the pier has also been lighted by electricity. A Belgian firm is now carrying on electric light plants in several mining centers of Southern Spain. The Coto Fortuna Mining Company, of Mazarron, ,has recently been equipped with a complete electric hoisting plant, which comprises the following international ensemble frequently found in Spain: Piedboeuf boilers, Schuckert dynamos coupled to 250-hp steam engines of the Swiderski system, and Sulzer high-pressure centrifugal steam pumps.

It will be seen from the above remarks that electricity is making progress in almost every corner of Spain. Let us hope that American manufacturers will try to secure at least a share of this trade.

Economical and Safe Limits in the Size of Central Stations.

At the April meeting of the American Institute of Electrical Engineers, Mr. H. A. Lardner read a paper with the above title, in which he gave in connection with the discussion of the subject, much interesting data as to the relative economy of large generating units. In opening, Mr. Lardner said that if the territory is large and the system is to serve several villages or small cities with power for lighting or for railway purposes, one large station located conveniently for coal and water has a decided advantage, owing to economy in labor, lower cost of fuel, water and first cost.

Frequently the business in the individual towns would not be large enough to permit of an independent plant in each, and any risk of interruption to service is put up with because it is the best kind of service that such a community can support. In fact, until the class of territory approaches that of our largest cities, the question of lower first cost and economy of operation must in general rule; for the size of station is not large enough to minimize those advantages or to demand the advantages of a service supplied by several stations, harmoniously designed and operated.

When the territory becomes similar to New York, Chicago, Brooklyn, Boston, etc., the large station has many claims for consideration. As the central stations now built in this class of territory are so much larger than those which have been erected elsewhere, the discussion of the paper was confined to stations for the larger cities, and water power stations were excluded, as they must of necessity be located at the point of development or waterfall, and it is seldom the case that several plants can be built, each large enough to secure the maximum advantages of low cost and low operating expenses, as at Niagara.

The system of distribution which must be used, frequently has a direct bearing on the demand for a large station. Where the distribution pressure is low as in Edison three-wire, 120-240-volt systems, there are few if any cities where a sufficient load can be found for a very large station without exceeding the limited zone of economical distribution at this pressure.

Where this system is in operation we find that the stations are generally of high first cost and too small to be operated at the highest economy. The location is necessarily chosen without regard to the water or coal supply, and the load factor is generally very bad, which adds to the expense of operation. As a temporary expedient, at least, rotary converters, transformers and high-pressure cables have found a place for connecting together the direct-current stations and thus enabling them to exchange power and considerably improve their load factors.

For instance, in New York City the Duane Street Station of the New York Edison Company, with its heavy day load of motors and early evening load of office buildings, has a very different shaped load curve from the Twenty-sixth Street Station or the generating stations formerly located in Thirty-ninth Street and Fifty-third Street, which delivered their principal service during the evening. However, the double conversion results in losses which should be saved, and still continus the use of uneconomical small stations.

The next step is to establish a large well-located alternating-current station and feed the rotaries from the machines there installed. This method permits the use of the largest size of generating units, gives their attendant economies, and the demands of the various sections of a city coming at different hours of the day produces a better load factor.

The generating apparatus installed in the distributing or sub-stations, as they may now be called, can be operated if desirable, for one or two watches during the heaviest loads in their particular sections, and the combination undoubtedly results in greater economy. The existence of these sub-stations with generating apparatus, provides a certain amount of reserve or emergency power which can be called upon, and the danger of concentrating all the generating apparatus in one station is in a measure avoided. The fact of their existence also acts as an incentive to keep down the number of new generating stations and to build one alternating station large enough to meet the entire demands of the system, no matter how large that may be.

The use of the 240-volt incandescent lamp is much more common abroad than with us, and Mr. Lardner considers that a more insistent demand for a 240-volt lamp would be met by our manufacturers and result advantageously. By the use of a three wire system and 240 volt lamps, the advantages of 500-volt distribution in copper economy can be obtained, and the zones which can be served from any one station very considerably increased. It is an open question whether with this system of distribution the stations can be made large enough to be built for a fairly low first cost and operated at practically a minimum expense. There is a case in point in Boston, where the Boston Elevated Railway Company has a number of stations ranging from 1,500 to 4,000 kw, and the results of operation are reported to be very low and comparable to the best results which have been shown in much larger stations.

The alternating-current system of distribution with primary voltage of 2,200 volts and over, has the ability to serve a very extended territory. With this system of distribution, the question of one large station should not be so important, as the load can probably be divided between two or three stations, each large enough to be economical, and by the use of trunk cables they may aid one another in handling the load and add materially to the safety and continuity of the service.

Mr. Lardner gave the following table of authoritative tests on compound Corliss condensing engines. The best results published, and one near the average, are given for several different sizes:

Pressure.	Vac.	I.H.P.	Steam.
155	..	1950	12.5
150	26.9	1713	12.3
123	25.6	1592	13.5
133	25.2	1539	14.1
126	27.0	1107	14.1
120	...	1018	13.3
117	...	1001	16.3
151	...	997	12.8
112	...	709	15.1
144	25.2	741	13.2
150	25.4	595	12.7
90	...	548	13.5

It will thus be seen that under proper conditions of design and operation, very good comparative results can be secured with units much smaller than those installed in the large stations in New York. The published guarantees for the steam consumption are as follows, in these stations:

Station.	Pressure.	Vac.	I.H.P.	Steam.
The New York Edison	175	27	5500	12.5
Manhattan Railway	150	26	8000	13.0
Metropolitan Street Railway	160	..	4500	13.14

That part of the cost of labor for engine operation, which varies with the size, amounts to but a small portion of the total operating expenses; and although the larger the unit, the smaller the item becomes per horse-power-hour, it is relatively of little importance, except in very small units.

The question of floor space required for reciprocating engines of different sizes, demands the largest units practicable. The vertical space required by an engine is provided more cheaply than the floor space, and as the requirements are of three dimensions, the floor area should not increase proportionally with the size of the unit. Again, the aisle space must be practically the same for engines differing in size by large percentages.

In spite of these facts, the floor space in engine rooms per horse-power appears to be affected more by the type of engine used and the judgment of the designer than by the size of the unit. The Edison station with engines of 5,500 hp normal rating require only about one-third of a square foot per horse-power and the Metropolitan, with 4,500 hp-units, one-half of a square foot per horse-power, against the 8,000 hp-units in the Manhattan station, with an area of .55 of a square foot per horse-power.

It therefore appears that economy of operation and in floor space may be made entirely too much of in discussing the advantages of large units, although with similar design and type of machinery, the large units undoubtedly have some advantages, provided the station is large enough to require a sufficient number of units to permit of economical loading.

The following table gives some published data about the engines in the New York Edison, Manhattan Railway and Metropolitan stations:

Engines.	Metropolitan.	Manhattan.	Edison.
Number	11	8	8 installed 16 ultimate
H.P. each normal rating	4.500	8,000	5,500
H.P. each maximum rating	6,600	12,500	8,000
Aggregate rated H.P.	49.500	64,000	88,000
Aggregate maximum H.P.	72,600	100,000	128,000

From the large number of units, we may assume that these are the largest machines the manufacturers cared to produce. Larger engines have been built for use aboard ocean liners, and as conditions are in many ways much more severe aboard ship than on land, it should be possible to have still larger units if central station engineers really demanded them. The following data apply to the engines of the *Kaiser Wilhelm der Grosse*.

Two engines, triple-expansion, four cylinders; diameters, 52, 89.7, 96.4, 96.4 in.; stroke, 68.8 in.; piston speed, 885 ft. per minute; revolutions, 77 + ; steam pressure, 178 lb.; rated horse-power of each engine, 15,000.

The steam turbine presents some characteristics which will affect decisions in regard to the arrangement and number of stations for a given system, and although much has been written of them lately, they may be briefly alluded to here. This type of prime mover has decided advantages over reciprocating engines for driving many classes of electrical machines, as it gives ideal conditions for the parallel operation of alternators and synchronous apparatus on account of its uniformity of angular velocity. We are assured that steam turbines run together in parallel with the same facility as hydraulic turbines have always done. It is well known that many difficulties in the operation of 60-cycle apparatus disappear when the supply of power is from water wheels, and if the steam turbines are to help us in this respect it will be a great point in their favor.

There is every reason to believe that the use of superheated steam with turbines will be a comparatively simple matter, as the turbines will have no internal rubbing surfaces or cylinder oil. Exhaust steam from turbines being free from oil, may be condensed and returned to the boilers, and this will be an important consideration in many plants now purchasing city water for boiler feed and which find the extraction of oil too difficult and expensive to permit the water being used a second time. Owing to the high speed at which turbines are operated, direct-current machines seem to be ruled out on account of commutator troubles.

Perhaps the greatest advantages of the turbine is its economy of floor space. The statement has been made that the Westinghouse-Parsons turbine requires about 80 per cent. of the space needed for the vertical and not over 40 per cent. of that wanted for the horizontal engine. This statement is based on a station layout with a clear space of seven feet in all directions between machines. This type of turbine being horizontal, requires less head room and consequently a cheaper building by a considerable amount than the vertical engine. Curves given place the required building capacity for turbines at about 50 per cent. of that for vertical engines.

The Curtis turbine of the General Electric Company is of the vertical shaft type, and while it requires more head room than the Westinghouse-Parsons machine, is very economical of floor space. The following table gives the principal dimensions of some of the sizes which are now being built.

CURTIS TURBINES AND GENERATORS.

Size.	Height.	Diameter.	Floor space.	R.P.M.
500 k.w.	12' 2"	7' 8"	46.2 sq. ft.	1800
1500 k.w.	16' 10"	10'	78.5 sq. ft.	900
3000 k.w.	22'	14'	154. sq. ft.	600
5000 k.w.	27'	14' 10"	175. sq. ft.	500

WESTINGHOUSE-PARSONS TURBINES AND GENERATORS.

Size.	Height.	Dimensions.	Floor space.
400 k.w.	7' 6"	19'x5'	95 sq. ft.
1000 k.w.	8'	43'x8'	344 sq. ft.
5500 k.w.	15'	50'x12'	600 sq. ft.

For comparison, the following is the floor space required by the vertical cross-compound condensing engines of a well-known maker. The figures include the space required for an alternating-current generator between the frames:

Size.	Dimensions.	Floor space.	R.P.M.
500 k.w.	15'x22'	330 sq. ft.	120
1000 k.w.	21'x24'	504 sq. ft.	110
1500 k.w.	22'x28'	616 sq. ft.	100
2500 k.w.	23'x32'	736 sq. ft.	90
3000 k.w.	23'x34'	782 sq. ft.	75

The height in all sizes thus exceeds that of a similar size of vertical turbine.

The steam consumption guaranteed for the above-mentioned Curtis turbines are attractive, especially at light loads. The figures are given in dry steam per kw-hour and for purposes of comparison with results per indicated horse-power, they have been reduced by assuming an efficiency for generator and turbine of 85 per cent.:

			Lbs. steam per k.w. hour.		Lbs. steam per i h.p.
Size.	Pressure.	Vacuum.	Full load.	Half load.	Full load.
500	150	28	20½	23	13
1500	150	28	20½	22	13
3000	150	28	20½	21.5	13
5000	150	28	20½	21	13

The simplicity of the turbine leads us to believe that the high efficiency will not decrease with use nor by reason of lack of adjustment. The method of guaranteeing the efficiency of generators and engines together, will permit this guarantee to be checked more closely than has ever been possible with large engines and generators, on which separate guarantees have been given.

The cost of labor for engine operation will be considerably cheapened with the turbine, and this and the other advantages shown should greatly reduce the necessity for very large units. If, therefore, steam turbines are to make the operation of smaller stations (with a suitable number of units to handle the load economically), equal in efficiency to some of the largest plants now installed, it will be advantageous in many cases to install several stations in place of one, and secure all the saving in distribution and safety against shut-downs that go with such an arrangement.

There are, of course, certain cases where a location cannot be secured convenient to coal and water in more than one place, but these cases are rare. Boston, New York, Chicago and nearly all our largest cities afford opportunities for securing a number of sites, all practically of equal desirability so far as facilities for getting supplies are concerned.

The advantages of large central stations may be summed up from what has been previously said, and consist mainly of the following:

The location of the station on the one most suitable site for the coal and water supply. The reduction of floor space by the use of large units. The economy of fuel secured by the use of large generators and engines. The economy of labor and general superintendence secured by the use of large units in one building. The saving in first cost effected by the installation of a large station with large units. The economy of operation secured by serving many sections of a city with different hours of maximum demand from one station, due to the better load factor obtained.

The installation of a large station presupposes supplying a very large territory from one source, and in order that the coal and water supply may be convenient, the chosen location is generally much further from the load than when it is divided among several plants. This involves a greater expense for a distribution system, although this may be minimized by the installation of high-potential current or by local conditions.

The economy of floor space by the use of large units will always be an important consideration where land is valuable, but the economy in this direction with the steam turbine may lead the designer of the future to give less consideration to this point.

The added economy of fuel, labor and general supervision in large units will also be reduced somewhat even with the large turbine units, and the first cost of the machines themselves will undoubtedly decrease per unit capacity with increase in size. However, the reduction in cost of turbine generator installation, from the prices now paid for generators and slow-speed reciprocating engines should be considerable and permit smaller units than are now feasible. This will undoubtedly be true after development charges have been cared for.

It is a question whether there is any saving in the first cost in the installation of very large stations, except in prime-movers and generators. The construction of double and triple-decked boiler rooms, long coal-handling apparatus and coal pockets high above the ground, involves heavy expenditures without compensating advantages. It is probable in the case of some large stations in this city that they could have been built to half their capacity as cheaply per unit as to the ultimate size. The size of the units in either case would probably have been the same.

The principal disadvantage of the very large station is the danger to a system if the disabling of the station leaves the company without a source of power, or takes away a larger portion of its supply than can be cared for by overloading the remaining plants. It is with this point in view that I have attempted to bring out all the points which may make smaller stations worthy of more consideration than they frequently get.

The stations in this city are wonderful examples of good design in all features which tend to make them reliable and free from dangers of serious break-down and interruption of service. As one designer said in describing his station, it was built to withstand anything but an earthquake or a bombardment. While it may be possible to build such a station, I do not believe that there has been a single station built, and I do not look to see one, which is free from weak points capable of causing interruptions. These features are apparently unavoidable, and while accidents due to them may not do any serious or expensive damage, they may render the building untenantable to employees or to enough of them to cause an interruption to the service.

The recent break-down at the station of the Niagara Falls Power Company is an instance in point, and while such occurrences have been rare, the one in question left Buffalo without Niagara power for twenty-four hours, and the Niagara Falls district was without power for nearly two days. I do not think an officer of a large company will look on a like condition without considerable apprehension. The trouble at Niagara is reported to have been started by a lightning storm, which resulted in destroying the cables leading across the bridge from the generator room to the transformer house. Now that it is over, engineers say that there should have been two routes for these important cables, and a number of suggestions may be made to avoid a repetition of the difficulty.

Shut-downs have occurred in some other large stations during the experimental periods of their operation, and while these were doubtless due to poor material or workmanship that had not been weeded out, the failure of material or errors of employees may occur after years of use, and the results are likely to be the same.

Instances occur in this city where cables may be damaged by one cause or another, and the results would not be very different from the Niagara break-down. Rheostats for the fields of generators may be the weak point in another station; switchboards exposed to flying pieces in another. These weak points can generally be corrected, but the fact is that they now exist and are in my opinion possible sources of trouble.

In conclusion, Mr. Lardner said that he does not advocte a greater refinement than is commercially justifiable, and perhaps this point has been reached by the designers of the large stations; and that smaller stations need not lack many of the advantages of the large ones, and with a number of them in place of one large plant, the necessity for excessive refinement ceases to exist.

Death of Professor J. Willard Gibbs.

Prof. J. Willard Gibbs died suddenly at his residence in New Haven on April 28. He had been sick for several days, but his illness was not supposed to be of a serious nature. His death was due to heart trouble.

Josiah Willard Gibbs, Ph.D., LL.D., Math.D., Professor of Mathematical Physics at Yale, whose father, of the same name, was a famous philologist and Biblical scholar, was born in New Haven, Conn., on February 11, 1839. After graduating from Yale in 1858, he pursued special studies in mathematics, and took the degree of Doctor of Philosophy in 1863, subsequently spending three years as a tutor in the college, and then going to the universities of Paris, Heidelberg and Berlin. In 1871 he became Professor of Mathematical Physics in Yale, a position he continued to hold. Along with his regular duties he did a great deal of lecturing at various other institutions. His work was principally in the development of graphical and analytical methods in thermodynamics, and for his researches the American Academy of Arts and Sciences gave him its Rumford medal.

In 1870 he was elected a member of the academy, and he was vice-president of the American Association for the Advancement of Science in 1886. His publications include many standard works on his chosen subject, and in late years he had been especially noted for his system of vector notation, simpler than that of the quaternions and more approximating to the German notation. Williams College and Princeton both honored him with the degree of Doctor of Laws, the latter in 1896.

The most noted work of Prof. Gibbs was in the application of thermodynamics to considerations of chemical equilibrium, the value of which is receiving greater and greater recognition with the development of modern theories of chemistry and particularly of electrochemistry and physical chemistry. His work in this field is indeed ranked as among the most important contributions in the last century to mathematical chemistry and physics.

April Meeting of the American Institute of Electrical Engineers.

At the April meeting of the American Institute of Electrical Engineers held last Friday, three papers were read relating to the central station, the authors being Messrs. H. A. Lardner, Peter Junkersfeld and Philip Torchio. The discussion which followed the reading of these papers is given below, together with abstracts of the papers of Messrs. Torchio and Junkersfeld, which will be printed in full next week; the paper by Mr. Lardner is printed elsewhere in this issue.

At the meeting Mr. Pope announced that at the afternoon meeting of the Board of Directors no less than 211 associates were elected. The board transferred to full membership Messrs. S. E. Johansenn, M. Von Recklinghausen, Robert Robinson and William Estey The secretary also announced that the Board of Directors had received a communication from Mr. C. O. Mailloux, enclosing his check for $1,350 as a further contribution to the library of the Institute, $1,000 of this sum being specified as a fund to be set aside and the interest expended to keep up the sets of *Transactions* which Mr. Mailloux has donated to the library; the remainder to be used in purchasing other sets, for binding, etc.

Following the secretary's announcements, President Scott stated that a guest from Europe, Dr. Adolph Franke, technical director of the Siemens & Halske Company, was present at the meeting. He added that Mr. Franke had just put in service the longest Pupin telephone circuit yet installed, 450 miles in length, from Frankfort to Berlin. Only about one-quarter of the usual amount of copper was required and the telephonic results are excellent. Dr. Franke begged to be excused from making any remarks owing to the imperfection of his English.

In introducing the paper of the evening, Mr. Scott called attention to the fact that the use of tools and machinery, together with the generation and the application of mechanical power, have brought about a new order of things in the relations between individuals and the relations between nations; manufacture and commerce have passed through a wonderful revolution; commercial conditions have changed. Society, he said, is not merely an aggregation of individuals, nor simply a mass of men, but a vast unit. Men are not independent; they are co-related and interdependent. No extension is so completely representative of modern development as is the central station. In it is found the application of nature's forces on a most comprehensive and diversified scale, and it is typically representative of co-operation and combination in design and construction; in the combustion of coal and the production of steam, the operation of engines and condensers, of dynamos and switches, of indicating instruments and safety devices, of conductors and cables, and the operation of apparatus in sub-stations and on the premises of a thousand customers. Referring to the reliability of the modern central station, he said that the Edison system now in New York City, as a whole, has never been without current, and added that on March 31, 1903, the New York Edison Company of Manhattan Island were supplying current to 26,000 customers, a total equivalent in 16-cp lamps of 2,391,431.

After Mr. Scott's address the papers of the evening were read, the first on the programme being that of Mr. Lardner, entitled, "The Economical and Safe Limits in the Size of Central Stations," which is reprinted elsewhere in this issue. The next paper was read by Mr. Philip Torchio, entitled, "Safety Devices in Central Stations and Sub-Stations." The paper relates more particularly to high-tension systems. After some general considerations a tabulation is given under 33 heads of desirable safeguards, classified under the general heads of generating stations, transmission lines and sub-stations. A reprint of this portion of Mr. Torchio's paper will be given in the following issue. The third paper of the evening was by Mr. Peter Junkersfeld, engineer of the Chicago Edison Company, and entitled, "Multiple vs. Independent Operation of Units and Central Stations." Troubles affecting the service of central stations are considered in detail under the heads of mains and services, low-tension feeders, sub-station apparatus, high-tension transmission lines, generators, prime-movers and auxiliaries, and steam supply. These are considered in detail with particular reference to the Chicago system. In conclusion, Mr. Junkersfeld advanced considerations favoring the independent operation of generating units, either in one generating station or in several stations. A reprint of Mr Junkersfeld's paper will appear in the following issue.

The discussion on the several papers of the evening was excellent, perhaps the best that has taken place for some months. Owing to limitations of space a brief outline of it will here be given, and the greater part will be printed in full in the following issue.

President Stott, in opening the discussion, called attention to the fact that the burden of the papers is notable for the reason that they do not set forth the general theory of the inter-relation of parts, the characteristic of engines or dynamos, of efficiency of regulation, but refer to those elements which come up in connection with a design beforehand. They deal more particularly with emergency conditions. Mr. H. G. Stott, after sketching the development of the central station, took up the question of steam generators. Referring to the steam turbine, tests of its performances, he said, seemed to indicate that it did not equal the best reciprocating engine in efficiency. As to floor space, too much stress had been laid upon that point for the reason that the limiting feature in all large stations is the boiler unit; and to get the best distribution of steam the turbine units would have to be spaced approximately the same as steam engines, so that economy in floor space is not a very important point. He said that high-tension underground cables are a great deal safer than low-tension cables. The storage battery he considered merely as an assurance against shut-down and not as a means of economical operation. He strongly opposed the independent operation of units.

Mr. Herbert Wagner expressed an opinion in favor of the use of motor-generators instead of rotary converter, the motors being of the induction type. He said that a cross-compound engine using superheated steam can be made equally as economical as a triple-expansion engine, and that single-cylinder engines using high superheated steam have almost equalled in economy triple-expansion engines. Mr. E. H. Sniffen said that experience thus far had with the Westinghouse-Parsons steam turbine shows it has a higher commercial efficiency than the reciprocating engine. At Hartford, Conn., 1,900 kw is developed with the steam turbine with the same fuel consumption as was previously required to develop 900 kw with two Corliss engines.

Mr. John W. Lieb, Jr., declared himself in favor of a single generating plant instead of a multiplicity of such plants, and stated that the experience of all large central stations operating transmission systems to sub-station, has shown that the storage battery is as absolute a necessity as an auxiliary as either the rotary converter, motor-generator or other equally essential pieces of apparatus. Mr. Townsend Wolcott said that there would not be the same advantage in the use of superheated steam in turbines as in reciprocating engines. In the latter the superheat prevents condensation, whereas in the turbine when the steam expands it does so without doing any work. Mr. W. S. Rugg expressed surprise that no attempt has yet been made to actually lay out an Edison multiple-unit station. Such a station he thinks would combine nearly all the advantages which have been brought out in the papers, since it could be designed so that the total operating expenses would be but little more than those in one room or two rooms, and at the same time there would be the advantage of a number of stations. Mr. A. V. Abbott considered that in discussing the subject of the evening the manager's standpoint should not be neglected, and the question of subdivision of a station into a number of units might well be considered from an insurance standpoint. On the one hand, there is perhaps greater cost of operation, but on the other, greater security. Mr. Junkersfeld, in referring to a remark of Mr. Lieb concerning the difficulty of getting suitable real estate for central stations, said that this difficulty had been encountered in Chicago and consequently a great multiplicity of plants is impracticable there. He said that Mr. Stott's remarks about high-tension cables giving less trouble than low-tension cables coincided with experience in the Chicago plant. As to storage batteries, with a peak of one hour the battery will pay, whereas if the peak is more than an hour and a quarter it will not pay. Mr. Lardner said that in New York he would advocate subdividing a central station system into two or three plants instead of one; and as to the difficulty in securing sites in New York City, he directed attention to the waterside plants at Kingsbridge, Ninety-fourth Street, Seventy-fourth Street, Fifty-ninth Street and Thirty-eighth Street. Mr. Torchio advocated the use of the storage battery as an auxiliary and referred to a plant operating at Milan, Italy, where the use of a battery for but a few days in the year enables the company to sell annually an additional three or four thousand kilowatts at $60 per horse-power-year.

The New Home of the New York Stock Excnange.

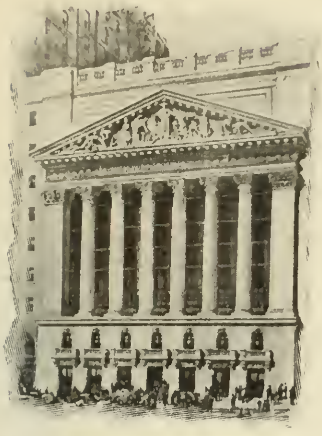


FIG. 1.—NEW YORK STOCK EXCHANGE.

A function that was largely attended last week by people of prominence in the electrical world was the opening of the magnificent new home of the New York Stock Exchange, whose total cost, inclusive of real estate, is understood to reach about $6,000,000, or about £1,250,000 sterling. The structure has a frontage of 137 ft. on Broad Street, 152 ft. on New Street and 14½ ft. on Wall Street. Its facade rises 156 ft. above the pavement on Broad, and the total contents are 4,300,710 cu. ft. The building not only contains the superb board room, but safe deposit vaults, luncheon club rooms and other features conducive to the comfort and convenience of the brokers who will do their work within its walls. We present herewith a good view of the beautiful board room, lined with colored marble, rising 74½ ft. in the clear, and being 144 ft. wide by 109 ft. long.

The electrical equipment has received unusual attention and the best experts obtainable were employed to design and carry out the plans. The equipment consists of a lighting and power plant located in the engine room three stories below the sidewalk level. Two 250-kw and one 150-kw generators operated at 235 volts, of the General Electric type, each direct-connected to a Ball & Wood center-crank tandem-compound, non-condensing engine, furnish the current for illumination, elevators and various motors, also serving to charge the storage battery used for lighting and the smaller batteries and motor-generators furnishing current for bells, telephones, signals, etc.

The main lighting and power switchboard of Italian marble, with its bronze pedestals and highly polished apparatus is a work of art, eqnalled only by the two smaller boards, one used for the control of the storage battery system and the other for the bell and telephone apparatus. Instructions were given to spare no expense in producing the finest and most serviceable piece of work.

The wiring system is of the most recent type. Every piece of wire in the building was installed after the plastering, marble and woodwork were in position and it is claimed that the wire could all be removed and replaced without a particle of damage to the building and without requiring the cutting or splicing of a single strand. The materials employed are those well known to the electrical fraternity. The conduits are Electroduct steel type, the wires and cables being manufactured by the Safety Insulated Wire & Cable Company.

The building is illuminated with 6,000 16-cp, 235-volt incandescent lamps and 75 arc lamps of the enclosed type. Twenty-five motors ranging in horse-power from ½ to 40, are located throughout for operating ventilating, pneumatic, filtering and dumb waiter apparatus.

The large board room is lighted with 75 arc lamps arranged with special reflectors so constructed as to form a part of the ceiling decoration. This brilliant lighting is reinforced with a background of thousands of dollars' worth of gold leaf.

Telephones are provided in the principal rooms and ticker and telegraph apparatus are found at every turn. An interesting portion of the equipment are the two large annunciators on each side of the board room with a total of 2,400 calls for calling members on the floor. Each annunciator board is approximately 50 ft. in height by 36 ft. wide and the mass of conduits and cables connecting these two pieces of apparatus alone is extraordinary.

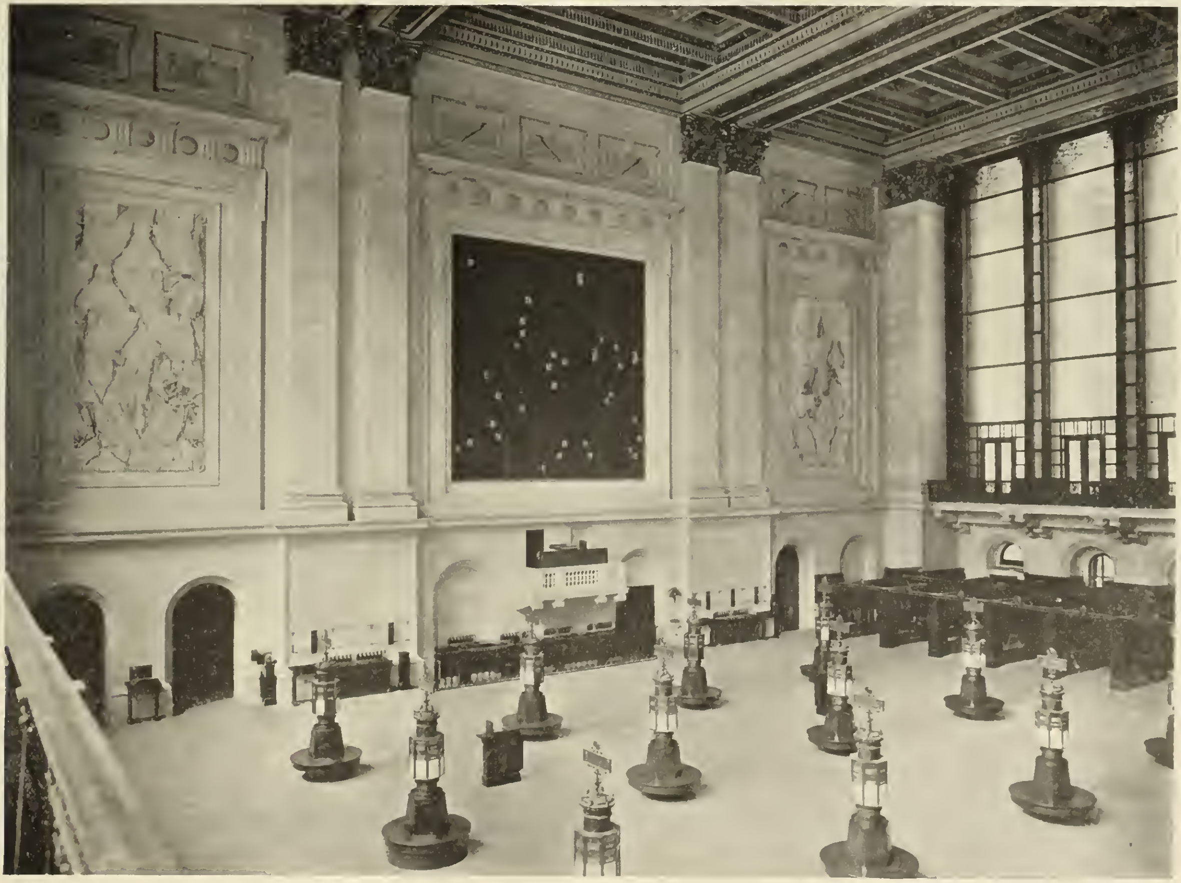


FIG. 2—GENERAL VIEW OF TRADING ROOM, NEW YORK STOCK EXCHANGE.

A messenger call, elevator signal, fire alarm and watchman's time detector system, all of the most recent type and of most elaborate design, are also provided.

Some of the interesting data furnished from the records of the Charles L. Eidlitz Company, New York City, who installed the equipment, are as follows: Total horse-power in engines for operating the plant, 1,040, total kilowatt of generators, 650; number of incandescent lamps, 6,000; number of arc lamps, 75; number of motors of various sizes, 25, total weight of steel conduit for lighting, power, telephones, bells, signals, etc., 1,144 tons; total weight of copper wire, 16 tons, total length of electric lighting, bell, telephone and annunciator cables in actual lineal feet of various sizes, 1,543,200 ft. The Chloride storage battery of 135 cells has a capacity of 400 lights for eight hours.

With respect to the telephone service of the exchange it may be added that the equipment of Bell apparatus furnished through the New York Telephone Company includes 502 private line stations, arranged in the booths and alleys seen at the side of the exchange floor for the exchange service of members. There are also nine public telephones in the New Street lobby, four in the Commercial Cable Building annex room and two in the Broad Street ground floor smoking room. There is also a special private board exchange for the use of the executive offices, including a switchboard, three trunk lines and eight stations.

Other facilities for communication embrace the pneumatic tube system. From the board room, tubes run to all portions of the building, offices, cable and telegraph companies, and are so arranged that messages sent on the longest tubes arrive at their destination to the fraction of a second, that a message on the shortest line requires. There are about 6 miles of brass and iron tubing and 175 automatic terminals. Included in the elevator outfit are five electric dumb waiters.

It may be added that the demolition of the old Stock Exchange Building on the same site began April 27, 1901, so that the whole work has been completed in just under two years. The governing committee of the Exchange have shown their appreciation of the work of the Building Committee by erecting a bronze tablet on the interior wall of the Exchange with the names of the committee, as follows: R. H. Thomas, chairman; J. T. Atterbury, Ernest Groesbeck, R. P. Doremus, H. G. S. Noble, Rudolph Keppler. To these gentlemen also gold medals have been presented as souvenirs of their labors and success.

Smoke and the Determination of its Density.

A paper with the above title was read by Mr. Albert A. Cary before the annual meeting last week of the New England Cotton Manufacturers' Association. After giving a concise account of the manner in which smoke is formed and of its composition, the paper took up methods that have been used in determining the density of smoke as it issues from the chimney. This is best accomplished by the use of a smoke chart consisting of five rectangles printed in different shades, namely, light gray, darker gray, very dark gray, light black and dense black. Owing to the care with which such a chart has to be printed in order to bring out the shades properly, it cannot be reproduced here. Mr. Cary then proceeded to describe a method of recording smoke density determinations.

When making smoke density determinations it is desirable to note the condition of the smoke at frequent and equal intervals of time. Every half minute has been found a very satisfactory interval. When the test is an important one, not less than two separated observers should make records with the time of observation carefully noted on their sheets along with the number expressing the shade of the smoke existing at that time; the separate records being finally compared and one checked against the other.

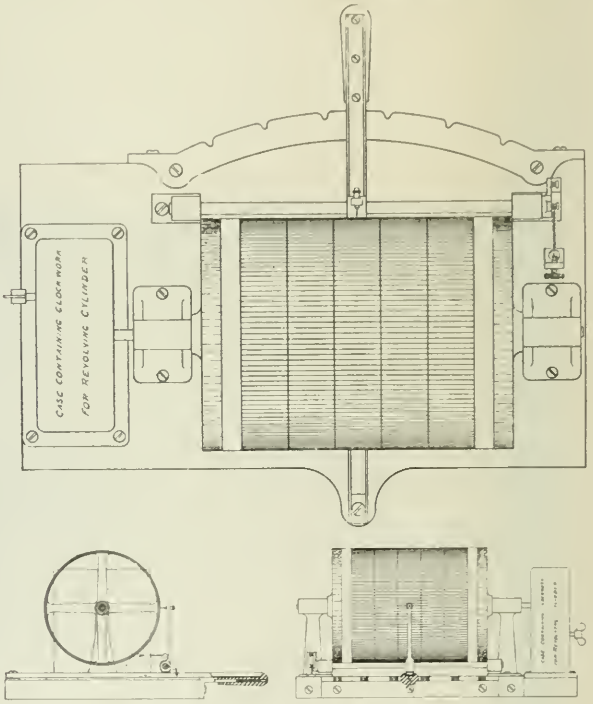
At the same time the above records are being made, some one in the boiler room should note the time of each firing and cleaning and also state the conditions existing at various other recorded times, such as "forcing the boiler," "running light," etc.

If furnace gas analyses are made during the time of these observations, and if the result of these analyses along with all of the other observed results are finally plotted on cross-section paper, we will be able to make a careful analysis of existing conditions pertaining to the production of smoke in the plant under consideration, and means for further suppressing the smoke can generally be found by making proper deductions from such plotted diagrams.

A time keeping apparatus was used by the smoke observers during the Paris smoke tests (conducted in France between 1894 and 1897). This device contained a cylinder driven by clockwork, and around this cylinder is placed a paper on which the record is written (similar in manner to the paper placed on the drum of a steam engine indicator). The drum of the smoke recording device is turned the same as the hands of a clock; a given distance around the circumference representing accurately one minute.

The pencil, pressing against this paper on the drum, is moved across the face of the cylinder (parallel to its axis) by the observer, who pulls the slide rod carrying the pencil, to its extreme left position when there is "no smoke." This causes the pencil to draw a line around the circumference as the clockwork revolves the cylinder, which line marks a zero position. When "slight smoke" was seen, the observer moved his slide rod one division to the right, which caused the pencil to mark a line around the circumference of the revolving cylinder a definite distance to the right of the zero line.

The slide rod was again moved another division to the right when "medium smoke" appeared, which caused the pencil to trace a new line, double the distance of the last one (for slight smoke) from the zero line.



SMOKE DENSITY RECORDING DEVICE.

As "black smoke" appeared, the pencil was again advanced to the right another equal distance, and, finally, when "very thick smoke" appeared, the observer pushed the pencil as far to the right as possible, and so the five equidistant circumferential lines represent the five different degrees of smoke adopted by the Paris Smoke Test Commission, and with the recording cylinder constantly revolving, we find our smoke record finally plotted on the paper, the same as if we had plotted it on cross-section paper calling the ordinates, time, and the abscissa, degrees of smoke density.

The accompanying illustrations show an apparatus of this kind devised by Mr. Cary, which is an improvement upon the Paris machine. It will be seen that the pencil is moved along the length of the cylinder by means of a pivoted lever, the outer end of which is grasped by the operator's hand. As the lever is moved, a spring detent slips easily into (or out of) one notch after the other in the segment on which the outer end of the handle rides, each notch holding the pencil in position on the paper corresponding to the degree of smoke observed.

Since producing this time-keeping apparatus, Mr. Cary had devised a further improvement on this machine, which allows the use of a long roll of ruled cross-section paper and also reduces the size of the smoke recorder.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

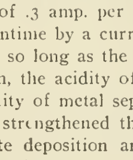
RECOVERY OF COPPER AND NICKEL FROM ORES.

Following are given the details of a method patented by E. A. Sjöstedt and J. H. James, of Sault Ste. Marie, Canada, and assigned to Francis H. Clergue, for the separate recovery of copper and nickel from mattes and ores. The novelty of the method does not lie in the application of any new principle, for the process consists, in outline, in dissolving the metals by sulphuric acid, electrodepositing the copper from the resulting acid solution with insoluble anodes, then making the solution ammoniacal, separating the iron by an air-blast, and finally depositing metallic nickel from the heated bath. In adopting this general procedure the inventors merely follow many earlier investigators, but their manipulations are given in detail and are of interest.

The bessemerized matte or roasted ore is treated for 8 to 10 hours with 40 per cent. sulphuric acid at the boiling point, and the resulting solution, containing the sulphates of nickel, copper and iron, is diluted to a sufficient extent to retain the salts in solution after cooling, the acidity being thereby reduced below 3 per cent. Copper is now deposited, using copper cathodes and insoluble anodes (graphite or platinum) and a current of .3 amp. per square decimeter, the electrolyte being agitated meantime by a current of air. The separation of the copper is continued so long as the deposit is of good physical character, and the solution, the acidity of which has been increased in proportion to the quantity of metal separated, is then returned to the ore; after being thus strengthened the deposition of the copper is continued, this alternate deposition and solution being repeated until the liquid is sufficiently concentrated in nickel. Thereupon the copper is completely separated, the last traces being removed if necessary by filtering through a bed of sulphide of iron or nickel; the solution is nearly neutralized by caustic soda, then rendered ammoniacal, and the iron precipitated by a blast of air. The nickel is now deposited from the resulting neutral or slightly ammoniacal solution with insoluble anodes and nickel cathodes, the solution being agitated and heated by a blast of hot air. During the deposition of the nickel a current density of .6 to .9 amp. per square decimeter is maintained.

ELECTROLYTIC GALVANIZING.

Heinrich W. Bötz, of Ludwigshafen-on-the-Rhine, Germany, patents a novel and convenient device for handling large and flexible metal sheets in the plating bath. The apparatus is designed particularly for electrolytic galvanizing, and is intended to permit the zinc anodes to be brought into close proximity to the sheet metal (iron) to be coated, while securing a positive spacing by means of pointed distance pieces. One form of the device, shown in the accompanying sketch, comprises a vat, having therein two anode holders, *B* and *E*, the former being stationary and fitted with a foot piece, *D*, for supporting the metal sheet to be coated, and the latter mounted for horizontal movement upon a carriage, *F*, moving upon rails, *F'*, upon the vat. The zinc anodes, *C*, *C'*, are perforated, and through these openings project inwardly from each anode holder the pointed distance-pieces, *g*, *g'*, of glass or porcelain. When the movable anode holder is brought into the relation to the stationary holder indicated in the figure, the distance-pieces serve to support the flexible metal sheet, *A*, from opposite sides, the distribution of the distance-pieces over the surface being such as to prevent any serious buckling of the sheet, and to avoid danger of short-circuiting from this cause. If desired, the position of the sheet may be shifted slightly from time to time during the electrode deposition of the zinc, but this is not important, since the zinc deposit is capable of protecting the iron for a distance of several millimeters beyond its own limits. The pits due to the distance-pieces do not, therefore, seriously injure the sheet, and the iron is stated to show no tendency to rust in these minute uncovered areas.



ELECTROLYTIC GALVANIZING.

New Telephone Patents.

In the days of flat-rate telephone service, when the number of messages and the cost of service bore no tangible relation, it was common practice for many telephone subscribers to offer openly the use of their telephones to neighbors and friends or customers, as the case might be. Unfortunately, the habit of borrowing telephone service thus formed has outlived the conditions under which it originated, and in some instances where the message rate system has been exclusively adopted, it has proved a considerable nuisance to a certain class of stores. The automatic pay station has, of course, furnished one method of overcoming this difficulty; but it requires the subscriber to have a special contract and to deposit personally a coin each time he calls. A second kind of device for stopping the promiscuous use of a subscriber's telephone by outsiders is the subject of a patent of the issue of April 14, granted to J. E. Head and assigned by him to The Controller Company of America, of St. Louis.

This device is a special form of the hook switch lock and is shown in Fig. 1. The lock can be secured to the wall beside the telephone instrument with its hook or bolt engaging the telephone switch lever, shown at *B*, in a manner to lock it in the depressed or non-calling position. As clearly shown, the bell crank latch must be tilted to release the bolt before a call can be sent to the central office. Two means of tilting it are provided. The first of these is for the use of the general public and consists of a coin slot wherein the proper coin may be deposited for the benefit of the subscriber. The second means is a dial and pointer. This is for the use of the subscriber, and is so arranged that when the pointer is placed upon the proper number of the dial the bolt is released. This number is naturally one of the "trade secrets" of the particular store in question. Of course, it is possible for unscrupulous persons to find the key number by trial, but such a process will be evident to the subscriber, who will probably be able to impress upon the offender without embarrassment the legitimate operation of the apparatus.

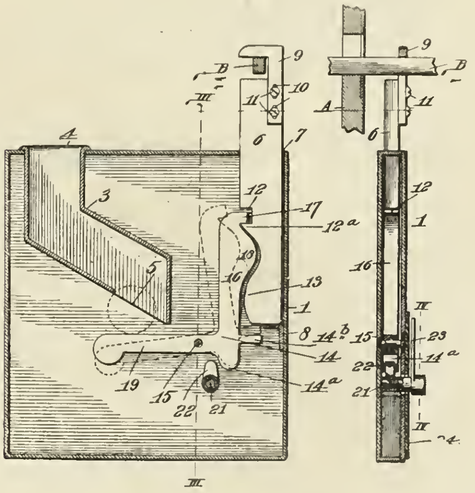


FIG. 1.—HEAD COIN LOCK FOR TELEPHONE HOOK.

Some time ago the "lazy tongs" was assigned a use in telephony in a patent for a train system wherein it formed a flexible connection between the train and the line wire. In the patent issue of April 21 it again appears, this time as the adjustable part of a receiver holder. One end of the lazy tongs is swiveled to a base, while the other carries a cross-bar bearing the usual spring, receiver-holding clips. The inventor pivots the receiver cross-bar about an axis parallel with the line of extension of the tongs, and provides two mountings for it, so that the receiver clips may be either parallel to or perpendicular to the axis. This arrangement forms the basis of the claims, which are very broad. The holder has the usual defect of removing the semi-automatic action of the hook switch. The inventor of this device is G. Königstein, of San Francisco.

A second telephone patent of the issue of April 21 provides a special method of wiring strips of lamp jacks for telephone common-battery switchboards. This patent is granted to Henry P. Claussen and is assigned by him to the American Electric Telephone Company. The continual diminution of the space assigned to jacks, in modern large telephone switchboards, has made the allowable clearance between the parts of adjacent apparatus so small that with the usual method of wiring wherein these adjacent parts are connected to opposite polarities, the danger of short circuit with its consequent troubles is very great. By Mr. Claussen's method, the order of wiring alternate jacks is reversed. The proximate springs of adjacent jacks are thus of like polarity, thereby rendering a short circuit between any two of little effect.

The third patent of this issue has been secured by Charles E. Scribner, of Chicago, and is assigned to the Western Electric Company. This patent describes a novelty in spring jacks, as a clamping split sleeve is used for one of the plug engaging terminals. Fig. 2 shows the jack strip, jack terminals and the plug of the kind described. The chief advantage claimed for the split sleeve terminal is that its use permits an extremely cheap construction for the jack strip. No milling of the rubber blank is necessary, the working consisting entirely of drilling and sawing. Four holes are required for each jack, as follows: a^1, drilled from the front, of a size to take the usual thimble; a^2, eccentric with a^1, and of slightly smaller diameter; and two small holes, a^3 and a^4, serving to lead the thimble and sleeve terminals to the back of the strip. As may be seen, the thimble, b, registers with the plug sleeve, g^2, the split sleeve, c, clamps the plug part, g^1, while the spring, d, engages the tip, g, in a manner to hold the plug home in the socket. As the milling of the rubber strips is the most expensive work on rubber jack strips, the present type should effect a considerable saving in cost.

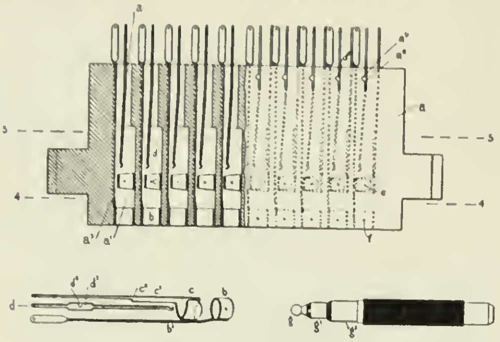


FIG. 2.—SCRIBNER SPRING JACK.

* * *

Independent Long Distance Lines in Indiana.

The Allied Independent Toll Company, with the Home Company as a nucleus, was formed at a meeting in Indianapolis on April 14. The organization is made up of about 20 independent companies of Northern Indiana and Eastern Illinois and will be incorporated. The object is to perfect a system of toll lines throughout Northern Indiana and Eastern Illinois to compete with the Bell Telephone Company. Walter J. Uhl was elected president and Henry Barnhart, of Rochester, secretary. Three cable lines to South Bend, to Wabash and to Remington, from Logansport, will be constructed. The movement is regarded as significant of the betterment of the long-distance service in that territory. A large number of well-known telephone men were present at the meeting. Another meeting will be held May 11 to complete the organization and file articles of incorporation.

* * *

German Electrical Industry.

Reports to the State Department as to the profits of the leading industrial undertakings in Germany for 1902 show that the average dividend paid by the electrical enterprises in 1902 was 4.13 per cent., as compared with 5.92 per cent. in 1901. 'In machine manufacture the rate in 1902 was 4.77 per cent., as compared with 6.13 in 1901. The electrical figures are understood to apply to manufacturing enterprises as distinguished from local companies; but this is not specifically stated. The remark is made by United States Consul Albert: "It is generally believed that the turning point in the business depression in Germany has been reached, if not passed. Many corporations which had fallen into financial difficulties have been reorganized and put once more upon a stable foundation."

CURRENT NEWS AND NOTES.

PACIFIC CABLE.—Secretary Root has granted permission to the Pacific Commercial Cable Company to land its line on the military reserve near Fort San Antonio, Philippines, and to erect a cable station there.

TELEGRAPHS IN MANCHURIA.—It would appear that dispute has arisen over certain points connected with the Russian occupation of Manchuria, but the government of the Czar is understood to deny having made demands on China that are attributed to it. One of these is to the effect that Russia is entitled to attach telegraph wires to the poles of all Chinese lines in Manchuria. This is said to be false.

LODGE VS. MARCONI.—A report comes from London through newspaper channels that Sir Oliver J. Lodge may sue Marconi for infringement of his (Lodge's) wireless telegraph patents. Lodge contends that Marconi's vertical radiator, his coherer and other essentials are infringements. In this connection Mr. Nikola Tesla is reported to have said that the dispute between Lodge and Marconi does not involve his own patents, as they are entirely distinct from either. "We are working in diametrically opposite directions," he said.

N. E. L. A.—Mr. C. O. Baker, Jr., master of transportation, writes us: "I take pleasure in advising you that the New England Passenger Association, the Trunk Line Association, the Western Passenger Association and the Southeastern Passenger Association have granted a rate of a fare and a third, on the certificate plan, from all points in their respective territories to Chicago and return for members and delegates attending the twenty-sixth convention of the National Electric Light Association, to be held in Chicago May 26, 27 and 28."

ST. LOUIS EXPOSITION opens with great ceremony this week, on April 30, when President Roosevelt will deliver a dedication address. The Engineers' Club of St. Louis visited the World's Fair grounds April 18. They assembled in the chapel on the second floor of the Administration Building, where brief talks were made by President Francis and Director of Works Taylor. The club then made a tour of the grounds in an observation train composed of an engine and three gondola cars. The members, including a great many electrical engineers, were highly pleased with what they saw.

PENNSYLVANIA RAILROAD TUNNEL.—President A. J. Cassatt, of the Pennsylvania Railroad Company, has appointed an advisory committee of experts to assist in the work of constructing the New York fifty-million-dollar tunnel. The appointees are Theodore N. Ely, chief of motive power of the Pennsylvania Railroad, chairman; W. H. Baldwin, president of the Long Island Railroad; S. D. Newhall, purchasing agent for the Pennsylvania, and A. W. Gibbs and A. S. Vogt, general superintendent of motive power and chief mechanical engineer for the Pennsylvania Railroad. The committee of experts has already decided to adopt for use in the tunnel an electrical engine, the motor of which will rest on a truck, so that it will only be necessary to increase the number of trucks to obtained increased power.

CUTTING A GOVERNMENT TUNNEL.—After only twelve days of usefulness, the United States Government submarine cable connecting the Farallon Islands with the mainland at Point Reyes has been severed. It was cut last Sunday afternoon, April 26, either accidentally or deliberately, by the crew of the steamer South Portland, which had put into Drake's Bay during the previous night to escape the northwest wind that was blowing at the rate of sixty miles an hour. It is presumed that the steamer's anchor picked up the cable near Chimney Rock, which marks the land end of the line, and that Capt. Hornsman gave orders to sever the cable rather than see the anchor lost. A report of the matter has been sent to Washington, and it is possible a suit will follow in the Federal Courts against the owner of the steamer. Facilities for grappling and splicing the cable are available.

BEDS OF RADIUM.—A funny dispatch from St. Petersburg in the New York daily newspapers alleges that "a Russian engineer is said to have discovered a bed of radium in a remote and uninhabited region of Siberia." The man who discovers mines of radium *au naturel* deserves encouragement.

PARIS TUBE EARNINGS.—A cable dispatch from Paris of April 25 says: "The annual report of the Paris General Omnibus Company shows the effect of the Paris Metropolitan Underground road on other methods of locomotion. The receipts in 1902 were about $200,000 less than the previous year and $1,400,000 less than in 1899. The number of passengers decreased 18,000,000. Fifty omnibus and tramway lines are being run at a loss."

AMERICANS IN GERMANY.—A cable dispatch from Berlin of April 25 says: "Because of the high German tariff many American manufacturers are considering the advisability of erecting factories in Germany. To-day the Carborundum Company, of Niagara Falls, announced its intention to build works in Prussia. The Westinghouse Electric Company and the Worthington Pump Company are deliberating similar steps. The establishment of factories in Europe is becoming necessary because European manufacturers are adopting American methods so extensively that the main advantage which the Americans are enjoying is gradually disappearing."

WIRELESS TELEGRAPH IN ALASKA.—In view of the recent discussions as to the delay in installing the proposed wireless telegraph plant in Alaska, it is interesting to note that Engineer Richard Pfund and his assistant, Herbert C. Welby, of the Marconi Wireless Telegraph Company, of America, have started for Alaska to complete the installation there of a series of wireless telegraph stations for the United States Signal Service. The apparatus originally sent to Alaska and left in charge of Stanley Cook, of the Marconi Company at Fort Gibbon during the past winter will be returned, and new apparatus substituted for it. Upon arrival at Seattle the party will arrange for the shipment of the new apparatus to Alaska. It was forwarded to the Pacific Coast some time since. With Fort Gibbon in Alaska as the starting point, the first station there will communicate with the second at Tolovana, distant approximately 100 miles. The third and last station is at Chena, on the Tanana River, 100 miles up the river from Tolovana. The Tanana flows into the Yukon at Fort Gibbon, and its general course is northwest. The stations are all located at army posts, and will be operated by Signal Service operators. It is expected that the system, the first of any consequence to be installed for overland transmission, will be completed and turned over to the Government about August 1.

LETTERS TO THE EDITORS.

A Theory of Magnetism.

To the Editors of Electrical World and Engineer:

Sirs:—You very kindly published my theory of magnetism in your issue of December 20 last year, and in the meantime I have finished the whole work and I am now able to give the following brief and chief "laws":

1. Iron as a shell or siding of an electromagnet outside the solenoid does not become polarized, but is only a protection.
2. Long arms or shoes at the free ends of magnets are not so-called poles, but concentrate the power between them, the poles existing only at the ends of the solenoid.
3. Iron near a magnet outside of a solenoid does not become a magnet, but is an obstacle or a resistance to the magnetic force which is directed to the poles.
4. The magnetism is an electrical force and not a special "magnetic" force.
5. The magnetic phenomena imply electrical pressure.
6. The electric and so-called magnetic phenomena follow the ordinary and well-known mechanical laws; there are no special laws, no attractions nor so-called unknown phenomena.
7. In a magnetic field there are not both pressure and attraction, but only electric pressure.
8. The force of the magnetism of steel exists only in the surface of the material; it is a skin effect.
9. The magnetic forces or waves can be derived, dispersed or refracted like electrical or light waves; all three have the same motive source—the motion of the ether.

Everyone can prove these points by experiments. They are not theory, but facts, and the old teaching was a phantom.

Charlottenburg, Germany. Joh. Zacharias.

Stress on Frames of Alternating Current Generators.

To the Editors of Electrical World and Engineer:

Sirs:—In your issue of April 11 I read with much interest that Mr. P. J. Frenell is not satisfied with the answer given by Mr. A. Hansson to his paper having the above title. On the contrary, he upholds his former opinion and considers it wise to calculate a frame with relation to stress instead of deflection, and he declares that he will be satisfied if any designer has received any practical benefit from his article.

I would like to state that Mr. Frenell has made a fundamental error, and in my opinion any designer who has applied his theory will very soon find its drawbacks. He writes that deflection and stress are different subjects. That is true, but they are fully dependent on one another, and the greater the stress at any point of a construction, the greater also the deflection or, as it is generally called, the deformation in such a place.

According to American practice, the frames of large electrical machines must always be designed for a very low stress, as a low deflection is essential; and I can only understand that the object of Mr. Frenell's paper is to illustrate that the laws of strain and elasticity are right not only for any other machine, but also in the special case of frames of alternating-current generators. As soon as Mr. Frenell uses such large differences of air-gap as he recommends he will also get greater stresses in his armature frame. But I am afraid he would have trouble with that machine. The admissible difference in the air-gap of a machine is not so great as Mr. Frenell claims, and its true size can always be determined only by means of the characteristic curves of the machine.

Mr. Frenell refers to a special machine, considered in the paper of Mr. Linsenmann in the *Elektrotechnische Zeitschrift*. Mr. Linsenmann gives an air-gap all around of 6 mm, the induction of which is 8,650 gausses. If the air-gap, according to Mr. Frenell, is at one point 1/16 in., 1.6 mm larger than at the other, the air-gap is 5.2, or 6.8 mm, and we find from Mr. Linsenmann's curves the induction with 9,050, or 8,200 gausses. The magnetic pull, therefore, is on one side 2.7 kg and on the other 3.3 kg per cm^2, and consequently this magnetic pull has a variation of 22 per cent. That is, at the point where, owing to deflection, we get the smallest air-gap, we have the greatest magnetic pull; and this difference in magnetic pull will enlarge the deflection until equilibrium is reached. In this case the stress in the armature frame will get higher than is common practice and it may be that it reaches a value corresponding to that which Mr. Frenell desires to get; but it is my opinion that the machine would not run satisfactorily and might perhaps reach a point where it is inoperative.

As the flux in the revolving field would vary about 22 per cent., as mentioned before, we would also have a loss by hysteresis in the field iron, and the efficiency of the machine would not be as high; but the loss would be insignificant. This is a small drawback, which probably would not prohibit this great variation in the air-gap.

I agree with Mr. Frenell that the theory in Mr. Linsenmann's article is somewhat elaborate, but its application is very simple. I wish to state this from experience, as I used it immediately after its publication.

If the characteristic curve of a machine is not obtainable, the deflection can generally be made as large as 1/40 of the single air-gap. I consider this a pretty good value for deflection in general, and prefer it to another formula which I used about 10 years ago. If D is the diameter of the machine in mm, taken at the air-gap, then the admissible deflection was $D + 1{,}000 \div 5{,}000$. At that time only machines of smaller sizes were made and then this formula held good; but with the large dimensions of the machines of to-day the deflection would be more than can be allowed.

I agree fully with him that the armature frames of American machines contain too much inactive material. The enormous waste of material can best be seen if we examine the large frames turned out by the principal American firms where the thickness of material is sometimes as much as 2½ m to 3 m. It would not at least be difficult to make a frame just as stiff or even stiffer with considerable less weight. The weight can always be reduced so far that care must be taken that the frame does not break in shipping. This would, of course, alter the construction also.

As Mr. Hansson has previously said, European manufacturers are far ahead of Americans in this line, as the prices of material are higher and standardization is not as far advanced there. You have several times criticized the American railway practice with its "scores of sub-stations with rotaries—nice, steady going, low speed rotaries all thoroughly standardized and fed from giant transformers to match." American alternating current machines are similarly standardized. Years ago this standard was developed for a machine of small diameter, and to-day machines of by far greater diameter are made in the same way. European manufacturers have done differently, and as early as 1894 the well-known firm of Brown, Boveri & Co., of Baden, Switzerland, made single phase machines for the municipal plant at Frankfurt (5,500 mm diameter at the air-gap), with a system of arms inserted in the armature frame instead of making the frame self-supporting. And in 1896 the Schuckert Company, at Nuremberg, began stiffening their machines by inserting tension rods in the armature frames something like the construction of a bicycle wheel. Machines of both constructions—Brown, Boveri and Schuckert—could be seen at the last Paris Exhibition. Later the A. E. G. developed its system of stiffening the armatures, and to-day one can say that the stiffened armature is a familiar construction with all European manufacturers. This is a matter of course, since developing machines of great output in Europe was always along the lines of slow-speed, while in this country more high-speed machinery, owing to our many water powers, was developed. And I believe this to be the reason why here the girded or stiffened armature frame is not yet used. Our manufacturers have not yet given their attention to this construction, as they have been engaged with high-speed machinery, and at the present time they are considering still higher speeds since the turbo-dynamo has become an issue.

If Mr. Frenell has actually applied his theory, I would be glad to hear something about his results.

Pittsfield, Mass. Fredk. W. Knopfe.

Sweden and Electric Railway Development.

To the Editors of Electrical World and Engineer:

Sirs:—I have noticed with interest the report of Mr. Dahlander submitted to the Royal Swedish Railroad Administration, which was published in full in the *Tecknisk Tidskrift* and abstracted by Mr. Westerberg in your issue of March 21, 1903. The fact that Mr. Dahlander reported in favor of the adoption of my system for the replacement of the steam locomotives is, of course, very gratifying to me.

It is interesting to note that this Swedish report looks upon the single-phase alternating system as the only commercial method of operating a trunk line railway system. I believe that I was the first engineer to insist, in 1891, that the single-phase alternating-current system was essential to success in this direction. The establishment of a single-phase alternating system of 25 periods for the Swedish railways will enable the government to employ either my locomotives or any other form which may be developed. The essential differences in the several single systems which are seriously considered to-day for heavy railway service are met with in the methods and means employed in the locomotive itself for utilizing the energy of the single-phase current.

There are three principal classes of duties in railway work, as follows:

1. Heavy freight haulage over existing railroads; in which economies are proportional to the increase in the tractive effort obtainable in a single locomotive under perfect control.
2. Rapid-transit passenger service in and about large cities; in which the most important factor is the smoothness with which the trains can be accelerated to a very high speed.
3. Long-distance, high-speed passenger service and interurban passenger service; in which rapidity of acceleration becomes unimportant and in which light-weight, high-powered, individually-equipped cars should be used.

The essential characteristics of these three classes of railway service are so pronounced and different that it would not be surprising to find each class employing a particular system best adapted to the requirements of that class of service and not employed in the other classes of service.

For example, the long distance, high speed passenger service seems likely to be handled by the directly employed, single-phase, alternating-current motor.

On the other hand, I feel the greatest confidence that my electric locomotive system will be found the best adapted to the haulage of freight on existing railways where the heaviest possible locomotive is demanded, and where simplicity and perfection of control under wide ranges of speed and torque are of vital importance.

As to the rapid-transit passenger service in and about cities, it is much less easy to predict what system will eventually prove to be best adapted to this class of service, on account of the many factors entering into this problem and the difficulty of giving at this time to each factor its proper relative value in importance. I believe, however, that some system which will smoothly apply, and continually maintain, during the period of acceleration, a torque just below the limit imposed by skidding, will supplant for such service the present series-parallel system of series motors by which the passengers have been already jerked to the limit of endurance, without even then securing a speed of acceleration at all comparable with that attainable by a continually-sustained constant torque just below the skidding point.

It may interest you to know that recent data received by me from the Oerlikon Company indicates that my electric locomotive system will, before long, see such a complete commercial demonstration in Switzerland as will be quite conclusive as to its value for freight service on trunk-line railways.

I observe that the Swedish report shows the entire cost of operation of 2,691 miles of railway requiring 102,000 hp to be only one-half of the cost of operation of the present steam locomotive system, figuring coal at the average price for many years past. The report shows a net saving for my system over the present steam-operated railways of $2,000,000 per year. In figuring the cost for the Leonard system all interest charges on the investment, together with a liberal sinking fund and all other proper charges of cost were included.

In view of such figures as these from a thoroughly competent and entirely disinterested engineer, and the evident faith of such an experienced concern as the Oerlikon Company, it is apparent that the articles we frequently see in the American press as to the practical impossibility of commercially operating by electricity a trunk line railway must be inspired by the electric railway monopoly which owns controlling patents on the conventional trolley system and, like all monopolies, strives to prevent the development of any ideas not controlled by it.

It is to be hoped that before long some American steam railway company will prove to be as progressive as the Swedish Government and the Swiss Government, and that Mr. Dahlander or some equally competent and independent engineer may have a chance to see whether American inventions are not just as applicable for use in America as they are abroad.

The most authoritative and conclusive figures as to the first cost and efficiency of the familiar sub-station system are contained in Bulletin No. 131 of the Stanley Electric Manufacturing Company, entitled "The Rotary Converter in Interurban Railroad Work." This bulletin was issued October 8, 1902, a few months before the absorption of the Stanley Company. It contains a fair and unbiased statement of the sub-station system and the figures were taken from the latest and best installation. The sub-stations are located twenty miles apart, so that the section normally fed by a sub-station is twenty miles. The schedule provides for two cars in a section, each car having an equipment of four motors, rated at 50 hp each. There is a high-tension alternating-current transmission and a working circuit of 600 volts, as usual.

The copper in the working circuit averages 750,000 circular mils, costing $34,000 per section, or $85 per motor-hp. The first cost of the sub-station is $20,000, or $50 per motor-hp, and the cost of operating the sub-station is equivalent to the interest on $20,000, so that the total capital represented by the sub-station and low-tension copper is $185 per motor-hp. The comparable portion of my system is the motor-generator, the first cost of which will not exceed $30 per motor-hp, or only about one-sixth as much.

As to relative efficiencies: If we grant 95 per cent. efficiency for the rotary and 65 per cent. for the low-tension circuit, we have an efficiency of 62 per cent. for the sub-station system between the high-tension circuit and the motors, while with the Leonard system the efficiency of the motor-generator will be not less than 83 per cent. The high-tension generators of the sub-station system must be at least one-third larger and more expensive than needed for my system in order to provide for this excessive loss in the low-tension circuit.

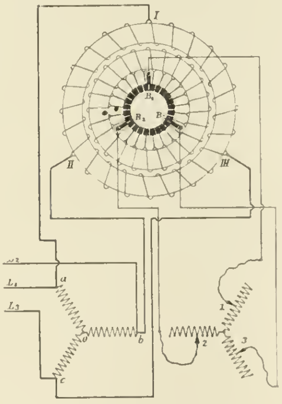
Just as long as American railway directors will blindly purchase sub-stations and series-parallel controls at several times the first cost and three-quarters the efficiency of other available long-distance systems, there is little hope for progress in serious heavy railway work in this country, until the successful application of American inventions on foreign railways forces upon their attention the fact that the monopoly in the electric railway field has prevented for many years the development in this country of the most important and valuable branch of electrical work, namely, the operation of our trunk line railways by electricity. H. Ward Leonard.

Bronxville, N. Y.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Speed Regulations of Induction Motors.—Winter.—An illustrated paper read before the Vienna Electrical Society on three-phase induction motors with adjustable speed, devised by Winter and Eichberg. If a direct-current commutator winding is used on the rotor, there exists at fixed brushes connected to the commutator, an e.m.f. of the frequency of the stator field, this frequency being independent of the speed of the rotor. This property of the direct-current winding in the rotor enables one, with the aid of a stationary transformer, to return the rotor energy to the network and thus make use of it: reversely it is possible, to change the speed at will by varying the e.m.f. at the rotor brushes. If the field is constant, no stray field being present, then the e.m.f. produced in the rotor of an ordinary induction motor, is directly proportional to the speed of the stator field relation to the rotor, i. e., proportional to the frequency of the rotor currents. The conditions of a motor with a direct-current armature are similar. The e.m.f. at the fixed brushes is also directly proportional to the speed of the field relation to the rotor, but it has a constant frequency. If the rotor is held at rest, there exists at the brushes an e.m.f. equal to the stator e.m.f. When the rotor begins to revolve, the e.m.f. gradually decreases and becomes zero at synchronism; with increasing over-synchronism the e.m.f. at the brushes again increases. If a certain e.m.f. is impressed on the rotor through the fixed brushes, then the rotor must revolve with a speed at which a counter e.m.f. of equal value is produced by slip in the magnetic field. The rotor will maintain this speed as long as the voltage at the brushes is kept constant; although the ohmic and induction loss in the windings produce variations from the exact rule. The adjoining diagram shows a bipolar three-phase stator winding in the form of a Gramme ring, and a bipolar rotor winding in the form of a direct-current armature with commutator. The currents are supplied to the stator through the points *I, II, III,* and to the rotor through the three brushes, *B*. If the ratio of both windings is unity, the three-phase e.m.f. at the brushes is the same as at the points *I, II, III.* If the position of the brushes is such that the phases of the rotor e.m.f. are in approximate agreement with those of the stator e.m.f., then the brushes may be connected to an ordinary transformer, as shown in the diagram. The primary of this transformer is generally connected to the conductor leading to the points *I, II, III,* while the secondary is connected with the three brushes, *B*. If the e.m.fs at the brushes, *B*, are chosen greater or smaller than the e.m.fs at *I, II, III,* the rotor will revolve and will assume such a speed that the e.m.f. generated in it, is equal to the applied e.m.f. If the above voltage is greater, the rotor revolves in the direction opposite to the revolving field; if smaller, in the same direction. At zero voltage it tends to reach synchronism. With a proper position of the brushes and gradual increase of voltage, the rotor also revolves with a speed above synchronism. The speed regulation may be obtained as well by varying the stator voltage as by varying the rotor voltage, i. e., in general by varying the difference. In practice it is best to work with small phase difference, i. e., with a high power factor. Two experimental motors of this type have been tested and have shown the correctness of the theory.—*Zeit. f. Elec.*, April 12.



SPEED REGULATION OF INDUCTION MOTORS.

Non-synchronous Single-phase Alternating-current Motors.—Georges—An article in which he first refers to the theories in which a single-phase alternating field is considered as the resultant of two rotating fields of equal intensity, revolving in opposite directions; theories of the induction motor, based on this supposition, are inexact and not very clear. He refers to another theory developed by Potier and himself, the fundamental principle being the assumption of a component of the magnetism perpendicular to the main field and proportional to the speed of rotation; he thinks this theory gives more exact results for the calculations of motors. As it has so far been given only in an analytical form, he explains it in the present article by means of dynamos, and assumes a bipolar motor, but remarks that it may also be applied to multipolar machines. The main results obtained by him are as follows: The main field generates a second field, nearly perpendicular to it and proportional to the speed; at synchronism its intensity is nearly the same as that of the main field. This second field generates e.m.fs which increase with the square of the speed and tend to decrease the current in both rotor and stator and may, therefore, be considered as counter e.m.fs. The torque varies as the sine, with double frequency between a greater positive maximum and a smaller negative maximum. The main field generates directly only a negative average torque, the power of which serves to compensate for the losses involved in the generation of the second field. At synchronism this is the only torque which exists. The positive mean torque is produced by the second field; to make it a maximum, it is necessary that the armature resistance should be very small. A speed regulation within wide limits is impossible by inserting resistance in the secondary circuit. At rest the instantaneous value of the total torque is zero; the mean total torque passes through zero before synchronism is reached. If the speed is increased above synchronism, both average torques become negative; the one corresponds, as before, to the compensation for the losses involved in the production of the second field, the other corresponds to power furnished to the actual circuit; the motor, therefore, acts as a generator above synchronism.—*Elek. Zeit.*, April 9.

REFERENCE.

Small Generators for Automobile Purposes.—In the conclusion of the illustrated article on the recent automobile exhibition in London, several types of a small generator are described and illustrated, which may be used either for charging batteries on a motor car, giving a practically constant current at variable speed, or for firing the ignition directly without batteries.—Lond. *Elec.*, April 10.

Lights and Lighting.

Arc Lamp.—An illustrated article on the recently opened lighting system of Hornsey and on the construction of the arc lamps which are installed there. There are at present 50 arc lamps, connected in series of five across from the neutral to either one of the outers of the 480-volt, three-wire system of distributors. The lamps are of the "Angold band brake pattern," rubber pads being used for the brake band by an arrangement which gives a steady feed and compensates for the wear of the rubber. The brake drum carries the band, which is furnished with rubber pads, one end being attached to a pulley controlled by a spiral spring in tension, and the other end hooked on to a working frame controlled by the two cores; the tension of the spring takes up any slack of the band as well as any slack that may be caused by the wear of the pads; this keeps the brake in action, and maintains the position of the band relatively to the drum. Regulation is effected by a pawl controlled by the rocking frame, which engages a toothed sector mounted concentrically on the pulley to which the band is attached. When the mechanism is at the predetermined feeding point, the pulley comes into action and the spring can no longer exert a pull on the brake band, feeding, therefore, takes place. When compensation is necessary the pawl rotates somewhat farther before all the slack is taken up; consequently, when the feeding point is reached, the pulley engages a different tooth. The regulation remains constant and independent of wear, because the release of the brake always occurs when the mechanism takes up a certain position. The suspension gear in use and the differential cut-outs are also described.—Lond. *Elec. Rev.*, April 10.

POWER.

Three-Phase Motors in Factories.—EBORALL.—A paper on the application of three-phase motors to the electrical driving of workshops and factories, read before the Society of Arts. A three-phase installation for most classes of work is preferable to a continuous-current one, owing to its flexibility, reliability and economy in cost of installation and maintenance; its ability to stand overloading and rough treatment cannot be equalled by direct-current machinery. Its only disadvantage is when economical speed regulation is required. He discusses the starting current of induction motors and the use of squirrel-cage armatures and armatures with slip-rings. Generally speaking, economical speed variation is of minor importance in workshops and factories, as the shafts are driven at practically constant speed; and in machine shops only the cranes need considering from a speed regulation point of view, and the difference in efficiency in this matter between three-phase and direct-current motors would be inappreciable in the consumption of coal. For traveling cranes the motor of the cross traverse may be of the short-circuited rotor type; for textile mill driving three-phase motors meet the conditions better than direct-current motors do; for cotton and woolen mills the best arrangement is to drive groups of machines from one motor; for silk weaving, individual driving of the looms is the ideal method. In general he lays down the following rules for three-phase installations. The pressure drop in the generators should not exceed 16 to 18 per cent. from no load to full load, at constant speed and excitation, according to size, the full load power factor being taken as 80 per cent.; high engine speed is favorable to good performance in this respect. The power factor of the motors should be as high as possible over a wide range of load; above 3 hp this should be not less than 80 per cent. from half load up, and a flat power factor curve over the working range should be insisted on. The efficiency curve should be as flat as possible over the working range of load. A proper starting performance should be insisted on, and short-circuited rotors should be installed with discretion in the larger sizes.—Lond. *Elec. Rev.*, April 10.

French Hydraulic Power Station Statistics.—COIGNET.—A long table giving some statistical data on hydraulic stations in France, stating what they are used for, where they are located, the height of the fall and the hydraulic power *"en poncelets"* (presumably in horse-power). There are three aluminum plants, power, 16,802; 5 electrometallurgical plants, power 15,166; 2 potassium chlorate plants, power 6,750; 15 calcium carbide plants, power, 72,063; 1 sodium and chlorine plant, power, 10,125; 21 stations for distributing electric power and light, power, 28,067; 22 printing and paper mills, power, 9,551; 4 textile mills, power, 695; 1 saw mill, power, 60; 6 cement factories, power, 1,913; 2 potteries, power, 151.—*L'Ind. Elec.*, April 10.

REFERENCES.

Electric Capstan.—An illustration with a brief description of an electric capstan for drawing ships into the dock; it is operated by a 30-hp motor.—*Eng'ing*, April 10.

Oregon Power Transmission.—A well-illustrated descriptive article on the "White River-The Dalles" electric power transmission.—*Jour. of Elec.*, March.

TRACTION.

Boosters.—In an illustrated descriptive article on the South Lancashire tramways, the following auxiliary machines are mentioned which are installed in the power plant in connection with the boosting arrangements and for battery charging, these including a positive feeder booster of 56 kw, two 8-kw negative feeder boosters, a "milking booster" for 240 amp. and a 40-kw "reversible booster." All these machines are driven by shunt-wound motors operating at 500 volts. The reversible booster is of special construction and is capable of working at 240 amp. and 130 volts when the battery is being charged, and 70 volts and 576 amp. when the battery is discharging. The reversible boosting process is carried out automatically in accordance with the requirements of the service, the arrangement being shown in the adjoining diagram. The booster armature is in series with the battery across the bus-bars, and the reversal of the e.m.f., together with the regulation of the pressure to the correct amount in either direction, is effected by means of a regulator, consisting of a regulating resistance for the shunt field of the booster, in conjunction with a reversing switch, both of which are operated by a small auxiliary electric motor. The motor runs continuously in one direction and drives a mechanism which cuts out and reverses or introduces resistance into the field of the booster, the speed and the reversing being controlled by means of a solenoid, which is governed by the bus-bar voltage. Thus, for instance, the contact arm of the shunt resistance in the booster field circuit moves in one direction and introduces resistance into the booster field circuit, then at a certain point in its travel it reverses the connections on the booster field, and cuts out resistance as required, in order to keep the bus-bar voltage constant. This varies the strength of the booster field in either direction, and assists or opposes the battery current, in accordance with the requirements of the external load. The rate at which this arm travels over the contacts is extremely rapid, the time taken to move completely around the dial, i. e., from the maximum charge in the battery to the maximum discharge, being something like 15 to 20 seconds. The particular direction of rotation of this arm is governed by the solenoid through a simple trip mechanism.—Lond. *Elec.*, April 10.

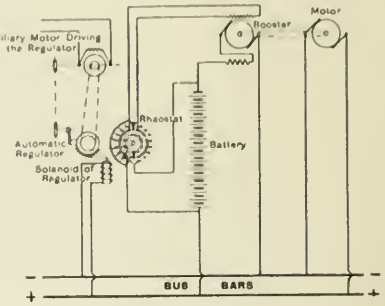


DIAGRAM OF BOOSTER CONNECTIONS.

Electrical Traction in Steam Railways.—ADAMS.—An article in which the author says that the difference between supply to distributed loads (as on tramways) and to concentrated loads (as on railways) is the main barrier to electric traction on steam railways. In a system of high voltage transmission and converter sub-station the cost of the converter sub-stations become prohibitive. He cites several European three-phase traction systems and one in Michigan, where the cars take high tension single-phase from the trolley wires and transform to low pressure for the motors. He concludes that whether the advantages of electric traction warrant a change from steam to electric traction, it seems certain that electric traction can displace steam locomotives for thorough traffic only if each train carries its own sub-station.—*Cassier's Mag.*, April.

Interurban Electric Railways.—GONZENBACH.—The conclusion of his serial on engineering preliminaries for an interurban railway. He deals first with accessories, including telephones, block-signal system, passenger stations and provisions for flag stops. The telephone has come to be accepted very generally for train dispatching and is pronounced superior to the telegraph for this purpose. It is pointed out that an automatic block-signal system is essential for the safe operation of a road of this character, and it is contended that there is now no justification for failing to employ apparatus of this description. An outline of a station platform suitable for a flag stop is illustrated. Special provisions for lighting waiting stations, highway crossings, switches, etc., are recommended, and it is suggested that a single galvanized wire which runs the entire length of the road be employed with the lights attached to this in series of five; these circuits could be turned on and off from the sub-stations. Where it is proposed to supply lighting and power, it is recommended that instead of purchasing outright the existing plant and using its system, as has frequently been done, an entirely new layout be provided, to consist of an alternating-current series arc light system, four-wire secondary system, in the business streets of small towns and groups of houses fed from one transformer in residence lighting. Considerable revenue may be derived from this service, while the additional investment in operating cost would be comparatively light. An estimate of the cost of building a road according to the plan here outlined is presented in detail, but no allowance is made for right of way, franchises and local expenses, as these are all determined largely by the locality. The operating expenses average 55 per cent. of the gross receipts. A summary of the recommendations made and a comparison of some recently established properties shows that less money should be invested in electrical equipment, power houses, transmission line, sub-stations, track rails and third rails, while more should be invested in track ballast, car bodies, trucks, block-signal system and waiting stations. Attention is further called to the lighting and power supply business as a means of utilizing the by-products of electric railway power stations, after the manner of the gas companies.—*St. R'y Jour.*, April 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Alternating and Direct-current Systems.—C. F. Scott.—A general discussion of the general problem of alternating current versus a combined alternating and direct-current system. Pure direct current cannot be used in many cases; alternating current must be used and the question is whether in those cases in which the conversion from alternating into direct current is commercially practicable, it is necessary or desirable. All of the important classes of service for which current from a central station is used may be undertaken in general equally well by direct or by alternating current; the only exception is that of variable-speed motors, in which case direct current is preferable. In the apparatus used in the stations, the principal difference lies in the expensive converter sub-stations required in a combined direct and alternating-current plants. This conversion also increases the liability to accident and interruptions. While the storage battery is often quoted as an element in favor of direct current, the author suggests that in an alternating current a rotary converter may be employed for charging the storage battery, and in turn the battery can supply current through the converter to the alternating-current circuits. Concerning the practical problem as to which system should be employed in any and every case, he remarks that there is no ideal system and no panacea which can be universally applied, as existing local requirements must be taken into account.—*Cassier's Mag.*, April.

High-Tension Switching.—An illustrated description of the sub-station of the Butte Lighting & Power Company, at Butte, Mont., where power is received from the transmission line of the Madison River Power Company, a building of 50 by 100 feet in size, being exclusively devoted to the purpose of high-tension switching, fusing and transforming. The receiving end of the system in Butte is laid out for the handling of 80,000 volts, and for a few hours the transmission has been operated very satisfactorily; but as the load has not yet been sufficient to warrant extensive experimenting at such a high pressure, 40,000 volts have been used up to the present. The transformers in the Butte sub-station are described in detail. The same issue contains an extended and well-illustrated description of the Butte County gas and electric systems.—*Jour. of Elec.*, March.

High-Tension Fuse.—Garrard.—An illustrated article in which he describes an oil fuse for 11,000 volts and 1,500 kw. The fuse pot is 18½ in. high and consists of a porcelain vessel divided down the middle by a partition; over this division hangs a porcelain saddle, with projecting cross-pieces, which divide the whole pot up into eight compartments; there is no lid, the pot being open to the air. The current is led in and out by two contacts, which are near the bottom, and make metallic connection on each side to a spindle, on which are four drums wound up by steel spiral springs fixed inside them. The flexibles which reach through the oil to the top of the middle partitions are fixed to the outside of these drums and when pulled to the top, wind up the springs. The copper fuse wires, which are about 1 in. long, are soldered to the ends of these flexibles; when these fuse wires melt, the flexibles are drawn down sharply into the oil by the springs inside the drums and the arc is extinguished on the top of the oil. The effect of the arrangement is that there are four fuses in parallel. Some tests with this type of fuse are noticed and it is claimed to be absolutely reliable.—Lond. *Elec. Rev.*, April 10.

REFERENCES.

Electric Legislation in India.—An article giving the most important portions of the "Indian Electricity Act" which was recently passed. It is well spoken of editorially; the privileges and rights of the public appear to be fully safeguarded, while at the same time a number of the irritating and hampering restrictions in force in England have been abandoned. The act deals with the procedure in the case of undertakings supplying electrical energy for traction or to the public, with factory installations, etc.; rules, penalties, and so forth, are provided for the different cases.—Lond. *Elec.*, April 10.

ELECTRO-PHYSICS AND MAGNETISM.

New Form of Radiation.—Blondlot.—A French Academy paper on experiments in which he discovered a new form of radiation by the action of which this radiation produced an electric spark. The rays are emitted by Röntgen ray tubes, but have properties different from those of other known types of radiation; while they are similar to infra-red rays by their invisibility and their general optical character, they penetrate aluminum, black paper and wood like Röntgen rays. They are polarized and refracted, but have no photographic action.—*Comptes Rendus*, March 23.

Emanation from Phosphorus.—Schmidt.—A paper in which he maintains that while air in which phosphorus evaporates, acquires electric conductivity, this is not due to an emanation of ions, but simply to the fact that the phosphorus fog contains a great number of oxidation products having a high conductivity. A charge is imparted to these particles by contact with one of the condenser plates, which provide the electric field.—*Ann. d. Phys.*, No. 4; abstracted in Lond. *Elec.*, April 10.

Theory of Magnetism.—Zacharias.—An article in which he puts forward an ether theory of magnetism. He does not like the idea that a live solenoid produces a magnetizing force, parallel to its axis, which polarizes the particles of iron in its core; his view is that the current in the solenoid create a reduction of ether pressure in the core, and that magnetic force is entirely an electric pressure phenomenon. There is no such thing as magnetic attraction; an armature is forced against the poles of its magnet by the pressure of the ether on its particles.—*Verh. Verein f. Eisenbahnk, Berlin;* noticed in Lond. *Elec. Rev.*, April 10.

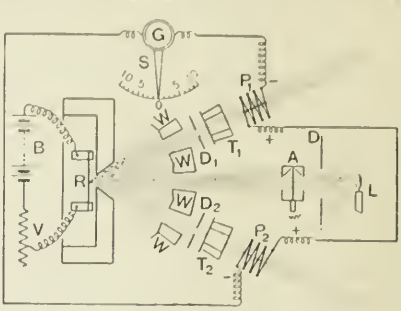
ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis of Alkali Chloride Solutions.—Foerster and Müller.—A long account of a very extended experimental investigation. He sums up the theoretical results concerning the process at the anode as follows. In the electrolysis of aqueous solutions containing chlorine ions at the anode, two negative chlorine ions discharge to form a chlorine molecule. Besides this, there are formed at the anode hypochlorous acid and hypochlorite, either by a primary electrochemical reaction or by a secondary chemical reaction. For more alkaline or for more dilute chloride solutions, the formation of hypochlorites increases. Besides this electrochemical anodic process, there is also a formation of hypochlorite in the electrolyte itself by a reaction of the alkalies present there with the chlorine gas formed at the anode; but only that hypochlorite which when formed in this way is at some distance from the anode, has a chance to remain in the electrolyte. Chlorate is formed either by an electrochemical anodic process or by a chemical process in the electrolyte. The anodic electrochemical formation of chlorate is always accompanied by the development of oxygen gas. The anodic electrolytic generation of chlorate requires the presence of hypochlorite, which may either have been formed directly by electrochemical action at the anode, or may have been formed chemically in the inside of the electrolyte; in the latter case it takes some time before the hypochlorite reaches the anode and before the formation of chlorate is started. In strong alkaline or neutral and in very dilute acid chloride solutions, anodic development of oxygen may be due not only to the reaction just noticed, but also to the discharge of negative hydroxyl ions. The secondary chemical development of the chlorate in the interior of the electrolyte takes place without development of oxygen. It occurs to a considerable degree, if in a large part of the electrolyte free hypochlorous acid can exist together with hypochlorite, i. e., if the chloride solution is slightly acid.—*Zeit. f. Electrochemie*, February 26 and March 5.

Aluminum.—J. B. C. Kershaw.—A second article on the present position of the aluminum industry. He gives a few data on companies which have introduced aluminum as a substitute for copper for overhead electric conductors. In motor car construction work, the alloys of aluminum appear to have a promising future, and the manufacture of these alloys may become a flourishing sub-branch of the aluminum industry; "builders of automobiles will, however, have to recognize that aluminum and its alloys are not absolutely non-corrosive under all weather conditions; and they will be well advised if they cover all exposed surfaces with some protective varnish." The use of aluminum plates as a substitute for zinc, or in place of stone for lithographic work, is rapidly extending. For general foundry work, as an addition to iron and steel at the moment of casting, aluminum continues to be largely used. The Goldschmidt process for the productoin of high temperatures by the use of a mixiture of powdered aluminum and iron oxide appears to be widely used. Aluminum is also largely used for manufacturing ornamental articles, combs, etc., and is increasingly employed by opticians in the form of the aluminum magnetism alloy "magnalium," which has a specific gravity of 2.52, is harder than pure aluminum and more suited for milling and screw-cutting purposes.—Lond. *Elec. Rev.*, April 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard of Light.—Petavel.—An illustrated article giving an account of a preliminary study for a new standard of light. There are three distinct types of standards; the first is the "absolute" one, the second a secondary standard carefully compared with the absolute one and preserved in a few of the principal laboratories throughout the world, and the third a commercial one, the accuracy of which will depend on the requirements; it will correspond, as the case may be, to the commercial scale. He claims that the problem of the first and third types of standards has been successfully solved. An absolute standard must be both constant and reproducible, and that is the case with the Violle standard. The commercial standards are very numerous and each has its distinctive qualities or defects: the "British candle" is the simplest and least accurate of them all; the "carcel" is free from flickering, unavoidable with an open flame, but is subject to considerable long period variations; the "Hefner" (or amyl acetate lamp) is convenient, portable and reasonably accurate, but very sensitive to atmospheric conditions, liable to flicker and gives too ruddy a light; the "Harcourt pentane standard," in its latest form, seems to combine the advantages of several of the previous lights. In his opinion several of these lights have considerable value as commercial standards. He then discusses the second type of standard and points out that "if we have a weight, a rule or a tape-measure, the accuracy of which we have reason to doubt, we do not go to the trouble and expense of sending them to the Bureau International des Poids et Messures; there are many laboratories in which a reasonably accurate comparison may be made." In the case of a standard of light the same facilities do not exist. The unit required for calibrating the commercial standard need not be reproducible, its one essential quantity is constancy. An electric lamp, the current through which is regulated by means of a potentiometer, will, during any one hour, show practically no variation, but in the course of days the light will steadily diminish. A Hefner lamp will vary slightly from minute to minute and from day to day; but, notwithstanding this, it will keep for years within a few per cent. of the mean value. For a satisfactory secondary standard both defects must be avoided and both qualities secured. Standards made incandescent by the passing of the electric current seem to promise the most satisfactory results, and the choice of the material seems to be limited almost exclusively to platinum, rhodium and iridium. The only satisfactory measurement of the temperature seems to be by the relative intensity of the radiation of two different wave lengths; for a metallic radiation as well as for a black body, the wave length at which the maximum radiation occurs is in inverse proportion to the absolute temperature; if, therefore, two wave lengths are selected, one in the infra red, the other in the visible spectrum, if in each case the energy of the radiation is measured in percentage of the total, it will be found that as the temperature rises, the former quantity decreases and the latter increases. At one given temperature only will the two quantities be equal. For analyzing the radiation it is best to make use of the thermal absorption of various bodies. Water and glass are practically opaque to radiation of a wave length longer than 3μ; on the other hand, black fluorspar is entirely opaque to the visible spectrum. If two thermopiles, one measuring the radiation through glass, the other through black fluorspar, are connected in opposition, there will be a critical temperature at which the resulting galvanometer deflection will be zero. The actual temperature at which this occurs will depend on the relative thicknesses of the plates and on the relative distances of the thermopiles, but for a given disposition of the apparatus it will always be the same. The adjoining diagram shows the arrangement, B being a battery, V a variable resistance, R a radiating platinum strip in a water-cooled enclosure, G a galvanometer, W water-cooled diaphragms, T_1 and T_2 absorbing media, P_1 and P_2 thermopiles, A a photometer head, L a lamp, D D_1 and D_2 diaphragms. The author finally makes some critical remarks on Fleming's proposal of an incandescent lamp standard.—Lond. *Elec.*, April 10.



STANDARD OF LIGHT.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCE.

Telegraphy and Telephony.—The first part of a summary of progress and improvements made in telegraphy and telephony during the last three months of 1902.—*Elek. Anz.*, March 1.

MISCELLANEOUS.

British Electrical Engineers in Italy.—The first part of an account of the present trip of the (Brit.) Institution of Elec. Eng. to Italy, 120 members are taking part in the visit. The journey was over Lucerne, the St. Gotthard Tunnel and Lugano, to Como. The first engineering visit was made to the Valtellini Railway, which as repeatedly noticed in the Digest, is an electric line with 3,000-volt, three-phase motors on the trains, the transmission being made at 20,000 volts to transformer sub-stations. There are four motors on each car, the cascade connection being used for speed regulations; all the switching gear is operated by compressed air; the system appears to be very satisfactory. It is stated that the visitors were especially interested in the lightning arresters on the extra high-pressure lines, consisting of three jets of water from earthed nozzles projected upwards into umbrella-shaped basins connected with the transmission line. These put a permanent earth on the line, but owing to the high resistance of the jets, which are ½ in. in diameter and about 10 in. long, only about 3 kw is lost in this way, while the protection against lightning is perfect.—Lond. *Elec. Rev.*, April 10.

Russia.—Heenan.—An illustrated article on electrical developments in Russia. Recently electrical schools have been opened there, but there are only two factories turning out dynamos and lamps, and in consequence the importation is large, chiefly from Germany and Switzerland; next comes Great Britain and then follow the United States, France and Belgium. In St. Petersburg and Moscow the use of electric lighting is recent, but has increased enormously. The progress of the electrochemical and electrometallurgical industries is interwoven with the utilization of hydraulic power for current generation. There are several electrolytic copper refineries, a calcium carbide plant, and a large caustic soda plant; electric welding is in use in a number of works. Cables and storage batteries are made in some Russian factories, but no instruments whatever or incandescent lamps. The only electrical industry fully supplied by home manufacturers is telegraphy. "It will require more than a casual visit to Russia on the part of business men if they are to win a proper share of the future business to be done in electrical appliances."—*Cassier's Mag.*, April.

REFERENCES.

Standardization.—An editorial stating that the British Government has granted $15,000 to the Engineering Standards Committee. This committee is supported by the (Brit.) Institutions of Civil, Electrical and Mechanical Engineers, the Naval Architects and the Iron and Steel Institute. It is pointed out that for electrical engineers, standardization of electric railway work would be most important, but that it will be necessary to proceed with great caution and deliberation in this part of the work.—Lond. *Elec.*, April 10.

Glass.—Boistel.—A long article on the mechanical and especially the electrical properties of glass as used in electrical engineering.—*L'Ind. Elec.*, March 25.

New Books.

Reference Library of Modern Engineering Practice: Steam, Electricity, Mechanics. Illustrating and Explaining the Theory, Design, Construction and Operation of all kinds of Machinery. By Frank W. Gunsaulus, President Armour Institute of Technology, and 25 Collaborators. Chicago: American School of Correspondence at Armour Institute of Technology. Ten volumes. About 4,000 pages and 2,000 illustrations. Price, $40.

This is a work of considerable magnitude and not of a kind to be dismissed with a perfunctory review. We must state at the outset, however, that although it contains much matter that is admirable in quality, there are some features that we cannot even force into this category. To begin with, the mechanical makeup does not altogether fulfill the promise of the external appearance. The binding is in handsome red half morocco, which, unless it be considered too delicate for a book that is to be handled a great deal, is certainly all that could reasonably be asked. On opening a volume, however, we find that the paper is not of a quality that commends itself to our judgment. The typography is clear and legible, and on better paper would have been handsome. The cuts in many cases are good ones, but they do not stand the ordeal as well as the letter press and for the greater part do not show up as well as could be desired. In some cases they are decidedly poor, both in imprint and in design. The half-tones are mostly well chosen as to subject matter, and are apparently very good cuts, but the imprint on this paper is far from satisfactory. Indeed, it seems to us a triumph in press work that they are legible at all. The polychrome half-tones are printed on a different paper, better adapted to that kind of work, and are excellent examples of their kind.

The subject matter of this work embraces the greater part of electrical and steam engineering, so it cannot be expected that the articles will be exhaustive, particularly in the case of the less important ones. In an encyclopædic work there is a great opportunity for the exercise of editorial judgment in the allotment of space to different subjects; in fact this is one of the most important editorial functions. In the present work this appears to have been done in a satisfactory manner. Of course, there will always be some who will wish that more had been said about one subject even at the expense of other subjects, but on the whole the division of space will probably be satisfactory to the class of readers for whom the book was written. Take, for example, the article on metallurgy. It is obviously impossible that this article should be exhaustive, or even that it should discuss the metallurgy of all the commercial metals, so the greater part of the space is very properly devoted to iron and steel; the Bessemer and open-hearth processes, which are by far of the greatest engineering and commercial importance to-day, are described in a very creditable manner and the less important processes are more briefly treated.

The formulation of good definitions, next to the construction of sound theories, requires the highest grade of mental effort that the scientific writer is called upon to make. This book is weak in definitions. To be perfectly fair, we will state that most text-books are also; some writers who have international recognition as authorities cannot, or at all events do not, formulate good sound definitions. On the other hand, we have seen school books, such as arithmetics and elementary algebras, written half a century ago, in which the definitions were models of scientific accuracy. It surely is not hypercriticism to apply the principle that a definition that will not bear analysis is useless. The opening statement of Volume VII, under the heading, "Elements of Electricity," is as follows: "Electricity is an invisible agent which manifests itself in various ways. The precise nature of electricity is not known, but the effects produced by it, the methods of controlling it, and the laws governing its action are becoming well known." It has been for many years with many persons a favorite catch phrase, that we do not know what electricity is, or that we do not know the exact nature of electricity. Granted, but in the same sense that we do not know what electricity is, we do not know what anything else is. For example, what do we know about the ultimate nature of matter? More than two thousand years ago some of the Greek philosophers assumed the existence of atoms, and the atomic hypothesis in one form or other has continued to the present time. With the ancients the atom was what its name signifies, indivisible. With Boscovich it was not only invisible in fact, but also in concept—a mere center of force, a mathematical point. Then Lord Kelvin made the atom a minute vortex in a frictionless fluid, and now J. J. Thomson tells us that the smallest atom is not only divisible, but actually is divided, being composed of a large number of still smaller bodies. No one of these hypotheses is more than an hypothesis, or rests on direct experimental evidence of a convincing character. We then know as much of the ultimate nature of electricity as of matter, and matter is certainly at the head of the category of familiar things. Take next the attraction of gravitation. A little investigation will show a similar state of knowledge in this case also. A number of conflicting speculations, but nothing proved. In this clause of the definition, therefore, there is nothing characteristic of electricity, and so far the definition is useless.

The next clause of the definition states that the effects, etc., are becoming well known. Maxwell, in the preface to his treatise written thirty years ago, says: "The internal relations of the different branches of the science which we have to study are more numerous and complex than those of any other science hitherto developed." "The mathematical laws of the different classes of phenomena have been to a great extent satisfactorily made out." This is certainly all that could have been said of any science at the time. It is, of course, true that we are learning a great deal about electricity, just as we are about other sciences, but the implication that we are only just beginning to learn is entirely wrong. Students of Maxwell find many of the alleged new discoveries recorded in that remarkable work. The second sentence of the definition quoted is, therefore, reduced to a mere platitude. The first sentence, stating "Electricity is an invisible agent," although perhaps unassailable as a statement, conveys very little information.

The second paragraph begins: "Electricity may be considered under three heads: First, magnetism; second, static electricity; third, dynamic electricity." This has a delightful Hibernian flavor. We have heard that a mule makes a very good horse when you don't try to yoke him up with another ox.

Under "Magnetism" we read: "Substances which have the property of attracting pieces of iron are called magnets." This is simply a case of faulty diction. It should read "bodies," instead of "substances." A substance may be magnetic, but it is not a magnet. A definite portion of a substance, that is a body, may be a magnet.

Turning to the section on "Electrical Measurements," we read, "Fundamental Units. All physical quantities, such as volume, velocity, force, etc., are derived from, and can be expressed in terms of, the three fundamental quantities—length, mass and time." This definition contains several misstatements, although the writer of the definition may perhaps stand ready to defend it on the ground that he got it from some other book or books. At all events the errors are very widely circulated, and it is, therefore, all the more urgent that when a new book is published it should not repeat them. The units of all other physical quantities may be, and are, expressed or defined in terms of the three fundamental units, length, mass and time, but it is absurd to speak of one quantity being derived from another. Cubic feet cannot be manufactured out of linear feet by any possible jugglery. A linear foot is no more fundamental, except as a matter of convention, than a square or cubic foot. A cubic foot does not exist because a linear foot does, but linear, square and cubic feet exist because space, or extension, has three dimensions. If there were anything in the idea that length is fundamental and that area and volume are derived therefrom, then we could derive figures of four or more dimensions, and pan geometry would be realized. The whole theory of derived units rests on this principle. We assume a unit length, and then take for unit volume a cube whose length, breadth and height are each one linear unit. We do not derive the volume; that is just as fundamental as the length. Neither is any other quantity "derived" at all, or any unit derived except in the sense just explained.

The next error is excusable, on the ground that Maxwell says on the first page of his first volume, "It is possible to define these units in terms of the three fundamental units of length, time and mass." This is interpreted by many to mean that there cannot be less than three fundamental units, but this is misinterpretation, for on the fourth page Maxwell states that in the astronomical system the unit mass is defined in terms of the units of length and time. Moreover, in the metric system the unit of mass is really a derived unit, although this fact is usually ignored. It is the mass of unit volume of water at a standard temperature. Both these systems reduce the fundamental units to two, and as a matter of theoretical interest, they may be reduced to one.

The book goes on to say: "Each of these quantities is independent of the other, and can only be measured in terms of its own units." We have just seen that all physical quantities are independent, and that they can only be measured in terms of their own units, is obvious; else why do we have a different unit for each quantity? Why, for example, do we not measure e.m.f. in centimeters or inches? On the other hand, the units of length, time and mass may be defined in terms of other units. These units happen to be most convenient to base a system upon; that is all.

It is hard enough to teach the theory of units so that it is really understood in any case, as is evident from the number of persons, including college professors and writers who have read Maxwell without understanding him; but from definitions like the foregoing the truth cannot be extracted—it can only be learned in spite of them. For example, toward the bottom of the same page we read, "the area of a rectangular surface is obtained by multiplying the length by the width. . . . It is, therefore, evident that the only unit entering into the measurement of surface is *length*, and that the surface is measured by the product of two lengths." This is positively vicious. As well say that the only unit entering into the measurement of temperature is length, because in an ordinary thermometer the temperature is indicated by a scale reading. The product of the *number* of linear units in the length, by the *number* of linear units in the width, equals the *number* of superficial units in the area of a rectangle. It is only in this sense that two lengths can be multiplied at all. One at least of the two factors of a product must be an abstract number. The product of a length by an abstract number is a length, the product of two lengths is impossible and the product of two abstract numbers is an abstract number. The only unit entering into the measurement of surface is the unit area. But enough of this.

The book is on the whole better in its treatment of practical subjects than in its exposition of theory. The articles on pattern making, foundry practice and subjects of similar nature are good. We note a method, in the article on mechanical drawing, of dividing a right angle into six angles by means of the two ordinary draughtsman's triangles. The reviewer worked out this method himself in his callow days, but has never before seen it in print, and it seemed like meeting an old friend to encounter it here.

EINFUHRUNG IN DIE ELEKTROCHEMIE. Nach der Elektrolytischen Dissociations-therie. By F. Gertes. Halle: Wilhelm Knapp 124 pages, 48 illustrations. Price, 4 marks.

This little volume is intended to be an introduction to electrochemistry, written with the purpose of serving as a primer, so to speak, for people who have no acquaintance with, and no particular training for, the subject. It is, therefore, written in a popular style, and the author devotes considerable space to the discussion of electric, magnetic and chemical principles. The treatment of the electrochemical subjects is based altogether on the dissociation theory, because, in the opinion of the author, this theory has already caused a great revolution in the field of electrochemistry, and quite certainly will continue its influence into the future. Practical applications of electrochemistry which one might expect to see discussed in a work of this kind are only touched upon in the most superficial manner in five pages, more than three of which are devoted to electroplating.

It is a very difficult matter to write in a popular manner on scientific subjects, and requires an intimate knowledge and thorough mastery of the subject. How it can be done successfully has been shown by men like Faraday, Helmholtz and others prominent in the field of science. The author of the present volume falls far short of the standard set by these men. He has failed to reach an intimate knowledge of the subject and therefore the book abounds in inexact definitions and inaccurate statements. For example, on page 38 it is said: "There are a few chemical elements, the atomic complexes (molecules) of which consist only of one atom, and hydrogen (?) belongs to them." Again, on page 72: "If we bring silver (Ag) into nitric acid (HNO_3), one atom of silver combines with the nitrogen (?) of the latter, whereby the hydrogen is set free and escapes." On page 73 we find the following statements: "Potassium (K) and sodium (Na) are strong bases" (?). "If one replaces the hydroxyl in the base NaOH (caustic soda) by an acid residue, as SO_4, there is formed the compound $NaSO_4$ (?), sodium sulphate or Glauber's salt." Instances like these might be multiplied. The writing of text books in such a manner cannot be too strongly deprecated, especially when they are intended, as in the present instance, for the use of beginners.

ELEKTROMECHANISCHE KONSTRUKTIONEN. By Gisbert Kapp. Berlin: Julius Springer. 292 pages, 114 illustrations. Price, 20 marks.

In this second edition of Kapp's very able and useful book, the author has made a number of important additions of considerable extent, thereby bringing the book up to date. Of the 25 large folder plates, seven showing the older constructions have been replaced by 18 showing the more modern machines, thus increasing the scope about 40 per cent. It therefore almost deserves to be called a new book rather than a revised edition. The same is true of the collection of formulas.

The general nature of this large quarto volume, with its inserted volume of plates, is a very well selected and arranged set of formulas and data involved in the calculation, design and construction of electric machinery, including continuous and alternating-current dynamos and motors of various typical kinds, such as railway generators and motors, single and polyphase generators and motors, transformers, regulating switches for accumulator installations, etc. Rotary converters are absent, probably because this apparatus is now out of favor abroad, though developed there. Numerous very large folded plates of working drawings are given of actual machines, as made abroad. These are exclusively of European manufacture, and most of them were constructed in Germany, the types of machines made in the United States being represented only by a few built by the European representatives of the American companies.

The text accompanying these drawings gives the method of calculating them, the reasons why certain arrangements or constants were preferred, and similar information, together with curves of data. The deductions of the formulas is not given, as the author distinctly disclaims the book to be a treatise on this subject, on the contrary being limited to a collection of examples of design and construction taken from actual practice, and as such it is a very excellent one.

Special stress is laid on the importance of using formulas intelligently, and with discretion, and not merely mechanically, as may be done with mathematically exact formulas. Many of the formulas involved are correct only when correctly applied, and the author very properly emphasizes this. He has even illustrated it by showing cases in which a particular formula is not correct, and he gives the reasons for this.

The discussion of the respective machines is in some cases very extended. For instance, in connection with street railway motors he discusses also the time schedule or diagram in the operation of cars.

From a publisher's standpoint, the book is conveniently arranged. The folded plates are bound separately in paper, being inserted in a sort of pocket under the same cover as the text. The advantage of being able to use them apart from the book is evident. The illustrations are clear and well prepared. The text is very wisely printed in the same type as is used by other nations, and not in the very objectionable native German type. The margins are exceptionally wide, forming considerably more than half the page, which is very convenient for notes and additional data.

The book is unique of its kind, and can be very highly recommended to all constructing engineers and students. The high reputation of its author is a sufficient guarantee of the reliability and choice of the matter contained therein. It is to be regretted, of course, that American machines are not included, but for this the blame presumably rests with the American manufacturer, whose principle in keeping the design of machines a trade secret, or at least trying to do so, is very wisely not shared by the foreigners, who feel that a free discussion and exchange of views is of great advantage so far as the art is concerned, while at the same time keeping manufacturers from getting into ruts and perhaps staying there, sometimes without knowing it, until the less secretive foreigner calls attention to his plight.

A similar book on American machinery by an equally able authority, might be more acceptable to American readers, but in the absence of such a book, and in view of the fact that probably none equal to it will ever be published here, under present conditions, the present one is unquestionably the best that exists. It may safely be said that every designer of such machinery will find it of great value.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association. F. P. Ide, Springfield, Ill., Secretary.

National Electric Light Association. Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

The Latest Big New York Hotel.

The magnificent Hotel Astor, which is now under construction at Forty-fourth, Forty-fifth Streets and Seventh Avenue, New York—the new "center of the town," socially speaking, is to be equipped with one of the largest and most elaborate electrical plants for hotel use in this city. The contract for the electrical equipment has been awarded to the Western Electric Company.

The generators, which will run on superheated steam, will be four in number, each having a capacity of 250 kw. They will be direct-connected to tandem-compound engines of 400 hp each. The engines will be built by the Providence Engineering Company. The boilers—1,600 hp in four units of 400 hp each—will be of Babcock & Wilcox build. Forced draft will be used so as to permit of the boiler capacity reaching 2,300 hp.

Thirty-nine motors, varying from 3 hp to 20 hp, and aggregating in all 250 hp, will be utilized for operating the ventilating system, conveyors, elevators, pumps, laundry machinery, etc. The B. F. Sturtevant Company, Baker, Smith & Co., and Howard & Morse will instal the ventilating system. The Otis Elevator Company will build the elevators, nine of which will be installed. The pumps are to be of Worthington (Dean) and Goulds type. The Stair Lift Company, of Nicetown, Pa., is to build the electrically-operated conveyors. Each of the 500 odd rooms in the hotel will have a telephone and fire alarm. There will be 17,000 lights in the building, and a variety of other electrical facilities, novelties and "contraptions."

Heating and Ventilation of Railway and Other Shops.

At a recent meeting of the New York Railway Club discussion took place upon the subject of heating railway shops and other one-story buildings of the same nature. While such buildings are very simple in construction, they are not so simple as might appear in regard to the problem of effectively and efficiently distributing heat and air. On account of the large amount of roof, wall and window surface, the loss of heat is very great, and also, because of this and the relatively great height of the building considered as a single room, there is a tendency towards unequal distribution of the heat, the warm air rising to the roof and the cold air flowing to the floor, where it renders the workmen uncomfortable. It is important, then, not only that a sufficient quantity of heat should be delivered to the building, but also that it should be delivered where it will do the most good.

In the discussion, Mr. C. H. Gifford, of the B. F. Sturtevant Company, advocated the adoption of the fan system as one rendering the control of the heating apparatus and of the ventilation ideal. During very cold weather, or in the morning when the building is being heated up, the air supply may be drawn from within the building itself, thus effecting a great economy of heat. In some buildings having a very high cubic space per occupant, sufficient ventilation during the winter time will be supplied by the leakage of air through doors and crevices about the windows, by transfusion, etc.

The following general classification of railway shops was given: First, machine, erecting and car shops. Second, paint shops. Third, round houses.

The second and third require special treatment. Paint shops require to be practically dustless and, consequently, the air velocities must be low. The temperature requires to be higher, and it is customary to arrange to circulate the air in a much more thorough manner than in shops of the first class.

This is done in the Pennsylvania Railroad shops at Altoona by means of ducts and in the New Haven shops, Readville, by a similar overhead system. There has been a great deal of hesitation among railroad men about installing the hot-blast apparatus in paint shops. They are afraid of getting their varnish dusty. But I might name a dozen or so paint shops all over the country; for instance, the Boston & Albany shops, at Allston; the New Haven shops, at Readville, and there are several Western shops, all of which are heated with the hot-blast system by a very ample distribution of air. The circulation is brought about by a counter-exhaust system, which circulates the air, returning the whole or a part to the apparatus. There are two ways of establishing this return of the air; one by an underground duct system, and the other by an overhead galvanized system. In the Pennsylvania Railroad shops, at Altoona, we have an installation that has been in a dozen years. I think it is one of the first we put in that returned the air from underground and back to the fans, using very ample distribution of air-pipe in the discharge.

In the Readville shops the air is brought back by means of an overhead galvanized pipe. In this way circulation is kept up in all parts of the room and thereby the paint is dried much more rapidly than it would be by any other system where the air in the room is practically still.

Round houses have been much neglected up to recent years, but of late they have been receiving better attention. Their proper heating is a problem of no little moment.

The hot-blast system of heating is a great improvement over the old method, since it allows for ventilation in the winter time with both windows and doors closed. In this class of buildings the air should be delivered through ducts which terminate in the walls of the pit, thus delivering the air where it will be most effective for thawing out engines that have come into the house covered with snow and ice. At the same time it is a very good idea to have a provision for admitting some of the air above the floor in case there are no locomotives which need special attention.

Automobile Charging Outfits.

To meet any case that may arrive in automobile charging service, the Westinghouse Electric & Manufacturing Company has devised a system admitting of no less than 108 combinations and variations—a sufficient variety undoubtedly to meet any conditions or demands of either private or public charging stations. With these combinations, one, two, four, twelve or more automobiles can be charged at once.

The outfits for charging one or two machines are intended for private use, that with a capacity of four are suitable for clubs, country houses, or small stables, while the standard twelve service is applicable for use by public garages, express and cab companies, or other establishments having a number of vehicles.

One of the chief advantages of the garage installation shown in Fig. 1—the only one possessing this valuable feature—is that all controls are at one point, with minimum apparatus, instead of, as in the former practice, having them individualized and spread over considerable space, involving double the trouble and expense. There is also a saving in that instead of being compelled to use twelve voltmeters and twelve ammeters, one of each is sufficient.

Another important item is that the charging may be in serial or simultaneous. Fig. 2 shows one of these garage switchboards with the series rheostats installed below it for controlling the charging rates of the various batteries. In this particular case rheostats are provided for eight vehicles, the greater capacity being obtained at any time by adding the requisite number of rheostats.

Each switch on the board is numbered to correspond with the number of its rheostat and charging stand. The throwing of a switch to the left places a battery in "charge"; reversing to the right connects the ammeter so that the current may be read. The voltmeter will indicate for the whole main line, or by pressing the push button corresponding to any switch the voltage reading of its stand can be taken. A separate push button gives the voltage reading on the line beyond the rheostats. Opposite each switch is a numbered hook upon which the charging record of the battery may be kept.

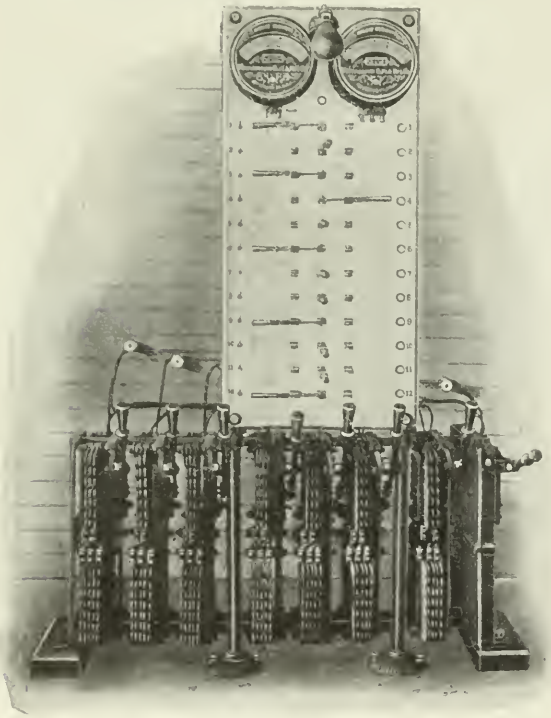


FIG. 1.—GARAGE INSTALLATION.

In connection with this central switchboard automatic circuit-breakers and fuse blocks are to be used at each charging stand. These switchboards (Fig. 2) may be connected with any 125-volt, direct current line, whether from central stations, motor generator set, or independent circuit.

For the one or two vehicles of the private owner, or the small garage designed for four machines the panels are as shown, with the necessary modifications in each case, and are adapted for direct-current voltage of 110 to 125. For single charging the automatic circuit breaker is mounted directly upon the panel with the meters and fused switch. Where two or more automobiles are to be charged the circuit breakers are displaced by switches, and the over voltage circuit breaker and fuse blocks are located at the carriage charging stands.

The meters, which for private use may be a combined voltmeter and ammeter, are provided with sub-scales and convenient terminals for reading voltages of individual cells; with volt scale from 0 to 150, sub-scales 0 to 3, and ampere scales 0 to 100. The circuit-breakers under normal circumstances automatically cut out the battery when the charge is completed, and in all cases protect the battery from any over-charge danger or damage, enabling the owner or attendant to set the charge and pay no more attention to it until the machine is again wanted for use, without loss or damage of any kind. The motor-starter rheostats, employed in starting the direct-current motors are mounted on the back of the panels, with handle projecting through; the same as with the generator field rheostats. Where a generator is employed the latter are used for the regulation of the battery charging of one carriage, without requiring the additional series rheostats of the grid or imbedded type. Where the series rheostats are needed, they are made in one of three types—grid, embedded or combined. In the first form they are mounted on the floor directly below the switchboard, the grids being of cast iron, set in the open air, thoroughly ventilated, and while they are normally made to carry 60 amp. each, they can be immensely overloaded without injury, surviving unhurt where other types burn out. This is an important point, since it obviates all danger of battery injury by the burning out of the rheostats, a danger that has been, and in some types still is, found only too frequently. The imbedded type of rheostat is in two styles, designed for use with either 10 to 14 or 20 to 24 cells, when charged from a 125-volt line, will each carry continuously 30 amp., and may be mounted with several of the same type or with the grid type. The life of the battery itself practically has no limit. Its efficient existence is merely a question of renewing the plates at long intervals when they are worn out.

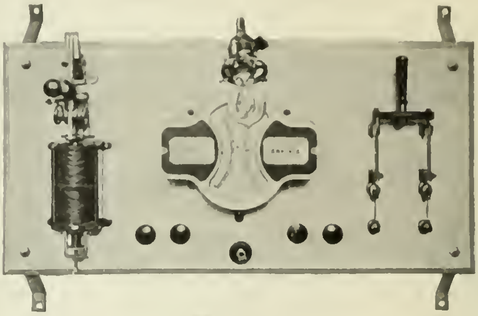


FIG. 2.—SWITCHBOARD.

The direct or alternating-current motor-generators furnished by the Westinghouse Company are of standard type and adapted to the panel used, transforming high-voltage, direct-current to the proper voltage, or changing alternating current to the desired voltage, direct current for charging. These present an advantage in that, being standard, they are always a marketable commodity.

In cases where the owner prefers his own isolated plant of gas or other power for driving a generator, accessory apparatus to meet the requirements has been added to the outfits.

Connecticut Purchase Law.

A report directing that the city shall pay $500,000 for the plant of the Norwich (Conn.) Gas & Electric Company, has been filed by a commission which has been investigating the matter. The proceedings were brought under the State law regarding the purchase of the plants of existing lighting companies by cities desiring to enter into the business of municipal lighting. This is the first report filed under the new law.

Queen's Engineering Works, Bedford, England.

One of the British engineering firms most widely known is the W. H. Allen, Son & Co., Limited, formerly having its works at Lambeth, London, and since 1894 at Bedford, where the Queen's Engineering Works were established in 1894. The illustration of one of the fronts of the works given herewith illustrates the admirable European practice of not neglecting architectural effect in the construction of buildings intended for manufacturing purposes.

The works have been built and specially equipped with plant, arranged for the manufacture of the highest class of machinery comprising auxiliary machinery for the Admiralty, dynamo-electric machinery, centrifugal pumping engines, air pumping machinery, fan engines and small electric gear for the mercantile marine and machinery for large central stations, comprising engines and dynamos, motors, condensing plants and air pumps. The electrical machinery of the Queen's Works enjoys an enviable standing throughout Great Britain and the colonies.

The works employ about 800 men. Very complete American methods have been adopted for the manufacture and interchangeability of parts, and some of the latest American machine tools have been put in during the last few years. The company has for several years past taken a great interest in the training of pupils, Mr. W. H. Allen devoting his personal attention to their progress. Messrs. Allen have set aside a department for this purpose and a demonstrator is in constant attendance who not only assists in solving difficult problems connected with their work, but also guides them as to the literature of allied subjects so that they may be able to read in their spare time and attain a deeper knowledge of their work.

FACADE OF QUEEN'S ENGINEERING WORKS.

The demonstrator superintends each pupil in the various departments and is entirely responsible for the work they are engaged upon. Lectures are given in a spacious lecture room connected with the main offices every Monday evening on various subjects. The pupils are also in constant touch with the directors, who endeavor to exercise a useful control in the welfare of each pupil generally. The pleasant relationship existing between the company and its employees is one of the characteristics of this admirably organized establishment, the result being a spirit throughout the works that everyone shall do the best he can for the company.

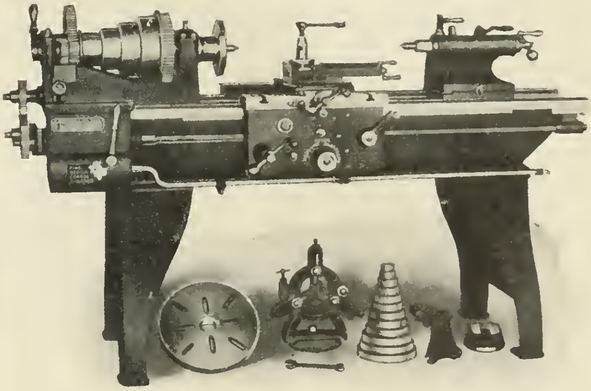
Chloride Accumulators.

The Electric Storage Battery Company, of Philadelphia, manufacturer of the "Chloride" accumulator, has recently closed contracts for a number of installations for isolated plants. Among these may be mentioned a large battery for the Astor Hotel, New York City, an installation for the Edmore lighting station, Edmore, Mich., and residential battery plants for Reginald Vanderbilt, Portsmouth, R. I.; Thomas Morrison, Pittsburg, Pa.; B. F. Jones, Sewickley, Pa.; J. J. Ryker, Port Chester, N. Y., and the Peace Dale Manufacturing Company, at Peace Dale, R. I. The last-named installation is made for the purpose of lighting six residences, a library, a church and two office buildings. The company has, however, a continuous growing demand for its batteries in a variety of miscellaneous work, outside central stations and isolated plants.

New "Star" Screw-Cutting Engine Lathe.

We show in the accompanying cut a new size (14-in. swing) of the "Star" lathes, which has been designed to meet the demands of modern shop practice, for using high-speed tool steel, large feeds, big cuts, etc. This lathe has an actual swing of 15¼ in. over bed, 8⅞ in. over plain and compound rests and 6¼ in. over rise and fall rests, with 6-ft. bed, a distance between centers of 34 in., and the net weight of 1,625 pounds. The head stock is heavy, it has a hollow spindle with 1 3-16-in. hole, made from a crucible steel forging, and large bearings of phosphor bronze. The spindle is ground true and the bearings are hand-scraped to insure an accurate fit. The cone pulley has four extra wide steps for a 2¼-in. belt; the ratio of back gearing is 9 to 1. The tail stock is the curved pattern, which allows the compound rest to swing around parallel with the ways and over the base of the tail stock, with room to operate the feed screw handle. The tail spindle has improved locking device, which insures perfect alignment. The tail stock has long bearing on the bed and is locked to the bed in such a manner as to render it very rigid.

The carriage is extra heavy, and provided with "T" slots for bolting on angle plates, etc. It has long bearing on the ways and is gibbed to the bed. A new cam-locking device in the apron is provided for locking the carriage to the bed when using the cross feed. This device is operated by the same lever that operates the split nut on the lead screw and the split nut cannot be engaged with the lead screw when the carriage is locked to the bed. The cross feed screw is graduated to read in thousandths of an inch. The compound rest has extra long travel, 5¼ in., and is capable of fine adjustment as the base is graduated. The tool post has a patented collar and shoe, which exclude all dirt and chips and admit of quick, easy and secure adjustment of the tool.



SCREW-CUTTING LATHE.

Power is transmitted from the head spindle to the lead screw entirely by gears and is arranged with three changes of feeds—fine, medium and coarse. There is a new friction feed, by which both cross and longitudinal feeds are thrown in and out of contact by one hand knob on the apron, which operates a double friction clutch in connection with a worm gear, which is actuated by a phosphor bronze worm on the lead screw. This construction prevents both cross and longitudinal friction feeds from being thrown in contact at the same time. The worm is keyed to the lead screw, which is spliced and simply acts as a feed rod, therefore the only wear on the threads of the lead screw is in screw-cutting. The range of feeds is very large.

The range of screw-cutting is extra large, cutting all standard threads without compounding the change gears and nearly all threads by compounding. The bed is extremely broad, deep and heavy and all other parts are accurately proportioned throughout, making a very strong, stiff and rigid lathe. The countershaft has patent friction clutch pulleys, easy to operate, strong and durable, also has adjustable and self-oiling shaft bearings.

This lathe, which includes also a number of other desirable features, is made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y.

An English Photometer.

The instrument illustrated herewith is designed for comparing two lights of the same or different colors and thus facilitating the estimation of the intensity of one in terms of the other. The researches of Rood, Ferry and Whitman, from 1892 to 1896, on the subject of retinal sensitiveness to varying luminosities, more especially in respect to the retentiveness or duration of the impression of luminosities of different tints, prove conclusively that intensity is the sole arbiter of the length of such impressions, and that color has no influence in the matter, and this conclusion has been confirmed by recent experiments of Simmance and Abady. This being granted, it is obvious that a photometer which, taking advantage of this phenomenon, bars out all differences of color and only registers intensities, will abolish the uncertainties which have accompanied tests of various tints of light.

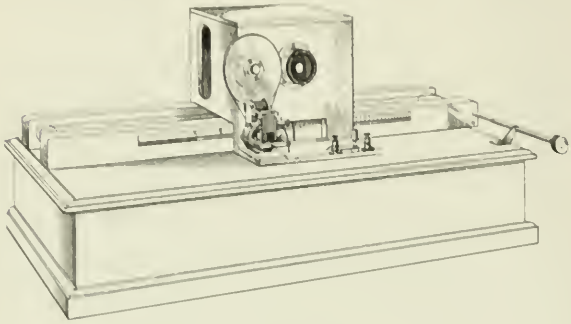


FIG. 1.—PHOTOMETER.

It is found that if rays from two sources of light, one being, for example, red, the other green, are allowed to fall in rapid succession upon a screen or upon the retina, the eye ceases to distinguish the colors, and is only sensible to the degree of intensity of the illumination. The utilization of this fact in a photometer satisfies practical conditions, for if the intensities of the two lights red and green are equal, no difference in the illumination is perceptible (the eye losing all sense of the colors), whereas if the intensities differ, the eye is acutely sensible of the fact.

The Simmance-Abady photometer as illustrated is claimed to be a simple means of carrying into practice the above theory. Beams from each light (one being of a known power and the other unknown) are directed on a paper screen across which vibrates a shutter, cutting off each ray in turn. Thus the eye perceives only one ray, the source of which is each light alternately. By careful adjustment the duration of each ray is exactly the same, and the two rays do not overlap. If the lights are unequal in power the oscillation of the shutter at a given speed produces a vibrating effect, but by moving the screen and shutter nearer the weaker light, a balance is gradually set up until the distances are such that rays from the two sources are equal, which point is indicated on the screen by a total absence of the vibration. Under these conditions the shutter cuts off first one ray and then the other without the eye being sensible of any movement; for although the rays may be of different colors yet the retina ceases to discern color and only judges intensity. In Fig. 2 *A A* are the lights, *B B* the reflecting surfaces, *C* is the illumination screen, and *D* the vibrating shutter.

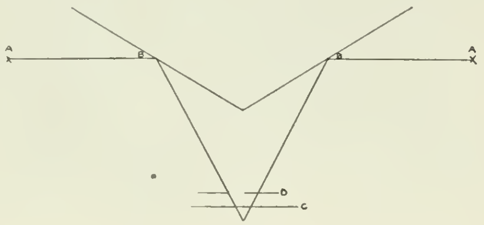


FIG. 2.—DIAGRAM ILLUSTRATING PRINCIPLE OF PHOTOMETER.

The introduction of this practical form of photometer, based on long known laws, has enabled very accurate estimations to be made of the actual power of electric arc lamps and the incandescent gas (Auer) light. A proof of the delicacy of the readings is afforded by the fact that when lights of the same color are tested by it, the results agree exactly with those made with the Bunsen or Lummer-Brodhun apparatus; whilst when the lights vary in color, different operators disagree totally in their readings with these photometers, but it is stated that all experimentalists coincide to the smallest fraction when the same lights are tried with the Simmance Abady instrument.

The instrument is provided with means of reversing the light receiving surfaces so as to avoid error through inequalities of material, and every angle and measurement is convenient for verification. The manufacturers are Alexander Wright & Company, Limited, of Westminster, England.

Fan Motor and Battery.

Messrs. J. Jones & Son, 64 Cortlandt Street, New York, are placing on the market a fan motor and battery, which we illustrate herewith. The motor in its general features follows closely the lines of motors made to run on lighting circuits. The body stands on a base containing the switch, the handle of which protrudes in the ordinary manner. The fields are properly proportioned for work on low current and in connection with the armature are designed for high efficiency. The fan blades are well balanced, a thing greatly needed in a battery fan where every little item means a call on the battery. The guard is a heavy one, well made and strong, with which the motor can be handled without trouble; it is made for handling, in fact, and is not the usual flimsy affair. The shaft, like the other parts, is mechanically balanced to a nicety in its bearings, and lubricated by means of efficient oil cups. In short, the fan is made mechanically and electrically for the work required of it—made with the view of having the battery power operate on the motor, and not expend its energies uselessly.

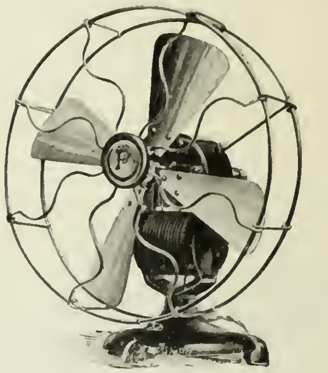


FIG. 1.—BATTERY FAN MOTOR.

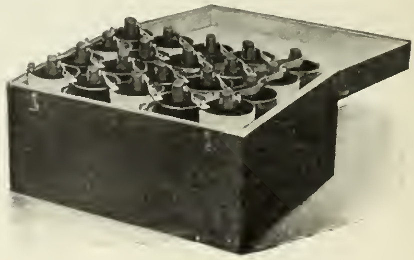


FIG. 2.—BATTERY OF DRY CELLS.

The battery consists of dry cells, and thus is free of the disagreeable features of recharging elements, odors and acids to leak and spoil the carpets, and may be placed among the most delicate furnishings in any position, and is guaranteed to run with ordinary use for at least 250 hours, and, therefore, during an entire season.

The Robb-Mumford Boiler.

The Robb-Mumford, internally fired boiler, illustrated herewith, although new to the American market, has been manufactured extensively for several years in British America, where it has been used for almost all purposes in various parts of the country from the Atlantic to the Pacific, with good and bad water and a variety of fuels, the conditions being similar to those in the United States. The result is that the boiler has passed through a process of evolution, in which the weak points have been eliminated and many improvements made.

The boiler consists of two cylindrical shells, the lower one containing a cylindrical furnace and tubes, and the upper forming a steam and water drum, the two being connected by two necks or circulating pipes. The lower shell has an incline of about one inch to the foot from the horizontal, for the purpose of promoting circulation and draught. A steel casing, stiffened by angle irons and lined with asbestos air cell blocks, forms the rear smoke box and return smoke flue between the lower and upper shells, the upper half of the steam drum and bottom of the lower shell being also covered by non-conducting material.

The furnace is of the well-known "Fox" or "Morrison" corrugated type, without joints, providing for expansion and contraction, and requiring no staying. The heads of the steam drum are spherical, and the tube sheets are stayed by the tubes; as every part of the boiler is cylindrical except the tube sheets, no other staying is required.

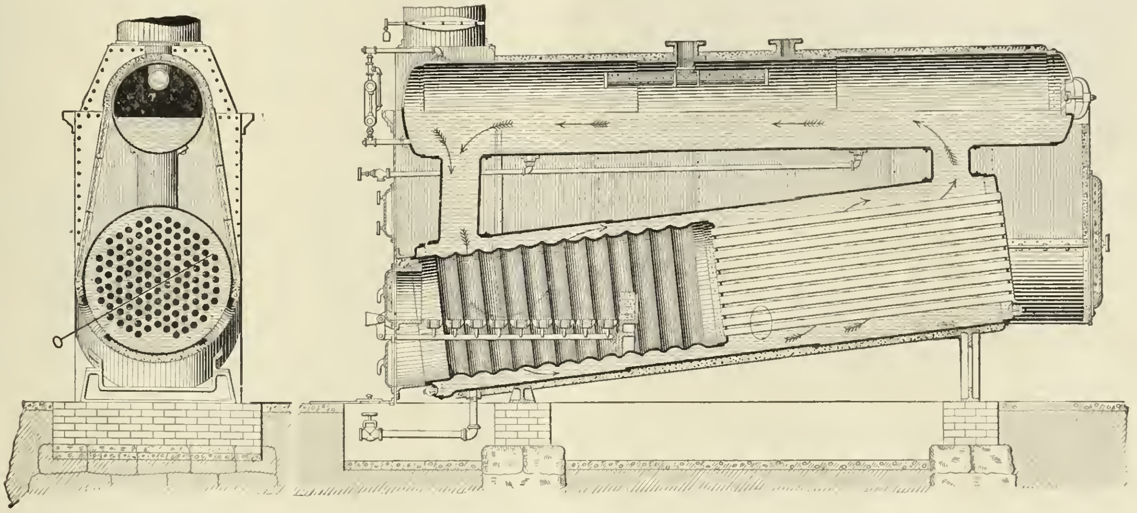


Fig 1.—Cross and Longitudinal Sections of Boiler.

The gases, after leaving the furnace, pass through the tubes and return between the lower and upper shells to the outlet at the front of the boiler. The furnace being of large diameter and highest at the back, with considerable space beyond the grate surface, is favorable to good combustion. The tubes are short, direct and proportioned to give the correct area, in order that they may all be filled with hot gases. Most of the soot is carried through the tubes and deposited in the rear smoke box, so that all the heating surfaces of the furnace, tubes and return flue between the upper and lower drum are very effective.

The circulation of water inside the boiler is around the furnace and tubes, up the rear neck into the steam and water drum, where the steam is released, the water passing along the upper drum towards the front, and down the front neck. A semi-circular baffle plate, which is placed about half way around the furnace, causes the down-flowing water to circulate to the lowest part of the shell under the furnace.

It will be seen by reference to the sectional cuts that the feed water enters the rear part of the upper drum, where it meets the current of hot water flowing towards the front, so that as it passes towards the front the temperature is raised to that of the steam and water in the boiler; an opportunity is thus given to drop any sediment or solvent impurities on the bottom of the upper drum, particularly in the pocket formed by a baffle plate placed back of the front neck, a blow-off outlet being provided at that point. Another pocket for the deposit of sediment is provided underneath the furnace, with a blow-off, so that there are practically two mud drums providing for the deposit and removal of sediment before the inflowing water reaches the hot surfaces of the furnace and tubes, where scale would be formed. It is found by experience in using impure water, that it is easy to keep the boiler clean by the regular use of the blow-off cocks, and the usual washing out through the hand holes at the front and back of the lower shell and through the man-hole in the upper drum. In addition, there are two large hand holes in the shell at the rear of the furnace for cleaning between the tubes, the tubes being spaced in parallel diagonal rows, so that a bar may be passed through every row of tubes at the rear of the furnace, where scale will form, if at all. Owing to the rapid circulation of water around the upper part of the furnace and tubes, it is found scale will not form, except at the lower part of the boiler. In cases where exceptionally bad water is used, the furnace and tubes are bolted in, so that by removing a row of bolts passing through the front ring and an exterior angle iron ring, and another row through the rear tube sheet and ring, the entire furnace and tubes may be removed for inspection and cleaning.

Every part of the boiler is open to inspection. A large space is provided under the shell, through which a man may pass and inspect the entire lower half of the shell. The upper half of the shell, drum and necks are open to inspection through the front and rear doors, and, if necessary, the side casings may be removed. A man-hole is provided in the upper drum and numerous hand holes in the lower drum, so that the interior of the boiler may be readily examined.

It is claimed for this boiler that it has the advantage of the Scotch marine and similar types of internally fired boilers, without the large diameter of shell, thick plates and expensive combustion chamber, while giving the lighter weight, less floor space and more perfect circulation of the best boilers of the sectional water tube type, but avoiding the large number of hand holes and joints usually necessary in boilers of this type. As the fire box is internal, surrounded entirely by water, there is no loss of heat, either by radiation or air leakage, which takes place in boilers of the brick-set type; and the expensive repairs incident to brick-setting are entirely obviated.

It has been stated that internally-fired boilers tend to imperfect combustion, on account of the cold surfaces of the furnace, but in this respect they do not differ from return tubular or water tube boilers, in which the water surface is directly above the fire. The long furnace and combustion chamber of this boiler, with greatest height at the back, favors complete mingling of the gases and good combustion.

The manufacturers of the Robb-Mumford boiler say that the best results are obtained by having a rather small grate surface, strong draught, and a thick fire; or, in other words, a high rate of combustion per square foot of grate. They claim that the practice of furnishing a large grate surface, as is frequently done in boilers of the externally-fired type, to increase the capacity of the boiler, is opposed, to good economy; first, because if more coal is burned than the heating surface of the boiler is calculated for, the gases will escape too hot, and, on the other hand, when the boiler is worked at a less capacity, the grate surface is so large that the fire may not be properly distributed over the whole grate, and is liable to have thin or dead spots through which cold air may pass, causing waste and imperfect combustion

As this boiler consists practically of two steam and water drums similar to those used in water tube boilers, and constructed entirely of steel plate without stays, it is considered to be equally as safe as the best of that type A battery of 1,000 hp occupies a space of about 32 ft. in width by 23 ft. in depth and 14.25 ft. in height. Each unit is entirely distinct and may be completely isolated for cleaning, inspection or repairs. The manufacturers for the United States are the Robb-Mumford Boiler Company, Incorporated, with offices at 135 Broadway, New York, and 170 Summer Street, Boston.

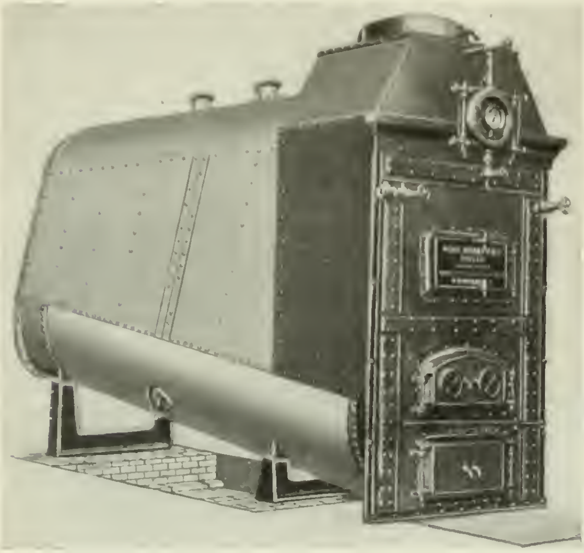


FIG. 2.—PERSPECTIVE VIEW OF BOILER.

New Combination Ohmmeter.

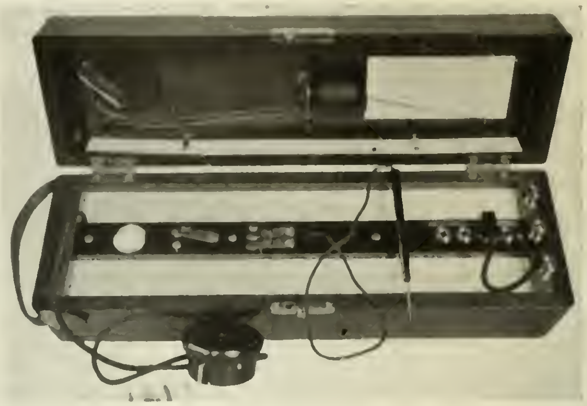
We illustrate herewith a new form of Sage ohmmeter being placed on the market by Messrs. Machado & Roller, the licensees under the Hanchett and Sage patents. As will be seen, this differs from the old form in having added a galvanometer and an induction coil. Two switches are also provided, with the aid of which either the telephone receiver or the galvanometer may be used as the current detector at will, and one applies either direct current from the batteries or alternating current from the secondary winding of the induction coil at will.

The galvanometer is of the D'Arsonval form unaffected by external influences, well balanced so that care in leveling is not required, and of a sensibility even superior to that of the telephone receiver. It is, of course, also unnecessary to place the meter in any particular meridian in order to bring the galvanometer needle to zero.

The galvanometer is a valuable adjunct in that it enables the set to be used where there is too much noise to make the employment of the telephone receiver possible, and further gives a means of working from a false zero in making the Murray test.

The induction coil makes it possible to compare capacities and inductances and to measure the resistance of electrolytes or internal resistance of batteries. It also comes in when locating faults on lines where an e.m.f. exists at the fault, as for instance in a submarine cable where one or more conductors are grounded or both open and grounded. By keeping the telephone receiver circuit closed the e.m.f. at a fault of this kind causes a continuous current to flow which does not affect the telephone receiver, the alternating current from the induction coil of the instrument alone being effective for use in obtaining balance.

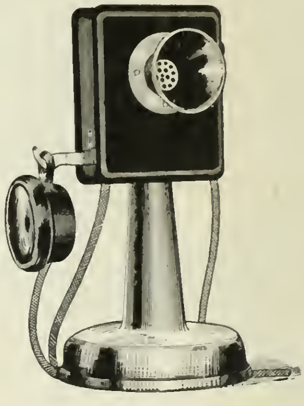
The number of cells of battery has not been reduced and the overall dimensions have not been increased, while the weight is only about a pound more than that of the original form of apparatus It is claimed that tests that have recently been made under the most severe service conditions show this form of meter to be superior in every way to a bridge and galvanometer for the location of faults.



OHMMETER.

New Desk Telephone Set.

The Atwater-Kent Manufacturing Works, Philadelphia, has brought out a desk telephone set which differs in several respects from the usual form of this type of instrument. It consists in the combination with a nickeled stand of handsomely finished oak box scarcely larger than an ordinary transmitter case. A flexible cord connects this with a terminal block on the wall. On this block is also placed the bell. The sets are made to be used with both the two-end and intercommunicating systems. The self-contained transmitter of the same make, which is always in adjustment, is mounted inside of the box. The receiver is made in one piece and has no parts to become loose. The hook contacts are knife edge, which makes it impossible for acid or dirt to prevent perfect contact. The instrument is finished in a neat and desirable manner.



DESK TELEPHONE.

New Works of "P. & B."

The Standard Paint Company, on the evening of April 22, gave a house warming to its employees and members of the press to celebrate the completion of its new factory buildings at Bound Brook, N. J. On the upper floor of the main building, about 250 x 100 ft., and handsomely decorated with flags, bunting, etc., for the occasion, refreshments were served and dancing was enjoyed.

The newly equipped factory is an evidence of the great success with which the products of this company have met. Since the company's inception in 1886, the "P. & B." insulating compounds, and, latterly, "Ruberoid," have become well known all over the world, and are extensively used.

The new factory is a model in every respect. It is electrically equipped, the power being furnished by a direct-connected engine and generator built by the American Engine Company, Bound Brook, N. J.

The elaborate entertainment furnished at this opening was a complete success through the untiring efforts of Mr. R. L. Shainwald, assisted by Mr. F. F. Vandewater and P. M. Wade.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a moderate demand for money with liberal offerings, the closing rates being 4¼ per cent. for 60 to 90 days and 4½ per cent. for four, five and six months. In stocks there were slightly reactionary tendencies following an advance early in the week, caused by the easing of the money market and the modification of the Northern Securities decision in a way which permits dividend payments pending an appeal of the case. Professional trading supplied most of the activity and there was a decided absence of features. Some interest was shown in the hearing of the charges growing out of the recent attacks upon the management of the Metropolitan Street Railway, although this did not materially influence prices of traction stocks. Brooklyn Rapid Transit was somewhat irregular, although the current reports regarding the company are favorable. The United States Steel stocks were dull, advancing in sympathy with the general list and then declining when the market weakened. Amalgamated Copper showed some weakness. Metropolitan Street Railway reached 133¼, but dropped off and closed at 129¾, being ¾ above the lowest figure, and representing a net loss of 2¼ points on the week's trading. Brooklyn Rapid Transit closed at 65, which was the lowest quotation of the week, and 1½ points net loss. General Electric declined to 192, but recovered some of the loss and closed at 193½, being a net gain of 3 points. Westinghouse common and preferred made net gains of 14½ and 8 points respectively, the closing quotations being 208 and 210. Western Union made a net gain of ½, closing at 85½. Following are the closing quotations of April 28:

NEW YORK.

	Apr. 21.	Apr. 28		Apr. 21.	Apr. 28
American Tel. & Cable	80	75	General Electric	192	192½
American Tel. & Tel.	158	160	Hudson River Tel.	..	..
American Dist. Tel	30	..	Metropolitan St. Ry.	131¾	130⅛
Brooklyn Rapid Transit	66¾	65¾	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	20	20	N. Y. E. V. T. Co.	..	..
Electric Boat pfd	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1	1¼	Western Union Tel.	85⅜	85
Electric Vehicle	12	12	Westinghouse com.	206	195
Electric Vehicle pfd	16	15	Westinghouse pfd.	206	195

BOSTON.

	Apr. 21.	Apr. 28		Apr. 21	Apr. 28
American Tel. & Tel	155	160⅞	Western Tel. & Tel. pfd.	96¾	96
Cumberland Telephone	..	..	Mexican Telephone	1⅞	2⅛
Edison Elec. Illum.	..	..	New England Telephone	135	136
General Electric	..	..	Westinghouse	..	95
Western Tel. & Tel	20	19	Westinghouse pfd	..	95

PHILADELPHIA.

	Apr. 21	Apr 28		Apr. 21.	Apr. 28
American Railways	..	..	Phila. Traction	97⅜	97½
Elec. Storage Battery	70*	74	Phila. Electric	7	7⅛
Elec. Storage Battery pfd	70*	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Apr. 21.	Apr. 28		Apr. 21.	Apr. 28
Central Union Tel	..	..	National Carbon pfd.	97	96
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry.	..	205	Union Traction	7⅛	6¼
Chicago Tel. Co	..	..	Union Traction pfd.	37	33
National Carbon	24¼	24¼			

*Asked.

INTERNATIONAL WIRELESS COMPANY.—Details are given as to the organization of the International Wireless Telegraph and Telephone Company, $7,500,000 capital stock, of New Jersey, controlling the inventions of Prof. A. E. Dolbear, C. E. Collins and H. Shoemaker. Mr. Fred G. Smith is president, and W. B. Averill, vice-president; Jacob Schiff, Edgar Van Etten, Henry L. Sprague and C. B. Walters are among the incorporators of the company. The International Company has taken over all the property, patents, etc., of the Consolidated Wireless Telegraph and Telephone Company, which had a capital stock of $25,000,000, and was the successor of the American Wireless Telephone and Telegraph Co. Dr. G. P. Gehring, of Philadelphia, was the chief promoter. The American Company had a capital of $5,000,000, and licensed six subsidiary companies, each capitalized at $5,000,000. The terms of the license were that the parent company should receive a stipulated royalty upon the sales of all stock. The promoters of one of the subsidiary companies are said to have sold some 800,000 shares, realizing about $200,000 therefrom. It is claimed that the money derived from the sale of these shares was diverted to the pockets of the promoters of the subsidiary companies, and was not used in the development of the wireless system. The Consolidated Wireless Telegraph and Telephone Company, was therefore organized to put an end to the career of these subsidiary concerns. Its stock is still purchasable from the company at from 50 to 75 cents per share. The stock of the International Company is not yet offered to the public. There are said to be 61 patents, 9 actual or prospective stations, and a copyright on the word "aerogram."

CHICAGO UNION TRACTION COMPANY IN DEFAULT.—A Chicago dispatch states that the Union Traction Company was virtually declared in default on April 22, when it was thrown into the hands of the United States Court. Three judgments aggregating $1,100,000 were entered against the company. The judgments were in favor of the Guaranty Trust Company, of New York, and were entered specifically against the Chicago Union Traction Company, the Consolidated Traction Company, the North Chicago Street Railway and the West Chicago Street Railway Company. The charter of the Chicago Union Traction Company appears to be such that a direct receivership could not be applied for, so the action in judgment proceedings was resorted to. The judgment against the North Chicago railway is for $570,052.66; against the West Chicago company for $280,440; against the Union Traction Company, $217,690.66. James H. Eckels, president of the Commercial National Bank, and Marshall E. Sampsell, clerk of the United States Circuit Court, were chosen to act as joint receivers for the properties.

EVANSTON (ILL.) YARYAN COMPANY.—The plant of the Evanston (Ill.) Yaryan Company, which was bid in at foreclosure sale last week by Lyman A. Walton, vice-president of the Equitable Trust Company, for $219,295, has been conveyed by him to the Evanston Heating Company, organized to succeed the Yaryan Company. The consideration is $285,000. The purchasing company executed a trust deed to the Illinois Trust & Savings Bank as trustee for $400,000, of which $125,000 is to be issued immediately, to be followed by additional issues from time to time in connection with the improvement and enlargement of the plant not exceeding in the aggregate 85 per cent. of the company's subsequent additional expenditures. The bonds run ten years and bear 5 per cent. interest. It is understood that interests friendly to the Chicago Edison Company are behind the purchase.

BOSTON EDISON INCREASE.—A special meeting of the Boston Edison Company will be held in May to authorize the issue of 8,640 shares of treasury stock and authorized by the gas commissioners to be issued at $200. This stock will be offered, on the basis of one new share for each ten now held, to stockholders of record on the date of special meeting. In the event that the gas commissioners authorize stockholders to subscribe for the new 20,000 share issue just voted at $200 a share, $4,000,000 will be realized, of which amount $2,250,000 will be used in making payments on the recently acquired electrical business of suburban companies, leaving $1,750,000 for improvements.

CUMBERLAND TELEPHONE.—The Cumberland Telephone and Telegraph Company (Bell system in some Southern States) reports for two months ending March 31, as follows:

	1903.	1902.	Changes.
Gross	$548,764	$488,664	Inc. $60,100
Expenses	381,318	356,390	Inc. 24,928
Net	$167,446	$132,274	Inc. $35,172

Subscribers number 96,168, against 81,621 in March, 1902, an increase of 14,547.

DIVIDENDS.—The directors of Westinghouse Electric & Mfg. have declared the quarterly dividend of 1¾ per cent. upon the assenting stock, payable May 15 to stock of record April 30. The Chicago Edison directors have declared the regular quarterly dividend of 2 per cent. payable May 1. The directors of the American District Telegraph Company have declared the regular semi-annual dividend of 1 per cent., payable May 15. The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable May 15.

THE FALL RIVER (MASS.) AUTOMATIC TELEPHONE COMPANY, after charging off depreciation has paid a quarterly dividend of 1¼ per cent., and has a surplus left. The number of subscribers' stations is over 1,000, and applications are being received daily. It is claimed that the expense as well as the plant investment shows a decided decrease per subscriber with growth of the exchange. The increased number of telephones in operation has shown no increase in number of troubles, and no necessity for additional help to take care of the system.

MONEY TO BURN.—The *New York Sun* gives space to the following curious item: "There is current in certain stock market circles the strange story that a crowd of operators with headquarters in a big Broadway building has been accumulating for several months past a large surplus of cash. There has been, it is said, heavy liquidation of stocks to swell the mysteries fund, the present proportions of which are estimated in figures that would excite scepticism but for the apparent sincerity with which the information is given. Various imaginary reasons have been assigned for the concentration of so much money. The matter, naturally, has given rise to a great deal of talk, and it is taken for granted that an important deal is foreshadowed, but the nature of it is a profound mystery. The crowd in question is heavily interested in traction and lighting affairs. Everything about the story is extremely vague, which, of course, gives it an increased speculative interest."

CUYAHOGA TELEPHONE COMPANY.—The directors of the Cuyahoga Telephone Company, Cleveland, Ohio, have agreed upon a plan for refinancing the company, to be submitted to a vote of stockholders on May 21. It provides for the reduction of the capital stock from $3,000,000 to $1,500,000, and the issue $2,000,000 of 6 per cent. cumulative preferred stock to be offered to present stockholders at 70. This would net $840,000, for which $569,348 would go to the Federal Telephone Company in payment of debts due that company, and the remaining $270,652 would go for immediate improvements. The remaining $800,000 of the preferred stock is to be held in the treasury and sold later at not less than $80 per share. The Cuyahoga Telephone Company has paid the back interest on its bonds and is now earning a good surplus above its charges.

MICHIGAN TELEPHONE COMPANY.—The Union Trust Company, of Detroit, as receiver of the Michigan Telephone Company, has filed a petition in the United States circuit court asking for authority to issue $50,000 worth of receiver's certificates, payable within three months from the date an order is issued, and carrying interest at a rate not exceeding 6 per cent. The $50,000 thus raised is to be used to construct as a part of the receivership property such telephone wires and conduits as may be necessary to connect the different parts of the system, which the petition alleges is now being done by apparatus that did not pass under the control of the trust company when it was appointed receiver. This refers to the old Detroit Telephone Company equipment, which, it is understood, will now be entirely separated from the Michigan plant.

MASSACHUSETTS LIGHTING CONSOLIDATION.—The consolidation of Massachusetts lighting properties recently set on foot now includes five companies, whose capital stock, price paid for control, gas output and electric lamp capacities for year ended June 30, 1902, are as follow:

	Cap. stk.	Price pd.	Gas out.	Elec. lamp.
Chelsea	$300,000	125	43,412,200	16,200
E. Bos. Gas	275,000	50	68,881,990	.....
N. & W. G.	250,000	300	123,596,000	14,970
Som. E. L.	200,000	185	....	22,806
Woburn L. H. & P.	175,000	110	....	15,200
Total	$1,200,000	...	235,890,190	69,176

CONSOLIDATION IN COLUMBUS.—It is reported in Columbus that a consolidation of the Columbus Edison Company and the Columbus Railway Company has been practically concluded. By virtue of the agreements of consolidation, it is stated that the stock of both companies will be taken by a holding company, the capitalization of which has not yet been made public, and the stock of both the companies will be guaranteed dividends. The capital stock of the Columbus Railway Company is $6,000,000, and of the Columbus Edison Company $1,000,000. The latter controls the two electric lighting and power plants of Columbus.

BOSTON WEST END.—Stockholders in the West End Street Railway Company have voted to increase the capital stock $454,250 by the issue of 9,085 new shares, the par value of which is $50, thus increasing the common stock of the company from 181,700 shares, of the par value of $9,085,000, to 190,785 shares, of the par value of $9,539,250. The new stock is issued for the purpose of providing means to repay to the Boston Elevated Railway Company amounts expended by it for the permanent additions, alterations and improvements on the property of the West End Company.

FEDERAL TELEPHONE COMPANY.—The Everett-Moore syndicate, Cleveland, Ohio, is considering plans for refinancing the Federal Telephone Company. It is probable that a new company, with reduced capital stock, will be formed to take over the assets and liabilities of the old company.

MARCONI COMPANY'S ANNUAL MEETING.—The annual meeting of the stockholders of the Marconi Wireless Telegraph Company of America was held last week in Jersey City. The principal business of the meeting was to elect successors to three directors whose terms had expired. Two of these, Samuel Insull, of Chicago, and John W. Griggs, of New Jersey, were reelected. John D. Oppe, manager for the Marconi Company, of Canada, was chosen to succeed Commander J. D. Kelley, United States Navy.

BOSTON EDISON INCREASE.—At a special meeting of the Boston Edison Electric Illuminating Company, the stockholders authorized the directors to petition the gas and electric commissioners for authority to issue 20,000 shares of new stock, the proceeds to be used for general increase of company's business, but principally for the acquisition of suburban companies.

Commercial Intelligence.

THE WEEK IN TRADE.—Cool weather in some sections of the country and numerous labor troubles have exercised some retarding influences in trade development, yet, notwithstanding these, the conditions were satisfactory, generally speaking. An easing in money rates in nearly all markets is an encouraging feature, but one not unusual at this time of the year. Collections continue to improve slightly but steadily. The manufacturing industry was never so active, and railroad earnings continue large. Foreign crop reports are favorable to American producers. In Germany the crop conditions are less hopeful than they were one or two years ago, and French reports are not altogether satisfactory. The remission of grain duties in the new British budget has been temporarily favorable to export business. In the labor situation the usual spring unrest is visible in many lines, and the building trades are being harassed by numerous strikes. Pig iron has eased in price, and buyers are backward, evidently hoping for further concessions, while the latter part of the year's requirements are still reported unplaced. Against this is to be noted the strength of steel and finished products in nearly all lines. Steel billets and sheets are very scarce. Much new work has been postponed because of inability to get supplies. The demand for structural materials is reported undiminished, notwithstanding the uneasiness in labor circles. The volume of new work offered and projected is heavy. In copper, the situation is unchanged; producers are maintaining nominal prices and consumers are not buying. During the week, offers of Lake copper were as low as 14⅛c., but no buyers could be found. The producers' prices are 15a15¼c. for Lake and electrolytic, and 14½a14¾c for casting stock. The business failures for the week ending April 23, as reported by *Bradstreet's*, numbered 152, against 160 the week previous, and 181 the corresponding week last year.

CONTRACT FOR MEXICAN LIGHTING PLANT.—The contract has been let to a Mexican concern for the equipment of the proposed electric lighting plant for the City of San Juan Bautista, capital of the State of Tabasco, to which reference has recently been made in these columns. The plant will be operated by the Compania Electro Motriz Tabasquena. The initial equipment will take care of 50 arc lamps and 3,000 incandescent lights. It is expected, however, that the installation will be very largely increased later on. The importing and exporting firm of Polte, Reyes & Castro, of Tiburcio 7, Mexico City, has secured the initial contract. The equipment, etc., will be purchased by them in the United States.

MORE CARS FOR PORTO RICO ROAD.—The San Juan Light & Transit Company, which operates the existing electric traction system in San Juan, Porto Rico, and is controlled by J. G. White & Co., is about to order some more cars. Those now in use were built by the American Car & Foundry Company and the Stephenson Car Works. The trucks are Peckham. The motors—35 hp type—were supplied by the General Electric Company.

LIGHTING OUTFIT FOR MANILA.—Mackenzie, Quarrier & Ferguson, Inc., 114 Liberty Street, New York, has secured an order for a 14-in. x 13-in. Harrisburg Standard engine, belted to an alternating-current General Electric generator of 100-kw capacity for shipment to Manila for United States Government lighting work.

CUBAN LIGHTING AND TRACTION FRANCHISE.—An electric light and traction system is to be installed in the City of Santiago, Cuba, a concession having been granted to Eduardo J. Chibas, contracting engineer of that city. The initial length of the road will be five miles.

BRAZILIAN MINING PLANT.—A British syndicate which is represented in Rio Janeiro by Edward H. Tyler, formerly engineer of Arens Brothers, of that city, intends to construct an extensive electrodynamic mining plant in that part of the world.

RONEY STOKER SALES.—Westinghouse, Church, Kerr & Co. have recently received the third order for Roney mechanical stokers from the Potomac Electric Power Company, Washington, D. C. The Potomac Company is the newer coporation which has taken over the properties of the U. S. Electric Lighting Company, of Washington, D. C., which formerly operated a large lighting plant at the corner of Fourteenth and B Streets. This plant has previously been partially equipped with another type of furnace. A new equipment of four 450 B. & W. boilers, fitted with Roney stokers, was rushed into service in the early winter to aid in sustaining the winter peak loads upon the plant, and their satisfactory operation has resulted in the provision for extensions above noted. The Roney stoker equipment at present aggregates 2,700 hp. The New York Central and Hudson River Railroad Company have also ordered Roney stokers for equipping the boiler plant of their new elevator, at Weehawken, N. J. The equipment will comprise four stokers operating under 2,000 hp of Aultman and Taylor water-tube boilers. The International Railway Company, of Buffalo, N. Y., have placed the sixth order for Roney stokers, increasing their present capacity to 6,900 hp. The Ingersoll-Sergeant Drill Company will install twelve stokers in their plant at Phillipsburg, N. J. Roney stokers of various sizes have also been sold to the Stirling Company, for Berwind White Coal Mining Company, Winber, Pa.; the American Bridge Company, the ninth order; the American Locomotive Company, the fifth order, and the Pennsylvania Railroad Company, for Altoona, Pa., the seventh order. The latter consignment will be installed in the new extension to the boiler-house serving the car shops at this point. This boiler-house was designed and erected by Westinghouse, Church, Kerr & Co., and also a similar boiler-house for serving the machine shops. The boiler and stoker equipment in the latter has already been duplicated, and similar extensions are under way for the boiler-house serving the car shops.

NIAGARA RESEARCH LABORATORIES.—This is the name of a $100,000 company which has filed incorporation papers at Albany. Its object is stated as follows: To maintain a research laboratory for scientific investigation at Niagara Falls; do analytical and experimental work for the general public; act as consulting engineers, and experts in perfecting or improving existing processes; rent space, power and the use of its laboratories for physical, chemical and electrochemical investigations; manufacture and sell chemicals and allied products, apparatus and supplies, etc. The primary object of the members of the new company is original research. They propose, however, to promote the interests of theoretical and applied electrochemistry and electrometallurgy by offering to experimenters for a reasonable sum the resources of their laboratories and the aid of experienced men. The technical men in the company are three young engineers—F. M. Becket, R. A. Witherspoon and L. E. Saunders—graduates of scientific schools, who have been for the last few years hard at work with electric furnaces, etc., aiding in the development of the processes now in successful operation at Niagara Falls. Among the directors for the first year are J. G. White, of the firm of J. G. White & Co., of New York City; W. B. Rankine, vice-president of the Niagara Falls Power Company; W. S. Gray, of New York City, a dealer in chemicals; Norman M. Pierce, of Binghamton, N. Y.; Henry J. Pierce, E. B. Stevens, W. G. Case and Dr. Elmer Starr, of Buffalo. It is understood that Mr. Stevens will be elected president of the company and Mr. Rankine vice-president.

SOME TRUMBULL FOREIGN AND DOMESTIC ORDERS.—The Trumbull Electric Company, of Plainville, Conn., through its New York offices, Electrical Exchange Building, which are under the management of Mr. Thomas D. Watson, reports recent receipt of a number of substantial orders for its specialties for shipment to various foreign countries. Frank A. Cundill, of 96 Wall Street, New York, acting on behalf of the British electrical engineering and contracting firm of Healing & Co., Yokohama, has sent in a large order for assorted switches. Anderson & George, of Shanghai, China, have been heavy purchasers for some time past. Arthur H. Merriam, of 132 Pearl Street, New York, has also purchased a quantity of assorted switches and rosettes for export. The Trumbull people have a big run at present in their combination switches for domestic consumption. The New England Electric Company, of Waterbury, Conn., is ordering these specialties at the rate of 2,000 per month. A lot of assorted switches has been ordered by the Delaware, Lackawanna & Western Railroad for signal purposes. The Carleton-Chase Electric Company, Havemeyer Building, New York, has ordered a complete line of knife switches varying from 15 to 200 amp. as well as about 10,000 assorted rosettes. The Trumbull Company has just decided to build a new addition to its factory. The manufacture of panel boards is contemplated.

WESTINGHOUSE TURBINE SHIPMENTS FOR AFRICA.—An interesting shipment has recently been made from the shops of the Westinghouse Machine Company, Pittsburg, Pa., of the first turbines of a large size and of American manufacture to be exported from this country. The shipment consisted of two 1,000-kw Westinghouse generating units of the most recent design. They are destined for light and power service in the De Beers mines, at Kimberly, South Africa. Steam turbine equipments have also within the last month been shipped from the Pittsburg factory, as follows: The B. F. Goodrich Company, Akron, Ohio, one 400-kw unit for supplying light and power to shops; The Johnson Harvester Company, Batavia, N. Y., one 400-kw unit for furnishing power to shops; The Consolidated Railways Light and Power Company, Wilmington, N. C., one 400-kw unit for railway and lighting service; The Nassau Light and Power Company, Roslyn, L. I., one 400-kw unit for local lighting, and S. D. Warren & Co., Cumberland Mills, Me., one 400-kw unit for furnishing light and power to the company's mills located at this point.

THE GENERAL ELECTRIC POWER COMPANY, LTD., of Germiston, Transvaal, South Africa, is calling for bids for the supply of one 1,000-kw and two 1,500-kw, 3-phase, 60-cycle, direct-connected alternators. Bids are asked for both steam turbines and reciprocating engine sets, in order to determine which is best suited for its work. These machines are for extension of the company's existing plant, which supplies current for power and other purposes to a neighboring group of mines, and further considerable extensions are contemplated. The inquiries were made locally, as all such machines are purchased direct through Transvaal representatives of Continental, English and American firms.

ALLIS-CHALMERS.—At the last meeting of the board of directors of the Allis-Chalmers Company, held in New York April 15, the regular quarterly dividend of 1¾ per cent. was declared on preferred stock. The volume of business on the books of the company to-day far exceeds that of any time since the organization of the company, notwithstanding the fact that the output of the plants has been increased to a large extent. The company can see no abatement of prosperity in its various branches of manufacture. There seems to be an unlimited demand for all kinds of high-grade machinery which is certainly a good indication that prosperity is enjoyed in all lines of manufacture.

PITTSBURG AND MONTANA COPPER COMPANY.—Westinghouse, Church, Kerr & Co. recently received an order for the entire mechanical equipment of a new smelter, to be shortly erected in the vicinity of Butte, Mont. The equipment comprises: two 160-hp Westinghouse compound engines, driving Connersville blowers; one 85-hp Westinghouse compound engine, driving a 45-kw D. C. 125-volt generator, with switchboard; two Westinghouse standard engines; four Roney mechanical stokers for four 250-hp B. & W. boilers.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., through the H. C. Roberts Electric Supply Company, of Philadelphia, has secured the contract for lighting the new Roberts Hall, Haverford College, Haverford, Pa., with two, three and six-glower Nernst lamps. The main auditorium of the college is also to be lighted by Nernst lamps. The Westinghouse Trust Company Building, of Washington, Pa., has been fitted throughout, including offices and billiard-room, with two- and three-glower Nernst lamps.

CEILING FANS FOR CHINA.—The Federal Electric Company, Washington Life Building, New York, has secured a contract through Fearon Daniels & Co. of China, 96 Wall Street, for alternating-current ceiling fans to be shipped to China for Shanghai. This makes the third order secured through the same source and for the same destination. The value of the present contract is about $3,000. The Federal Company has just taken a good-sized order for Standard Underground rubber-covered wire for Mexico for a lighting plant.

THE SHERWIN WILLIAMS COMPANY, a large paint manufacturing concern operating several factories in United States and Canada, have purchased a Westinghouse steam turbine power outfit, for their Cleveland factory, to be direct-connected to a 400-kw, 2-phase turbo-generator. The current to be generated at 440 volts, and 60 cycles will be used for general power and lighting puposes throughout the factory.

SUPPLIES WANTED.—The Crookston Waterworks, Power & Light Company, of Crookston, Minn., Mr. W. F. McNally secretary, are in the market for one mile of vitrified clay conduit for underground work, and 6,000 ft. of stranded bare cable for overhead feeders, all 500,000 circular mils.

PRETORIA, SOUTH AFRICA, will, it is stated, install an electric light and traction system to cost $1,250,000

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, has begun the shipment of automatic telephone equipment to the Dayton Home Telephone Company, of Dayton, Ohio, and the Citizens' Telephone Company, of Grand Rapids, Mich. The Dayton Company will begin business with 6,000 stations, and its ultimate capacity will be 19,000. The Grand Rapids Company will have a present installation of 5,000, with an ultimate capacity of 10,000. Both of these companies have erected new buildings, which were designed especially for the automatic exchange. No party lines will be used. The Automatic Electric Company is also manufacturing complete equipment for the Citizens' Telephone Company, of Columbus, O., in which plant 7,000 stations will be installed at first, with an ultimate capacity of 19,000. The Northeastern Telephone Company, of Portland, Me., has also placed an order with the Automatic Electric Company for 2,500 telephones and switches, the switchboard to have a capacity of 10,000. Out in Iowa, the recently-organized Commonwealth Telephone Company has placed an order with the Automatic Electric Company for the equipment of 1,200 stations, with a capacity of 10,000. An order has also been given by the Wettstein Construction Company, which will build the new exchange in Burlington, Iowa. This order calls for the present equipment of 800 stations and an ultimate capacity of 10,000.

THE AMERICAN RIVER ELECTRIC COMPANY.—Articles incorporating the American River Electric Company have been filed in California. The capitalization is $2,500,000, and San Francisco is named as the principal place of business. Among the company's objects are the generation of electric power, which is to be transmitted from a point on the American River near Placerville, Cal., to Stockton, for lighting and power purposes. Mortimer Fleishacker, Herbert Fleishacker and A. J. Hechtman have been planning this system for some time. The new company has perfected its water rights on the American River, and has let contracts for a 75-mile double-pole line, which after leaving Placerville, will extend to Plymouth, Amador City, Sutter Creek, Jackson, San Andreas, Lodi and Stockton. Contracts have been let for some of the machinery, and Mortimer Fleishacker says that the quick deliveries promised will enable them to operate the plant by the close of this year. While the company is desirous of supplying current in Stockton for lighting purposes it will not depend largely upon that for its revenue, as the rich mining districts of the Mother Lode will furnish a good market for electric power. The initial installation will be 5,000 hp.

THE KOKOMO, MARION AND WESTERN TRACTION COMPANY has filed articles of incorporation and plans with the Secretary of State of Indiana. This company has acquired the Kokomo Railway and Light Company, and has commenced the construction of 33 miles of road over a private right of way, connecting Kokomo Marion and intermediate towns. Later on it is proposed to build 47 miles of road east of Marion. This will be an over-head trolley line of single-track construction, and the power house of the Kokomo Railway & Light Company will be used in the operation of the road. The contract for the road-bed has been let to the Indiana Inter-urban Construction Company, of Kokomo. F. F. Van Tuyl & Co., of Detroit, are the consulting engineers for both the railway and the construction companies. It is proposed to push the construction of the railroad as fast as possible, and to operate 10 miles of the road by the 4th of July. That the completion of the road is to be pushed with all possible haste will be gathered from the fact that the company was organized, the articles of incorporation and plans filed, and the actual work of construction begun in a little more than one week.

CONTINUOUS RAIL JOINT COMPANY.—Messrs. Geo. G. Frelinghuysen and Fred'k. T. Feary, representing the Continuous Rail Joint Company of America, have concluded the purchase of about twenty acres of land at Troy, N. Y., with the rolling mills, machine shops and numerous other buildings formerly owned by the Troy Steel Company, part of which they have been operating under lease for the past three years. The property has a dock frontage on the Hudson River, and the New York Central Railroad runs through it. The new switch has just been completed from the New York Central Company's tracks around the rolling mill. The Wynantskill Brook runs across the entire plot, giving an excellent and constant supply of fresh water. The plant will hereafter be known as the Albany Iron & Steel Works Department, of the Continuous Rail Joint Company of America. The output of the products of the company will be greatly increased. In railroad circles the Continuous Rail Joints are universally liked, and fifteen thousand miles of track have been equipped with this appliance. The general offices have always been and will remain at Newark, N. J.

ST. LOUIS EXPOSITION PLANT.—The 500-hp Duerr marine boiler, which was taken out of the battery of boilers of the German man of war *Sachsen* for exhibition at the Louisiana Purchase Exposition, raised steam for the first time April 22, and operated the 300 hp, high-speed, automatic, tandem-compound engine supplied by the Buffalo Forge Company, of Buffalo, N. Y. This was the first work done by the pre-Exposition power plant. Besides the Duerr boiler and the Buffalo engine there were placed in operation a 200-kw alternator, built by the Stanley Electrical Manufacturing Company, of Pittsfield, Mass.; a Sorge-Cochrane feedwater heater and purifier and two duplex steam-driven boiler feed pumps, with a capacity of 100 gallons per minute against a boiler pressure of 150 pounds to the square inch, furnished by the National Steam Pump Company, of Upper Sandusky, Ohio. All these machines were entered as exhibits in the Machinery Department. Two Morrin-Climax water-tube boilers, with a combined rating of about 700 hp, supplied by the Clonbrock Steam Boiler Company, are now being installed, and one will be ready for service before the dedication.

MECHANICAL STOKERS FOR BOSTON EDISON.—The Boston Edison Company has recently purchased from Westinghouse, Church, Kerr & Co., a complete equipment of Roney mechanical stokers, to be installed in its new central station, now in process of construction. The station is located in South Boston, on the water front, and, it is understood, will be eventually the main station of this company. The new plant is arranged for steam turbo-generating power units, and the design of the building and equipment provides for future extensions to any desired capacity. The boilers are of the B. & W. 500-hp water-tube type, and are arranged in batteries of eight boilers each, seven of which aggregate sufficient capacity for supplying one power unit, with an eighth as a reserve. The first consignment will comprise eight boilers aggregating 4,000 hp, each fitted with rocking-grate stockers of the Roney type.

MUNICIPALITIES IN ENGLAND.—A special meeting of the Salford Borough Council was recently held to consider the placing of contracts for the new tramcars required for the borough, and after a very animated discussion, lasting nearly three hours, the recommendation of the Tramways' Committe was approved, and the contract for fifty tramcars at approximately $3,700 each, was given to the Westinghouse Company. The London County Council recently received tenders covering the switchboard installations for the sub-stations at the Elephant and Castle, New Cross and Camberwell for the tramways, the contract being awarded to the British Westinghouse Electric & Manufacturing Company, Limited. This contract amounts to approximately $27,000.

BALL ENGINE ORDERS.—The Ball Engine Company, Erie, Pa., has received an order for two engines of 400 hp, from the Washington Electric Light and Power Company, Washington, Pa. The Franklin Electric Light Company, Franklin, Pa., has also purchased a 150-hp engine from the Ball Engine Company. The Beloit Iron Works, Beloit, Wis., have purchased a 70-hp engine arranged for direct-connection to a Northern generator, from the Ball Engine Company, which also secured an order for four vertical cross-compound engines, each direct-connected to 150-kw Crocker-Wheeler generator, for the new First National Bank Building, of Chicago.

A MODERN BAKERY.—A novel application of electricity is a recent installation of the Sprague Electric Company's direct-current motors in the new bakery of the American Pastry and Manufacturing Company, in East Fifteenth Street, New York City. A large number of electric motors will be used to operate the machines for mixing dough for crackers, biscuits and pies. An ingenious apparatus has also been perfected for electrically operating the ovens, which is a new departure in this industry.

WORCESTER WIRE WORKS.—Improvements in power facilities will be made at the Worcester (Mass.) works of the American Steel & Wire Company, the United States Steel Corporation. A number of engines will be compounded and condensers installed, and electric motors will be installed to do away with shafting. It will probably be necessary to put in a new engine with direct-connected generator, to provide the necessary current. The works were never so busy as now.

PLANT FOR ELMIRA, N. Y.—The Elmira Water, Light and Railroad Company, Elmira, N. Y., are installing a 300-kw 60-cycle Westinghouse rotary, which will be used to handle their day motor load. At night it will be driven mechanically, giving alternating current and 3-wire 500 and 250-volt direct current.

BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio (Mr. Paul Bigelow, New York), has recently secured several contracts for engines for driving generators. The Ingalls Building, at Cincinnati, Ohio, is to be equipped with a 10-in. x 14 in. simple engine, which is to be used for lighting purposes. A 7¾ in. x 12 in. simple engine has been ordered by the New Amsterdam Gas Company, 340 Third Avenue, New York. The same concern has requisitioned for a 16½ in. by 16 in. simple engine for installation in its Ravenswood (L. I.) plant. Both these will be utilized for power purposes. The Pittsburg and Conneaut Dock Company, of Conneaut Harbor, Ohio, has ordered two 20 in. by 38 in. by 36 in. compound engines for power use. The Pennsylvania Railroad will install an 18¾ in. by 30 in. simple engine in its Cleveland, Ohio, shops, and an engine of similar size and type has been ordered for its Erie (Pa.) shops. Both these machines are for lighting use. The Union Stock Yards and Transit Company, of Chicago, Ill., has sent in orders for a 16½ in. and 28½ in. by 30 in. compound engine; also for a 14¼ in. and 25 in. by 18 in. machine, for both light and power. The Dayton (Ohio) Arcade Company Building is to be equipped for lighting purposes with a 14¼ in. and 25 in. by 21 in. compound engine; also a 11 in. and 19 in. by 16 in. one. The Norfolk and Western Railway Company has ordered two 14¼ in. and 23 in. by 16 in. compound engines for its Roanoke (Va.) shops, for lighting. The Fletcher Paper Company, Alpena, Mich., will be furnished with a 13 in. by 24 in. simple belted engine for light and power. An 18¾ by 18 in. simple engine has been ordered for light and power by the S. W. Connellsville Coke Company, Leckrone, Pa. The Atlas Furniture Company, Jamestown, N. Y., has requisitioned for a 14¼ in. by 24 in. simple belted engine for light and power. The La Belle Iron Works, of Steubenville, Ohio, will be equipped with a 13 in. by 22½ in. by 30 in. compound engine, for light and power. The New York Mutual Gas Light Company, 36 Union Square, has ordered, for power use, two 13 in. by 18 in. simple, and the same number of 10 in. by 21 in. engines. The Seamless Rubber Company, of New Haven, Conn., will be supplied with a 15¼ in. by 16 in. simple engine, to be direct-connected to a Bullock generator, for lighting. Two pair twin 20 in. by 30 in. engines have been ordered by the Stearns Salt and Lumber Company, of Ludington, Mich. They will be utilized for power purposes. An 18¾ in. by 30 in. simple engine will be installed for light and power in the Wellsville, Ohio, plant of the American Sheet Steel Company. A 15¼ in. by 30½ in. by 33 in. compound engine has been ordered by the Wilmington (Del.) Malleable Iron Company. This engine will be direct connected, for light and power, to a Crocker-Wheeler generator. The new structural material plant of Milliken Brothers, which is to be electrically operated throughout, will be installed with a 14 in. and 28½ in. by 21 in. compound. The generators and motors for this plant will be Westinghouse.

SOME HEINE BOILER CONTRACTS.—The Heine Safety Boiler Company, of St. Louis, Bowling Green Building, New York, reports recent receipt of several substantial contracts for boilers in electrical plants. A 1,500-hp outfit in three units of 500 hp each has been ordered by the Suburban Electric Light Company, of Scranton, Pa. The Taunton (Mass.) municipal lighting plant is to be equipped with three 300-hp boilers. The American Type Founders' Company has ordered two 160-hp boilers for installation in its new plant at Communipaw, N. J., which is to be electrically operated. Edward R. Knowles, 136 Liberty Street, is acting as consulting engineer regarding the matter. The Rockland Light & Power Company is putting an addition on to its plant near Nyack, N. Y., and has ordered a 250-hp Heine boiler. Sibley, Lindsay & Curr Company, which concern operates a large dry goods store at Rochester, N. Y., has ordered a 480-hp boiler outfit in three units of 160 hp each. The boilers will be installed in connection with an electric lighting and general power plant for the establishment. The United States War Department has requisitioned for Heine boilers to be installed in Forts Levett, McKinley and Williams, Portland, Me. The boilers for the first two forts will aggregate about 350 hp each, in three units of 116 hp each. At Fort Williams a small additional equipment will be added to the Heine boilers already installed there. The boilers will furnish power to operate Westinghouse equipment to light the fortifications and to handle the heavy guns, etc. The Schuylkill Valley Illuminating Company, of Phoenixville, Pa., which concern is remodeling its plant, has ordered three 367-hp boilers from the Heine people. The new Whitehall Building at Battery Place, New York, is to be equipped with a 900-hp boiler outfit in three units of 300 hp each. These boilers will furnish power for operating the electrical equipment to be installed in the building. The Bliss factory building now under construction at Third Avenue and Twenty-third Street, New York, is to have a 1,000-hp Heine outfit in four units of 250 hp each. An extensive electric plant is also to be installed.

IMPORTS AND EXPORTS.—The imports into the United States exceeded one billion dollars in the twelve months ending with March, 1903. This is the first time in the history of our foreign commerce that imports in twelve months have exceeded $1,000,000,000. Prior to 1870 they had never reached as much as a half million dollars in a single year, and it was not until 1890 that they reached three-quarters of a million dollars in value, and now, for the first time, they have passed the billion-dollar line. Meantime the exports have grown with like rapidity. In the twelve months ending with March, 1903, the total exports were $1,414,786,954, against $1,001,596,683 of imports, giving an excess of exports during the twelve months of $413,190,271. Exports never reached a half-billion dollars' value in a single year until after 1870. In 1880 they passed, for the first time, the three-quarters of a billion-dollar line; in 1892 they, for the first time, exceeded $1,000,000,000, and in the twelve months ending with March, 1903, they were $1,414,786,954; and should the exports of April, May and June average as high as those for March, they would bring the total exportations for the fiscal year past the $1,500,000,000 line.

EXPORT ORDERS FOR ROCHE BATTERIES, ETC.—William Roche, of 42 Vesey Street, New York, reports having lately taken some heavy orders for his new standard dry batteries, flashlights, gaslighters, etc., for shipment to different parts of the globe. The American Trading Company, 25 Broad Street, New York, has sent in an order for flashlights and gaslighters to be exported to Martinique. The New York Export & Import Company, 56 Pine Street, New York, has contracted for several thousand dry batteries, etc., for shipment to India. Wilhelmi & Co., 116 Broad Street, New York, has just ordered a 5,000 lot of batteries, which are intended for the Chinese trade. Guiterman, Rosenfeld & Co., 35 South William Street, New York, has requisitioned for a large lot to be shipped to England, while for the Australian markets a big order has been secured through R. W. Forbes & Son. The largest order recently secured for the domestic trade came from St. Louis. It called for 100,000 dry batteries.

GROWING PROPORTION OF EXPORT GOODS.—To sum up in a single sentence a comparison by the United States Treasury Bureau of Statistics of production with exportation, in agricultural and manufactured products, respectively, it may be said that, comparing conditions in 1900 with those of 1870, agricultural production has increased 92 per cent. agricultural exportation 132 per cent., production of manufactures 209 per cent., and exportation of manufactures 538 per cent. Percentage of increase in production and exportation of agricultural products and manufactures, from 1870 to 1900 is as follows:

	1870. Value.	1900. Value.	% Inc.
Agricultural products	$1,958,030,927	$3,764,172,706	92.1
Agricultural exports	361,188,483	835,858,123	131.8
Manufactures produced	4,232,325,442	13,039,279,566	209.1
Manufactures exported	68,279,764	433,851,756	537.7

LARGE MEXICAN WATER POWER PROJECT.—One of the most important water power schemes ever projected in Mexico is being pushed forward by James Butler, a capitalist located in Colonia Marez, State of Chihuahua. It is proposed to develop the immense water power of Guaynopa Cañon, at a point called Sale Que Puede, where a large hydraulic plant is to be installed. The head available is no less than 3,000 ft., and the volume at the gate of the penstock, which is planned to be put up, is estimated to be 5,000 cubic ft. per second. It is proposed to supply current for lighting and general power purposes for a large portion of the western part of the State of Chihuahua and to operate the bulk of the sawmills in the Guaynopa forests.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, of Dayton, Ohio, New York offices, Washington Life Building, has secured a substantial contract for electrically-driven pumping euipment from Frederick Nell, of 95 Queen Victoria Street, London, E. C. Several Victor turbines have also been ordered by the electrical engineering and contracting firm of Town, Mohlan & Seebeck, of Durban, for installation in water power plants for electric railway work in South Africa.

SYRACUSE LIGHTING PLANT.—The electric lighting plant of the Syracuse (N. Y.) Lighting Company is to be largely remodeled. A 2,000-hp equipment will be installed in the first instance. Ultimately the capacity will be 3,000 hp. Four Heine boiler of 500-hp capacity each have just been ordered. Curtis turbines will also be installed.

EQUIPMENT FOR WASHINGTON INSANE HOSPITAL.—Considerable electrical equipment is to be installed in the Government Hospital for the Insane at Washington, D. C. The Heine Safety Boiler Company has taken the contract for the boilers. Nearly 1,600 hp will be put in. There will be five units of 316 hp each.

YUCATAN LIGHTING PROJECT.—The town of Ticul, some 40 miles south of Meridu, capital of Yucatan, Mexico, is to have an up-to-date municipal electric lighting plant. The present illuminating system in that part of the world is oil lamps.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The People's Home Telephone Company, of Birmingham, a competitor of the Bell Company, is seeking to raise rates above the franchise limit, it being represented that the company cannot make money under the present rates.

SANTA ANA, CAL.—The Chamber of Commerce has sent a resolution to the Board of Supervisors asking that there be offered for sale a franchise for the operation of a telephone system on the streets and highways of the county. Thus the chamber puts itself on record as favoring the coming of a new company into the local telephone field.

TRINIDAD, COLO.—The Colorado Telephone Company will build a new exchange at this place, and make other improvements which will cost $80,000.

NAMPA, IDAHO.—The Nampa Automatic Telephone Company, with a capital stock of $20,000, has been incorporated by J. S. Fox, A. K. Stoddard, N. C. Joyner and others.

MARION, ILL.—The Marion Telephone Company has been incorporated with a capital of $15,000. Incorporators: J. B. Bandy, J. C. Mitchell, A. F. White, Joab Goodall.

CORYDON, IND.—The Eureka Telephone Company will build an exchange in Corydon to connect with out-of-town lines. Lainesville is to have an exchange also, and a new line is to be built from Breckenridge to Corydon.

PERKINSVILLE, IND.—The Perkinsville & Lapel Telephone Company has incorporated with a capital stock of $2,500. The principal office and exchange will be in Perkinsville. W. M. Garretson, O. A. House, J. F. Anderson, and A. B. Hoffman, are the incorporators.

PETTYSVILLE, IND.—The Roann Telephone Company, capital stock $15,000, has incorporated to build a telephone system and exchanges through Wabash and Miami counties. G. T. Grimes, Ellis Conner and T. K. Baker, all of Pettysville, are the incorporators.

SALINE CITY, IND.—The Art Telephone Company, capital stock $7,000, has incorporated to build an exchange in this city and extend lines through Clay County. The directors are Aba Long, Miller Hyde, A. G. Barber, Henry Wagoner and John Fogal, of Saline City.

INGLESFIELD, IND.—The Rural Telephone Company, of this city, has incorporated. The capital stock is $1,000. The company will construct and operate a telephone system in this city and immediate vicinity. Joseph Burston, J. R. Knowles and W. D. Miller, are directors.

VEEDERSBURG, IND.—The Veedersburg Telephone Company has filed articles of incorporation. Capital stock $25,000. The company will construct and operate a system in Fountain, Park and Clay counties. John L. Oshorn, J. K. Quinn, D. P. Heftner and C. E. Osborn, are directors.

BROWNSBURG, IND.—The Brownsburg Telephone Company has incorporated with a capital stock of $6,000. The company will establish an exchange here and build and operate lines in Hendricks, Boone and Marion counties. J. S. Thorp, J. R. Flinn and W. H. H. Medsker are directors.

ROCKFIELD, IND.—The Rockfield Co-operative Telephone Company has incorporated with a capital stock of $3,000. This company proposes to establish an exchange and construct and operate a telephone system in this town and throughout Carroll County. F. M. Tyrell, C. L. Wilson and S. M. Causer are directors.

PORTLAND, IND.—The Co-operative Telephone Company has incorporated to establish a telephone system and exchanges in Jay, Delaware, Madison, Randolph, Blackford and Wells counties. The capital stock is $10,000. D. M. Baker, C. N. Hardy, Portland; A. M. Poland, Albany, and J. B. Andrus, Red Key, are directors.

LOGANSPORT, IND.—The Logansport Home Telephone Company has voted to expend $10,000 in extending its lines to Walton, Lincoln, Galveston, Young America, Burrows and other towns, the intention being to locate exchanges and bring the entire territory into connection with the local plant as well as to form a fine local service in the towns mentioned and the adjacent farming territory.

MANILLA, IND.—A telephone exchange and system have been installed here by the Central Union Telephone Company and is now in operation. The construction throughout is on a complete metallic circuit basis. The exchange is connected with the one at Shelbyville and the subscribers have free use of this connection, a 15-cent toll rate to Indianapolis being charged. The rate is $1 per month and many citizens and farmers are clamoring for the service.

LOGANSPORT, IND.—The American Telephone & Telegraph Company has asked for a long-distance franchise in this city. The Home Telephone Company is opposing the grant until the ordinance more fully and explicitly sets out what long-distance service is. The franchise asked for by the American Company might be construed into meaning a local plant service and the Home Company is anxious that no mistake be made. The council and citizens are opposed to a dual system.

ELKHART, IND.—The Lake Shore & Michigan Southern Railroad is making arrangements to construct a private telephone system to connect the division terminals and at each terminal to have an exchange to connect the various offices at that terminal. There will be two No. 8 copper wires from Chicago to Buffalo for the through business, and each terminal exchange will be something of an investment itself. It is understood the work will be begun as soon as the various chiefs can make their estimates for requisitions. The two main line wires will be strung on the telegraph poles already in use. The telephones will be used for general business that does not necessarily require a written record and trains will be governed by telegraph as at present.

LOGANSPORT, IND.—There was a very important joint meeting of the officers and directors of the Logansport Home Telephone Company and of the Ft. Wayne Telephone Company held here on April 9. Recently there was incorporated in New Jersey a corporation known as the Illinois and Indiana Long Distance Telephone Company, for the purpose of building and operating long distance telephone lines throughout the East, middle states and the West, connecting with the local exchanges in the above named territory. Steps were taken at this meeting to bring together at a future meeting representatives from all the independent companies of Illinois and Indiana to confer relative to taking stock in the long distance company and thus guaranteeing the extension of its benefits to the plants in these States. A good attendance and a hearty co-operation is anticipated in this enterprise.

EVANSVILLE, IND.—The Evansville Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The company has a capital stock of $390,000, of which $190,000 is preferred and divided into 7,000 shares of $25 each. More than 300 residents of Evansville, including leading business men have subscribed to shares of the preferred stock. The receipts from the sale of the preferred are to be used for the complete installation and equipment of a telephone plant in Evansville and fitting it for service for at least 2,500 subscribers with an ultimate switchboard capacity of 7,200. The preferred stock bears 3½ per cent. interest semi-annually, and is redeemable at par at the end of five years. Every holder of forty shares of preferred may take also one share of common stock, but the common must be surrendered with the preferred and at par. The city has accepted 7,900 shares of stock in the company, which is supposed to represent the value of the franchise granted. The success of the undertaking depends upon the outcome of the suit to oust the Cumberland Company which assumes to have a perpetual franchise and is making elaborate plans for a protracted stay in Evansville. The Cumberland Company is erecting an imposing telephone building and boasts that it will install one of the finest telephone plants in the world. It has the valuable American long distance connections and if the courts sustain its contention it will put an established system and experienced management with unlimited capital against a new system and service, inexperienced political management with limited capital.

DES MOINES, IA.—An ordinance has been prepared and will probably pass the council requiring the telegraph, telephone and electric lighting companies to remove their wires from poles in the downtown district and place them in underground conduits.

LONDON, KY.—J. W. Creech, of East Bernstadt, has purchased the London Telephone Company.

LEXINGTON, KY.—A certificate of amendment was filed by the Bourbon County Home Telephone Company, of Lexington. The capital is changed from $75,000 to $130,000.

LEWISTON, ME.—The Lewiston & Auburn Telephone Company has a capital of $250,000 and not $25,000 as previously stated. It is to instal the Strowger automatic system.

OVID, MICH.—The Ovid Telephone Company is building several rural lines and adding to the capacity of its switchboard.

LANSING, MICH.—The Bell Telephone Company will build two new lines from Charlotte to Saginaw affording improved facilities in the Saginaw Valley.

ALMA, MICH.—The Union Telephone Company has elected officers as follows: S. E. Parkwill, president; J. H. Tilden, secretary, and G. S. Ward, treasurer.

HOWELL, MICH.—The Livingston County Mutual Telephone Company has increased its capital stock from $10,000 to $50,000. Improvements will be made at once.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company will build additional toll lines between St. Joseph, Holland and Benton Harbor. The improvements will cost $20,000.

HART, MICH.—The Oceana Telephone Company has increased its capital stock from $20,000 to $50,000, and is planning extensions to its system. The company has 120 farm-line and 300 exchange subscribers with 45 miles of metallic circuit toll lines. T. S. Gurney is president and G. S. Root, general manager of the company.

RED LODGE, MONT.—At a special meeting of the Montana & Wyoming Telephone Company the company's capital stock was increased from $40,000 to $100,000.

ANACONDA, MONT.—The Allen Gold Mining Company which has filed articles of incorporation here, proposes to build telephone and telegraph lines in connection with its mining enterprises.

TRENTON, N. J.—Judge Kirkpatrick in the United States Court has directed a nonsuit in the case of the Delaware & Atlantic Telephone Company against the township of Pensauken and the Eastern Telephone Company. The Delaware & Atlantic Company sued for $50,000 damages for the cutting down of about one hundred and sixty of its poles in the township of Pensuaken in the spring of 1901.

GRANVILLE, N. Y.—The Granville Telephone Company has increased its capital stock from $30,000 to $50,000.

SALISBURY, N. C.—The Salisbury Telephone Company and the Southern Bell Company have perfected an agreement by which the former service will be greatly improved and connected with the long distance service of the Bell Company.

NEW PHILADELPHIA, OHIO.—The Central Union Telephone Company has completed lines from Navarre and Cambridge to Canal Dover.

NORWALK, OHIO.—The Central Union Telephone Company is erecting a new exchange building and making other improvements at Norwalk.

WARREN, OHIO.—The Warren & Niles Telephone Company has increased its rates on new contracts for residence telephones from $12 to $18 per year.

CONNEAUT, OHIO.—The Central Union Telephone Company is building additional lines between Cleveland and Conneaut. Service between Erie and Conneaut will also be improved.

LOGAN, OHIO.—The Logan Home Telephone Company is building lines to Webb, Summit, Gore and New Straitsville and is planning to connect up all the farmers in Hocking County.

NORTH LEWISBURG, OHIO.—The North Lewisburg Telephone Company is preparing to build a large number of farmers' lines this summer and will extend its system throughout the county.

STRUTHERS, OHIO.—The Central Union Telephone Company (Bell) is preparing to establish a new exchange at Struthers. Heretofore a few citizens have had communication through the Youngstown exchange.

WEBSTER, OHIO.—The Webster Telephone Company, of Wood County, has incorporated with $10,000 capital stock. Incorporators: M. Jameson, J. A. Stabel, C. F. Fis, C. D. Hagerty, L. E. Philo and Anthony Seifert.

HAMILTON, OHIO.—The Hamilton Home Telephone Company announces that it has closed a contract with the Fitzsimmons Telephone Company, of Cincinnati, whereby it will have toll connection with points in Cincinnati.

GLOUCESTER, OHIO.—The Sunday Creek Valley Telephone Company has been incorporated with a capital of $50,000 to build an independent system here. The incorporators are G. E. Turner, A. F. Turner, A. B. Allen and G. W. Rose.

MARION, OHIO.—The directors of the Marion Home Telephone Company have declared a semi-annual dividend of three per cent. on both common and preferred stock. The company is installing a new section to its switchboard which will accommodate 450 new subscribers.

CLEVELAND, OHIO.—The American Telephone & Telegraph Company is making efforts to secure all the long distance business of business houses of the city and vicinity. Books affording $100 worth of service are sold at 25 per cent. discount and $50 books at 15 per cent. discount.

ADENA, OHIO.—The Adena Exchange Telephone Company, of Jefferson County, has been incorporated with $5,000 capital stock, to build lines connecting Adena, Smithfield, Hopedale, Harrisville and Unionvale. The incorporators are Mills Hall, C. A. Ickes, J. G. Ickes, W. H. Thompson and J. W. Smith.

DAYTON, OHIO.—The new automatic exchange of the Dayton Home Telephone Company is nearing completion and it is expected it will be in operation with 5,000 subscribers within thirty days. A contract has also been placed for the installation of an automatic system at Columbus which is controlled by the same people.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company will ask the new city administration for permission to increase its rates, and if the permission cannot be secured, it is stated the rates will be raised anyway, as it is claimed the city cannot control the matter of rates. The new rates will probably be $24 per year for four-party line service, $36 for two-party line service; $48 for full metallic residence service and $60 per year for full metallic business service. The Cuyahoga Company is planning to issue $1,000,000 of 6 per cent. cumulative preferred stock at 60, which will realize $600,000. This would pay off the debt to the Federal Telephone Company and leave $150,000 for improvements to the Cuyahoga system.

GUTHRIE, O. T.—The Grant County Telephone Company, of Wakita, has secured a charter to construct and operate telephone lines for twenty years. The capital stock is $100,000. The men interested are C. L. Bickerdike, W. H. Garrett, Sand Creek; W. E. Lemon, J. J. McMullin, P. H. Loomis, M. B. Rutherford, E. M. Garrett, J. E. Garrett, Wakita; Chas. N. Ernest, Medford.

UNIONTOWN, PA.—A number of Uniontown capitalists having recently purchased the entire holdings of the Tri-State Telephone Company are at present engaged in extending their lines, principally in Fayette County. The system will, it is claimed, be second to none in equipment and service. Mr. S. M. Graham of this place is president.

CLARKSVILLE, TENN.—Arrangements have been completed for the consolidation of the Houston Telephone Company and the Home Telephone Company of Clarksville. This will be one of the strongest independent telephone concerns in the State.

DALLAS, TEX.—It is announced that the Southwestern Telegraph & Telephone Company has acquired the system of the Northwestern Telephone Company, an independent organization operating 600 miles of line along the Texas and Pacific Railway west of here.

AUSTIN, TEX.—The toll lines of the Indianola and Lone Star Telephone Companies, representing a capital stock of $1,000,000, and the local independent telephone exchanges in San Antonio, Austin, Waco, Houston and a number of smaller cities of the State are reported to have passed into the hands of the North American Telephone & Telegraph Company. These independent toll lines extend from points in Oklahoma and the Indian Territory, to San Antonio, Houston, Beaumont, Tex.; Shreveport, La; Dallas, Tex., and many other points. The amount of capital invested in these several independent companies exceeds $3,000,000.

LOGAN, UTAH.—The Rocky Mountain Bell Telephone Company has been granted a franchise to extend its lines to Mendon, Cache Junction, Newton and Clarkston.

STAUNTON, VA.—A charter has been granted to the Weyers Cave Telephone Exchange, whose capital stock is not to exceed $5,000. The following-named officers have been elected: J. B. Kegay, president; S. A. Driver, vice-president; N. L. Shreckhise, secretary; S. I. Cline, treasurer.

FOND DU LAC, WIS.—The Little Wolf Telephone Company was sold at receiver's sale on April 20 to Leander Choate, of Oshkosh, one of the bondholders, for $65,000. This amount represents the bonded indebtedness of the company, which has been in business for four years, and has a local exchange of 800 subscribers, besides over 400 miles of toll line. Creditors to the amount of $30,000, it is stated, are not provided for, and the stockholders, who had invested $80,000, get nothing.

ELECTRIC LIGHT AND POWER.

SAN DIEGO, CAL.—Press reports state that bids will be opened June 1 for an electric light plant. The city clerk may be addressed.

STOCKTON, CAL.—The City of Stockton proposes to hold a special election on May 28th to vote on the proposition to issue $160,000 bonds for the construction of a municipal electric lighting plant. This action is being opposed by lighting companies.

AZUSA, CAL.—At the annual meeting of the Azusa Electric Light & Power Company a new board of directors was elected as follows: W. J. Wade, president; T. C. Bouldin, vice-president; Ed. Mace, Charles W. Crawford, E. K. Pierce, J. W. Calvert and C. H. Lee. Ferber L. Wade was chosen secretary.

EUREKA, CAL.—It is reported that the Van Duzen Electric Power Company has completed surveys for the power system to Eureka and every point in Eel River Valley. Arrangements will be made for a plant of 2,000-hp to be established at once on the Van Duzen. Five other plants will follow, aggregating a total of 10,000-hp.

LITTLETON, COLO.—The citizens have voted to grant a franchise to Nelson Rhoades, Jr., to construct an electric light, heat and power plant.

DENVER, COLO.—The Arapahoe Electric Light & Power Company has been incorporated with a capital of $50,000. Nelson Rhoades, Arthur G. Reynolds and Wm. C. Sterne are the incorporators.

ATLANTA, GA.—A recommendation will go to the City Council of Atlanta that the municipal lighting contract shall go to the Georgia Railway and Electric Company for a period of five years. The company agreed to furnish lights at the rate of $75 per arc light per annum.

MOSCOW, IDA.—The Electric Light and Power Company at this place will increase the capacity of its plant.

REXBURG, IDA.—A power company which will utilize the falls on Snake River near this city is in process of organization.

KENDRICK, IDA.—Preliminary steps are being taken towards the re-organization of a company which proposes to install an electric light plant at the Kendrick flumes.

SILVER CITY, IDA.—The power plant installed at Swan Falls, on the Snake River, with a capacity of 8,000 horse-power is supplying light for Dewey, Silver City and Murphy, and power for numerous mills and mines now being actively operated in that district.

QUINCY, ILL.—The Quincy Gas & Electric Company has sold its plant to the J. T. Lynn Company. It is to improve the electric system. J. C. Sloan is manager.

PAXTON, ILL.—The Paxton Light, Heat & Power Company has been incorporated under the laws of New Jersey, with $75,000 cumulative preferred stock and $75,000 common stock.

CONVERSE, IND.—The Converse Electric Light Company has been incorporated to construct and install an electric light plant in this town. The capital stock is $15,000. O. P. Swengen and S. M. White are directors.

ANDERSON, IND.—The City Council has instructed the city electric commissioners to arrange for private capital to rebuild and install the light plant, with the understanding that the city can then buy it on the installment plan. This plan is made necessary in order to keep from going beyond the legal debt limit for a city. A company composed of J. J. Nelterville, C. L. Henry, C. W. Haven and J. E. May has been organized to secure control of the electric light and water plants now owned by this city. The new company will enlarge and improve the plants and install new machinery.

MISHAWAKA, IND.—The City Council has sold the city lighting plant to the Public Utility Company. This action was taken to avert foreclosure by holders of unpaid bonds. Under the deed the city resumes the right to buy back the plant after five years. The Utility company will enlarge and improve the plant and install new machinery.

LEWIS, IA.—The citizens have voted to grant Stevens Bros. a franchise for an electric light plant.

MUSCATINE, IA.—A company is about to be formed here by the business men, with a capital of $50,000, to construct an electric light plant.

CROWLEY, LA.—Electric light and water works bonds amounting to $100,000 have been sold.

NEWROADS, LA.—The City Council has granted the Safety Electric Mfg. Company, of New Orleans, a franchise for an electric light plant and water works.

IPSWICH, MASS.—The citizens have voted to appropriate $25,000 to establish a municipal electric light plant.

MANCHESTER, MASS.—At a recent town meeting it was voted to authorize the selectmen to grant locations for an underground system of electric lighting to a corporation now forming, providing the corporation give the town an option to purchase the property at any time within 5 years.

SCHOOLCRAFT, MICH.—Electric light bonds amounting to $11,450 are reported sold.

SWANZY, MICH.—The I. Stephenson Company, of Marinette, Wis., it is reported, have decided to develop the water power on Escanaba River, at Swanzy. About 1,100-hp will be generated and transmitted to Ishpeming and Negaunee.

LAKE CRYSTAL, MINN.—The citizens have voted to issue $12,000 bonds for an electric light plant.

FARIBAULT, MINN.—The Faribault Gas and Electric Company, of this city, has filed articles of incorporation. The capital stock is $250,000. The incorporators are B. W. Cowperthwaite, John Haug and E. F. Preston, of Faribault. The bulk of the stock is owned by New York parties.

NORBORNE, MO. The Norborne Electric Light & Power Company has been incorporated to furnish light and power; capital, $10,000. Incorporators: J. I. Wilson, Jas. W. Cunningham and others.

JEFFERSON CITY, MO. An ordinance has been introduced into the city council providing for the holding of a special election on August 4 for the purpose of voting on a proposition to bond the city in the sum of $30,000 for the construction of an electric light system, to be maintained by the city.

HELENA, MONT.—The Helena Light & Traction Company is about to commence the construction of a new sub station.

LIVINGSTON, MONT.—C. F. Hefferlin has purchased the light plant here and will consolidate it with the Livingston Water Power Company's plant.

GREAT FALLS, MONT.—An ordinance has been passed by Council granting John D. Ryan a franchise for an electric light, heating and power plant.

GARDINER, MONT.—The Gardiner Electric Light & Water Company has been incorporated with a capital of $15,000, to establish and maintain an electric light plant and water system. Incorporators: J. C. McCartney, Lawrence Link, and others.

OSCEOLA, NEB.—This town has voted for electric street lighting.

LINCOLN, NEB.—The citizens voted to issue $65,000 bonds for a municipal electric light plant. Bonds have been ordered for sale by Council. Geo. L. Campen is city engineer.

MANCHESTER, N. H.—A contract with the Manchester Traction, Light & Power Company for lighting the city at $90 per arc light of 2,000-cp for 5 years was practically agreed upon by the Mayor and Board of Aldermen.

JERSEY CITY, N. J.—The Northern Jersey Light, Heat and Power Company, capital $100,000, has been incorporated by George Francis O'Neill, Joseph Wehrie and Thomas Boyle.

BROCTON, N. Y.—Bids will be received May 2 by G. C. Harmon, Village Clerk, for $10,000 electric light bonds.

GREENPORT, L. I., N. Y.—The citizens have voted to issue $20,000 bonds to enlarge and extend the village electric light and power plant and water works.

ALBANY, N. Y.—The Long Acre Electric Light and Power Company, of New York, capital $50,000, has been incorporated. Directors: William Harris, W. W. Walter and Frank McKee, New York.

LAURINBURG, N. C.—The town of Laurinburg has sold $10,000 worth of electric light bonds. The contract for a lighting plant has been let and work will be started at once.

COOPERSTOWN, N. D.—The Northwestern Electric Company, of Fargo, has secured a franchise for a lighting plant.

WESTWOOD, OHIO.—The village of Westwood is to be illuminated by current furnished by the Cincinnati Gas & Electric Company, and 235 lamps will be installed.

DESHLER, OHIO.—The plant of the Deshler Electric Light Company has been purchased by the Findlay National Bank. It is reported that $8,000 will be expended in improvements.

SANDUSKY, OHIO.—The Central Heating & Lighting Company, recently organized here to furnish light and power and steam heat, is seeking a location for its plant, which will be built at once.

CINCINNATI, OHIO.—The General Light, Heat & Power Company has been incorporated with $20,000 capital stock, by T. S. Spivey, W. C. Hattersley, W. E. Arnold, W. Scott and G. A. Hattersley.

BELLAIRE, OHIO.—The Bellaire Gas & Electric Company and the Belmont Electric Light & Power Company have consolidated under the name of the Bellaire Light & Power Company with a capital stock of $150,000.

BAKER CITY, ORE.—It is announced that an electric plant will be installed soon at the Sanger mine at a cost of approximately $75,000.

HEPPNER, ORE.—An electric light plant to be equipped at an estimated cost of $18,000 will be installed shortly 15 miles south of Heppner, diverting power from Willow Creek.

TILLAMOOK, ORE.—The City Council has granted C. E. Hadley a franchise to install an electric lighting system. It is proposed to get the power from north fork of Wilson River, and the plant will be put in this summer, at a cost of $10,000.

BERLIN, PA.—The citizens have voted to issue $15,000 bonds for an electric light plant.

MARION, S. C.—The H. B. Dysart Water & Electric Company has been granted a franchise at Marion to build an electric light plant. It will begin work at once.

LEWISBURG, TENN.—A new electric light plant will be erected at Lewisburg.

KNOXVILLE, TENN.—The Knoxville Power Company has filed an amendment to its charter increasing the capital to $10,000.

LOGAN, UTAH.—A decision has been rendered in regard to the $65,000 bond issue for the construction of a municipal lighting plant at this place, and the bonds will be issued.

FILLMORE, UTAH.—C. S. Pulver, of Ogden, Utah, will install an electric light plant here. Water power will be used.

CONNELL, WASH.—The Connell Land & Improvement Company has been granted a 25-year franchise to furnish the city with water, electric light, electric power and telephone systems. A franchise has also been granted for the construction of similar systems at Mesa.

ENCAMPMENT, WYO.—An electric lighting system is now in operation here, the power being generated from the South Fork of Encampment River.

CODY, WYO.—An electric light plant will be installed at the De Maris Springs and hotel here.

THE ELECTRIC RAILWAY.

FT. SMITH, ARK.—Articles of incorporation of the Fort Smith Light & Traction Company have been filed. The company is to operate an interurban electric railway across the Arkansas River, near Van Buren. The capital stock is $300,000, all of which has been subscribed.

SONORA, CAL.—The bid of Herschel F. Lamotte for a franchise to construct and operate an electric railway through the county has been accepted by the supervisors.

LOS ANGELES, CAL.—Two important franchises have been sold by the City Council to the Pacific Electric Railway Company for $7,500. They grant the privilege of a third rail for standard-gauge purposes down Main Street and enable the company's big interurban lines of the Huntington-Hillman syndicate to reach the company's $600,000 depot now building in the heart of the city.

COLORADO SPRINGS, COL.—C. L. McKesson and J. E. Little, of Colorado Springs, are interested in the plan to build an electric railway from Cripple Creek to Gillett, thence to the summit of Pike's Peak, and ultimately to Colorado Springs. F. A. Wright and W. A. Parkinson, of Gillet, are also interested in the project.

ROME, GA.—The committee on subscriptions for extending the street railway from Rome to Lindale has raised $5,000, Northern capitalists having agreed to invest $125,000 in the local electric street railway if the city of Rome, would give a bonus of $15,000.

BRAZIL, IND.—The City Council has granted a franchise to H. D. Hall and E. Adams for the use of the streets for an electric railway.

VINCENNES, IND. The Citizens Street Railway Company, of this city, will erect a new power-house and install it with new machinery this summer.

NEW CASTLE, IND. The City Council has granted a franchise to the Union Traction Company for a terminal of a line from Anderson to this city.

RICHMOND, IND.—The Richmond & Northwestern Electric Railway Company has been granted a franchise for an electric line through Wayne County.

VERSAILLES, IND.—The Commissioners of Ripley County have granted a franchise for the Madison, Greensburg and Indianapolis Electric line across the county.

VALPARAISO, IND. The Union Traction Company, of Indiana, has asked the City Council for a right to pass through the city with its Logansport-Chicago line.

HARTFORD CITY, IND.—The Commissioners of Blackford County have granted the Montpelier-Warren & Portland Traction Company a franchise through the county.

MUNCIE, IND.—It is reported that a deal has been made to consolidate the Muncie, Hartford City & Ft. Wayne Traction Company and the Muncie and New Castle Traction Company.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company has filed a notice with the Secretary of State of an increase of capital stock from $10,000 to $1,000,000. The company also filed notice of a change of name from the Converse & Marion Traction Company to the Kokomo, Marion & Western Traction Company, authorized by the Howard Circuit Court. The interests in this company also filed articles of the Indiana Interurban Construction Company, of Kokomo, to "promote, finance, conduct, equip, rent and operate" street and interurban companies and plants for distribution of light, heat and power and to deal in stocks and securities of other companies. The capital stock is $20,000. The directors are O. V. Darby, H. D. Thomas, C. C. McFann, G. W. Norwood and George E. Brunner. It is the intention of the company to build a road from Kokomo to Marion, about 60 miles.

DUBUQUE, IA.—The Iowa, Illinois & Wisconsin Interurban Railroad Company has been organized, with a capital stock of $750,000, to build an electric railway from Dubuque to Platteville, Wis., a distance of 30 miles. The officers of the company are Peter Keine, of Dubuque, president; S. B. Howard, of New York, vice-president; C. H. Eighmey, of Dubuque, treasurer; Charles Peaslee, of Dubuque, secretary.

MADISONVILLE, KY.—Chicago capitalists are interested in a proposed electric railway from Madisonville to Earlington and the road is now said to be almost assured. A franchise has been applied for from the former town.

LOUISVILLE, KY.—The *Louisville Times* says that the Louisville Railway Company is to be reorganized and that two plans have been worked out for the reorganization.

NEW ORLEANS, LA.—The City Council of New Orleans has advertised for bids for the franchise of an electric railway to operate in Algiers.

SPRINGFIELD, MASS.—The Woronoco Street, Railway Company has awarded Seymour & Newell, of Springfield, the contract for the construction of the company's new line to Holyoke.

GREENFIELD, MASS.—The Greenfield, Deerfield & Northampton Street Railway Company, is having plans prepared for developing the water power at Gardner Falls. C. W. Clapp is engineer. The company has asked for authority to make an increase of $30,000 in its capital stock, making the total $150,000.

WESTFIELD, MASS.—The Woronoco Street Railway Company is planning to increase the equipment of its power house in Westfield to provide power for the operation of its line to Holyoke now being built.

PITTSFIELD, MASS.—The committee on water supply and towns of the legislature has granted the Huntington & Westfield Street Railway Company the right to dam the Westfield River for the development of power.

WORCESTER, MASS.—The Worcester & Holden Street Railway Company has under consideration a request from citizens of Rutland to build a line to that town. A proposition is being considered by other street railway men of building a line from Rutland to West Brookfield.

SPRINGFIELD, MASS.—The Railroad Commissioners have approved an issue of $1,500,000 twenty-year 4 per cent. bonds by the Springfield Street

Railway Company. Of the proceeds of this issue $1,250,000 are to be applied to fund floating debt, and $250,000 are to be used for improvements and betterments.

CUMBERLAND, MD.—The Cumberland Electric Railway Company has been granted a 25-year franchise for the construction of a number of new lines here.

LAUREL, MD.—The Laurel Traction Company has filed articles of incorporation at Annapolis. Charles J. Fox, Matthew Hanley, J. K. Lamb, of Philadelphia; Edward T. Benton, Jr., and George G. Benton, of Prince George County, Md., are interested.

CARTERSVILLE, MO.—The Southern Missouri Electric Railway Company has filed for record articles showing that it had made an increase in its capital stock from $800,000 to $1,500,000.

UTICA, N. Y.—The stockholders of the Utica & Mohawk Valley Railroad Company have voted to increase the capital stock of the company from $3,100,000 to $6,300,000.

OSSINING, N. Y.—The Westchester Traction Company has obtained from the State Railroad Commissioners approval of an increase of capital stock from $300,000 to $1,500,000.

JAMESTOWN, N. Y.—Contracts are to be awarded at once by the Chatauqua Traction Company for the construction and equipment of its proposed road between Lakewood and Mayville, a distance of 19 miles.

JAMESTOWN, N. Y.—The Jamestown, Chautauqua and Lake Erie Railroad, which runs from Jamestown to Westfield, skirting Chautauqua Lake for its entire length, is to be converted into an electric trolley line. It is owned by Eastern capitalists.

BAY SHORE, N. Y.—The South Shore Traction Company, which purchased the electric light plant at Patchogue, and has options on the plants at Islip and Amityville, has made formal application to the Islip Board of Highway Commissioners for a franchise to run an electric railway.

HAMMONDSPORT, N. Y.—F. J. Kilpatrick and John F. Tuerk, of New York, have been granted a franchise in Hammondsport. Messrs. Kilpatrick and Tuerk have in contemplation the construction of an electric railway from Hammondsport to Bath, and unofficial reports say they have secured an option on the property of the Penn Yan, Keuka Park & Branchport Electric Railway.

COLUMBUS, OHIO.—The Columbus, Marysville & Bellefontaine Railway Company has been incorporated with $25,000 capital stock, by W. H. Luchtenberg, R. O. Luchtenberg, L. J. Guthke, M. B. Earnhart and O. E. Luchtenberg.

CLEVELAND, OHIO.—The Cleveland, Painesville & Eastern Railway Company is installing a storage battery at its power house at Willoughby. The company will make a number of improvements at Willough Beach Park.

ELYRIA, OHIO.—The Elyria, La Grange & Southern Traction Company has been incorporated with a capital of $80,000, by F. H. Foster, H. J. Ely, Wm. Heldmyer, G. H. Chamberlain, W. B. Johnson, J. M. Starr, I. A. Freeman and P. K. Clark.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company has placed contracts with the Westinghouse Company for its electrical equipment. It is probable that the contract for building the road will be awarded to the Philadelphia Construction Company.

CINCINNATI, OHIO.—The Cincinnati & Columbus Traction Company is having plans prepared for a large power station to be erected at Perinton, with sub-stations at Perinton, Milford, Fayetteville and Hillsboro. Philip C. Swing, Cincinnati, is at the head of the project.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company is planning a number of important improvements to its system. A storage battery booster outfit will probably be installed and some new cars will be purchased. The Shelby interurban line will be extended to Plymouth.

MT. VERNON, OHIO.—The promoters of the Mt. Vernon, Mt. Gilead & Western Railway Company assert that they have practically all the franchises and rights of way required, and that capital sufficient to build a portion of the road has been secured. W. C. Bennett, of Mt. Gilead, is one of the chief promoters.

CLEVELAND, OHIO.—Tucker, Anthony & Co., of Boston, are negotiating with the Pomeroys, of Cleveland, for the control of the Tuscarawas Traction Company, whose line will form a part of the through system which the Tucker, Anthony-Appleyard interests are building to connect Cleveland, Columbus and Cincinnati.

CLEVELAND, OHIO.—The Youngstown & Ohio River Railway & Light Company has been formally organized in Cleveland and the following-named officers elected: T. W. Hill, president and treasurer; Will Christy, vice-president; Max P. Goodman, secretary. The road will extend from Youngstown to Salem and later will be extended to East Liverpool. The capital stock has been increased from $10,000 to $1,500,000.

SPRINGFIELD, OHIO.—The controlling interest in the Springfield & Xenia Traction Company has been sold to the Bushnell syndicate, of Springfield, by J. R. Nutt, Will Christy, of Cleveland, and their associates. The new owners have elected the following-named officers: J. J. Fisher, president; J. E. Bushnell, vice-president; Dr. H. C. Diamond, secretary-treasurer. The road will be consolidated into the line which the Bushnell syndicate is building from Springfield to Troy and Piqua.

YORK, PA.—The York Traction Company is surveying a line from Dallastown to Glen Rock.

NANTICOKE, PA.—It is proposed to extend the People's Street Railway to Berwick, 20 miles from Nanticoke.

WAYNESBORO, PA.—Baltimore capitalists are reported to be considering the plan of building an electric railway in the vicinity of Pen Mar.

CHAMBERSBURG, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has appointed a committee to secure a site for a car-house and power house.

GREENVILLE, PA.—The Borough Council has granted a franchise to the Greenville & Westside Street Railway Company. The company is composed of Congressman E. Acheson, Hon. J. V. Clark, W. I. Berryman and J. W. Taylor.

UNIONTOWN, PA.—The Myersdale & Salisbury Street Railway Company, of which O. W. Kennedy is president, has commenced the construction of 8½ miles of street railway between Myersdale and Salisbury in Somerset County. The capital is $250,000.

JAMESTOWN, PA.—The Chatauqua Traction Company has organized as follows: A. N. Broadhead, president; S. B. Broadhead, vice-president and treasurer; W. R. Reynolds, secretary; George E. Maltby, general manager. The company plans to build an electric railway between Mayville and Lakewood.

DALLAS, TEX.—A party of bankers and engineers have arrived in Dallas from London, accompanied by capitalists from New York and Boston. They came with a view of investing largely in electrical properties in this and other Texas cities. Members of the party are A. E. Ginnis, of Ginnis & Mason, London; B. S. Ginnis, of Ladenburg, Thalman & Co., of New York; J. K. Newman, banker, of New York, and G. W. Bacon, engineer, of New York, and Guy E. Tripp, of Boston.

LEGAL.

LITIGATION ON TELEPHONE APPARATUS.—Injunction suits have been brought by the Kellogg Switchboard and Supply Company, of Chicago, in the United States Circuit Court, against the Stromberg-Carlson Manufacturing Company, of Rochester and Chicago, and the Louisville Home Telephone Company, of Louisville, Ky., asking that the former be restrained from infringing patent No. 718,855, granted to Kempster B. Miller, for a telephone wall set, and that the latter be restrained from infringing, by purchase and operation re-issue patents Nos. 12,031 granted to Francis W. Dunbar for a 2-wire telephone system, and 12,090 granted to William W. Dean for a 2-wire testing system.

OBITUARY.

MISS MARY A. HENRY.—News just received by friends in Washington announces the sudden death on April 10, at Seville, Spain, of Miss Mary A. Henry, eldest daughter of the late Joseph Henry, the first head of the Smithsonian Institution. Miss Henry had been engaged for several years in collecting the scientific, literary, and personal papers of her father, with whose work she was sympathetically familiar, and fortifying his claim to the discovery of the essential principle of telegraphy. Two sisters survive her. Miss Henry's death appears to have been without warning of any sort. She went to bed apparently in her usual physical condition and died before morning. Readers of *The Electrical Engineer*, one of the constituent journals of ELECTRICAL WORLD AND ENGINEER, will doubtless recall the series of admirable articles on her father's work that she contributed to its pages some years ago. She also took an active part in these columns, in the Henry-Morse-Vail controversy, a few years ago.

MR. W. F. D. CRANE.—It is with deep pain and regret that we record the death, at Orange, N. J., on April 28, of Mr. William F. D. Crane, at the home of his father, Thomas S. Crane, from typhoid pneumonia, after an illness of two weeks. He was thirty-eight years old and unmarried. He was a graduate of Cornell. He figured prominently in the development of the electric storage battery, electric motor, electric railways, etc., and though a young man had had notable success as an electrical engineer. At the time of his death he was with the American Stoker Company, of New York. Mr. Crane had been a member of the American Institute of Electrical Engineers since 1888 and was also a member of the New York Electrical Society for several years past. He contributed from time to time to the pages of this journal, and his articles were always valuable and instructive. When noting recently his illness in these columns we little expected so soon to mourn the loss of this estimable and talented young engineer.

MR. S. MORGAN SMITH.—We noted recently the death, in California, of Mr. S. Morgan Smith, and are now able to give a few interesting details about his career. He was born Feb. 1st, 1839 in Davie County, N. C., and was educated in the public schools there. Later on he attended the Moravian College at Bethlehem, Pa., from which institution he graduated in 1861. During his college course he prepared himself for the ministry and from 1861 to 1866 he was pastor of the Moravian Church at York, Pa. In 1864 he was elected Chaplain of the Two Hundredth Regiment Pennsylvania Volunteers, in which capacity he served until the end of the war. In 1866 he went to Canal Dover, O., where he had charge of a congregation for five years. Here he was forced to quit the ministerial work in 1871 on account of a serious throat affliction and he returned to York. About this time he began giving his attention to the perfecting of a washing machine, known as the "Success" which he invented and had patented. Thousands of these machines were sold in this and foreign countries. In 1875 he became interested in the manufacture of water wheels. His first wheel was known as the "Success," many of which were installed in mills and factories throughout the country. Later he placed upon the market the "Improved Success," a wheel giving more power than the "Success" of the same diameter. He found ready sale for great numbers of these wheels in this and foreign countries and many hundreds are in use driving all kinds of machinery. In 1892 he engaged in the manufacture of the "McCormick" water wheel and supplied many of the largest plants in operation in this country, Canada and foreign countries. Although the shops were small in which he started the manufacture of water wheels, they have assumed such proportions, that at the time of his death, they were among the largest and best equipped devoted exclusively to the manufacture of water wheels and power transmitting machinery. He was a member of General John Sedgwick G. A. R. Post No. 37 and for a number of years president of the Society for the Prevention of

Cruelty to Animals; President of the York County Sunday School Society, during which time he visited many conventions held under the auspices of this association throughout the county. He was a member of the Ministerial Association of York, President of the Board of elders and trustees of the Moravian Church for more than 30 years; Superintendent of the Sunday School for over 20 years, Member of the Board of Trustees of Linden Hall Seminary, Lititz, Pa., a school director for several years, President of the Atlanta Water & Electric Power Co., as well as president of the company which bears his name. As a minister of the Moravian Church he was a close student and an eloquent orator. In his demeanor he was a man of warm disposition, kindly nature and charitable in every sense. In 186[illegible] he married Miss Emma R. Fahs, daughter of Mr. and Mrs. John Fahs, of York, Pa. He is survived by a widow and six children: Charles Elmer, Stephen Fahs, Beauchamp Harvey, Mrs. Hugh Lee Miller, Mrs. C. I. Etner and Miss Mary Delia Smith.

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PERSONAL.

MR. FRED RECKENZAUN, E. E., has changed his consulting offices from 1 Broadway to 77 Chambers Street, New York City.

MR. W. S. ACCLES, the European manager of the Niles-Bement-Pond Company, 136 Liberty Street, New York, is now visiting the United States.

MR. I. STERNFIELD, of the Goulds Manufacturing Company, Seneca Falls, N. Y., has sailed for a business trip to Europe. He expects to be absent several months.

MR. W. H. SELDON, JR., secretary and treasurer of the Miller Seldon Electric Company, of Detroit, Mich., was a visitor in New York City last week making various business arrangements.

MR. J. J. LOWTHIAN, representative of Baker & Company, platinum refiners, made a call at the Chicago office of ELECTRICAL WORLD AND ENGINEER recently, while on business in the West.

MR. V. H. YARNALL, the general manager of the American Vitrified Conduit Company, 170 Broadway, New York, has left for Russia to superintend laying the conduit for the St. Petersburg municipal telephone system.

MR. BASSETT JONES, JR., formerly with the Electric Storage Battery Company, has accepted a position as supervising engineer with the well-known New York City real estate firm, Douglass Robinson, Chas. S. Brown & Co.

MR. GEORGE T. HANCHETT, consulting electrical engineer, has moved his offices to the Engineering Building, 114 Liberty Street, New York City, where he proposes also to provide convenient laboratory and testing facilities.

PROF. W. D. MARKS, M. E., the well-known engineer and central station expert, of Philadelphia, has been in New York recently on important business, and renewing acquaintance with many old friends who have not seen him for a long time past.

MR. J. F. CUMMINGS, formerly of Detroit, Mich., and until recently manager of the British electrical engineering and contracting firm of Maguire & Baucus, London, has been appointed European representative of the American Vitrified Conduit Company with headquarters in London.

MR. C. H. WILMERDING, consulting engineer, and one of the past presidents of the National Electric Light Association, has removed from his old offices in La Salle Street, Chicago, to new quarters, 1100 Old Colony Building that city.

MR. J. W. HOLMAN, recently of *The Engineering and Mining Journal* and Mr. G. W. Scott, recently of the *Mining and Scientific Press* have purcahsed the *Western Mining World*, of Chicago, and after May 1 it will be known as the *Mining World*.

MR. R. FULLER, secretary and manager of the Fuller Company, of Detroit, Mich., spent a few days in Chicago recently looking after some important matters connected with the interests of his company, which manufactures electrical and ventilating apparatus.

MR. ANDREW CARNEGIE sailed for Scotland last week and before doing so made another gift in aid of education by placing $600,000 at the disposal of Tuskegee Institute, the Southern College for colored students, and to assist Prof. Booker T. Washington in his admirable work there.

MR. J. B. ORR, of the electrical engineering and contracting firm of James Mitchell & Company, Rio de Janiero and San Paulo, is expected to arrive in New York from the West to-day. He can be found in the Brazilian department of the American Trading Company, Broad Exchange Building. He intends to sail for Brazil, May 5.

PROF. ALEXANDER GRAHAM BELL visited Indianapolis, Ind., recently. Among other statements made by him during an interview, he is reported as saying: "I am credited with receiving royalties that make my mouth water, but I am sorry that I do not get them. The fact is," he continued, "I own just one share in the Bell Telephone Company."

MR. J. K. ROBINSON, of Iquique, Chili, who looks after the business of the Westinghouse and other allied American interests throughout Chili, Bolivia, Peru and Ecuador, is now in New York. He is making his headquarters at the offices of William E. Peck & Company, Centennial Building. He will place some substantial orders for equipment before he returns home.

SIR OLIVER LODGE, in a speech last week, said: "In the Somaliland campaign, the first war in which an organized attempt has been made to use the wireless system of telegraphy, it has not, I understand, succeeded. Yet at sea it has proved of the utmost possible convenience, and any ship which is not provided with this apparatus considers that it has a first-class grievance."

MR. EDWARD R. TAYLOR, of Penn Yan, N. Y., will sail for Europe May 12, where he will attend the meetings in Berlin of the International Congress of Applied Chemistry as a delegate of the American Electrochemical Society and of the Society of Chemical Industry. Mr. Taylor has accepted an invitation to prepare a paper for presentation before the Congress.

MR. F. H. CHAMBERLAIN, some time connected with the General Electric Company and who more recently was on the construction staff of the Sydney City & Suburban Tramway System, which is being equipped with American equipment, etc., has been appointed to draw up plans for the electrical conversion of the existing horse car system in Christchurch, New Zealand.

MR. GEORGE A. ANNABLE, lately manager of the New York office for the Cutter Company, of Philadelphia, Pa., has taken other territory for the Cutter Company, outside of the Greater New York, and has added to his line the "Yost" incandescent lamp socket, made by the Yost Electric Mfg. Company, of Toledo, O. He retains the same office as before, 120 Liberty St.

MR. FRANK J. SPRAGUE was a member of the dinner committee for the dinner given last week by the Colonial Club, of New York, in honor of Mr. Horace White, the retiring editor of the *Evening Post*. That model journal under Mr. White's management has been very liberal in its policy toward electrical matters and has taken a deep interest in the advance of electric traction.

MR. MORTIMER J. HIGLEY, formerly superintendent of the lighting department of the Burlington (Ia.) Railway & Light Company, has accepted the management of the Belvidere, Ill., Gas & Electric Company. Mr. Higley has been at Burlington seven years, where he has made a good record, and the Iowa Electrical Association will regret to lose him, as he has been one of its most helpful members.

MR. FRANK KLEPETKO, consulting electrical engineer, Maritime Building, New York, has returned from Peru, where he went in the interests of the J. B. Haggin group of capitalists, who are developing the Cerro de Pasco mines. Mr. Klepetko is now engaged in drawing up plans for the construction of a 5000-hp. hydraulic plant which is to furnish power to operate a large smelter to be built at the Peruvian mines.

MR. F. F. SAPP, of the North Electric Company, Cleveland, Ohio, accompanied by Mr. R. Hendrickson, its engineer, was a welcome caller at the offices of ELECTRICAL WORLD AND ENGINEER during the past week. Starting for pioneer work in the field of rural telephony, the North Company has gradually built up a business which includes some of the largest modern city exchanges in the country, and Mr. Sapp is now seen more frequently around twenty-story buildings than among the waving hills of corn.

MR. STEPHEN M. HALL has recently associated himself with the C. & C. Electric Company in the capacity of sales engineer, and will be stationed at the New York office. Mr. Hall is a graduate of the Massachusetts Institute of Technology, and during the several years since his graduation he has acted as chief electrician in the Norfolk Navy Yard, and has been connected with the C. W. Hunt Company and the Storey Motor & Tool Company.

MR. H. T. HARTMAN, editor of the question box for the coming convention of the National Electric Light Association, Chicago, May 26, 27, 28, has already received over two hundred answers to the preliminary list of questions sent out April 1st. Nearly every one of the 125 questions has been answerd. A supplementary list, nearly as large, has just gone to the members, and the question box this year promises to be an encyclopedia of useful knowledge for central station managers.

MR. ROBERT L. ELLIOTT, of Chicago, reporter on theft of current, has prepared an excellent report for the Chicago electric light convention, describing different ways in which electric current is stolen, showing means for detecting the guilty parties, and suggesting methods for preventing the possibility of theft. The report will also show which of the states have laws punishing this crime and what uniformity exists in the laws of the different states. It is hoped that a uniform law can soon be enacted in all the states.

MR. W. E. RUNDLE, of New York, has made several improvements in the chart which he designed for mapping an underground cable system, and which was described in these columns some time ago. It is proposed to modify the original plans so as to show overhead construction as well as underground, substituting in place of the man-hole in underground work a pole with its length, diameter at top, number of cross arms per pole, number of pins on each cross arm and the location of each wire upon each pin and also the blank pins.

MR. EDWARD D. ADAMS, the well-known banker and creator of Niagara power interests, as well as American representative of the Deutsche Bank, entertained at luncheon last week, on the day the new Stock Exchange opened, at the Midday Club, Dr. Ad. Franke, technical director of the Siemens & Halske Company. The party comprised Dr. Franke and Messrs. E. D. Adams, Wm. Stanley, C. S. Bradley, L. B. Stillwell and T. C. Martin; so that the visitor was enabled to review many aspects of electrical activity here during a very pleasant afternoon.

CHARLES D. JENNEY, president of the Jenney Electric Manufacturing Company, of Indianapolis, has perfected plans to light a baseball park by electricity so that baseball may be played at night and thus give everyhody a chance to see the game. Several years ago Mr. Jenney became interested in the idea and made an experiment with strong reflectors, but the reflectors made a shadow and the players could not judge a ball when in air. Mr. Jenney's new invention is far superior to the former one, he says, and with it he can cause a diffused illumination all over the grounds, making it almost as light as day and without shadows.

MR. LYMAN T. SMITH has promised Chancellor Day to give three more buildings to Syracuse University, which, with the one he has already given, will form a quadrangle on the campus. The Smith buildings will be devoted to applied sciences. The first structure will be for electric, hydraulic and steam engineering, the second for wood-working shops and the third for forge and foundry work. The amount of money to be expended has not yet been determined, as Mr. Smith desires to wait until the close of the year to see what needs develop in connection with the present Smith College of Applied Sciences. These improvements will give Syracuse one of the largest and best equipped engineering colleges in the country.

FIELD & HINCHMAN, the well-known consulting engineers of Detroit, have incorporated under the name of Field, Hinchman & Smith, the firm of Mortimer L. Smith & Son, architects, having affiliated with them. Because of an ever-increasing business, more commodious quarters have been secured at 708-9-10 Washington Arcade Building which will be occupied by the first of May. Reversing the usual order of things, it is their intention to design complete power and industrial plants and to house these plants in suitable buildings, thus adapting the latter to the needs of the former and not vice versa. Because of important work which they are carrying on in Canada, a branch office has been established at Windsor, Ont.

Trade Notes.

THE FRANK ADAMS ELECTRIC COMPANY, of St. Louis, Mo., has increased its capital stock from $25,000 to $100,000.

THE LAWRENCE HALL ELECTRIC COMPANY, of Cincinnati, Ohio, has increased its capital stock from $20,000 to $50,000.

ANDREAS & CO. announce that on and after April 30 they will be found in their new offices at Whitehall Building, 17 Battery Place, New York City.

THE STERLING ELECTRICAL MFG. CO. was represented in New York City last week in the persons of Mr. William Coale, its treasurer and Mr. Glenn C. Webster, superintendent.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is out with a new fan catalogue listing a complete line of direct and alternating current fans. This catalogue will be mailed promptly upon application.

A. C. BECHEN, manufacturer of the Paillard non-magnetic watch so familiar to electricians, has found it necessary to seek larger quarters and is now located in the Powers Building, Monroe St. and Wabash Ave., Chicago.

THE BRODE ELECTRIC COMPANY, Los Angeles, Cal., recently incorporated, has moved into its new store at 306 So. Los Angeles Street, where it has better accommodations for its large stock of supplies. The company would be glad to hear from any concern who desires to push its business in the West.

THE ILLINOIS ELECTRIC SPECIALTY COMPANY, of Chicago, announces that it is again compelled to seek much larger quarters in order to keep pace with the demand for its I. E. S. ohmmeters, pole changers, etc. About May 1 it will remove from its present location to 171 to 173 So. Clinton St., where it will have more than double the space which it formerly occupied

THE PROMETHEUS ELECTRIC COMPANY on May 1 moved its offices to 39 Cortlandt Street, and its factory to much larger quarters at 81 Dey Street, New York, where it has much better facilities for the production of its electric heating and cooking apparatus. Mr. Max Loewenthal is secretary of this progressive company, and he reports that there is an increasing demand for its products.

REMOVAL.—Roth Bros. & Co., Chicago, on May 1 removed to their new location and now occupy the entire building at 27 and 29 South Clinton Street. In the new quarters the firm has twice the former floor space and largely increased facilities for taking care of its rapidly increasing business. This firm, as is well-known, makes a line of dynamos and motors which have acquired an excellent reputation for efficiency and service.

PAWLING & HARNISCHFEGER, manufacturers of traveling cranes, Milwaukee, Wis., whose works were recently damaged by fire, have leased the works lately vacated by the Nordberg Mfg. Co. These shops will be in operation around May 1st and, in connection with other buildings, will place the company in better position to build cranes and hoists than prevailed before the fire. All machinery has already been purchased to equip the shops just acquired.

DUNCAN METERS.—The Duncan Electric Mfg. Co., Lafayette, Ind., has issued a handsome 28-page pamphlet devoted to the Duncan integrating wattmeter. The meter is illustrated and described in minute detail, and instructions are given for installing and testing, a number of useful tables being included under the latter head. The Electrical Material Company, Baltimore, Md., is general sales representative.

THE ELECTRICAL MATERIAL COMPANY, Baltimore, Md., which was recently appointed general sales representatives of the Duncan Electric Manufacturing Company, Lafayette, Ind., is energetically pushing the sale of Duncan recording wattmeters for direct and alternating current. The Duncan meter, it is claimed, has many advantages. In the bulletin descriptive of the Duncan meters is given a great deal of valuable information to any one with reference to various methods of testing meters.

ROSSITER, McGOVERN & CO. removed on April 28 to the Whitehall Building, 17 Battery Place, New York City. This will give them more commodious quarters and increased facilities for handling their business. In addition to the office which will be occupied by their operations, it is contemplated having an ample reception room for the use of their friends and customers, and already the Rossiter McGovern Company is contemplating the large use of this room by out-of-town visitors to make it their headquarters while in New York.

OIL FILTERS.—Among the orders recently received by the Burt Mfg. Co., Akron, Ohio, for its Cross oil filters are, one 50-gallon for a large electric light plant in Mexico City, Mex.; four large ones to be used on steamers now being built by the Eastern Shipbuilding Co.; two to be used in one of the pumping stations of the City of New York; one for the Plano works of the International Harvester Co.; the eighteenth order from the American Sheet Steel Co.; eight for San Francisco, and one to Portugal. Its agent at Mexico has just ordered sixteen, and reports business good.

McCREARY SPECIALTIES.—Since the first of the year the McCreary Electric Company, 136 Liberty St., New York, has had a very gratifying increase in sales, in fact over 60 per cent. over the same period last year. Recent export orders have been shipped to England, Mexico and China. Its "Amal" brilliant decorating stands and cup reflectors are now fitted with shade holders and conform to all requirements of fire underwriters. The company will bring out for the Fall trade several new electrical specialties, among them a new brilliant, non-tarnishing headlight reflector and several styles of car reflectors.

THE GOUDEY-McLEAN COMPANY, engineer, announces that from May 1st, 1903, its offices will be located at 120 Liberty Street, New York City. With increased capital and facilities the company will continue to operate as the foreign department of American manufacturers, syndicating the export interests of many well-known firms. It also acts as agent for the distribution and sale of electrical apparatus and material in both the export and domestic branches. The officers for the ensuing year will be Robert McLean, president; Edward E. Goudey, vice-president and general manager; Laurence W. Miller, secretary, and William D. Vanderbilt, treasurer.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, manufacturer of the Exide battery for electric vehicles, has recently placed on the market a new battery for sparking purposes. The great increase in the use of gasoline vehicles has convinced the company that a reliable sparking battery, which will furnish a "fat and hot" spark will be greatly appreciated. The company has placed on the market a number of sizes, which are found fully described in a pamphlet recently issued by the company, giving capacities, weights and dimensions of the different types. A copy of this will be forwarded upon application to the Electric Storage Battery Co. at any of their sales offices.

ALBERT & J. M. ANDERSON CO.—The stockholders of the Albert & J. M. Anderson Manufacturing Company, a Massachusetts corporation, believing it to be for their advantage so to do, on March 27, 1903, caused to be organized the Albert & J. M. Anderson Manufacturing Company under the laws of Maine, and on April 25 the Massachusetts corporation, by unanimous vote of its stockholders sold, assigned and transferred all of its business and assets to the new company so organized in Maine. The new company has the same officers and stockholders as the old and will take over and carry on its business assuming all its outstanding liabilities at the date of the transfer, April 25th, 1903, and carrying on business at the same location and with the same facilities.

YACHT LIGHTING.—The use of storage batteries for lighting private yachts is rapidly increasing, so much so, that practically every steam yacht of modern construction now includes a battery of accumulators in its equipment. The great advantage of a storage battery lies in the fact that it enables the lights to be used throughout the night while the machinery is shut down, thus avoiding the annoying vibration from the running of a generator which is especially noticeable in a yacht while lying at anchor. The Electric Storage Battery Co. has recently contracted for the installation of five yacht lighting plants on boats now under construction at Morris Heights, N. Y., thus adding to the large number of boats already equipped with its Chloride accumulators.

THE STROMBERG-CARLSON TELEPHONE MFG. CO., of Rochester, N. Y., and Chicago, Ill., reports that it has begun the erection of a second factory in Rochester, which will be engaged in the manufacture of telephones. The plans call for a factory having two hundred thousand feet of floor space and capable of turning out two thousand telephones per day. The company also reports having just secured the contract from the Home Telephone Company, Kansas City, Mo., for six thousand five hundred central energy telephones. The Stromberg-Carlson Company has also recently sold switchboards and equipments to the following companies: Local Telephone Company, Crestline, Ohio; Harrisonville Telephone Company, Harrisonville, Ohio; Foster and Faber, Summerfield, Ohio. It has also recently sold switchboards and complete exchange equipments at the following points; Troy, Mo., Orrick, Mo., and Gillman City, Mo.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 21, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

725,224. INDUCTION MOTOR; Abe L. Cushman, Concord, N. H. App. filed July 8, 1902. The secondary winding is made up of elements of low specific resistance and means are provided for forming a closed induced circuit from a part only of said element, so as to decrease the current induced in the secondary at starting; additional elements are brought into action as the motor speeds up. (Issued April 14.)

725,663. ELECTRICAL RESISTANCE DEVICE OR HEATER; Johann F. Bolling, Frankfort-Bockenheim-on-the-Main, Germany. App. filed April 4, 1902. A resistance material is spread upon a sheet of mica and confined by a non-conducting plate.

725,664. OUTLET BOX FOR INTERIOR CONDUITS; William F. Bossert, Utica, N. Y. App. filed March 19, 1902. Details.

725,667. TROLLEY POLE; Charles A. Bray and Florien C. Fry, Schenectady, N. Y. App. filed Sept. 17, 1902. The pole has a bend in it and is pivoted on top of the car; the wheel can make contact with a wire suspended either above the car or to one side at the level of the car roof.

725,675. DRIVING MECHANISM FOR SELF PROPELLED VEHICLES; Patrick J. Collins, Scranton, Pa. App. filed Aug. 29, 1902. A field frame contains a central space for a generator armature and two side spaces for motor armatures, the latter armatures being geared to the wheels of the vehicle.

725,681. METHOD OF CONTROLLING INDUCTION MOTORS; Harry Phillips Davis, Pittsburg, Pa. App. filed Dec. 26, 1901. (See Current News and Notes.)

725,692. REGULATOR; James B. Foote, Jackson, Mich. App. filed July 23, 1901. The object is to check the regulating movement as soon as the proper regulating effect has been produced, without permitting it to pass through a series of oscillations or decreasing amplitude about the desired point.

725,703. ELECTRIC LAMP GLOWER AND METHOD OF ATTACHING TERMINAL WIRES THERETO; Marshall W. Hanks, Pittsburg, Pa. App. filed Oct. 31, 1902. Terminal wires are wound around the ends of the glower and alloying material applied thereto by means of the high degree of heat.

725,708. ELECTRIC METER, Frank Holden, London, Eng. App. filed Oct. 23, 1901. (See Current News and Notes.)

725,719. TROLLEY STAND; Geo. E. Johnson, Pinners, Va. App. filed June 26, 1902. Details.

725,730. CONTROLLER; John B. Linn, Schenectady, N. Y. App. filed Aug. 4, 1902. Details of construction of the reversing switch.

725,731. CATAPHORIC ELECTRODE; Samuel H. Linn, Rochester, N. Y. App. filed Aug. 9, 1901. An anode of absorbent material and means for forcing an electrolyte through the same, under pressure, and against the surface or tissues undergoing treatment.

725,754. ELECTRIC HEADLIGHT; John A. Mosher, Chicago, Ill. App. filed June 17, 1902. Both incandescent and arc lights are contained in the casing, the former used in city limits and the latter in the country districts; an automatic switch provides for the cutting in of one lamp when the other fails.

725,765. VOLT AMPERE METER; Louis M. Pignolet, Orange, N. J. App. filed Sept. 27, 1901. A manual device is employed to stop the needle from swinging when the current is turned on.

725,767. SYSTEM OF CONTROL FOR ELECTRICALLY PROPELLED VEHICLES; Wm. B. Potter, Schenectady, N. Y. App. filed July 22, 1898. In a multiple unit system, the motors are automatically transformed into generators in case the conductor between cars is broken.

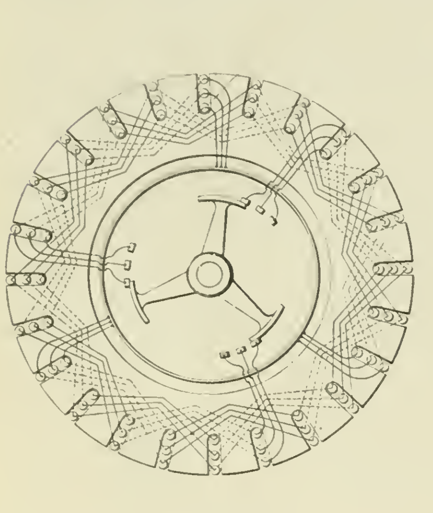
725,773. ROTATING FIELD MAGNET FOR ALTERNATING CURRENT GENERATORS; Henry G. Reist, Schenectady, N. Y. App. filed Oct. 18, 1901. A spider having a laminated rim body and a cast rim flange extending beyond said body to afford material for truing up without the necessity of facing off the rim body.

725,776. ELECTRIC MOTOR SEWING MACHINE TRANSMITTER; Julius Rosenberger, New York, N. Y. App. filed Oct. 14, 1902. The switch, rheostat and brake are controlled from the treadle.

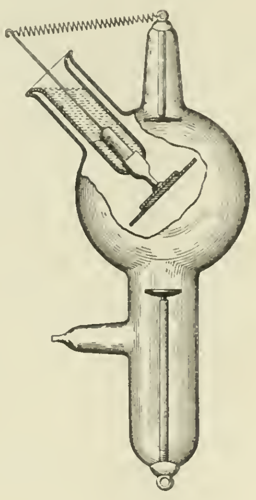
725,777. SYSTEM OF ELECTRICAL DISTRIBUTION; Norman Rowe, Wilkinsburg, Pa. App. filed June 18, 1897. (See Current News and Notes.)

725,798. MULTIPLE-RATE METER; Elihu Thomson, Swampscott, Mass., and Frank P. Cox, Lynn, Mass. App. filed Feb. 25, 1899. (See Current News and Notes.)

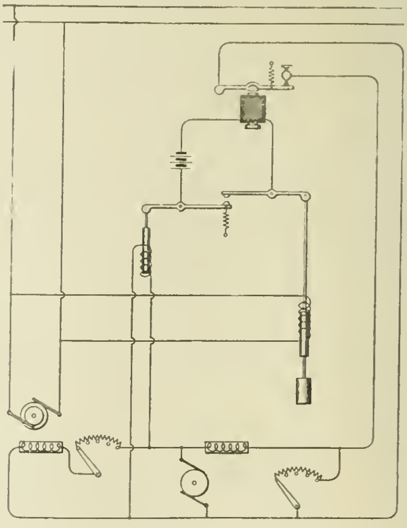
725,799. AUTOMATIC POTENTIAL REGULATOR FOR DYNAMOS; Allen A. Tirrill, Laconia, N. H. App. filed April 13, 1900. This patent together with 725,800 and 726,234, relates to methods and apparatus for regulating the voltage of dynamos by exciting the field of the machine, controlling the excitation in response to the voltage at the regulated point, and causing the excitation voltage to react upon the control independently of its action through the fields of the machine and of the exciter.



725,224.—Induction Motor.



726,044.—X-Ray Tube.



726,234.—Automatic Potential Regulator.

725,800. AUTOMATIC POTENTIAL REGULATOR; Allen A. Tirrill, Concord, N. H. App. filed Dec. 16, 1901. (See preceding patent.)

725,803. APPARATUS FOR PURIFYING, STERILIZING, OR AGING LIQUIDS; Robert C. Turner, Columbus, Ohio. App. filed May 29, 1902. The apparatus consists of several tanks into which the liquid is successively introduced and electrolyzed.

725,826. ELECTRIC CURRENT SHUNTING DEVICE; Edward R. Cliff, New York, N. Y. App. filed March 22, 1902. An automatic shunting device for lamps, consisting of a paper strip adapted to be perforated under abnormal conditions, the strip being coiled upon spools and together with the various contact devices, located in a weather-proof casing through the wall of which a key shaft projects for moving the strip.

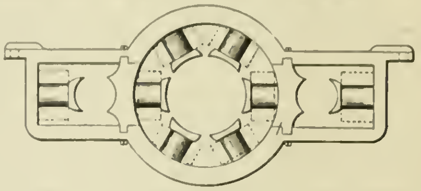
725,864. APPARATUS FOR THE TREATMENT OF GOLD OR OTHER ORES; Wm. B. McPherson, Los Angeles, Cal. App. filed Nov. 28, 1902. The charge of ore introduced into the apparatus is kept continuously agitated and moved in cycles until all the metal sought to be extracted has been removed.

725,968. PLASTIC COMPOUND; Oliver T. Hungerford, Brooklyn, N. Y. App. filed May 21, 1900. A plastic compound for use as an insulator, composed of a silicous base, a binder and rosin oil.

725,985. ELECTROMAGNETIC BRAKE; Frank C. Newell, Wilkinsburg, Pa. App. filed Dec. 16, 1899. The braking force of the several shoes on the track is controlled by a suitable switch.

725,992. ELECTRIC LIGHTER; Wm. Roche, Jersey City, N. J. App. filed April 18, 1902. A cigar lighter in which a platinum foil wet with alcohol is brought to incandescence by pushing a button.

725,998. ELECTROLYTIC SEPARATION OF COPPER AND NICKEL FROM MATTES OR ORES; Ernst A. Sjostedt and Joseph H. James, Sault Ste. Marie, Canada. App. filed Sept. 20, 1901. A description of this process is best obtained from a copy of the patent.



725,675.—Driving Mechanism for Self-propelled Vehicles.

726,044. X-RAY TUBE; Theodor Friedlander, Chicago, Ill. App. filed July 15, 1902. The cathode is sealed into a water chamber which extends obliquely into the tube. The water prevents undue heating of the terminal.

726,061. SAFETY DEVICE FOR AUTOMATICALLY PREVENTING ACCIDENTS FROM TROLLEY WIRES; Wm. A. Heyes and Lancelot O. Heyes, Wigan, England. App. filed Jan. 3, 1902. The sagging or falling of the trolley wire automatically closes a circuit to ground the wire.

726,124. ELECTRIC INCANDESCENT LAMP AND CIRCUITS AND CONDUCTORS THEREFOR; Gustave Weissmann, Paris, France. App. filed Aug. 16, 1902. The terminal wires of the lamps are bent into hooks which engage the distribution conductors to support the lamp for decorative purposes.

726,147. SUPPORT FOR COILED WIRE; Kern Dodge, Philadelphia, Pa. App. filed Feb. 21, 1903. A support for coiled wire capable of contracting or expanding with the wire, to hold the wire in proper position under all conditions.

726,177. ELECTRIC MOTOR OR ENGINE; John Massey, Anderson, Ind. App. filed Dec. 2, 1901. Details.

726,211. TROLLEY; Wm. H. Bachtel, Canton, Ohio. App. filed March 10, 1903. A vertical pole having a horizontal loop the bend of which is a spring.

726,225. MECHANISM FOR CUTTING, CRUSHING, AND DISLODGING ICE OR SLEET ON THE THIRD RAIL OF ELECTRIC RAILROADS; Henry Klein, Hoboken, N. J. App. filed Feb. 17, 1903. A serrated wheel adapted to be thrown down against the contact surface of the third rail to remove ice therefrom.

726,233. MULTIPLE-RATE METERING; Elihu Thomson, Swampscott, Mass., and Frank P. Cox, Lynn, Mass. App. filed Feb. 25, 1899. (See Current News and Notes.)

726,234. AUTOMATIC POTENTIAL REGULATOR; Allen A. Tirrill, Schenectady, N. Y. App. filed Dec. 16, 1901. (See 725,799.)

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CONTENTS.

Editorial 781
One Million Dollars for a Union Engineering Building........ 784
Electrical Equipment of a 24-Story Bank Building, Pittsburg 785
The Arnold-Bragstad-La Cour Polycyclic Power Transmission System. By O. S. Bragstad 786
Multiple versus Independent Operation of Central Stations 788
Multiple-Rate Metering 792
Discussion of A. I. E. E. Central Station Papers 793
Telephone Exchanges—II. By Arthur V. Abbott, C. E. 796
The New York Electrical Society and Transportation Problems 798
The New "Plaza" Exchange of the New York Telephone Company 798
Party-Line Telephone Service Before the Chicago Electrical Association 799
Financing the Yerkes London Underground 799
New Telephone Patents 800
Statistics of American Street Railways 801
Stealing Electricity in Mexico City 801
Programme of Papers for the N. E. L. A. Convention........ 802
Current News and Notes 802
LETTER TO THE EDITORS:
  Hungarian Telegraphs and Telephones. By P. de Szalay 803
Digest of Current Electrical Literature 804
New Books 807
Objections to the Proposed Cable Vocabulary 808
Electricity for Gas Works Operation 808
S. K. C. Circuit Breaker 809
DEPARTMENTS:
  Financial Intelligence 810
  Commercial Intelligence 811
  General News 813
  Trade Notes 816
  Record of Electrical Patents 817

UNION ENGINEERING BUILDING.

An idea that for twenty years past has haunted many minds as noble and altogether desirable has at last been brought into the realm of possibility and reality by the generous gift of Mr. Andrew Carnegie of one million dollars for a union engineering building in New York City to be shared on appropriate bases of equal partnership by the four great national engineering societies, the Engineers' Club, and kindred engineering bodies to whom a meeting place and a home can also be offered, under the unrestricted and unconditioned offer that has been made. It is a fact that deserves to be put on record here that not only has the American Institute of Electrical Engineers embodied in its transactions for many years its desire and efforts to bring about such a consummation, but that the chairman of the Institute Library Committee has a letter in which, after having submitted the idea for his approval in 1895, Mr. Carnegie wrote back in warm approval and commendation of the plan, which thus, eight years later, he is himself the means of rendering feasible of execution. The history of the course of events during the past three months and of the present situation will be found on another page.

This gift of Mr. Carnegie to the societies of which he is a member and representing the professions to which he is glad to acknowledge his indebtedness comes "without strings," but it has, nevertheless, serious obligations. The Engineers' Club has already provided itself with land, but the four engineering bodies named specifically have to deal with a real estate transaction of between five and six hundred thousand dollars. In fact, the necessary steps have already been taken to secure the land, and at this moment the Union Engineering Building is to be regarded as a tangible actuality. When we remember that the societies in question have at least 10,000 members in good standing, the financial responsibility upon them dwindles into insignificance. Even if one or other of them should not feel able or willing to come in, there is all the more left for those which do respond to this clarion call to co-operation.

We can see and imagine many points of difficulty in the plan. We have heard them for nearly a quarter of a century. They are well made. There is nothing fanciful about them. Full and prayerful consideration should be given to them. In no particular will any society be urged to surrender its autonomy or self-respect. But it is always easier to find reasons for grimly standing apart than to hit upon methods of harmonious union; and just now the men in each body who believe that civilization itself is based on "getting together" for the common good have their opportunity to benefit the profession to which they belong by making the most of the situation. Possibly some time in the future each society in interest may have an individual golden chance not yet accorded to the others, but we do not hesitate to say that if this generous proposal is spurned it will be a long, long time before the next comes from anybody else.

Whatever may happen, we cannot refrain from noting how events lead on to each other. The gift by Dr. Wheeler of a unique library to the Institute forced the issue of a permanent home for that body now growing at an unparalleled rate. The foundation of the John Fritz medal next brought all the societies together as never before, and revealed their splendid strength when working in union. The presence of Mr. Carnegie at the Institute Library dinner this year was the fact bringing together these and other precedent conditions; and out of it all emerges this building endowed as such a building never was before. We subscribe humbly to Lord Kelvin's conception of Providence expressed last week and submit this confirmation to his notice.

The New York Electrical Society.

Few things have given more satisfaction to all concerned in electrical matters in New York City than the continuing activity and growing prosperity of the New York Electrical Society. It might well have been supposed that the extraordinary advances made by the American Institute of Electrical Engineers during the past year would have absorbed the energies of most men taking an active interest in the technical welfare of the profession and industry, and that other bodies might have suffered; but, on the contrary, the society appears to have been stimulated, for it certainly has never seen a year of better work, whether in regard to excellent additions to its membership or in the high quality of the meetings and the crowded attendance. In spite of the rigorous persistence with which the society cuts off from its membership list all "dead wood," the growth in numbers is maintained, and is an indication of the fact that at no distant date the society may well expect to attain a thousand members. Its record has been so conspicuously good that inquiries have reached it from all parts of the Union as to its methods and principles; and while the creation of Institute chapters in different parts of the country may obviate the necessity for the creation of local bodies of the New York society type, there is no doubt that this organization, with its popular but thoroughly practical programmes reaching a great many people who would never otherwise come into active touch with the technical leaders and deeper technical questions of the profession, will long find a large sphere of usefulness.

It is for this reason that we may express the hope that the society will not make the mistake of fixing in its constitution the plan which recently has been abandoned by the Institute of electing a president for more than one year. It would be curious now if the society should take this retrograde step just when the Institute has also put into its constitution the one-year idea; but after the obviously strong manifestation of sentiment on the subject last Wednesday night, we hardly think it is likely that the plan will be brought forward again. It is a good deal better that there should be frequent rotation in office with numerous good men available, and especially in a body where so many new and younger men want to win their spurs.

At the same time, we think it is a pity that the plan of giving the nominating committee a broader base could not be carried out, for so long as the nominating committee is in the hands of the executive committee, there is more or less tendency toward self-perpetuation of the body in power. The idea of enlisting the counsels of past presidents is an excellent one, although even that may be overdone. Unless we are mistaken, at one time all the past presidents of the Mechanical Engineers were *de facto* members of the council, but we believe that now this is limited to the last five. While the presence of a large number of past presidents must undoubtedly exercise a somewhat chilling effect upon the exuberance and enthusiasm of the new men when they come into office, it seems likely that a nominating committee embracing one or two of them would be all the better qualified for its important and delicate task.

The Debate on Central Stations.

Rarely has any meeting of the Institute been productive of more vigorous discussion than the last. The topics discussed were of direct and active interest to many of the members, and the papers were sufficiently suggestive to stir up active debate. On the whole, the discussion, which is printed elsewhere in this issue, added considerable interesting information to the papers and yet after carefully reading it over, it seems to us that many of the really vital points were passed by in favor of relatively unimportant details. Still, the steam turbine which is far from an unimportant topic, came in for a liberal amount of attention, and the point was brought out that the economy of the reciprocating engine can be brought by multiple expansion and superheating to a point considerably beyond anything that has been claimed for the turbine. One feature of the comparison, however, escaped attention—that the steam pressure in a reciprocating engine can be raised, and the superheating forced until further advance is blocked by the failure of lubrication, while with the steam turbine the pressure cannot be pushed without increasing a peripheral speed, already inconveniently high, nearer and nearer to the danger limit set by the strength of the materials, and the advantage of superheating fails. The strongest point of the steam turbine is the high economy at low load, which results from the small frictional losses; and the gain in compactness that comes with high speed of both turbine and generator.

The mooted point of one central station of enormous size versus several smaller ones came in for plenty of attention, but the discussion was far from illuminating, being largely a reiteration of old arguments pro and con without eliciting any important practical data. As we indicated last week, the vital point in this comparison is not the cost of power on the bus-bars, but its cost delivered at the center of distribution. It makes little practical difference at what size of station the production cost of power reaches a final uniformity, for the real question is whether this final result can be reasonably expected ever to reach a figure great enough to compensate for the losses in the transmission and reconversion between the station and the center of distribution. So long as three or four conversions lie between the one point and the other, the single station must show a very considerable economy in generation to justify its existence, and the really important thing is to find out whether this economy actually exists to the required extent. We know of no data which have been made public, covering this phase of the case. Instead of direct statements of cost per kilowatt-hour *delivered,* including proper interest and depreciation charges on the high-tension lines and transformers, the rotaries and their stations, and the batteries which Mr. Lieb pertinently remarked were quite indispensable, we have eulogiums on the great advantages of modern methods of power transmission from consolidated central stations of great efficiency. One of these advantages we think has received far too little attention. We refer to the desirability of putting the whole generating plant well outside of the city. If the lighting and power generation could be carried on, say, 10 miles from the urban center, it would be easy to bring so great a popular pressure on burners of coal within the city limits as virtually to compel the use of electric power almost universally, to the great gain of the city as well as the electric supply company. If transmission is a good thing, why not work it to its legitimate conclusion?

The Rise of the Technical Graduate.

The change in the status of the technical graduate which has occurred during the last twenty years is one of the most remarkable incidents in the professional and industrial history of the period. Even as recent as ten years ago, a young man entering the electrical field from a technical school found himself a target of contemptuous remarks from the "practical" engineer and the "hard-headed" business man, and not infrequently a victim of malice on the part of his associates of practical training. His theoretical attainments were scoffed at as entirely superfluous in the work-a-day world, and tales of his blunders and inaptitude were spread far and wide by eager critics, who were legion. In looking back to those days, one can now see that the mistake of the detractors lay in lack of recognition of the intrinsic value of the systematic training of the mind received in the schools, and in rendering judgment on defects incident to the transitory states of youth and lack of experience. Time has brought its revenge, and to-day the graduate absolutely dominates in the electrical profession, and where not already occupying the posts of profit in the administrative and business branches, he is, according to present indications, the only candidate who in the future will be considered.

It might be assumed that the revolution noted could be ascribed to the peculiar circumstances of the electrical field—to abnormal conditions arising from a sudden and enormous development. In point of fact, however, while the value of technical education was first most fully recognized in that field, and the graduate there has most quickly gained the ascendency, similar influences have been active everywhere. In agriculture, for example, we learn from the old and conservative *Rural New Yorker* that the graduate of the agricultural college is coming to the front more and more. In a recent editorial it is stated that in the cultivation of large blocks of land as a business investment, the principal difficulty encountered has been in finding capable managers, and employers have been turning to agricultural colleges for the type of man combining the necessary qualifications of knowledge, skill and tact, with the consequence that the demand for graduates many times exceeds the supply. Commenting upon this condition, our agricultural contemporary says there was a time when practical farmers sneered at the college graduate and had little use for him. "But now the whole aspect of affairs has changed. The colleges are turning out trained and sensible men who, with fair experience, will make excellent managers. Western men have, during the past few years, invested quite extensively in farm lands. Their plan is to throw several farms together and conduct the whole under one management in a business-like way. This has given opportunity for trained men, so that to-day a capable graduate of an agricultural college has a far better business opportunity than the average graduate at a professional school. This, we think, is only an indication of what is coming in the future." Indeed, the world do move!

POLYCYCLIC TRANSMISSION SYSTEMS.

Mr. Bragstad's article on page 786 of this issue revives the subject of composite transmission, to which we referred in the number of last February 28th in connection with the Bedell system. The general plan is the same in both systems. That is to say, there is at the central station a two-phase generator, or group of generators, and also a single-phase generator, or group of generators. The transmission wires are the same in both systems, there being four such wires. So far as the two-phase transmission is concerned, there are two separate pairs of wires or independent two-phase circuits. So far as relates to the single-phase transmission, the active pairs are those which are inactive for the two-phase transmission. Out of four wires, six pairs may be drawn. Two of these pairs carry the two-phase power currents. The remaining four may be regarded as carrying, or as capable of carrying, the single-phase currents. The two systems differ, however, in the details of interconnecting the single-phase and polyphase machines. In one the single-phasers are connected to the centers of the transformers, just as in the usual common battery systems of telephony the direct-current source, or storage-battery, is connected to the circuits at the centers of the induction coils. In the other case the single-phasers are connected to the outside mains. For the full utilization of each system, either step-up transformers or auto transformers at the generating station, appear to be needed.

The advantage of such a composite system of transmission is usually claimed to be a saving in copper by reducing the total conductive drop. It is doubtful, however, whether any marked advantage lies in the direction of economy of copper. As a rule, an equivalent saving of conductor might be made by raising the pressure. Moreover, these systems require four transmission wires, instead of three, the usual number for multiphase transmission. On this account the extra wire with its insulation and erection offsets a considerable part of the conductor economy effected.

It would seem that the real advantage of composite systems lies in the direction of separating the lamps from the motors, so far as concerns the regulation of pressure. There is often much disturbance in the pressure at incandescent lamp terminals owing to the sudden addition or release of a motor load on the system near by, as when, for instance, an alternating-current elevator motor is suddenly started or stopped and incandescent lamps are operated from the same mains. The motors do not need close pressure regulation, but the lamps do call for close regulation, and in order to maintain the lamp regulation under variations of motor load, more copper has to be invested in the mains than would otherwise be necessary; or, if smaller and fewer motors are connected to the mains, than would be admitted, if the lamps were independent. By connecting the lamps to the single-phase part, and the motors to the polyphase part of a composite system, it is theoretically possible to let the motors tear their pressure regulation to shreds, and yet to maintain the single-phase pressure at incandescent lamp terminals as closely as though the motors were entirely disconnected from the system.

RONTGEN RAYS AND OTHERS.

A recent discovery which is of very great interest seems so far to have attracted less than its due share of attention. We refer to the discovery by M. Blondlot of an entirely new set of radiations derived from an ordinary focus tube and capable of penetrating thin wood, paper, aluminum foil and the like. The striking feature of the new-comers is the fact that while possessing a fair amount of penetrative power they are unmistakably to be classified with ordinary light, and yet do not affect the photographic plate. They can, however, be reflected and refracted, are in themselves plane polarized, but can be given elliptic polarization or rotary polarization by the usual means, and can be brought to a focus by a lens and be deviated by a prism. M. Blondlot, using a tiny spark for an indicator, demonstrated all these properties and finally obtained a rough measure of the index of refraction through a quartz prism. It proved to be in the neighborhood of 2.0, although the radiation evidently covered quite a range of refrangibility. This would indicate that the Blondlot rays, as they deserve to be called, are allied to the extreme ultra-violet rays of the known spectrum. Ordinary metallic spectra rarely show anything beyond a wave length of about 200 $\mu\mu$. By putting source and apparatus in vacuo, wave lengths down to about 100 $\mu\mu$ have been found by photography, but beyond this atmospheric absorption or failure of the photographic plates has blocked further progress. Now from the index of refraction observed Blondlot's rays are likely to be very much shorter in wave length even than 100 $\mu\mu$, so that at first glance the discovery would look as if we had passed beyond a great atmospheric absorption band and reached a new region one step nearer to the debatable ground held by other mysterious radiations. Each year we are getting material for the study of generalized radiation in place of our previous fragmentary knowledge, and sooner or later the time will be ripe for a general clearing up of the subject. Just now we are fumbling around rather in the dark and making very hard work of things that will probably turn out to be simple.

One Million Dollars for a Union Engineering Building.

During the present week a pamphlet has been issued to the officials of the four national engineering societies and of the Engineers' Club, as well as to the daily and technical press, detailing the manner in which Mr. Andrew Carnegie has, unsolicited and without conditions of any kind, placed at the disposal of the societies and the club the sum of $1,000,000 for a Union Engineering Building. It will be remembered that after giving a sum of several thousand dollars to the library fund of the American Institute of Electrical Engineers, Mr. Carnegie was the guest of honor at the "Library" annual dinner, where he had an enthusiastic welcome and spoke most eloquently on the American characteristic spirit of co-operation as evidenced in engineering work, and bodies such as he addressed.

Next day he sent for President Scott and Mr. Calvin W. Rice, chairman of the Institute Building Committee, and they report what occurred as follows:

"At the interview Mr. Carnegie stated that he had enjoyed the annual dinner of the American Institute of Electrical Engineers the evening before in celebration of the founding of its library. He said that he had been interested in what had been said about the work of electrical and other engineers, and also in the suggestion of a common building for the various societies. He asked many questions concerning the status, the building and the income of the several organizations. We spoke of the present project of the Engineers' Club for a building on Fortieth Street.

"Mr. Carnegie asked what plans, or definite suggestions, we had in mind. We replied that so far the scheme of an Engineering building had been discussed by individuals, but that no official or concerted action had been taken. We could simply outline a policy—not a specific plan. We said that our ideas would be met by an adequate building on Fortieth Street to accommodate the National Engineering Societies, to provide headquarters and meeting places for other engineering bodies and to provide for the Engineers' Club. Each body should have such individual rooms as would meet its requirements, and there should be suitable assembly halls and the like, to be used in common. The placing of the technical libraries of the several societies in one building, near the new public library, appealed to Mr. Carnegie.

"He wanted us to ascertain what the land would cost; but, later, when we had indicated about what the societies are paying in rent, and the value of the property held by some of them, he said: 'Why, you are able to support a building if you had one'; and a little later he said: 'Why, if you can provide the ground I will put up the building.'

"Mr. Carnegie asked that we take up the matter confidentially with others interested, and that we call again with a few other gentlemen as soon as we have a plan to submit."

The upshot was that on February 14 Mr. Carnegie, in a letter, directed to the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers, and the Engineers' Club, said: "It will give me great pleasure to give, say, $1,000,000 to erect a suitable union building for you all, as the same may be needed."

On April 30 the following met at dinner at the Engineers' Club on behalf of the informal committee and the various bodies: Messrs. John Fritz, John C. Kafer, Alfred Noble, J. M. Dodge, C. F. Scott, G. E. Weed, B. B. Lawrence, E. E. Olcott, Calvin W. Rice, T. C. Martin, W. A. Redding, John Thomson. On this occasion statements were made by Messrs. Scott and Redding and the subject discussed thoroughly. The various presidents promised to communicate with the councils of the different bodies; and it was arranged to meet again at the house of the Civil Engineers on May 7 at 8:30 P. M. In the mean time, the sum of $50,000 has been paid out for options on five contiguous properties on West Thirty-ninth Street, on the north side, giving a frontage of 125 ft. and a depth of nearly 100 ft. as a site suitable to be occupied by the four societies, or such others as may be determined on. This property is immediately south of the real estate on West Fortieth Street, acquired for the Engineers' Club already, so that the proposed united building, for all the purposes contemplated, will have an ideal location and frontages at what will long be the heart of New York City, and the most accessible spot on the island.

A plan of co-operation has been drawn up, on legal lines, by Mr. W. A. Redding, the well-known patent lawyer, speaking on behalf of the Engineers' Club, and suggesting how the different bodies, while retaining full and absolute independence, can join forces and avail themselves of this opportunity. Mr. John Fritz contributes an admirable letter heartily endorsing the plan, for which he has already done so much, and in the course of which he says: "No one society of engineers can claim that its members did it all; for it has all been accomplished by their united efforts. I most ardently hope they may still become more closely associated, both on social and on engineering lines. The societies are so interdependent and overlap each other to such an extent, that to me it is most surprisingly strange that the efforts which have been made before this time to bring them in closer contact with each other, have not been successful."

Mr. Redding, in his draft of one plan by which the character and arrangement of the buildings should be determined, says:

There should be a joint committee, composed of the president and two other members of each of the organizations that shall unite in accepting the gift of $1,000,000 from Andrew Carnegie, and this joint committee should have power to determine by the affirmative vote of at least two thirds of all the members thereof the character and arrangement of the buildings to be erected on the site on Thirty-ninth Street and on the site on Fortieth Street; and should also have power to obtain from competent architects plans and specifications for the erection of such buildings, and to approve by the affirmative vote of at least two thirds of all the members thereof of the plans and specifications for the erection of such buildings; and should also have power to make and enter into such contract as shall be approved and authorized by the affirmative vote of at least two-thirds of all the members of such committee for the erection of such buildings.

The vesting in such joint committee of these powers would avoid great diversity of opinion and much controversy that would arise if these matters should have to be submitted to each organization for approval.

The building to be erected on the site on Fortieth Street should, of course, be occupied exclusively by the Engineers' Club. The joint committee above suggested should have power to determine by the affirmative vote of at least two-thirds of all the members thereof what portion of the building to be erected on the site on Thirty-ninth Street should be occupied by each of the four national societies of engineers above named that shall unite in accepting the gift of $1,000,000 from Andrew Carnegie, and what portions of that building should be reserved for the occupancy by other societies of engineers that shall be permitted to locate therein.

This joint committee should also have power to determine by the affirmative vote of at least two-thirds of all the members thereof what societies of engineers, other than the four national societies of engineers above named, should be permitted to occupy portions of the building to be erected on the site on Thirty-ninth Street.

Mr. C. F. Scott furnishes to the pamphlet an excellent letter going into many details of the proposed plan. The following points will be of great interest:

The four general engineering societies named by Mr. Carnegie are but a part of the engineering societies which are to be benefited by a union engineering building. There are numerous societies, many of them strong and vigorous, whose membership contains many of the members of the general societies, but whose fields of activity are specialized in their scope. The work of these societies is of a high order, and taken in the aggregate it is a most important part of American engineering. Definite permanent headquarters and accommodations in the same building with those of other societies will be advantageous to the societies themselves, and will be of great convenience to their members.

Some of the uses and advantages of a union engineering building may be indicated in a general way without entering upon details.

A large assembly hall will be available for lectures and for the holding of general conventions of engineering societies.

A number of smaller halls will accommodate smaller audiences and will be suitable for monthly meetings of societies and for sectional or supplemental meetings at the time of conventions.

The libraries of the several engineering societies placed in adjacent alcoves or rooms will constitute a magnificent engineering library. Economies will be effected as many books need not be duplicated which would be necessary if the libraries were separate, and there may be reduced cost for administration. The several libraries may have a common index. Moreover, the Union Engineering Library will be adjacent to the new building of the New York Public Library, Fortieth and Forty-second Streets. Rooms may be available for reading and writing. The building itself may become a gallery of portraits of eminent engineers and illustrations of engineering works.

Accommodations for the administrative offices of the several engineering societies may be arranged to suit their various needs. Facilities for the officers, boards of direction, committees, as well as for the mailing, and possibly the printing, of transactions may be afforded.

Facilities may be arranged for the serving of luncheons or dinners at the time of conventions or meetings and for the holding of formal dinners and banquets. A common cuisine may serve the Engineers' Club and the engineering societies.

The present Building Committee of the American Institute of Electrical Engineers includes Messrs. Calvin W. Rice, S. S. Wheeler, C. O. Mailloux, W. D. Weaver and T. C. Martin, and it has already considered the scheme and reported favorably to the council on the subject. President Scott will doubtless have important announcements to make in regard to the matter at the annual meeting next week, May 19.

Electrical Equipment of a 24-Story Bank Building, Pittsburg.

A GREAT twenty-four-story office building recently erected in Pittsburg—that of the Farmers' Deposit National Bank—is notable for the many new features introduced in its electrical equipment. The alternating current is used throughout and all illumination is furnished by Nernst lamps.

The electric plant consists of four generating sets, one of 75 kw, and three of 150-kw capacity. The 75-kw unit is driven by a 120-hp, single-cylinder, enclosed-type center-crank engine, running at 277 r.p.m., and the remaining generators by three center-crank tandem-compound engines of 240-hp, running 240 r.p.m., all engines having been supplied by the Phœnix Iron Works Company, Meadville, Pa. Steam at 125 lbs. is delivered from a battery of four Babcock & Wilcox boilers of 300 hp each, fitted with Babcock & Wilcox chain-grate stokers. The generators are Westinghouse composite-wound, two-phase machines of a frequency of 60 cycles per second and a voltage of 225. The frequency of the 75-kw machine is the same as that of the 150-kw machines, so that although running at different speeds all four may be operated in parallel. The separate excitation of each machine is by a dynamo mounted at the end of the main shaft. The capacity of the separate exciters is 4.4 kw for the larger size and 3.1 for the smaller. A series transformer in the armature spider produces a secondary current of low voltage, which is rectified by a commutator on the shaft, and excites the series windings of the alternator field.

The switchboard, built by the Walker Electric Company, is over 43 ft. long and is made up of 17 panels; 4 of these are the generator panels, 1 panel for the power circuits, 11 for the lighting circuits and one is spare for additional light and power switches. Four bus-bars are provided for power distribution and six for light. The light switches are triple-pole, a three-wire system being in use for lighting with a Westinghouse balancing coil or phase-splitter of 20-kw capacity installed in each phase, so that a voltage of 110 is obtained between the middle bus and each outside conductor, and they are also double-throw, so that the light load may be distributed on either phase. These balancing coils are mounted on the wall back of the switchboard, as are also the rheostats for exciters and generators. The board is furnished with Noark fuses mounted on the front, I. T. E. circuit-breakers and Keystone instruments.

From behind the switchboard the feeds run to three main risers and distribute up through the building. These risers have pull boxes on the sixth, twelfth and eighteenth floors, where the feeds may be tied in, in cases where they do not terminate. There are panel boards at each riser on each floor, and on these panel boards are three sets of bus-bars fed by different feeders. These three sets of busses are intended for the lights in the offices, the regular hall lights and the special hall lights or night circuit. All main switches to the panels are triple-pole, and the busses, which extend horizontally across the board, are secured in place by removable screw connections to the main vertical bus-bars. This arrangement allows the changing of any branch circuit from 110 to 220 volts by means of these movable connections.

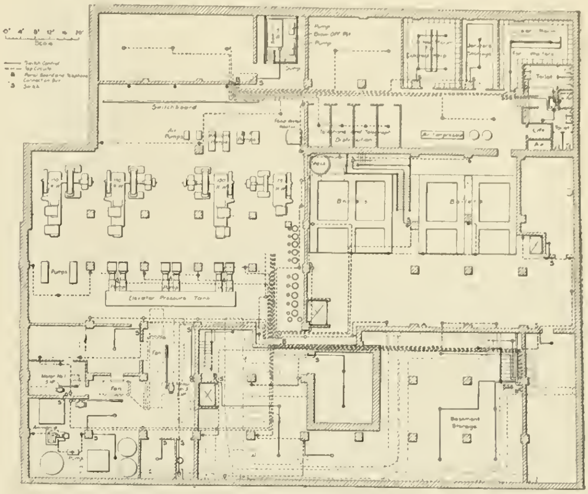
FIG. 2.—PLAN OF BASEMENT.

The Nernst Lamp company is supplying lamps for the halls and offices at 225 volts. Two 110-volt circuits are run to small tablet boards in each office. In cases where so desired, these circuits may be continued from the tablet boards by means of the chair rail to locations where desk lights are needed. These lights are the only cases where other than Nernst lamps are likely to be used. There are installed 1,000 55-kw, single-glower; 1,250 88-kw, single-glower; 20 two-glower and 20 six-glower Nernst lamps in the building. The halls are finished in green, with white marble trimmings, which illuminated by the soft steady light of the Nernst lamps have a most pleasing effect. The office trimmings are of mahogany, and the offices are in general attractiveness and beauty especially noteworthy.

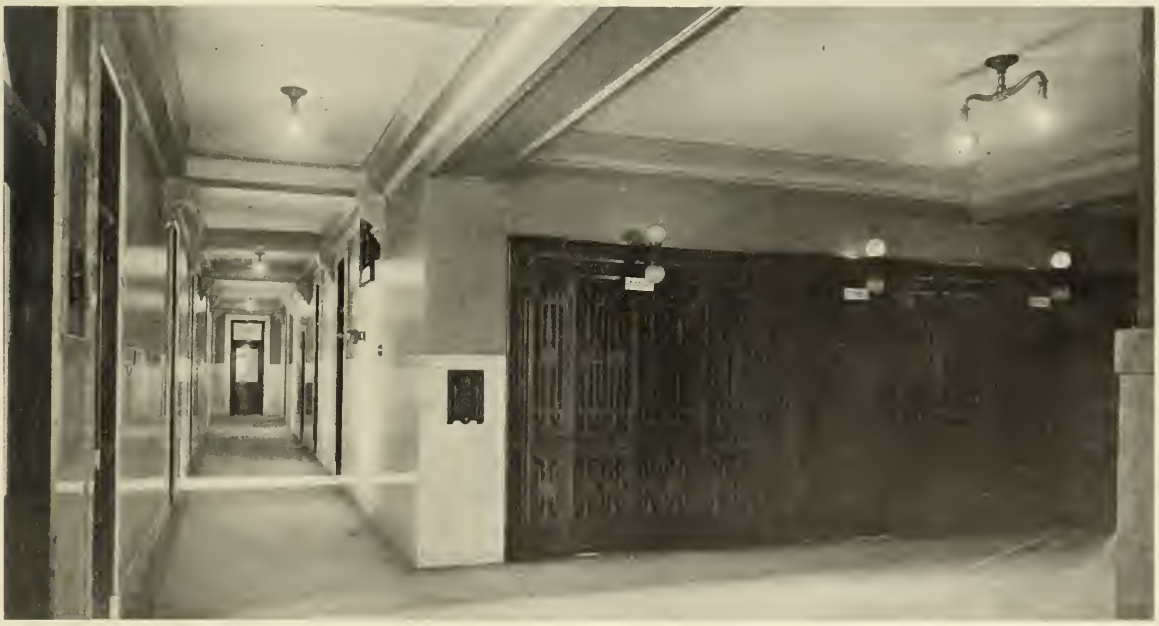
Fig. 1.—View of a Corridor Illuminated by Nernst Lamps.

A peculiarity of the Pittsburg regulations respecting the electric wiring of buildings is that switches must be provided on all lighting circuits, not more than four lights, under the control of one switch The use of smaller than No 12 wire is prohibited

There are installed in the building seven induction motors aggregating about 75 hp In the attic are three disk exhaust fans of 7, 5 and 3½ ft diameter, which are belt driven from 15, 7½ and 5 hp, two-phase Westinghouse induction motors In the basement are three motors of the same type, one of 20 hp drives a 7 ft steel plate fan supplying fresh air to the engine and boiler room, another of 10 hp for a 6-ft blower supplying tempered air to the banking room, and the third of 5 hp running the filter cleaning fan

In addition to ten Otis hydraulic elevators for general passenger service, there are two electric elevators in operation between the bank floors, one as a book lift and the other for passengers. The electric equipment for the electric elevators includes a motor generator for the control and a 5 hp variable-speed Westinghouse induction motor for each elevator These elevators are also of Otis manufacture and of the automatic push-button type of control. The absence of direct current in the building has made necessary the employment of a motor-generator in only one other instance, and that is of very small size, for the signal system for the elevators It was thought that the electric winding mechanism in the bank vault, installed by the Hollar Lock Inspection & Guarantee Company of Philadelphia, would require a separate mechanism for supplying direct current; but by running a line back to the main switchboard, the direct current from the exciters at 110 volts was made available for the purpose.

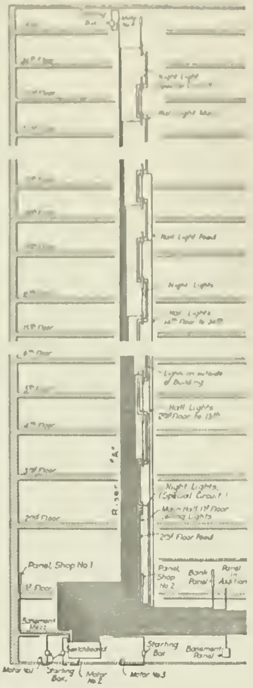

FIG. 3.—DIAGRAM OF FEEDERS.

Above the two revolving doors at the main entrance are two smaller General Electric motors installed by the Van Kannel Revolving Door Company, of New York. As these motors were provided after work had advanced too far to permit of a separate power line, they were placed on the lighting circuits, which was practicable since they have a power factor of 100 per cent., the motors being single-phase with condenser compensator.

The telephone cables on entering the building run along the ceiling of the basement to the terminal booths, where each company is assigned its space, there being in Pittsburg two telephone companies, two telegraph companies, one ticker company and the Electric Protective Company to be provided for. On leaving the booths the cables run up the riser situated back of the elevator shaft and terminate at boards in the halls on each floor. From these floor terminals a one-inch conduit is run to each of the office sub-tablet boards already mentioned in connection with desk lights. A portion of the space in the boxes where these sub-tablet boards are placed is divided off and provided with terminals for eight pairs of telephone wires. From these boxes through either the chair rail moulding or around the baseboard the connection is made to the instruments.

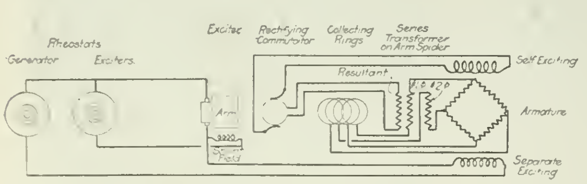

FIG. 4.—DIAGRAM OF GENERATOR CONNECTIONS.

After the plans were drawn for the main building and work well under way a 40 ft addition was decided upon on the Fifth Avenue front To provide for this annex the generators were ordered of larger capacity and feeders increased in proportion. This addition is now completed to the height of the original structure, but the interior is still in the rough.

Messrs Clark & MacMullen, of New York, are the electrical engineers for the work, which has been installed under direction of their Pittsburg office by Messrs. Hatzel & Buehler, of New York

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The Arnold-Bragstad-La Cour Polycylic Power-Transmission System

By O. S. Bragstad

ELECTRICAL power transmission systems are generally compared with one another with respect to their relative copper outlay under the assumption of equal losses with the same voltage between the wires and the same transmitted power. In this way the copper outlay with the three phase system is found to be equal to 75 per cent. of that with the single or two-phase systems (the latter assumed to be with four wires).

For the distribution leads in which the insulation plays no great part, the two-phase system possesses the advantage that the load (lamps) has only to be distributed between two divisions and not three, as with the three phase system. The load is, therefore, more easily uniformly distributed with the two-phase system, and the installations are, therefore, simpler and cheaper than with the three-phase system.

In order to combine both these advantages—saving of copper and simpler balancing—the three-phase system is often employed for the mains and the two-phase system for the distributing leads, the Scott transformer being employed for stepping down the voltage.

In Fig. 1, T_1 and T_2 are the primary windings of two transformers connected, according to the Scott method, with the three-phase system. The two transformers have the same output and carry the same current. The number of windings, T_1 and T_2, are as $\sqrt{3} : 1, 5$. Since the currents in the phases 1 and 2 are 30° out of phase with the secondary current of the transformer, T_1, the effective number of ampere-turns in this phase is only $\cos 30^\circ = 0.865$ of the total number. In consequence of this, the primary copper losses in the transformer, T_1, for equal cross-section of wire—that is, for equal current density in the two transformers—are increased by 13.5 per cent.; the expenditure of copper for the winding, T_1, is further, in spite of the equal output, 13.5 per cent. greater than for the winding, T_2.

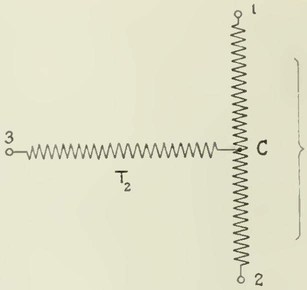

FIG. 1.—DIAGRAM OF WINDINGS.

It is not only the ohmic losses and the consequent ohmic voltage drops in the three phases which are different, but also the inductive voltage drops. If, for instance, the windings of phases 1 and 2 are separated from one another either on two different cores of the transformer or on two halves of one core, then the current components, $\pm I \sin 30^\circ$, which are not neutralized by the secondary current, produce a very great magnetic leakage. If it is desired to reduce this leakage flux to a minimum, the primary coils of the phases, 1 and 2, must be made only half as large as the secondary coils, and each pair of primary coils (one belonging to phase 1 and the other to phase 2) must be followed by a secondary coil. This renders, however, the use of more insulating material necessary, and the winding takes up more room. Besides the inequality of the ohmic voltage drops in the three phases, there is, thus, always a certain inequality in the inductive voltage drops which, especially in the case of long transmission mains, can easily become a source of disturbance.

If we examine the matter a little more closely, we find that—at any rate with overhead conductors—the voltage between the wires and the insulating supports, and not that between the wires themselves, must be the governing factor; for upon it depend both the losses in the insulators and the probability of piercing of the same. The insulating supports are, however, more or less well conductively connected with one another and form thus the neutral point of the system. A judgment of the individual systems in respect to their copper demand should, therefore, to be correct, be made on the presumption of equal phase-voltage; phase-voltage to be understood in a one-phase system, as half the voltage between the wires, and in a two-phase system with four wires, similarly half the voltage between two wires of opposite phase.

When we consider the various systems from this standpoint, we find that the three-phase system offers no saving of copper over the other systems; but, rather, that all the systems, inclusive of the single-phase, stand on about the same level. The expenditure for insulating and supporting material increases naturally with the number of phases, as does also the loss through the insulators.

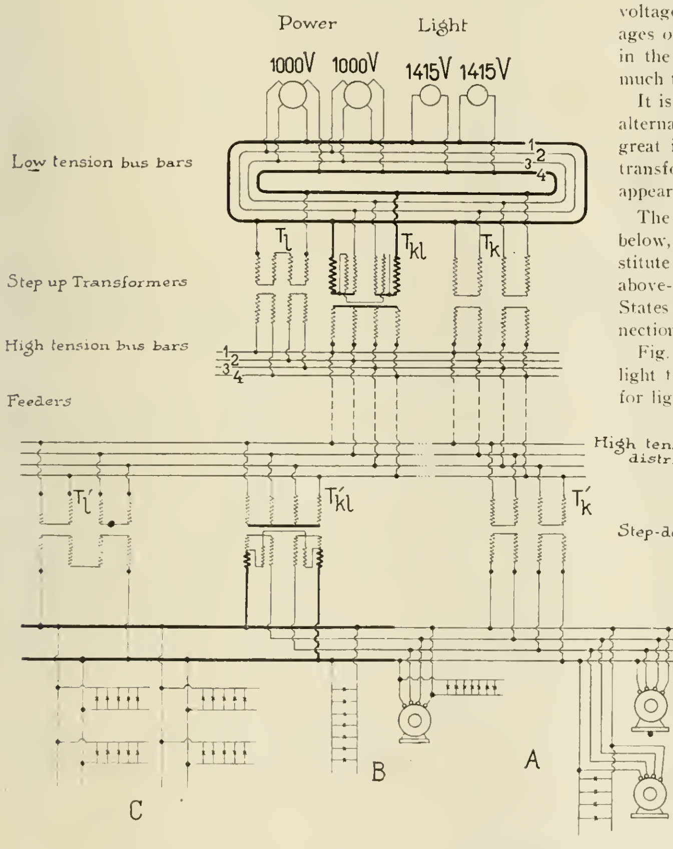

FIG. 2.—DIAGRAM OF CONNECTIONS OF TRANSMISSION SYSTEM.

When the single-phase system cannot, in consideration of the running of motors, be employed, the three-phase system appears thus, in respect to the saving on insulators and fastenings, to be the best. On the other hand, should the necessary size of wire with the three-phase system become so great that it would have to be divided between two parallel-connected wires, then we can, under certain circumstances, use a two-phase system without the necessity of dividing the cross-section between two wires, in which case this latter system requires only four wires as against six with the three-phase system.

American practice often employs, as mentioned above, a transformation from three to two phases, while in Europe the three-phase system is generally retained throughout both for mains and distributing leads. One might, as stated above, in many cases be quite as much justified in employing the two-phase system throughout. To this may be added that, with the two-phase system, other distinctly important advantages can, without essential increase in cost, be obtained, as will be described more fully in the following.

Dr. Frederick Bedell showed first how, at points of equal potential of a power transmission system, currents of various characters, especially continuous current, can be sent in and taken out, without influencing thereby the existing currents, and this discovery has been protected by him in United States patents Nos. 645,907 and 647,741.

The arrangement given by Dr. Bedell was described for a practical case by Mr. A. S. MacAllister in this *Journal*, February 28, 1903. This arrangement permits of a separation of the light and power delivery of an installation, without the necessity of employing special separate systems of leads. In this case single-phase current is used for the lighting and two-phase currents for the power. The voltages, voltage drops and frequencies of the two currents can be chosen as most appropriate for their respective uses; and since the superposed currents are quite independent of one another, variations in the motor current and its phase displacement do not produce any voltage variations in the lighting current, and vice versa. The voltages of the two currents are regulated independently of one another in the central station. A constant light is thus obtained, however much the load on the motors may vary.

It is easy to see that, with the Bedell arrangement, the superposed alternating-current led in at the neutral point must suffer a very great inductive voltage drop in the windings of the generators and transformers. On this account the arrangement in its original form appears to be of little practical use.

The Arnold-Bragstad-La Cour distribution system, described below, which was worked out by them in the Electrotechnical Institute of the Technical College at Karlsruhe independently of the above-mentioned invention, and forms the subject of several United States patents, avoids the drawbacks of the Bedell systems of connection.

Fig. 2 represents the connections of a high-voltage power and light transmission system. In the central station special generators for light and power are installed. The machines for power generate two-phase currents at about 30 periods and 1,000 volts in each phase. The phases are not connected. The generators for lighting are single-phase machines with an e.m.f. of about 1,415 volts and about 60 periods. The generators for power work on all four bus-bars, while those for lighting only work on the outer two (1 and 4). This is possible because the phases, 1 and 2, in the generators for power, are unconnected with the phases, 3 and 4.

The low-voltage bus-bars connected with the generators are connected with the four high-voltage bus-bars through step-up transformers. The high voltage is assumed to be 20,000 volts, and is equal between all four conductors.

For the stepping up of the machine voltage, three kinds of transformers can be used. The one kind, *Tk* serves only for the transformation of the two-phase currents, i. e., for the power consumption, and consists of two ordinary single-phase transformers with a transformation ratio of 1 : 20, which are connected between phases 1, 2 and 3, 4, respectively. Since these transformers are unconnected, no single-phase current goes through thm. The second kind of transformers, *Tl*, transform only the single-phase current and thus serve only for the lighting. These lighting transformers are also ordinary single-phase transformers and have, like the power transformers, a transformation ratio of 1 : 20, but the connection of these transformers to the bus bars is somewhat different.

Each group of the transformers, *Tl*, consists of two single-phase transformers, the primary windings of which are both connected in series between the lighting bus-bars, 1, 4. The secondary winding of the one transformer is connected between the high-tension bus-bars, 1, 4, and that of the second transformer between 2, 3. From the single-phase current of higher frequency, we obtain thus 14,150 volts between each pair of high-tension bus-bars, 1, 4, and 2, 3; since beyond this, between these bars a voltage arising from the two-phase current of lower frequency and of the same amount exists, we obtain between the same an effective e.m.f. of 20,000 volts. This voltage arising from the two-phase current is the same in both of the series connected primary windings of the transformers, *TT*, but the phases are opposite, thus giving rise to no e.m.f. between the low tension bars, 1 and 4. These transformers take in through their secondary winding a no load current of the lower frequency and get a corresponding magnetic flux, which superposes itself over the magnetic flux of higher frequency produced by the primary winding.

Since the two kinds of transformers just described are commercial and customary and forms the same type whether they serve for light or power, we can, without further alteration, use the same set of transformers, sometimes for lighting and at other times for power, by simply switching over. The transformers would thus be worked during the day principally for power and in the evening principally for lighting; thereby effecting a saving on the original outlay for transformers.

A third arrangement of the transformers, which permits of the two currents being simultaneously and independently transformed in a single apparatus, appears also very useful. A combined single and two-phase transformer of this kind is shown in the diagram by *Tke*. This transformer has four cores, and while the cores have each one secondary winding, two of them have each one primary winding, and the other two each two primary windings, as indicated in the figure. All the primary and all the secondary coils have an equal number of turns. The advantages of this combination are that it diminishes the necessary active material and increase of efficiency. A disadvantage of the arrangement is that a special construction is demanded, which fact, however, would be of no great importance in the case of a large order.

The mains which go out from the high-tension bus-bars, together with the high-tension distribution leads, consist always of four wires of equal cross-section. These four wires all carry always the same current independently of the relation between the demand for light and power.

The step-down transformers connected to the high-voltage network can, like the transformers of the central station, be made of three kinds. In a quarter of a town, A_1, where almost nothing but motors are connected, transformers for power, *Tk'*, are installed. On the other hand, in that part, B_1 where almost the same number of motors as lamps are to be fed, the combined transformers for light and power come into use. Finally, in the part of the town where residences are mostly to be found and hence only light is needed, the lighting transformers, *Tl'* are employed.

Since a higher e.m.f. is preferably used for motor work than for incandescent lamps, viz., 500 volts as compared with 125 volts, the transformation ratios of the power and lighting transformers are here different; otherwise they are arranged similarly to those at the central station.

The distributing leads for light and power consist of four wires; the lighting current of higher frequency and of an e.m.f. suitable for glow-lamps, is taken from two of them, and from all four the power-current of lower frequency and higher e.m.f.

In those parts of the town where the lighting load is small, for example, at *A*, all the wires of the low-tension network will have the same cross-section; on the other hand, in parts of the town like *B*, where comparatively much lighting is to be done, the two wires which carry both lighting and power current will have a greater cross-section than the other two; lastly, in that part of the town, *C*, where only lighting installations are fed, only the two lighting leads will be laid.

To resume, the principal characteristics of the thus-described system are, briefly, the following:

1. *Machine Installation* separate for light and power, consequently separate speed and voltage regulation, different frequencies, abolition of phase displacement in the lighting machines.

2. *Bus-bar System* in common for lighting and power, hence the simplest arrangement of apparatus.

3. *Step-up Transformers* are either (*a*) separate for lighting and power, but able to be switched over according to need, in which case single-phase transformers of ordinary construction are used; or (*b*) combined for lighting and power, but in such a manner that the two functions do not mutually influence one another. This latter arrangement offers some saving in material, but necessitates a special construction (four-core apparatus).

4. *High tension Bus bars* are common, but independent of one another for light and power.

5. *High tension Mains* are likewise common, but independent for light and power. With equal effective e.m.f., the current carrying capacity of the wires is increased by 50 per cent over the single or two phase systems and by 12.5 per cent. over the three phase. With respect to the effective e.m.f. to earth, all systems are equal. The same applies to high tension network.

6. *Step down Transformers* are, according to requirements of the individual districts to be fed, either only for power, only for lighting or combined.

7. *Distributing System*, according to requirements, either with four wires for light and power or with two wires for light alone. All lighting installations are made in the simplest way, with only two wires; they are, hence, cheaply installed and maintained. Since the voltage variations produced by the motors do not in any way influence the light, motors up to any desired size can be connected; motors with short-circuit armatures (without starters) of much larger sizes than formerly, can be installed.

The advantages enumerated above are, so to speak, obtained without any complication of the lighting systems. If the combined transformers (*Tkl* and *T'kl*), which could equally well be left out, be disregarded, then the diagram (Fig. 2) is not, at first sight, to be distinguished from that of a corresponding two-phase system. The simplification of the lighting installations, as well as of the low-tension network in the parts of the town consuming only light, is obvious.

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Multiple versus Independent Operation of Central Stations.

IN the paper with the above title read at the April meeting of the American Institute of Electrical Engineers by Mr. Peter Junkersfeld, after a discussion of some general considerations, the links of a central station system subject to trouble are enumerated as follows:

Main and services. Low-tension feeders. Sub-station apparatus. High-tension transmission lines. Generator, prime mover and auxiliaries. Steam supply. Troubles in wiring or translating devices on consumer's premises are usually more directly under the control of the consumer than of the central station.

These different classes of central station troubles are all more or less liable to occur, but the prevalence of any one class or number of classes of trouble depends upon the character of the different installations, and on local operating conditions. In the discussion of these different classes of trouble the writer would, as a matter of illustration, refer to conditions in Chicago where all 25-cycle, high-potential transmission and direct-current distribution is underground. In the outlying districts the 4-wire, 3-phase, 60-cycle distribution is overhead.

MAINS AND SERVICES.

Formerly Edison tube was principally used for all underground mains. The more recent practice has been to use, largely, cables in conduit giving less trouble than the Edison tube, which is true also of services. However, miles and miles of the old tube mains are in service to-day, and must necessarily remain in service for years to come.

Any trouble, either on mains or services, is usually confined to a comparatively small area by the blowing of strips in the feeder junction boxes. The total amount of current that could be "pumped" into such a short circuit is limited by the drop in mains and feeders, at least back to the sub-station bus-bars. Obviously, the duration of such a short circuit depends on the condition and relative carrying capacity of the "short" and the fuse strips back of it. The drop in mains may be such that it is impossible to deliver enough current to burn off the trouble or blow the fuse strips. These cases, while rare, are very annoying. Sometimes they will "clear" only to start again at an unexpected time, occasionally even making it necessary to remove junction box strips and thus cut out the troublesome section until permanent repairs can be made.

LOW-TENSION FEEDERS.

On account of the larger carrying capacity the energy delivered on short circuit is very much greater in feeders than in mains. The total length of conductor in feeders being much less than in mains, the number of troubles with equally good construction are correspondingly less. Furthermore, instead of tubes, cables have been very generally used for several years. This improved construction makes the actual number of feeder troubles still less. Serious trouble on feeders, when it does occur, however, obviously affects a much larger area than trouble in mains. The extent of area affected depends also on the arrangement of bus-bars and class of apparatus in station or sub-station.

SUB-STATION APPARATUS.

In sub-stations supplying direct current, rotary-converters with their accompanying step-down transformers and potential regulators, are used almost exclusively. The direct-current ends of these rotary converters are often worked in multiple with an old generating station, at least during the peak hours of one or two months in the early winter. A storage battery with end cell switches for discharging on two or sometimes three different potentials is an important adjunct to a sub-station. The batteries in all sub-stations are discharged simultaneously at time of peak on principal generating station, or in an emergency; at all other times they are allowed to float on system. They are charged either by using a booster or direct from a rotary converter equipped with sufficient regulator and transformer capacity for working at the higher voltage necessary for charging.

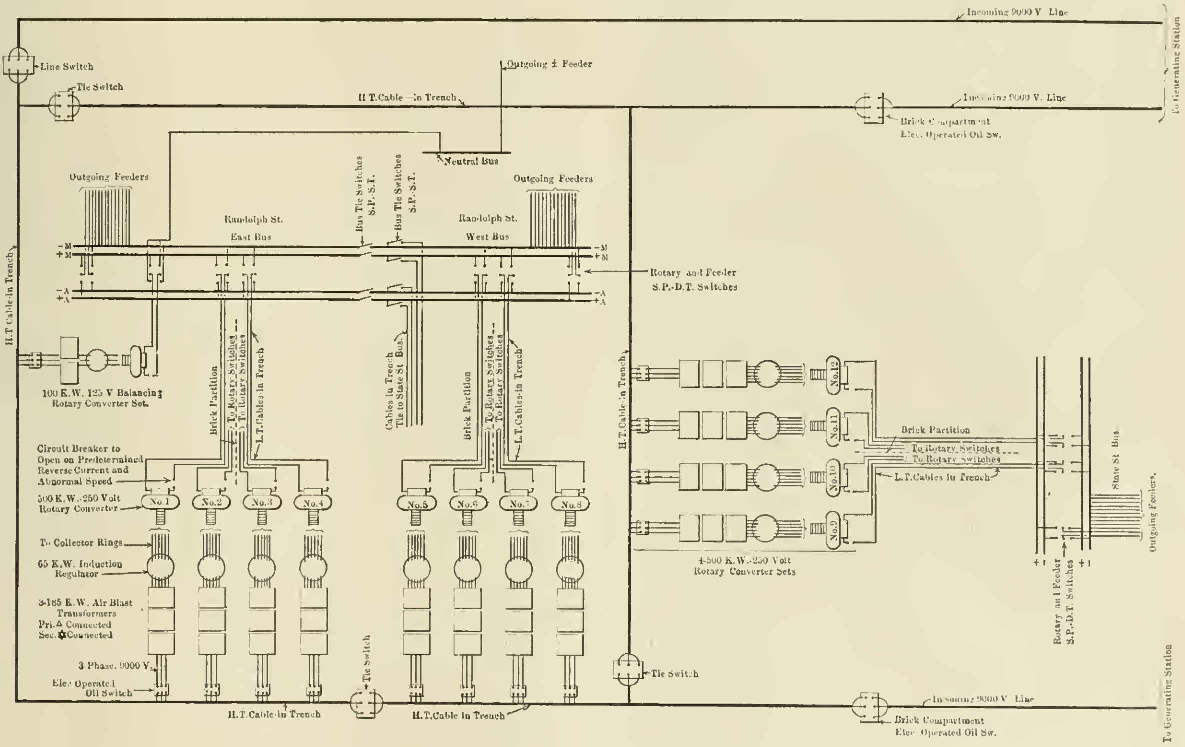

Fig. 1.—Diagram of Principal Connections in Sub-station.

Even in a sub-station having a storage battery and a subsidiary steam plant, all of the annual kilowatt-hour output, except a few per cent., is supplied to distribution system through the rotary converter. Special precautions are necessary to guard against interruption of service, as the radius of possible transmission of large powers in case of trouble is very much greater than in the case of services, mains or feeders.

The characteristics of a rotary converter are such that it will carry an enormous overload with very little drop in voltage. Serious troubles or short-circuits, whether they occur in the rotary-converter and accessories, in the direct-current connections or in the alternating-current connections, will be violent and are liable to be destructive unless the damaged unit can be quickly and effectually disconnected, both from the alternating-current transmission and the direct-current distribution systems. The localizing of trouble and the effectiveness of disconnecting depends on the arrangement of the alternating-current bus-bars and the automatic safety devices.

The practice of operating practically all units on a single set of bus-bars, at least during long-hour, light-load period in the direct-current generating stations, undoubtedly had some influence on the earlier sub-station bus-bar arrangements. In many large sub-stations all rotaries are operated from one set of bus-bars; in others they can be operated on either one of two sets of bus-bars. Another arrangement consists in running all rotaries from a single bus-bar arranged with disconnective knife switches, so that each rotary or group of rotaries could be operated independently from its own transmission lines. An improvement consists in replacing the disconnective knife switches with remotely controlled oil switches.

With the latter arrangement, each rotary or group of rotaries can be operated all in multiple if necessary or advisable, and be quickly sectionalized in case of trouble on any one transmission or conversion unit. An example is shown in Fig. 1, which gives the scheme of principal connections in a sub-station that was put into service about one year ago. There are twelve 500-kw rotary-converters arranged in three groups of four, each group supplied from its own high-tension line and delivering current to its own section of the direct-current bus-bars. The incoming lines, apparatus, cable connections and switchboards, and the low-tension feeders to street, are all located and arranged to prevent a bad burn-out spreading from one group to another.

On each rotary-converter there is mounted a direct-current circuit-breaker operated only by means of a 125-volt trip-coil. A centrifugal speed-limit device on shaft closes the trip-coil circuit, thus disconnecting the rotary-converter from direct-current bus-bars and preventing its running away, the causes of which are well known. A reverse-current device also trips this circuit-breaker in any case of trouble that would draw more than a predetermined amount of energy from the direct-current bus-bars.

The oil switches on each individual rotary-converter outfit, and those used for tie switches, are all equipped with overload attachments, which are so adjusted that they will open only in case of serious trouble. The tie switches should also be equipped with interlocking devices, so that these tie switches between lines can be closed only when the two sources of e.m.f. are in synchronism. The low-tension feeders in most of the large Edison systems are provided with very heavy fuses and often with solid links. The adjustment of overload attachments on oil switches must, therefore, also be made for heavy loads and with due consideration for the particular conditions involved in each individual case.

TRANSMISSION SYSTEMS.

In most of the larger cities the 25-cycle transmission systems are potential at voltages varying from 6600 to 11000 volts. Much higher voltages have been successfully used on through trunk lines in several other cities. This, however, is obviously a very different condition. The large transmission systems with their multiplicity of lines, cable terminals and oil switch connections have grown into networks that are continually becoming more complex. As each and every case of serious trouble anywhere on a system having almost exclusively synchronous apparatus necessarily affects every part of the system, the possible chances for trouble affecting any one of the thousands of customers, are also continually increasing. Commercially, this is a very serious matter indeed, especially when we consider that with many of the more desirable customers the greatest possible security for continuous service is of first importance.

Realizing this fact, many central station engineers have taken extraordinary pains with high-tension cable work and in some cases have succeeded in making the transmission network in itself one of the most reliable parts of the central station system, except in so far that inherently this high tension network with its synchronous apparatus is lacking in elasticity.

This has been the experience in Chicago, where a 2,250 volt, 25-cycle transmission line supplying rotary-converters was first put into service about six years ago. Since then the transmissioin voltage has twice been doubled. The first line, three and one-half miles long, supplied one sub-station having 200-kw capacity in rotary-converters. The resulting high-tension system, shown in Fig. 2, will, by next fall, aggregate about 60 miles, supplying nineteen sub-stations with approximately 24,000 kw installed in rotary-converters and 4,000 kw in frequency-changing motor-generator sets.

About twelve months ago the potential was raised to 9,000 volts. The previous and subsequent experience indicated many desirable improvements. Until this time the system was supplied only through delta connected step-up transformers from double-current generators.

The capacity effect of lines was found to be such that in event of slight ground on one phase, it might result in an excessive rise of potential and very severe strain, if not an actual break-down, on some part of system. The grounding of neutral on this high-tension system has been attended thus far with very satisfactory results. As star-wound 9,000 volt alternators were installed, the common point of winding was in each case connected to ground. Practically all high-tension transmission cable installed during the past two years consists of No. 4-00 three-conductor paper and lead-covered cable. The thickness of paper wall on each conductor is 6-32-in., over all is 4-32 in. and lead wall is ⅛-in.

The arrangement and installation of terminal appliances is obviously of great importance. All forms of fuses and air-break switches have been abandoned, so that at present the main circuits are made and broken only under oil. Various forms and methods of making up joints and cable heads were tried. These are now made up in parts, so that the lead sleeve or cylindrical part of head is put in place after the individual joints have been made and insulated with paper tape. The sleeve or cable head is then filled with a special compound, which is a non-absorbent of moisture and has a much higher dielectric strength than the paraffin which was formerly used. The process of filling is such that every minute particle of moisture is expelled.

The selection of routes for transmission cable is made with a view to provide two or more lines on different streets if possible, at least in different groups of conduit for each sub-station. The cables are isolated and mechanically protected, so that the spreading of a bad "burn-out" in either high or low-tension cables will be prevented as much as possible. A well-designed and constructed conduit and manhole system is, therefore, essential. Overhead connections to an extensive high-tension underground network are a source of trouble to be avoided, if possible. When unavoidable, these overhead taps should be isolated by means of transformers.

GENERATOR, PRIME MOVER AND AUXILIARIES.

The necessity for operating all units in multiple for long hour periods in order to obtain good station economy, still exists to a very large degree. During the past ten years the sizes of units in the largest stations have been increased from 800 and 1,500 kw to 3,500 and 5,000 kw. The number of units, however, in any one station has often been decreased, making multiple operation of at least a large portion of plant more necessary than before, and also placing much greater dependence on any one unit. Such stations have been and are still passing through a critical transition period. Every case of serious trouble on generator, engine or auxiliaries affects the entire system, but it frequently happens that the system cannot be sectionalized even into two parts without serious sacrifice in engine economy. The gradual increase in number of units will only partially relieve the situation.

The engine-driven unit is ordinarily one of the most uncertain elements in the central station system. Duplicate units are often installed and operated side by side under apparently the same conditions, and one, for a time at least, will prove much more reliable than the other. There is so much fitting, so many fine adjustments and valve settings, all of which must be done with great care, precision and patience. Much depends also on the faithfulness and the skill of the men in immediate charge of the apparatus. This is true of any similar apparatus, but particularly of the large engine-driven units operating in multiple on transmission systems.

With an arrangement of bus-bars, high-tension lines and sub-station apparatus similar to that shown in Fig. 2, generating units can be operated independently, and a certain amount of shifting of load can be done at the larger sub-stations having four or more units in service. Rotaries can be shut down one at a time, transferred to another generating unit or another station and again put on load. During peak hours there would be shifting which would introduce some additional chances of trouble due to possible mistakes of men handling apparatus, which, in that case, would partly offset some of the advantages of sectionalizing.

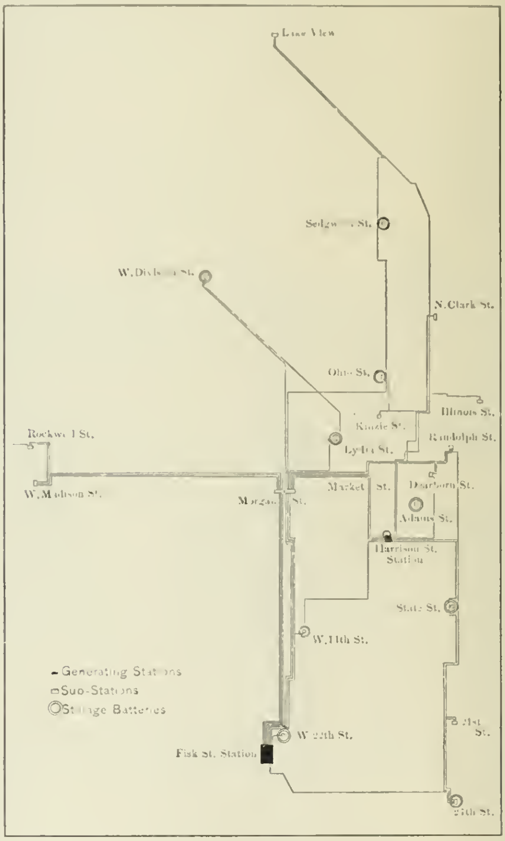

FIG. 2.—DIAGRAM OF DISTRIBUTION SYSTEM.

In this respect, a very decided advance would be the use of a prime mover giving practically a straight line economy, such as the steam turbine. The differences between one-half load and full load performance for short hour periods will not be great enough to warrant much shifting. The auxiliary apparatus, particularly the condensing plant, is frequently a cause of trouble. The "sticking" of pumps, "dropping" of vacuum, and similar reports, are heard occasionally in every steam plant. The arrangement should be such that the condensing plant and auxiliary apparatus and the excitation of any one unit are simple and positive in operation and normally independent of every other unit.

STEAM SUPPLY.

Practically every steam plant has its own peculiarities in piping and arrangement of boilers, but in most cases all boilers are in one room. The bursting of a steam pipe or boiler tube fills the entire room with steam instantly, making it impossible to close a valve in the ordinary way. The location of boilers in two or three different rooms or floors and the providing of means for closing valves from inside of engine room has lessened the danger of a shut-down. The placing in separate rooms, as far as circumstances will permit, of the boilers and piping corresponding to each generating unit and connecting only through fairly quick-acting remotely-controlled valves will further lessen this danger.

With careful operation, customers' troubles (bad or interrupted service, that are chargeable to the boiler room are few, while those of the central station manager are many. Investigations, experiments and some improvements have been made from year to year, but the buying and economical handling of coal and making of steam still involve problems that are worthy of the very best attention, both as to the cost of operation and reliability of service rendered. These problems are especially important when we consider large stations which consume 2,500 or 3,000 tons daily, and the many possible chances of delay and interruption between the coal mine and the boiler room.

GENERAL CONSIDERATIONS.

A survey of the various classes of trouble between coal pile and customers' service indicates at once the unfortunate feature of large modern transmission systems. True, as has been done in some cases, induction motor-generators might be used instead of rotary-converters. The sub-station apparatus would then be much less sensitive to sudden fluctuations in engine speed, or to line disturbances due to short circuit on some other part of the system.

The first cost of motor-generators of 500-kw and 1,000-kw capacity installed complete is, however, from 15 to 25 per cent. greater than for rotary converters with accessories. Under ordinary operating conditions there is a difference of from 3 to 5 per cent. in efficiency in favor of rotary converters. The power factor of the rotary-converter is obviously much better than that of the induction motor. The characteristics of a rotary-converter are often a practical advantage in cases of trouble on low-tension feeders or mains.

In some few cases where it is necessary to run a large number of converting units from a long transmission line which itself is subject to heavy fluctuations in potential and frequent interruptions, it may be advisable to use motor-generator sets. In the large majority of cases, however, in both lighting and railway work, the rotary-converter has been found the best and most economical. If the objectionable features thus introduced cannot be overcome, the result can at least be minimized by judicious sectionalizing in large systems.

The electrostatic capacity of these large high-tension cable systems is such that there is necessarily a practical limit to the mileage of cable that can safely be operated as an interconnected network. In the 60 miles of 9,000-volt, three-phase, 25-cycle lines previously mentioned the charging current as calculated will be about 16 amp. At the present rate of increase in mileage the condenser effects will soon be troublesome and possibly prohibitive, as troubles may occur which will result in building up a potential at some point and breaking down insulation on apparatus that was comparatively safe on the smaller system. In that event, and with several very large units all in multiple, the amount of power delivered on short circuit would probably be so great that it could not safely be interrupted by any oil switch thus far built.

In a rapidly growing system provision for a reasonable amount of sectionalizing can easily be made. The investment in the portion of central station system between coal pile and customers' service most directly involved, is, under most conditions, divided approximately as follows:

Station-real estate, building and generating apparatus	35% to 45%
Transmission system-cables and conduit	3% to 6%
Sub-station-real estate, building and converting apparatus	10% to 15%
Feeders and mains-cables, conduit and Edison tubs	40% to 48%

These percentages are greatly influenced by local conditions, such as average and maximum density of load; value per duct-foot of underground conduit; average length and voltage of transmission; cost of real estate and character of buildings. In railway plants, the investment in sub-stations and that corresponding to feeders and mains will be less, while the investment in transmission lines will be somewhat greater. A considerable capacity in storage batteries will, under load conditions obtaining in most large systems, decrease slightly the investment in the first three, but would not affect that in feeders and mains.

The provision for sectionalizing will not increase the investment or operating costs, either in sub-stations or in feeders and mains. In the transmission system it may, under some conditions, slightly increase the total mileage of lines; but such an increase in the 3 to 6 per cent. thus involved is a very small increase in the total investment in entire system.

A review of power houses indicates that there is a wide difference in cost of station buildings. This difference is a matter partly of engineering and partly of management. Taking the total cubical contents of six of the large modern station buildings, we find that from 6 to 10 per cent. is devoted to coal storage and that the complete buildings vary from 100 to 240 cu. ft., and from .05 to 2.5 sq. ft. per kw-rated generating capacity. The boiler room portion of the same stations vary in total net cubical contents from 65 to 130 cu. ft. per rated boiler horse-power, while the engine room portions vary from 40 to 90 cu. ft. per rated engine horse-power. As practically the same types of boilers are used, the former depends almost entirely upon the design and arrangement; but the latter depends largely upon the type of generating unit adopted. In the case of vertical turbine-driven units, the figure for this portion of plant can be reduced by at least one-half.

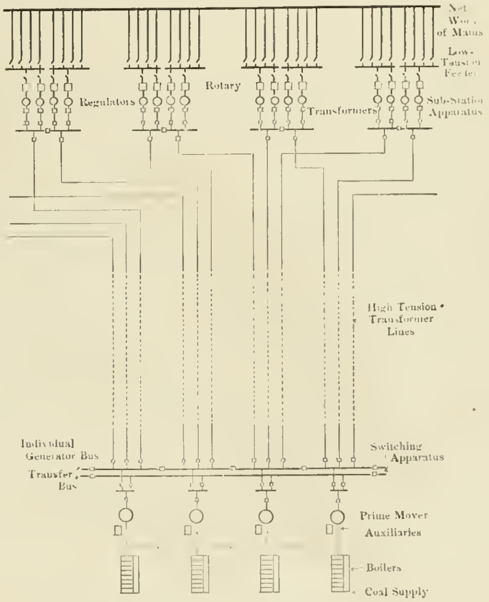

FIG. 3.—DIAGRAM OF DISTRIBUTION SYSTEM.

The tendency, however, in power house design is toward a much more liberal allowance for space for all equipment. The high-voltage generators of large capacity and multiplicity of lines demand extraordinary switching apparatus which requires considerable space. A suitable arrangement and reasonable isolation of switching apparatus and connections need not require any additional space and should preferably be much simpler than that in many existing stations.

It would seem, therefore, that in the large modern power house sectionalizing and even entirely independent operation of units can be provided for with very little, if any, additional investment in the generating station or in any other part of the system.

While the independent operation of generating units would tend to minimize the effect on customers of many central station troubles and thus increase the co-efficient of reliability, there will also be some disadvantages. A heavy overload or perhaps short circuit coming entirely on one unit or group of lines might trip the oil circuit-breaking switches on lines, and the sudden release from load severely strain the prime mover. This cause would be improbable if, as indicated in Fig. 3, each generating unit supplies at least two different sub-stations and when only part of the load would be thus released on any one generating unit.

If a short circuit occurs on a feeder supplied by a small group of rotaries, the percentage of overload is larger and after one rotary trips the other will immediately follow. This might not have occurred with a larger group, when the percentage of overload would have been correspondingly less. All transmission lines should be equipped so that oil circuit breakers at both ends of line open automatically in case of trouble, whether the entire system is operated in multiple or independently.

In the latter event, if time limit attachments are used with overload devices at the station, the amount of energy delivered at the point of break down might not only slow down the engine, but draw enough energy from network to trip the circuit-breakers on all rotaries supplied from the particular generating unit. If operated, as shown in Fig. 3, this would mean, under full conditions, an overload of 50 per cent. on the remaining rotaries in each sub-station supplied from three different generating units; 100 per cent. overload on those supplied from two, and a total shut-down of such small sub-stations as are supplied exclusively from the particular unit in trouble. Usual result: low pressure on part of direct current system; no trouble elsewhere.

In event of multiple operation of the entire system, with several units in service, a large amount of energy from the station bus-bars would be delivered until time limit overload devices at the station and reverse current devices at the sub-station cut out the troublesome line. Usual result: heavy fluctuations in pressure on entire system, until line is opened at both ends, several machines shut down and sometimes a total shut-down.

During the hours of light load the system would naturally be divided into fewer parts or perhaps all in multiple. In event of a shut-down during these hours, the capacity of storage batteries would be so much greater in proportion to load that the drop in pressure would not be so serious.

The successful operation of large systems necessitates the maintaining of a well-organized operating force of competent and experienced men. Every operation involving the starting or shutting down of a generator, line or sub-station unit should be carefully regulated and checked to reduce to a minimum the possibility of a mistake. In one of the large stations now under construction provision is made for a load dispatcher, whose office will be convenient to the operating switchboard and who can control absolutely the transferring of load between all generating, transmitting and converting units, with the same implicit confidence and accuracy of judgment and action as can the train dispatcher on an important railroad system. His office should be a clearing house for all orders concerning operation of system.

After considering some of the advantages and disadvantages of multiple and independent operation in large underground transmission systems, it might be of interest to consider small overhead systems. The latter are operated independently, in very many cases with satisfactory results as to reliability of service rendered. In order to secure more economical engine performance, it was necessary to adopt large units operating in multiple. This step also improved the reliability of service rendered, particularly where each feeder emanating from the bus-bars continued to supply its own independent system. If these small systems of taps radiating from a center of distribution at feeder ends, had been arranged into one interconnected overhead network covering a large area, the coefficient of reliability with the same character of construction would undoubtedly have been decreased. These systems, usually supplying current for induction motors and for lighting, are fairly elastic; but on account of the higher potential usually, 2,000 volts or more, a short circuit obviously affects a very large area and often the entire system. The matter of regulation being comparatively easy, there is, therefore, a distinct advantage in operating independently the different feeders instead of on an interconnected network. With an overhead system exposed to the elements and so many chances of interference from an exterior source, a modern station is usually the more reliable part of a system, and therefore there is little necessity of sectionalizing the station. As a precautionary measure, however, and to facilitate future extensions and repairs, stations should be designed so that this can be done.

In conclusion, it might be said that considering responsibility for the business and return on investment, every central station system should be designed, if not for independent, at least for sectional operation. In the very large stations, the independent units from coal pile to distributing network, or to rails, should be effectively isolated to make a total shut-down practically impossible. The matter of independent, sectional or multiple operation at different hours of the day or days of the year is entirely one of local conditions, which may change frequently. Great care and constant attention is needed to maintain a fairly uniform and consistent coefficient of reliability on every part of the central station system. Independent and even sectional operation will mean a small sacrifice in operating costs. With a system properly designed, this matter, then, becomes to the central station management a plain business consideration, to take the risk of inferior service and possible shut-down, or to pay a premium in the form of very slight sacrifice in operating costs and thus obtain an additional safeguard for superior service to all or such groups of customers as business requirements may demand.

Multiple-Rate Metering.

The specifications of a patent recently issued to Prof. Elihu Thomson and Mr. E. P. Cox contain an interesting discussion of multiple-rate metering, which we reproduce below:

In the art of electric measurement of energy two systems in addition to the older one of directly indicating the current flow in either watts or amperes have come into use. The old system is to measure the energy in watt-hours or ampere-hours, as may be desired, and to make to the consumer a charge based directly upon the consumption. To encourage the use of current at times when the station is not fully loaded and as nearly as possible equalize the total load, thus diminishing the cost of energy and increasing the efficiency of the boilers, engines and generators, which, as is well known, are best adapted to maintain their full load (or work at highest efficiency when run near full load), the two other systems have been devised. One of these methods is to use a two-rate meter, which by various contrivances is adapted to register at a given rate during part of the day and at a lower or higher rate during another part of each twenty-four hours.

Various forms of this device have been elaborated, some of which indicate the two charges on different dials, and some of which simply shift mechanism of one sort or another, so as to effect a direct change in the registration, measuring all of the energy upon a single set of dials.

Another system which has been developed is the so-called "maximum-demand" system of bookkeeping, which consists in its essence of making a certain fixed charge proportioned to the maximum energy which may be consumed in a given branch circuit at any time and over and above that another charge proportioned to the actual energy consumed.

There are inherent inequitable features in each of these systems. The maximum demand, for instance, may be established for any month or other period by factors which do not give a true measure of the probable demand for current which the station must supply to the branch circuit under consideration. For instance, in some forms of such devices an accidental short circuit or a very unusual supply of current taken for only a brief period may be registered as a basis for the fixed charge referred to, although such a demand may not occur again for months or years, and this leads to dissatisfaction on the part of the customer and is manifestly unfair. The charge also has no relation to the station load, and being the same no matter at what time the demand occurs, has no tendency to encourage consumption at times of small station load.

Similarly, two-rate meters as heretofore developed have in a measure been open to some objections. For example, the change of rate is made at a certain definite time (where it is effected by clockwork attached to each meter), and this time should vary at different seasons of the year, whereas the mechanism of a clock is such that the period of high charge is not ordinarily susceptible of variation. Furthermore, the change in the rate of registration is effected all at once, so that during the transition from light load at the station to full load, which is always more or less gradual, the consumer is paying either at a less rate or a greater one than is equitable either to him or to the station.

The invention of the Thomson-Cox patent relates to the latter type of two-rate meters. By means of clockwork actuating a cam, resistance is cut into the meter circuit to effect a registration varying with the state of the station load. That is, varying by steps the rate of registration, for example, from the beginning of a peak load to its culmination, and then in reverse order as the load decreases. By suitably shaping the cam, the meter may be made to meet any local condition.

Discussion of A. I. E. E. Central Station Papers.

Owing to lack of space, only a brief abstract could be printed in the issue of last week of the discussion on the Institute papers of Messrs. Lardner, Torchio and Junkersfeld. As this discussion was quite full and of much interest, we give below the greater part of it.

In opening the discussion, President Scott said that the papers of the evening were of exceptional value on account of their particular character. In dealing with the subject of central station practice, they have not gone into generalities; they have not dealt with matters in a theoretical way; but the last two papers, in particular, are what might be called heart-to-heart talks from the men who have been operating large stations for a considerable time. The burden of the papers, particularly of the last two, and a strong sentiment in the first paper, is notable—it is not on the general theory of the interrelation of parts; not on the characteristics of engines or dynamos, of efficiency or regulation, but the papers refer to those elements which come up in connection with the design of the station beforehand, which have more to do with the operation of the station, which affect the man who runs the station. They have to do more particularly with the emergency conditions, with safety devices; and through all the papers we have this sentiment—how shall we protect the station against emergencies and interruption of service? We almost might be led to think, from what has been said, that these are chapters from experience, and one might almost conclude that Mr. Torchio has given us the results of thirty-three accidents and shut-downs in his system; but we fortunately have already been assured that this is not entirely the case, by Mr. Lieb's statement that this same system has been running since its beginning always with some current on its lines, and for some ten years with no interruption of the service.

Mr. Stott thought the present occasion was a good time for us to look back historically. We have been told a good deal about modern tendencies. History seems to repeat itself. We started out fifteen years ago with one machine and one circuit all the way through; a little later it became a question of adopting two or three circuits, and having them so divided as to suit the size of the units. A little later the size of the units was increased, and also the size of the feeders which they supplied. Then it became a problem of combinations, how to adapt the feeders to the size of the machines. At that time everything was run, practically, with high-speed engines and high-speed belted generators. Following that came the period of slow-speed engines, and we began to look then into the possibilities of multiple operation. Multiple operation meant, instead of running five, six or eight small units, on perhaps fifty per cent. load for a greater part of the time until the load went down sufficiently, a combination of the service on one or more machines, thus producing a fair load factor. Then as soon as multiple operation came with slow-speed engines, we began to look around for some further development; and there seems to be at the present time a tendency to go back to the higher speed generator, such as the steam turbine. The steam turbine is practically an unknown quantity to most of us, and whilst some results have been published, yet it has not been in use long enough to justify a prediction that it will displace reciprocating engines. Reciprocating engines to-day are built with higher steam economy than is claimed for the turbine. He understood that tests with the Sulzer engines in the Berlin Moabite station show a consumption of 8.97 lbs. of steam per indicated horse-power. The larger units in operation in New York to-day are all approximately consuming about 13 lbs. of steam per indicated horse-power. That corresponds approximately to 19 lbs. per kw-hour. The best of actual records of the steam turbine is just about that. By going into triple-expansion engines, a step which seems obvious for railway power plants, we can get down twenty per cent. lower than that, without any trouble at all. In a message just received from the Boston Edison Company it is stated that with a 1,200-hp compound condensing engine, with 98° of superheat at the throttle, they got a steam consumption of 11.57 lbs. per indicated horse-power. At the present time he felt personally, in regard to the steam turbine, that we will have to return the Scotch verdict of "Not Proven," and wait until we get actual results.

The feature of floor plan, the space in relation to the general size of the plant and the unit, has been referred to. He thought a little consideration will show that the size of the generator unit has nothing to do with it. It is the size of the boiler room. If we can reduce the size of the boilers, we can reduce the size of the station, but to get an economical distribution of steam from any plant we must run the boiler room parallel to the engine room. He believed we will find the limiting feature in all large stations—no matter what the size of the generator unit—is that we must have a certain size of boiler unit, and to get the best distribution of steam, even though the units only occupied one-fourth of the space claimed for the steam turbine, you would have to space the steam turbine units at approximately the same centering distance as you do the steam engine, so that the economy of floor space is not a very important point.

Coming to the transmission lines, the claim has been made, and it perhaps dwells in the minds of many able engineers, that the high-tension lines are very dangerous. He differs from that and thinks the high-tension underground cable is the safest thing we have—a great deal safer than low-tension. If you have a short circuit in a low-tension cable it may burn up a thousand feet of the cable before you can stop it. If there is a short circuit on a high-tension cable, with proper safety appliances on each end of it, should a burn-out occur it does not destroy more than two feet of the cable. There is quite a large capacity on the bus-bars in the Manhattan plant, all in multiple, and a short circuit on the high-tension feeder, 11,000 volts only gave a puncture such as you would get from a station transformer, not destroying more than two feet of the cable; whereas with a short circuit on a 600-volt, direct-current cable, a large amount of cable may be readily destroyed.

Referring to storage batteries, Mr. Stott considered that the storage battery has found its proper place as an assurance against shut-down and not as a means of economical operation. That statement is probably open to discussion, and he would be glad to hear it discussed. It seems to be almost impossible to find a condition in which the storage battery pays for itself as an investment. He considered it essentially as an insurance, and not as an element in economical operation that the storage battery finds its best applications.

The idea which seems to pervade in all of these papers, the returning to the single operation of units on a certain number of feeders, or employing a certain number of sub-stations, and not multiple operation, seems to be a backward step. It is a confession of weakness in our safety devices. Is it not a better solution to improve the safety devices and operate in multiple and thereby gain the maximum economy of station operation? The price of coal is soaring all the time and apparently always will do so, and in the economical operation of a power plant coal forms over sixty per cent. of the actual cost of power; and it is, therefore, most important for us to do everything possible to economize in the operation of the plant, and this can only be done by running the units as near full load as possible, and to do this we must run in multiple. The separation of high-tension apparatus can be very easily carried out, and it seems to me that by means of proper appliances as indicated in Mr. Torchio's paper, and as actually carried out, there is no difficulty whatever in making a station practically safe in all kinds of operation. He has seen an actual short circuit in a station with four 5,000-kw machines in multiple, and an oil switch take care of it perfectly, long before the attendant could touch the switch and throw it out. With a switching apparatus brought down to such pefection as this, it seems to me that we ought to be very careful about reducing the efficiency of operation of our plants by going into independent units

Mr. Herbert A. Wagner said he has recently been connected with the engineering work of the Boston Edison Company, and there all the alternating-current generators and feeders are operated in multiple, and with practically no trouble. The generating station, until three years ago, was used for alternating-current distribution only. No rotaries or motor-generators were used prior to that time That was the station of the Boston Electric Light Company, which was consolidated with the Edison Illuminating Company, of Boston, and then the change was gradually made, and has been entirely made by this time, from alternating-current distribution in the city proper to alternating-current transmission and distribution by the old Edison low-tension system and extensions thereto. The alternating-current generating station, therefore, is now used entirely for transmitting current to sub-stations from which current is distributed on the three-wire, direct-current system. All these sub-stations are equipped with motor-generators in place of rotary transformers, and Mr. Wagner attributed the freedom from many of the troubles which other central stations had to the use of motor-generators in place of rotaries. A large proportion are induction motor-generators, and therefore the troubles which are often caused by synchronous apparatus are entirely obviated. Of course, there is something to be and quality [illegible] of some governors. The first cost is something more. The power factor with induction generators is lower, but with a proper apportioning between induction motor generators and synchronous motor-generators that can be obviated.

The company is now building a 30,000-kw station in which turbines are to be used entirely in place of engines, in 5,000-kw units. That station will probably be operated in sections, but this has not been definitely determined upon yet. Referring to a statement of Mr. Scott, Mr. Wagner said that the engine economy which he quoted refers to a cross-compound engine. In fact, all the engines are cross-compound, of McIntosh & Seymour make. No triple expansion engines are used, except some very old ones built by the General Electric Company a good many years ago, of small size. The German practice and experience has shown that there is nothing to be gained by the use of triple expansion over compound engines, especially without superheating. They have carried superheating to a very much higher degree there than here, as they have used independent superheaters. In this country nothing over 100° has been reached, and that is much above the average practice; 75 to 80° superheating is probably the best that has been obtained in practice, and that is quite varied. With a high degree of superheating the cross compound engine can be made fully as economical as the triple-expansion engine; single-cylinder engines, with high degree of superheat, have almost equalled triple-expansion engines, but the difficulty of using such high degrees of superheat is almost insurmountable, especially with the type of engines used in this country.

Mr. F. H. Sniffen, in referring to some statements made concerning steam turbines, said that we are all tolerably familiar with what the reciprocating engine will do, and it is probably a fair statement to say that the steam turbine will not give materially better results, under test, than the best-known results of reciprocating engines. That is a fair statement for full-load regulation, although under light loads the turbine is more economical. As we accumulate experience we will find a distinct difference between the inherent, commercial, every day efficiency of the turbine and the reciprocating engine. This has been already shown by the amount of experience we have had. At Hartford, Conn., where there is a good-sized turbine running a 1,500-kw machine, they have found by pretty careful experiments that they develop about 1,900 kw with the steam turbine, as against 900 kw with two Corliss engines, with the same fuel consumption. Possibly these engines are not in the very best condition; it may be the valves are not well seated, or the internal condition of the engine is not exactly as it should be. The turbine, of course, is direct-connected, and the engines drive the generators by belting, and to the belt drive we may ascribe some of the deficiencies of the steam engine, but certainly not all of it. We should not be misled in comparing the efficiency of two different types of apparatus simply by tests of them, unless the results are obtained by every-day use. As these new plants are installed and we get the actual results of the commercial operation, Mr. Sniffen thinks that in inherent efficiency a very marked improvement in the steam turbine will be demonstrated.

Mr John W. Lieb, Jr., said that in reading over Mr. Junkersfeld's and Mr. Torchio's papers one would be almost inclined to think that Mr. Lardner had a great advantage from the standpoint of safety of operation in a considerable number of smaller stations. He thought, however, that Mr. Lardner, in his statement of the case for a multiplicity of smaller stations, has probably not taken into consideration the extremely important factor in locating such smaller stations in such a city as New York. He certainly did not agree with his statement that it is not a difficult matter to locate smaller stations within the Borough of Manhattan. Any one who has undertaken to operate an electric light station on Manhattan Island will have become very soon convinced of the great difficulties which attend a selection, such as the bringing of coal to the station and the drawing away of ashes, and the liability of annoyance to the people living in the neighborhood, and these things are all included in the difficulties of securing a proper location. As the state of the art progresses to a point where it is possible to concentrate the chief generating plant, so that these objectionable features are minimized, it soon becomes evident that this is a step which one is practically forced to take.

If prospective customers of the electric light and power companies could read over this very formidable list of all kinds of automatic overload and underload relays, and other things tributary to the protection, that are a necessary concomitant of a large power station, he feared that the contracts which would come in would be few and far between; but as a matter of fact these different requisites are rather in the direction of extreme refinement, necessary to secure the greatest regularity of service and the greatest freedom from disturbances, and not only mere disturbances which would affect the customer, because a great many of these contrivances which have been referred to as being necessary to the operation of a large power station might not be necessary as far as simply giving service which the customer would consider as absolutely regular. It is on account of the extremely high requirement that is placed upon the system so that the service shall be above reproach in every respect, and not so much from the standpoint of continuity as from regularity and constancy of the supplied voltage.

The papers link one thing very closely with the problem of whether we shall have one large station or a number of small stations, and that is what one of the gentlemen has referred to as the commercial risk. It is perhaps true that if an accident should happen to a large station that it may possibly involve a larger territory, and therefore perhaps might not be as absolutely safe as a number of small units; yet that safety can by proper engineering methods and careful installation be reduced to a point where the risk is entirely a commercial one. That has been fairly demonstrated in the operation of the large central stations which have supplied the larger cities where the exigencies of the service are of the very greatest. Mr. Lieb emphasized the absolute necessity, as an auxiliary, of storage batteries in such systems of distribution. It is perfectly safe to say that the experience of all large central stations operating transmission systems to sub-stations has shown that the storage battery has impressed itself upon them as an absolute necessity, as much a necessity as an auxiliary as either the rotary converters or motor-generator sets, or some other of the equally essential pieces of apparatus.

In connection with the consideration of the cost of production, Mr. Lardner, in his enumeration, has made, it seems, a rather formidable list of advantages of the large stations and has cited as the principal and only disadvantage of the large station the possibility of current interruption; but he has not, perhaps, sufficiently emphasized the very large difference between operating a dozen or more small plants and one large plant. In the case of a large number of smaller plants the volume is large of what may be called unproductive labor; in other words, the people you have got to keep at the smaller plant, no matter what its output may be, and even if there be practically no output—a certain amount of superintendence, a certain amount of janitor work, a certain number of unproductive people, who must be employed in the small plants, and who are done away with if the system is concentrated in one large power plant. While the various matters which have been brought forward during the evening might seem to indicate that the service from these larger plants may perhaps be less reliable than the service from a multiplicity of smaller plants, experience sufficiently demonstrates that the service which the large plants can produce is sufficiently constant and reliable for the most exigent and difficult conditions.

Mr. Townsend Walcott remarked, in reference to a statement in Mr. Lardner's paper respecting the use of superheated steam in steam turbines, that if he understands the theory of the steam turbine, there would not be the same advantage in the use of superheated steam as in the reciprocating engine. The superheating of steam in the ordinary engine prevents condensation in the cylinder, whereas in the steam turbine the steam expands without doing any work. Superheating would thus only be putting more energy there which could not be recovered.

Mr. W. S. Rugg said that Mr. Lardner brought out the point that we can expect nearly the same economy of operation with a small station as we can expect in the operation of a large station, which is an important point, and one with which we are all familiar. Mr. Lieb has also brought out the point that the cost of operating such a number of plants has increased very greatly over the cost of operating a single large plant. Mr. Torchio has called our attention to the importance of isolating and duplicating the various parts of the distribution system. This is one of the points in which most advancement has been made in central station practice in the last few years, and one which is not as well known and as evident as other matters, because it is somewhat hidden and not as carefully looked into as the power house itself. Mr. Junkersfeld called attention to the importance of isolating the power plant and dividing it into several units. This is a point which has not been considered as favorably as it should be, and it is of vital importance to consider these various facts. It is surprising that we have not heard brought out, and especially we have yet to see the first attempt, to actually lay out an Edison multiple-unit station. In such a station we could combine nearly all the advantages which have been brought out in the papers. Such a station could be designed so that the operating expenses would be but very little more than the operating expenses in one room, or two rooms, and at the same time we would have the advantage of a number of stations. This principle is well recognized in the design of small stations. We would not have to tie two small stations up in one unit, but we do not hesitate to defend some of the large stations of the country in which the entire station practically depends upon the continuity of operation of a single system.

Mr. A. V. Abbott spoke of another side of the question, which is important from the manager's standpoint. May we not consider the question of safety appliances and the question of the subdivision of the station into a number of units, partly from an insurance standpoint? In one of the papers the Niagara plant was referred to and it was stated that after the accident there, the engineers of the plant said there should have been two bridges, or two sets of cables. That is an easy thing to say after the accident has occurred, but it is quite probable that the engineers considered one set of bridges and one set of cables amply sufficient considering the probability of interference with the service. To put it in another way: Suppose, for example, all of the service of New York was concentrated into a single plant. There would undoubtedly be more or less probability of interference to the service occasionally. On the other hand, if we can imagine New York supplied by a hundred plants, the probability of any serious interruption would be almost nothing, because if one or two of these hundred plants were put out of commission, the other ninety-eight or ninety-nine would be amply sufficient to carry the service for such a period of time as would enable the repairs to the one or two plants to be made. On the other hand, it is also quite certain that the expense of generation, expense of supply and the capital invested would be very much increased. Let us suppose there was an insurance company which would go into the business of insuring both customers and the electric light plant and should take up the question something in this fashion: For a certain amount per kilowatt-hour per annum, we will insure you positively against interruption in just the same way that a fire insurance company insures the merchant against the destruction of his building; or, in other words, the company will pay for whatever actual damages occurred due to interruption of electrical service. That is a business proposition. The insurance company could also say to the electric light company: You may put in so much less apparatus, so much less capital, have so many less bonds on which to pay interest, because we will assume the risk of indemnifying your customers for any interruption that occurs.

Would it not be possible for some of us to contribute to the general fund of information to endeavor to show, perhaps in the form of a curve, a certain relation between the number of accidents and delays between the large station and a multiplicity of small stations, and the amount of capital that would be invested therein, and reach some sort of a plan on which insurance companies could go into the field and insure electric light companies and their customers against the probability of interruption of service? We should take this question up not solely from the engineering standpoint, but from the business standpoint as well. The engineer should make everything absolutely safe, so far as his knowledge will permit, because there are always sufficient exigencies in the unknown which we cannot recognize; on the other side, there is the commercial point of view, and it is desirable that some light should be thrown on that phase of this question.

Mr. Junkersfeld said that the question proposed seems to be one of preference between a multiplicity of small stations as against one large plant. Mr. Lieb pointed out that a multiplicity of plants is impracticable, because you cannot get suitable real estate. For that reason the companies are forced to concentrate their power stations in places where coal and water can be easily secured. Mr. Lieb has covered the proposition very clearly, and as far as Chicago is concerned he endorsed his remarks. The same conditions apply in Chicago; a great multiplicity of plants is impracticable, and sites could not be secured for them, even though we tried to do so. Mr. Stott made the remark he would rather have trouble on a high-tension cable than a low-tension cable, and that in his experience there is really very little trouble from that source. In this he fully agreed. At Chicago there has been very little trouble, as far as the cable itself is concerned, in the high-tension work, in transmitting trouble from one part of the circuit to the other.

The question of the storage battery was brought up by Mr. Stott with the statement that as an investment he could not consider it economically. That is largely a question of conditions. In the Manhattan station perhaps he cannot see any great saving in installing storage batteries, but in the lighting business, with narrow peak, it is easy to see how a storage battery can be installed and used with profit up to a certain capacity. If you cut off enough of the peak so that it is more than an hour or an hour and a quarter, the battery will not pay. With a peak of one hour the battery will pay. Returning to multiple and independent operation, it has been shown in some of the papers and during the discussion that a multiplicity of plants has some safeguard over and above one large plant; and with this idea in view the work in Chicago has been carried on with the idea of centralizing the sub-stations in a transmission system. They have been built and run independently, as the units were quite large, and very little sectional operation was possible on that account. With the installation of the turbine units, with a good load economy, sectionalized operation will be entirely possible. He was glad to know that in New York they had actually started operating their large plant in two sections, where they are employing reciprocating engines. That they have found this possible here in New York, will be given quite a good deal of consideration, because, after all, what is done in these larger lighting stations is based on wide experience, and is a matter of interest to all stations.

Mr. Lardner said no one knows better than Mr. Lieb the difficulties of operating small stations in New York, or of securing locations which shall insure the company freedom from complaint due to the annoyance incident to such plants. He said he had been slightly misunderstood, as he did not advocate a multiplicity of plants, but subdivision into a few plants instead of one large plant; perhaps two or three. As to the difficulty of securing sites in New York City, there is the site at Kingsbridge, at Two Hundred and Nineteenth Street, at Ninety-fourth Street, at Seventy-fourth Street, at Thirty-eighth Street, and at North River and Fifty-ninth Street. These five suitable locations have been found, and the engineers of the respective companies probably each think each has the best site.

Mr. Torchio, referring to Mr. Lardner's remark with reference to the locations of power plants in New York, said that the only stations he has mentioned on the water front are high-tension current stations, and he asked if he meant that the New York Edison Company should have multiple low-tension stations along the water front. In reply, Mr. Lardner said he suggested the advisability of two or three high-tension stations; not low-tension ones. Mr. Torchio then proceeded to say that a low-tension station would be out of the question. He took issue with Mr. Stott in his statement that there is no place for the storage battery from the standpoint of economy. The local conditions in New York City are such that they have the big load of the station supplying the commercial district downtown below Eighth Street, where the load diagram is very light in the daytime and then about 5 o'clock there is a full peak, and a sharp drop. A storage battery at that point, with a peak of short duration, can show advantages from an investment standpoint because in this case you can discharge the battery in one hour and you do not require the battery as a reserve. Having the battery, you have two advantages as to capacity and reserve during the operation. In reply to an inquiry from Mr. Stott, Mr. Torchio said the battery is discharged at this period at the maximum rate of discharge. Where there is a lighting load extending for three or four hours in the other district, the question is different. He said he had in mind a load diagram of the power station of the Milan Edison Company in Italy, operating a transmission line—a water power plant—where they transmit 10,000 kw and sell a good deal of power to industrial motors, and also for running the railway in the city as well as for lighting. At the peak a very large battery takes care of the lighting load. They sell power in Milan in the neighborhood of $60 per yearly horse-power, and that battery for a few days in the year enables the company to sell annually an additional three or four thousand kilowatts. In this case the efficiency of the battery is of no importance as a commercial consideration. You get 4,000 hp at $60 a year.

Telephone Exchanges. II.

By Arthur V. Abbott, C. E.

RECEIVER WINDING.

THE illustrations in Figs. 10 and 11 are diagrams of a pair of telephone lines as they would appear when connected for conversation. In Fig. 10 the sub-stations are shown as equipped with a local battery transmitter and receiver. The lines then extend to the office into a branch terminal switchboard, and are connected by the usual cord and plug. In Fig. 11 common battery sub-stations and switchboard are represented. The approximate resistances of the various parts of the circuit in both illustrations are given, for the object of these illustrations is simply to convey a faint mental picture of the chief conditions which prevail during a telephone conversation.

When one speaks into one of the transmitters the result is to produce (as will be subsequently explained in the paragraphs on transmitters) an undulating e.m.f. in the induction coil. As the circuit between the two lines is closed by the switchboard cords, this e.m.f. excites electric waves which oscillate backward and forward around the circuit. To secure the best results it is evident that the winding of the receiver coil must be such as to appropriate and transfer to the magnet on which it is placed as large an amount as possible of the energy impressed on the line by the transmitter.

In dealing with alternating currents, particularly with those of as high frequency as telephonic waves, the operation of inductance and capacity becomes of far more importance than that of mere ohmic resistance, and must in the design of apparatus be treated with corresponding consideration. The ohmic resistance of the line is divided between the coil of the receiver, the windings of the induction coil, the line wire, the various connections and other miscellaneous apparatus distributed over the circuit. Similarly each part of the circuit is endowed with its portion of the inductance and capacity of the whole. It is easy to measure with a suitable dynamometer the e.m.f. at the terminals of the transmitter or even to calculate it as will subsequently be explained. If the maximum value of this e.m.f. be represented by E, the total resistance, inductance and capacity of the circuit respectively by the symbols R, L and C, and the number of waves per second of time by n, it is easy to show * that the resulting maximum current, I, is expressed by the formula:

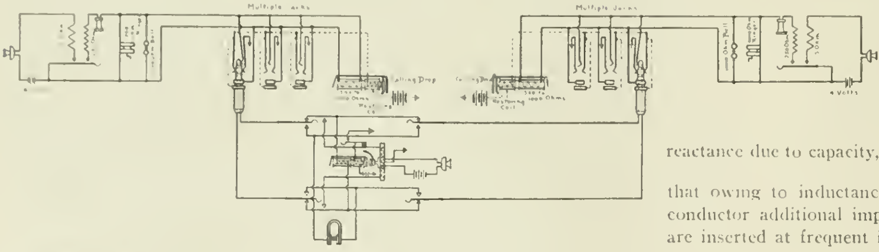

FIG. 10.—DIAGRAM OF CONNECTIONS OF TWO JOINED LINES.

$$I = \frac{E}{\sqrt{R^2 + \left(2\pi\,n\,L - \frac{1}{2\pi\,n\,C}\right)^2}}.$$

It can also be shown that the current wave may either lag behind or be in advance of the e.m.f. wave depending on whether $2\pi\,n\,L >$ or $< \frac{1}{2\pi\,n\,C}$ for the algebraic sum of these quantities is the tangent of the angular relation of the current and the e.m.f. that produces it. The quantity $2\pi\,n\,L - \frac{1}{2\pi\,n\,C}$ is known as the *reactance* of the circuit, and manifests itself as an opposition, and a very serious one, to the establishment of a current under the action of a varying e.m.f. As telephonic apparatus deals largely with coils of wire and magnets, whose capacity is very small, the portion of this formula, $1/2\pi\,n\,C$, may oftentimes, with sensible accuracy, be neglected, and the expression simplified by writing,

$$I = \frac{E}{\sqrt{R^2 - (2\pi\,n\,L)^2}}$$

In the formula, $\sqrt{R^2 + (2\pi\,n\,L)^2}$ is called the *impedance* of the circuit. It opposes the passage of the current in a manner that closely resembles the barrier offered by the more familiar "ohmic resistance" and is often expressed as equivalent to so many ohms. Ohmic resistance, however, operates to destroy, or degrade a portion of the electrical energy, and changes the same irrecoverably into heat, which is radiated away from the circuit. But inductance and capacity, while they absorb energy, retain and store it, the one in the magnetic field which is created about every conductor through which a current passes, and the other in the form of a charge or portion of electricity that seems to adhere, so to speak, to the surfaces of the conductors, and at the proper time the energy thus retained both magnetically and by capacity may be recovered. It is this property of giving up absorbed energy that causes the current to either lag behind, or advance before the propelling e.m.f.

There are two other exceedingly important deductions to be derived from the formula. In the quantity termed reactance, $2\pi\,n\,L - \frac{1}{2\pi\,n\,C}$, the factor, "$n$" enters. This is the number of waves per second. Now speech consists of a great many different waves, varying very greatly in speed. If n increases, the reactance will increase; that is, there will be a much greater opposition to the transmission of quick waves than to slow ones. This is the explanation of the fact that *ceteris paribus*, a bass voice can be heard better over telephone lines than a high, shrill one. Furthermore, it is evident that in any voice the high, shrill tones will, from this cause, suffer greater obliteration than the lower fundamental; hence the distortion that is noticeable in all telephonic transmission, and the reason why the letters, *s* and *c*, particularly, and *b*, *p*, *t*, etc., are with difficulty distinguished. If we examine the quantity, $2\pi\,n\,L - \frac{1}{2\pi\,n\,C}$ still further it is seen that $\frac{1}{2\pi\,n\,C}$ is negative, and the thought at once occurs to so design apparatus as to make $\frac{1}{2\pi\,n\,C}$ equal to $2\pi\,n\,L$, and thus neutralize inductance with capacity. In other branches of electrical engineering this method is practiced with great success, and this principle is the basis of Dr. Pupin's invention for improving transmission over cables and aerial lines. In the line that portion of the reactance due to capacity, namely $\frac{1}{2\pi\,n\,C}$ is much greater than that owing to inductance, $2\pi\,n\,L$. So in the Pupin loaded conductor additional impedance in the shape of coils of wire are inserted at frequent intervals for the purpose of balancing the capacity, and the test of practice shows that conversation is equally transmitted over a loaded conductor that is five times as long as an unloaded one. But in telephony one deals simultaneously with vibrations differing very widely in number, and the quantities themselves are exceedingly minute, both as regards e.m.f. and current. Thus Mr. Kennelly cites some experiments showing that .000000044 amp. can produce an audible sound in a receiver. This is about equivalent to saying that the energy expended by a weight of one grain falling one inch could keep a receiver sounding for two and a half years. Other investigations show results that are practically concordant. It is exceedingly difficult to deal with quantities so minute, for the possibilities of the unknown, and the present unknowable are vastly greater. For example, any mechanic can, on any lathe, turn up a bridge pin six inches in diameter to fit an eye bar, within a few thousandths of an inch. The pin is tossed on a freight car, rolled down a sandy embankment at the bridge site, and driven home in its place in the chords with never a thought of its gritty condition. But take a watch pinion possibly but one or two-thousandths of an inch in diameter. The error of a millionth of an inch is fatal. The kick of a fly's foot may bend it, and a grain of dust that even a sensitive eye could tolerate can arrest its motion.

To deal with a transmission plant reckoning voltage by tens of thousands, and amperage by hundreds is doubtless difficult, and taxes engineering science to the uttermost. But at the other extreme when the pressure and current become so small that the most analytic mind cannot grasp their minuteness, calculation fails, and only the cut-and-try method of experiment remains. Nevertheless, even if telephonic magnitudes are so small as to elude the clutch of mathematics, electrical principles apply as a guide with as much force to telephone circuits as to any others, and it is certain that apparatus designed along well-known electrical lines is much more likely to succeed than any haphazard heterogeneous concatenation of apparatus thrown together by the accident of ignorance. For example, the line has for a quarter of a century remained unimproved. Now, owing to the suggestion of Dr. Pupin, transcontinental telephony is assured, and transoceanic telephony within grasp. Yet Dr. Pupin is a mathematician, pure and simple, and the problem was solved at the desk and in the laboratory and not in the field. We may, therefore, be quite certain that all improvements in telephone apparatus will follow definite electrical laws, and that those who are quick to perceive them will be the first to design the better types so ardently desired.

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* Alternating Currents. Bedell & Crehore, p. 15.

From the preceding formula it is seen that with a given varying e.m.f. the current from instant to instant varies with the reactance. By the laws of the electro-magnet we know that the rate of change in the magnetic field produced by a coil of wire carrying a current will be proportional to the number of ampere-turns. Ampere-turns may be increased by either augmenting the amperes, or the turns, or both. But to increase the turns in any coil to which a given e.m.f. is applied is to decrease the amperes, by augmenting the impedance of the circuit, and the problem is to determine the dimensions of the coil which will give the best result. That portion of the impedance due to ohmic resistance may be decreased by using a large wire of low resistance. This means a bulky coil of large radius, to hold heavy wire. Now the inductance of any coil is proportional to the square of its radius and the square of the number of turns, while the ohmic resistance is proportional to the radius and the number of turns. From the formula it is evident that the current will be a maximum when the denominator is a minimum, and as *L* varies as the square of the same quantities (the radium and number of turns of the coil) with which *R* varies directly, it is evident that the denominator will be a minimum when $R = \sqrt{2\pi \; n L}$, but space considerations will usually preclude putting this theory into practice.

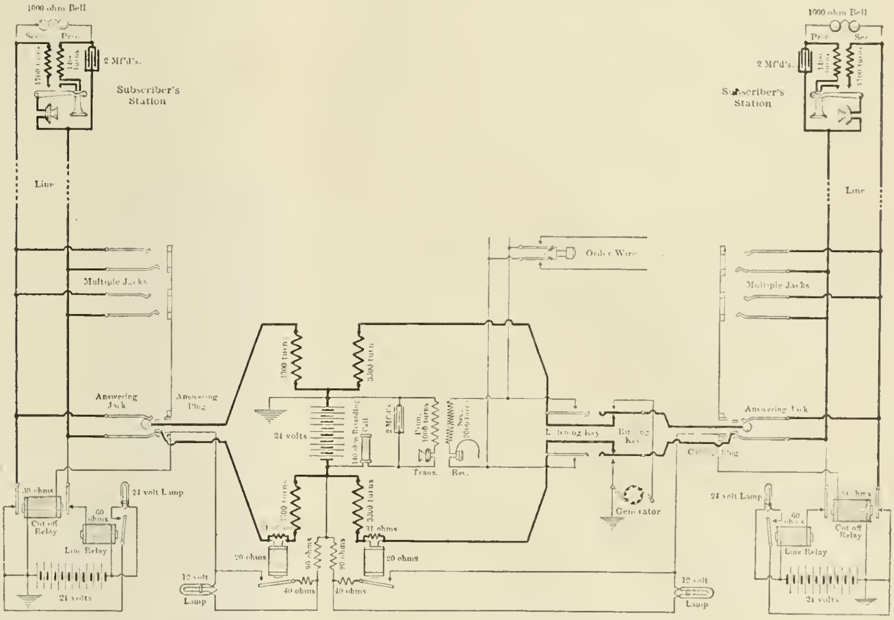

FIG. 11.—DIAGRAM SHOWING CIRCUIT OF SUB-STATION, COMMON BATTERY SYSTEM.

Not only does impedance reduce the total current that traverses a circuit on which an undulating e.m.f. is impressed, but it operates to prolong the time occupied by the current in reaching its possible maximum value. We are so accustomed to think of all electric action as being instantaneous, that it is hard to realize that every tick of a telegraph sounder, and every vibration of a telephone diaphragm requires a certain very measurable though minute period of time for its accomplishment, and whenever impedance is added to a circuit, the "time constant" or interval required by the current to reach its (approximately) full value is increased. It is easy by a formula given by Helmholtz to calculate the current in such a circuit at any interval of time after the e.m.f. has been applied. Suppose *i* be the current, *t* seconds after the application of the e.m.f., then

$$i_t = \frac{E\left(1 - 2.7183^{\frac{Rt}{L}}\right)}{R}$$

in which *E R* and *L* have the same meaning as before. It is evident by inspection that $\frac{E}{R}$ will always be reduced by the value of the quantity inside the parenthesis, and hence the current will theoretically never cease rising. Practically, however, it attains a value sensibly equal to the theoretical amount in a very small interval of two or three minutes may sometimes elapse. As *L* enters into the parenthetic coefficient, it is evident that the time constant will vary with *L*, and will also be proportional to the square of the number of turns and the radius of the coil.

To calculate the impedance of a circular coil in air is not difficult, but when the complications of an irregular shaped space, occupied by wire with an indefinite thickness of insulation, the insertion of an iron core of unknown permeability, and the addition of a permanent magnet of uncertain strength, an accurate calculation becomes impractical. By winding the coils in several sections connected in parallel, some advantage is gained. The ampere-turns are decreased directly as the number of coils, while impedance is reduced as the square of the number of turns is decreased. For example, if the two coils with which receivers are usually supplied be joined in parallel the ampere-turns are reduced one-half, for half the current will flow through each coil, but the impedance will be diminished to one-fourth, for there are only one-half as many turns on the line. There is, therefore, a decided decrease in reactance by winding the coils in sections joined in parallel. Several wires on one spool serve somewhat the same end, but with very small wire the proportion of time; although with the large field magnets of dynamo machines, the total coil bulk occupied by insulation is so great compared to the volume of copper, that this plan soon ceases to be of advantage.

The capacity of receiver coils is even under the most adverse circumstances very small, so small as to be almost negligible compared with the relatively enormous inductance. What little capacity there is is probably of advantage in balancing to some extent the inductance. In this respect improvement in receiver design is likely to take the shape of the addition of more capacity to neutralize more perfectly the inductance, than any attempt to reduce that which already exists.

Some attempts have been made in the direction, but were never carried to any decisive conclusion. This certainly seems a promising direction for the ambitious inventor, and deserves to be explored.

Considering all these diverse elements, it is exceedingly difficult to arrive theoretically at the best size, shape, wire gauge, resistance and number of turns for receiver coils. Practical experience seems to have settled down to making the spools about .90 in. long., .45 in. wide, and .50 in. deep for the ordinary hand receiver, and .70 in. long, .30 in. wide, .40 in. deep for a head receiver. The very best single silk-covered wire is used and great care taken with the winding to pack the wire as closely and tightly as possible on the spool. The end of the winding of each spool is reinforced by a few inches of relatively heavy wire, say No. 28 to 30, to guard against rupturing the coil during the operation of assembling. Local battery or high-receivers are usually wound with from No. 34 to No. 40 wire to a resistance of 100 to 150 ohms. Some few makers carry the resistance up to 300 or 400 ohms, but such instruments are rare. Low resistance receivers, or common battery instruments, are usually wound with from No. 32 to No. 40 wire, and have a resistance of 40 to 80 ohms. Some are made as low as 25 ohms and some as high as 80, but these again are the exceptions. The spools should be made of some non-metallic substance like fibre or rubber, but if of metal should be laminated to prevent eddy currents. When complete the coil should be thoroughly impregnated with a non-hygroscopic insulator like shellac or paraffin, and covered with moisture-proof varnish or tape.

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The New York Electrical Society and Transportation Problems.

At the 234th meeting of the New York Electrical Society, held in this city last week, Mr. Bion J. Arnold, consulting engineer to the New York Central Railroad and the Chicago City Council, gave an interesting illustrated address on the subject of the transportation problem in Chicago and other great cities. This address, accompanied by a large number of lantern slides of maps, curves and tabulated data, as well as of overhead and subway systems of operation, was based upon the valuable and exhaustive report which Mr. Arnold submitted a few months ago to the Chicago City Council, in order to assist the city to arrive at some basis of agreement with the street railway companies operating in that city. This report has already been elaborately discussed and analyzed in our pages, and need not therefore be taken up again in extenso. The address was a swift and masterful presentation of the wonderful mass of data dealing with the unification of the street railway service, either under single control—which was preferable—or by the co-operation of several systems, each under their own management. Mr. Arnold also went into a discussion of the relative increase of population and of traffic and surveyed the growth of the great cities here and in Europe for a hundred years past, in order to show the rate at which our newer centers of population might be expected to increase, and what would be the resulting necessities for street railway extension. Mr. Arnold, in his lecture, also considered the question of one fare for one city, the important subject of transfers, terminals, looping, underground and overhead net-works, and other features pertinent to the subject. In conclusion he pointed out that each city constituted a distinct problem, and that what might be desirable and even necessary for Chicago would not be at all applicable in New York or Boston. There was no discussion of the paper as the hour was late, but Mr. Frank J. Sprague, in a neat little speech, moved a vote of thanks, which was enthusiastically carried.

Prior to the lecture of the evening, an animated discussion took place in regard to some proposed constitutional amendments, the result of which would be to permit an extension of the present presidential term of one year, and which also made certain changes in the constitution of the nominating committee each year. The amendment brought forward had been prepared by the present executive committee, but it was soon evident that the membership in general, as representd by the audience, was very much against any change which would increase the length of the presidential term, or give undue power to a president in appointing a nominating committee. The sentiment in this respect was voiced very vigorously by Mr. Francis Forbes and Mr. Charles L. Eidlitz, both of whom from different points of view, insisted that the best interests of the society would be served by a rule rendering a president ineligible for immediate re-election. Mr. Forbes took up the subject along constitutional lines and gave notice of his intention to pursue the subject further in that manner at later meetings. Mr. Eidlitz, in a forcible but humorous manner, dwelt upon the large amount of excellent available presidential timber to be found in the Society, now 600 strong and growing rapidly, and showed that if they were only to get a new president once every two years, but twenty-five could enjoy the honor in the next fifty years, which would give no show at all to a great many men in the membership upon whom the distinction could be worthily conferred, with consequent stimulation of interest in the welfare of the Society and the bringing to bear upon its affairs the thoughtful activity of a greater number of well trained minds from different branches of the industry. These views and others of like nature were heartily applauded by the audience, and the amendments as presented from the executive committee were promptly tabled.

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New "Plaza" Exchange of the New York Telephone Company.

The latest addition to the exchanges of the New York Telephone Company is that known as the "Plaza," and which is here shown. It is a fine building of fire-proof construction, located at 110-114 East Fifty-eighth Street. The Plaza district, it is interesting to notice, is made up of portions of the old Thirty-eighth and the Seventy-ninth Street districts, and the transfer of the lines to the new central was accomplished with the utmost smoothness and celerity, and without any interruption of the service. The latest type of central energy switchboard has been installed. The statistics of the switchboard are given in the above table.

VIEW OF EXTERIOR OF PLAZA EXCHANGE.

a.—Ultimate capacity subscribers' lines	9,600
Ultimate capacity incoming trunk lines	720
Ultimate capacity outgoing trunk lines	600
b.—Present equipment subscribers' lines	5,600
Present equipment outgoing trunk lines	360
Present equipment incoming trunk lines	480
Subscribers' lines now in service	3,111
Subscribers' stations now in service	4,893
Outgoing trunks now in service	247
Incoming trunks now in service	290
c.—Number of operators now employed:	
Day force	68
Evening force	21
Night force	15

Party-Line Telephone Service Before the Chicago Electrical Association.

An enthusiastic telephone meeting of the Chicago Electrical Association was held on May 1. A large number of men interested in that branch of the business, both from a commercial and from an engineering standpoint, were present, and the president of the Association called attention to the fact that Chicago, geographically speaking, was at the center of the telephone business. The meeting was semi-social in character, being held at the Albion Café.

Mr. H. P. Clausen, Chief Engineer of the American Telephone Company, was the principal speaker of the evening, and discussed the "Development of Party Line Telephone Service During the Last Ten Years," the subject receiving consideration with reference to the earliest attempts at operating party-line systems, and with particular reference to the developments in this line of work during the past ten or twelve years.

Reference was made to the original series arrangement—party-line systems in which all telephones were connected in series upon a line—and attention was drawn to the evil effects observed by reason of telephone currents being required to pass through the ringer magnets connected into the circuit. Several plans were referred to in which the matter of talking through the ringer magnets was overcome by supplying a separate calling wire, one being used for talking and another for signaling purposes. In connection with this system, reference was made to several attempts to provide lock-out devices, that is to say, the call-wire circuit was provided with a step by step electrically-operated mechanism for either shunting out all stations but the one wanted, or cutting in only such stations as might be wanted, and after this cutting in or shunting out had been effected by sending the proper number of impulses of current over the call wire, the station would be called by projecting signaling current over the talking wire.

Reference was further made to the system in which each station is provided with a low reading ammeter arranged with contact points at the different scale reading points. The needle of the ammeter formed one side of the signaling circuit and the contact point the other, this permitting of placing a certain amount of current upon the line, and through the ammeter needle making connection with the contact point, establishing the signaling circuit.

Further reference was made to the development of the bridging system. Plans were shown for permitting the use of signaling telephones over long lines.

The plus and minus system also received considerable attention, particularly in respect to showing its operating principles and the difficulties encountered in attempting to apply the plus and minus system to the present universally-adopted common battery swtichboard system. Attention was drawn to the impracticability of operating the bells when condensers were connected in series with the arrangement.

Next, attention was given to the high and low frequency selective signaling system invented by Mr. O. M. Leich, and placed upon the market by the American Electric Telephone Company, of Chicago.

The high and low frequency system was gone into thoroughly as to its method of operation and the apparatus which was provided was used for demonstrating the different points made by the speaker. Actual experiments made demonstrated the great working margin of the system, it being possible to project a current over the line to which several telephones were connected without affecting either the low or high frequency station equipment. That is to say, the low frequency station equipment was adjusted to operate on a 20-cycle current, while the high frequency operated on 60 cycles, and upon projecting a 40-cycle current neither bell would respond, but upon reducing the frequency to about 30 cycles, the low frequency bell responded, and upon increasing the frequency to approximately 50 cycles, the high frequency station would respond. At the same time, while projecting the 40-cycle current it was possible to produce a signal on the low frequency equipment by reducing the impedence of the coil connected in series with this equipment, and the high frequency equipment would be operated by increasing the impedence of a coil connected in parallel with the ringing equipment.

The discussion following the talk was interesting, as it brought out a number of valuable suggestions: Mr. W. F. Gradolph drew attention to the difficulties he encountered in maintaining the plus and minus system in working condition in actual practice, while Mr. M. W. Zabel discussed the developments of the high and low frequency equipment. Mr. C. Roth made a brief reference to the construction of the high and low frequency selective signaling machinery, Mr. Roth's company having supplied the very complete machine used by the speaker for demonstration purposes. Mr. Carl Kinsley, of the University of Chicago, described the application of resonance effects, and called attention to the fact that in the case of long lines, a change in current caused by a change in frequency is not rapid enough to make it possible to operate more than two selective ringing devises on the same line. This system can be used practically only in the case of very long and expensive lines, as the expense at each station is so largely increased.

Mr. Christ, of the Stromberg-Carlson Company, and Mr. Ames, of the Kellogg Switchboard and Supply Company, were called upon to give the Association some information in respect to selective signaling systems, which are being prepared by their respective companies, but begged to be excused, stating that patent papers being prepared by the companies were not in such condition as to permit publishing anything at this time.

Financing the Yerkes London Underground.

At the close of last week the banking firm of Speyer & Co. announced that they had formed a syndicate to float here half of the $30,000,000 loan required to build the Yerkes-Speyer London rapid transit tube. This loan will be in the shape of ten-year 5 per cent. gold notes issued by the Underground Electric Railways Company, of London, Limited. The Old Colony Trust Company, of Boston, is also in the syndicate. The London end of the deal will be managed by Speyer Brothers & Co.

The capital will be £5,000,000 ($25,000,000), of which 50 per cent. has been paid in, the remaining 50 per cent. being subject to call. The articles of association provide that for a period of ten years the majority of the Board of Directors shall be named by Speyer Brothers, of London; Speyer & Co., of New York, and the Old Colony Trust Company, of Boston. The first board of directors will consists of the following: James Speyer, T. J. Coolidge, Jr., James A. Blair, James H. Hyde, L. F. Loree, Robert H. McCurdy, Charles A. Spofford, the Right Hon. Lord Farrer, Major Ernest St. Clair Pemberton, Walter Abbott, Frank Dawes, Charles J. C. Scott, Edgar Speyer, Henry Teixeira de Mattos. Charles T. Yerkes will be chairman of the board.

The policy of the company probably will be to control different companies through traffic agreements and ownership of securities, or both, the bulk of the actual capital to defray the cost of construction of each of the roads being obtained through the sale of guaranteed securities of the subsidiary companies, the interest or dividends being guaranteed by the parent company.

The capital of the parent company is necessary to finance the subsidiary companies until their respective securities have been marketed, and to give the proper stability to the parent company in order to make it a satisfactory guarantor company. The surplus earnings, over and above the guaranteed interest and dividends, on the sub-company securities will constitute the chief source of income of the parent company. Another source of income will be in the ownership of ordinary shares obtained through the profit of construction of sub-companies.

The new company now controls the Metropolitan District Railway, which is a shallow subway and surface road, owning its right of way in fee. In addition the new company is building three deep level tube roads, namely the Baker Street and Waterloo, Great Northern, Piccadilly and Brompton, and the Charing Cross, Euston & Hampstead. It also controls the United Tramways Company, with many miles of surface roads running in a general westerly direction from around Shepherd's Bush and Hammersmith.

Of the Metropolitan District Railway over one-half of the ordinary stock will be, on the completion of the work under way, owned by the parent company, and the voting power of a large amount of the preference stock has been secured under a guarantee The guarantee begins at 1 per cent per annum the first year on the deposited stock, and runs up to a limit of 3½ per cent after some six years Surplus earnings above the guaranteed amount go to the parent company This railway is now being electrically equipped It is expected that this work can be finished before the end of 1904

In this connection, it is interesting to note that the electrification of the London transit systems, which promises to absorb a great quantity of money, had a very important condition imposed last week by the Parliamentary committee which is empowered to grant the franchise This committee has rejected the application for a franchise of the Northeast London Railway, which proposed to serve 2,000,000 people and was supported by the trunk lines which traverse that district The rejection was because the backers of the company had not the financial strength to guarantee to the committee that they would carry the scheme through, commencing the building of the road at once and continuing the work uninterruptedly until its completion The committee added that in all future London traction schemes it must have evidence of full financial guarantee before engineering and local questions will be considered

A cable dispatch from London of May 4 says: The Yerkes-Speyer scheme for the consolidation of all the underground tube railways of London is meeting with considerable opposition. The newspapers protest against such "Americanism" and monopoly, and urge Parliament not to submit thereto. The Parliamentary committee of the London County Council will submit its report to the council to-morrow. This report will insist upon a further investigation of the consolidation scheme, which, the committee contends, will raise fares and otherwise operate to the disadvantage of the traveling public.

New Telephone Patents.

Probably few telephone men have considered the difficulties of maintaining telephones of the ordinary design in a state of high efficiency, where continually subjected to a corrosive atmosphere. The salt air and spray found on shipboard forms such a corrosive atmosphere, and one which will soon rust ordinary instruments into a state of comparative uselessness. Mr. F. A. Wood, of Newport News, Va., has endeavored to overcome this difficulty by a special design of instrument which he has described in two patents of the issue of April 28. Mr. Wood's apparatus seems to be fully and carefully worked out and to provide not only against corrosion, but also, through the provision of a double ear tube, to render of little effect extraneous noises liable to disturb the listener.

This apparatus has been worked out in two forms. These are alike in principle and one of them is shown in section in Fig. 1. As will be readily observed, both the transmitter and receiver are contained wholly within a protecting case. This case is cylindrical in form and has an opening in one side, which has the shape of the outer portion of a transmitter mouthpiece. A tubular shaft extends through the center of the cylinder to which not only the double ear tubes are attached, but also both receiver and transmitter. In the normal or disused position, the ear tubes extend downward from the shaft, and being of semi-flexible construction, are made to clamp the supporting frame in a manner to be completely closed by it. This closing of the tubes is rendered very positive, as the rims of the ear pieces consist of rings of soft rubber.

With the instrument in this condition, the mouthpiece opening is also closed, this not only by a manually operated lid, but also by a plate of metal shaped to conform to the enclosing cylinder and held over the opening by the position of the hollow shaft to which it is secured. It will also be noted that the receiver and transmitter revolve with the hollow shaft, being integrally connected with it.

Now, when it is desired to use the instrument, the ear tubes are swung into a position somewhat higher than the horizontal, which motion carries the sliding spring contact pins, shown in the casting beneath the receivers, into the position indicated by the dotted lines, where they not only perform the usual contact functions of the hook switch of ordinary practice, but in addition drop into depressions indicating thereby that contact has been accomplished. At this time the transmitter has also been revolved into the position indicated by the dotted lines, its mouthpiece registering with that of the casing. As the ear tubes are semi-flexible, it is easy to adjust them upon the head to cover both ears and, as before mentioned, exclude extraneous sounds. A further feature of the apparatus is the proportioning of the parts such that as soon as the ear tubes are released, they will return to the normal position by their own weight This not only seals the instrument automatically, but revolves the sliding contacts away from their contact plates and opens the telephone circuits.

A third telephone patent of the April 28 issue describes a transmitter which is designed to have extraordinary sensitiveness, and in which novel means are employed to prevent packing of the carbon granular filling This transmitter is shown in section in Fig 2 The diaphragm is of carbon and is supported upon a pad consisting of superimposed perforated discs of flannel. These form the button casing, at the rear of which a back electrode is mounted shaped as indicated in the figure, and carrying at the flared end of the cone a cross-bar. This cross-bar is normally in a horizontal plane, and its rear edge is cut away at the middle. Now, when the diaphragm is under vibration, its inward motion tends to force granules up toward the apex of the cone and over the cross-bar, while at the outward motion of the diaphragm the increasing space is largely filled with granules from above. This results in a circulation of the granules. It cannot be stated just how effective such a circulating device will be in practice. The long-distance transmitter of the Bell Company, which had a device of very similar principle, has long since been superseded by a transmitter without any obstructions in the carbon chamber. The present transmitter is the invention of F. W. Senkbeil, of Germany.

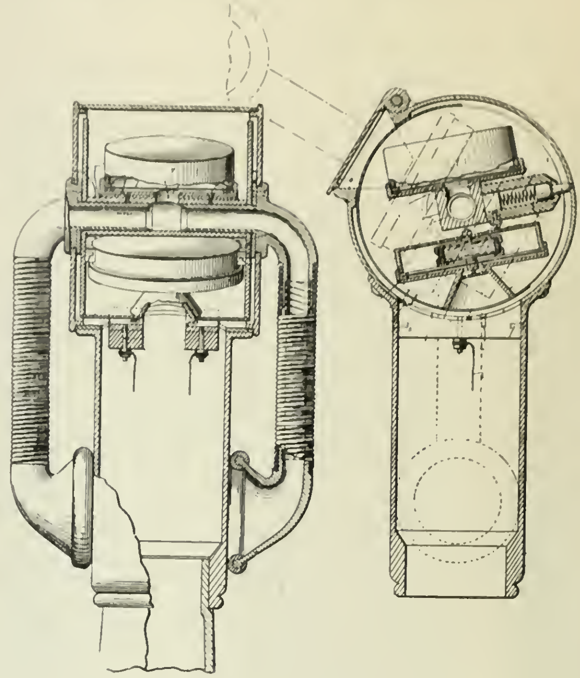


FIG. 1.—WOOD TELEPHONE.

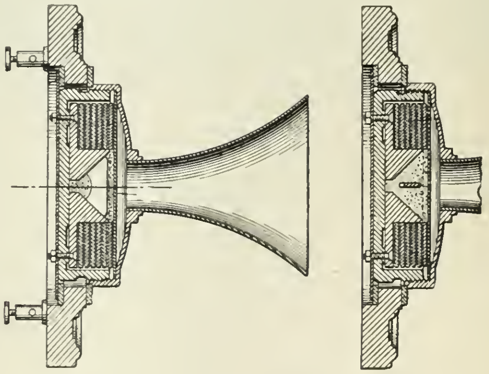


FIG. 2.—SENKBEIL TRANSMITTER.

Statistics of American Street Railways.

We present herewith the statistics of the street railways of the United States, in a preliminary report given to the press on May 4 by Mr. W. M. Steuart, chief statistician of the Division of Manufactures, U. S. Census office, to Director W. M. Merriam. The figures are for the year ending June 30, 1902, and are the first results of the inquiry which has been conducted under Mr. Steuart, with Mr. T. C. Martin and Prof. E. Dana Durand, as experts and special agents in charge of the work. The report, when finished, will be a most elaborate and careful compilation, with running comment of the figures of the street railway industry. It may be noted that the mileage does not include a considerable quantity that was under construction during the year covered by the report. The agents were instructed to secure reports from railway plants that were in process of construction, but a number of plants had only just commenced work. Others had constructed one or two miles of track. In cases where the work had only started, of course, no return could be obtained. Hence the schedules as to track under construction or contemplated are not summarized.

Street and Electric Railways.

Number of companies	967
Length of line (first main track) miles	16,647.83
Length of single track, miles	*22,589.47
Total number of cars	67,199
Passenger	60,200
All other	6,909
Steam engines:	
Number	2,337
Total horse power	1,293,133
Dynamos for generating power:	
Number	3,257
Horse power	1,200,138
Number of fare passengers carried	4,813,466,001
Number of transfer passengers carried	1,062,403,392
Total mileage	1,097,806,884
Accidents:	
Persons killed	1,216
Persons injured	47,428

* Includes 12.48 miles of duplicated track and 4.20 miles lying outside of the United States, but does not include track under construction and not operated.

Condensed Income Account, Operating Companies.

Earnings from operation	$241,584,697
Operating expenses	139,012,004
Net earnings	102,572,693
Income from other sources	2,907,156
Gross income less operating expenses	105,479,849
Deductions from income, taxes, interest, rental, mis.	74,524,616
Net income	30,955,233
Dividends	15,908,216
Surplus	15,047,017
Percentage of operating expenses to earnings	57.54

Balance Sheet, All Companies.

Assets:	
Total	$2,428,317,117
Cost of construction and equipment	2,088,965,677
Other permanent investments	128,458,625
Cash on band	27,342,313
Bills receivable	22,247,704
Supplies	10,340,448
Sundries	150,964,350
Liabilities:	
Total	$2,428,317,117
Capital stock	1,216,277,989
Funded debt	929,328,656
Bills and accounts payable	94,858,371
Interest due	13,748,010
Dividends due	2,342,827
Sundries	130,589,472
Profit and loss	41,171,792

Average Number of Employees and Salaries and Wages.

Salaried officials	2,749
Salaries	$4,625,015
Clerks	4,301
Salaries	$2,575,936
All other employees	131,133
Wages	$77,437,324

The final report will contain an analysis of the above totals and present detailed statistics for other phases of the industry. While the statistics reported at the census of 1890 are not comparable in all respects with those for 1902, the totals indicate that, during the twelve years, the length of line has increased from 5,783.47 miles to 16,647.83 miles, or 187.85 per cent.; the length of single track miles from 8,123.02 to 22,589.47, or 178.09 per cent; the number of passenger cars from 32,505 to 60,290, or 85.48 per cent.; the number of fare passengers carried from 2,023,010,202 to 4,813,466,001, or 137.94 per cent. The miles of single track operated by electric power increased from 1,261.97 to 21,920.07, or 1,636.97 per cent.; the miles operated by animal power decreased from 5,661.44 to 259.10, or 95.42 per cent.; the miles operated by cable from 488,51 to 240.69, or 50.71 per cent.; and the miles operated by steam from 711.30 to 169.61, or 76.15 per cent.

The statistics for equipment, exclusive of length of track and number of cars, do not include two companies with 41.00 miles of single track, who failed to make reports of any character. The financial statistics do not include nineteen companies with 739.79 miles of single track, who failed to answer the inquiries concerning financial operations.

Stealing Electricity in Mexico City.

A Mexico City hotelkeeper has just been convicted by a local judge for stealing from the electric light company the current with which his hostelry was lighted. He was condemned to a year's imprisonment and a fine of $33.70, and as an additional penalty was "disqualified for all kinds of public honors and employments." The landlord who attempted to evade the electric company's charges wired his house and made a connection with the company's cables, with the intention, as he pleaded, of calling at the office of the company and explaining the matter at a later day. He also declared that he had used the current for "only a month." The company had its suspicions aroused, and applied to the court for authority to make an examination of the hotel lighting system, which was granted, with the result of revealing the fraud. The legal point of interest involved in the case hinged upon the definition of the word "robbery," which the district code thus elucidates: "He commits robbery who possesses himself of a moveable thing belonging to another, without right and without the consent of the person entitled by law to dispose of it." The judge's ruling was as follows:

"By things or properties (for in legal phraseology these two words are synonymous) are understood all the objects that constitute the patrimony of man; and if it is plain that electricity, whether it be called a fluid, a current, an energy or any other name, at present forms a part of human wealth; that, thanks to the prodigious progress of the times and to his own activity, man has succeeded in harnessing it and using it as a commercial article; it is unquestionable that the electric current forms part of men's commerce, and is, therefore, capable of being appropriated; and as it is also unquestionable that this fluid can be transmitted and transported from one place to another; whatever the means employed to that end, it must also be regarded as a moveable thing; and, therefore, there will assuredly be no difficulty in allowing that the clandestine tapping of the fluid constitutes the crime of robbery as it fits exactly the terms of the legal text which comprises and defines it."

In view of the summary punishment inflicted in this, the first case of the kind which has come before the courts of Mexico, it is believed that the "thing" dealt in by the electric light companies, the illuminating current, to wit, will hereafter be carefully avoided by individuals who desire to economize at the expense of others.

Electrifying the Swiss Railways.

The railway system of Switzerland is likely to undergo a mighty transformation. At a convention of representatives of Swiss railway lines and the prominent technical experts of the state, lately held at Berne, the introduction of electric traction formed the object of deliberation. A special committee was appointed to investigate the subject in all its details and to report thereon next year and make proposals for adopting the most practical mode of applying electricity as the motive power for Swiss railroads. Ample funds have been supplied to the committee to enable them to make ample tests and to carry out the purposes for which it has been created. The director-general of the Swiss railroads (which belong to the State) was appointed chairman, and the manager of a prominent Swiss electrical company, vice-chairman of said special committee. Switzerland has no coal, but is rich in water power. This transformation would save the little republic many millions of money which it now pays every year to Germany for coal imported from there.

Programme of Papers for the N. E. L. A. Convention.

An excellent list of papers and topics has been prepared for the meeting at Chicago this month of the National Electric Light Association, and there is every evidence that an unusually large attendance will reward the officers and authors. The programme of papers is as follows:

"Fuel Losses in Furnaces and Boilers, and How to Lessen Them," Mr. A. Bement; "Salt as a By-Product," Mr. Alex Dow; "Advantages Derived from the Use of One System of Generation and Transmission in One Locality," Mr. C. L. Edgar; "Tactful Relations with Customers," Mr. J. W. Ferguson; "Relative Advantages of Electrical and Mechanical Methods at Variable Speeds for General Power Service," Mr. William Cooper; "First Aid Appliances," Mr. J. D. McGowan; "Standard Ratios for Transformers," Mr. John S. Peck; "Steam Turbines," Prof. William Lispenard Robb; "The Application of Four Ampere Series Arc Lamps for Street Lighting," Mr. J. Henry Hallberg; "Some Fundamentals of Photometry," Prof. H. F. Clifford; "Exhibition and Description of the Matthews Integrating Photometer," Prof. Charles P. Matthews; "Attitude of Employer towards Benevolent Insurance and Educational Associations among Employees," Mr. Arthur Williams; "District Heating," Mr. John W. Glidden; "The Young Engineer and the Electric Lighting Plant," Mr. Charles F. Scott; Prof. Elihu Thomson.

The Committee reports to be presented are as follows: 1. Report of Editor of Progress, Mr. T. C. Martin. 2. Decorative and Sign Lighting, Mr. Arthur Williams. 3. Unaccounted for Current, Mr. I. G. Van Ness. 4. Theft of Current, Mr. R. L. Elliott. 5. Office Methods and Accounting, Mr. W. M. Anthony. 6. Photometric Committee, Mr. H. L. Doherty. 7. Committee on Analysis of Flue Gases, Mr. H. L. Doherty. The editor of Question Box, Mr. H. T. Hartman, who will present a large amount of valuable material for consideration.

CURRENT NEWS AND NOTES.

FORTY SECONDS is the time in which the Commercial Pacific Cable Company proposes to put a message around the world on July 4.

PACIFIC WIRELESS TELEGRAPHY.—The Pacific Cable Board is reported to be conducting negotiations for a series of wireless telegraph experiments between here and the Fanning Island cable station. Fanning Island is a station on the British Pacific cable from Vancouver to Australia.

TRACTION MUNICIPAL OWNERSHIP.—The Mueller traction bill, authorizing municipal ownership of railways, has passed the Illinois House of Representatives. This bill has been fought by the great traction interests of Chicago because it would confer authority on the city to take over various street railways when their franchises expire.

AN ELECTRIC SPRINKLER.—A cable dispatch from Paris of May 2 says: A leading engineer of Paris has invented an electric sprinkler which will water ten miles of streets an hour. It will be an automobile and will be able to water the Champs Elysees and the Avenue due Bois de Boulogne in fifteen minutes. The machine only costs $3,000. If it proves successful the city will ordere a large number.

IN AID OF ELECTRICITY.—A cable dispatch from Paris of May 2 says: The Institute of France has decided to divide the Lebrousse prize of $10,000 into four parts, one part to go toward the maintenance of the *Journal des Savants*, the second to the publishing of the memoirs of Richelieu and his agents, the third to the publishing of the works of Leibnitz, and the fourth to experimenting in electricity.

WESTERN UNION AND PENNSYLVANIA RAILROAD.—The Western Union Telegraph Company has filed a suit in the United States Court at Baltimore asking that the Philadelphia & Washington Railroad Company, a branch of the Pennsylvania Railroad, be enjoined from destroying the telegraph company's lines. The railroad company requested the Western Union to remove its wires and poles from the line of the road by May 15. This the latter refuses to do, and has asked for an injunction to prevent any forcible action on the part of the railroad company.

AMERICAN INSTITUTE ANNUAL MEETING.—The annual meeting of the American Institute of Electrical Engineers will be held on May 19, when the following is the programme: 1. Annual Reports of Officers and Committees. 2. Introduction, President Scott. 3. "The Experimental Basis for the Theory of the Regulation of Alternators," by B. A. Behrend, member, chief engineer Bullock Electric Manufacturing Company. 4. "The Heyland Motor," by C. A. Adams, Jr., associate, assistant professor of electrical engineering at Harvard University. Some very important announcements are also expected. The meeting will be preceded by the usual informal dinner at Mouquin's.

LIEBIG CENTENNIAL.—The twelfth of May, 1903, being the centennial of Justus Liebig's birthday, a committee has arranged a celebration in memory of the illustrious investigator on that day, to which the members of the American Chemical Society, the Society of Chemical Industry, the American Electrochemical Society, and the Chemists' Club, are cordially invited. Prof. Ira Remsen, president of Johns Hopkins University, and Prof. William H. Brewer, of Yale University, will deliver orations. Dr. C. Duisberg, vice-president of the parent society, Verein Deutscher Chemiker, and Prof. Charles F. Chandler, of Columbia University, will also address the meeting. The exercises will begin promptly at 8:30 P. M. in the assembly hall of the Chemists' Club, 108 West Fifty fifth Street, New York.

STUDENTS' THESES.—The board of directors of the American Institute of Electrical Engineers has requested that the head of the electrical engineering department in each of the universities and technical schools in which local Institute meetings have been held during each year, be requested to select from the theses of each year's graduating class, the one which in his judgment is of superior merit and is a valuable contribution to electrical engineering work. Such theses will be submitted to an Institute Committee on Theses, which will select those of superior excellence, and designate to the board of directors which in its judgment are worthy to be printed in full or in abstract in the *Transactions* of the Institute. The theses to be presented to the Institute should reach the secretary not later than July 15th of each year.

SCIENCE AND RELIGION.—Lord Kelvin, in moving a vote of thanks to Prof. Henslow before the University College Christian Association in London last week, according to a dispatch printed in a New York newspaper, demurred to the professor's assertion that, with regard to the origin of life, science neither affirmed nor denied the creative power. On the contrary, he said, science positively affirmed the creative power. Science made every one feel that he was a miracle in himself. Modern biologists were once more coming to the firm acceptance of a vital principle. They had been absolutely forced by science to admit and believe in a directive power. "Was there," he asked, "anything so absurd as to believe that a number of atoms falling together of their own accord could make a crystal sprig of moss, the microbe of a living animal? Nobody could think that anything like that even in millions and millions of years could, unaided, give us a beautiful world like ours. Let nobody be afraid of true freedom of thought. Let us be free in thought and criticism, but with freedom we are bound to come to the conclusion that science is not antagonistic, but is a help, to religion."

WATER SUPPLY OF MILAN.—The water supply of Milan, Italy, like that of many American cities, is now being assisted by electric motors. In 1896 it was again found necessary to increase the production, and the pumps, which were then operating in Via Parini for supplying the fountain service in the public gardens, were connected with street mains for the supply of the houses in the vicinity. In 1901, being found unserviceable from long use, the pumps were replaced by a centrifugal of the Sulzer type, driven by an electric motor. A new well, also, was sunk to a depth of 197 ft. It produces 17 gallons of water per second, and is provided with a sand filter. The numerous demands for both public and private service caused a new plant to be decided on, and in 1899 it was finished. It consists of two pairs of double-action pumps of the Riedler type, each group being driven by a 75-hp electric motor, and produces 55 gallons of water per second. In 1900 four other Sulzer pumps, with electric motors, were placed at the Rondó di Loreto, on the outskirts of the city. This plant also furnishes 55 gallons per second from its eight wells.

NEW YORK-BOSTON TROLLEY.—The Connecticut House of Representatives has passed an important resolution incorporating the Wallingford Tramway Company. The charter provides for the building of the final link of a continuous trolley line between New York and Boston. The company is authorized to build from the terminus of the Meriden Electric Company's lines in Wallingford South, through North Haven to Montowese, where connections are made with the Fair Haven & Westville Railroad Company's system. The company is capitalized at $500,000. The charter carries power to make traffic agreements with connecting railroads, and it also gives almost unlimited authority of merger with gas, electric light, railway or power companies. The incorporators are Walter J. Leavenworth, Frank A. Wallace, George E. Dickerman, Charles B. Yale and Ralph T. Ives, all of Wallingford. The Senate, in concurrence with the House, has passed a resolution increasing the capital stock of the Windsor Locks and Rainbow Street Railway Company. The construction of this line will complete a through trolley road between Hartford and Springfield on the west side of the Connecticut River.

A MUNICIPAL OBJECT LESSON.—In 1899 the electrical experts in the employ of the London County Council showed that the cost of constructing and equipping an electric line between Westminster and Tooting and from Blackfriars to Kennington would be about £255,000, or £15,000 per mile. Fourteen months later, when the appropriation was applied for, the estimates had been advanced to £623,500; but now that it is completed the system is found to have cost nearly £1,000,000. Up to the present time the cost of transforming the lines controlled by the County Council has been about four times as much as the official estimate and about three times as much per mile as like work on other systems in Great Britain has averaged. The estimates of profits to result to the community from the change were based on the assumption that gross earnings would be 10½d. to 1s. per train-mile, and operating expenses 6d. On this basis it was figured that after paying interest and providing for additions to the sinking fund the electrified system would show a net gain of £53,618 in earnings over operation with horses. Lord Welby, chairman of the Finance Committee of the County Council, has now stated officially that there is an extremely good prospect in the near future of the Southern tramways becoming a charge upon the rates.

FIRES IN RAILWAY CARS AND BARNS.—Mr. William T. Bennallack, electrical inspector of the Michigan Fire Underwriters' Inspection Bureau, in a paper on the fire hazard in electric railway car houses, states that of 19 fires he has investigated, 7 were due to defective wiring, 3 to broken trolley wires, 1 was not electrical, and 7 were of unknown origin. Of the origin of 61 fires in cars, 25 were due to controllers and heaters, 13 to wiring, 4 to miscellaneous electrical causes, 1 was not electrical, and 7 were of unknown origin. He states that statistics clearly indicate that the greater part of the hazard exists in the cars, where 75 per cent. of the fires listed have started and the electrical equipment is responsible for more fires than all the other causes combined, 65 per cent. having originated from electrical sources. In the wiring in cars, car houses and repair shops, he finds that with few exceptions the 500-volt grounded street railway current is installed mechanically and electrically far below the standard found to exist in ordinary commercial wiring where the usual voltage is 125. In recently visiting the works of some of the representative car builders where he inspected the latest types of cars, he found the lighting and motor wires run in grooves in the framework, fastened in place with nails and metal staples, in contact with electric bell wiring of interior insulation, and with no insulating tubes of any kind through the woodwork, floors or vestibules of the cars. The general conditions, in fact, indicated an absolute disregard of the fire hazard.

METER PATENTS.—The Patent Office issue of April 21 contains three patents on wattmeters, two of which were issued to Prof. Elihu Thomson and F. P. Cox, and the third to Frank Holden, of London, England. The first-mentioned patents are on an adaptation of the Thomson wattmeter whereby a meter may be made to register at a rate varying from hour to hour, dependent upon the load upon the central station and in more or less direct proportion thereto. It consists in general of the ordinary recording wattmeter to which is connected a variable resistance; over the contacts of the resistance a switch arm is moved by a cam driven by clockwork mechanism, so that at the time when the least load comes upon the station the greatest resistance will be in circuit with the meter, which resistance will be decreased as the load comes on and decreased as it falls off. By varying the shape of the cam, this change may be made anything desired. In a lighting system where the peak of the load appears from 5 to 8 o'clock in the evening, the shape of the cam would be such as to cut out the resistance quite gradually, or if the load falls off more rapidly the shape can be adapted to compensating for this. The Holden patent relates to means whereby a meter will register not only the total consumption of energy, but also indicate separately the energy consumed above a predetermined rate. There are two registering trains, one of which is constantly in gear with the armature of the meter and another which is provided with means for automatically setting it in operation when the rate of consumption rises above the predetermined rate. This is done by a magnetic arrangement dependent for its action upon the field of the meter coils.

NEUTRAL WIRE BALANCER.—In a patent issued April 21 to Norman Rowe on an application filed June 18, 1897, a system of electrical distribution is described whereby a three-wire system may be locally derived from a two-wire general distributing system. Two motors are employed having their armatures on the same shaft, each of the motors being provided with a shunt and a series field winding. The third or neutral conductor is connected at one end to the armature of one of the motors and to the outer terminal of the series field winding of the other motor. When the loads are equally balanced, the two motors will run as differential motors and provide mechanical power. If, however, the load is decreased upon one side or increased upon the other, the machine connected across the more lightly loaded side will continue to run as a differential motor, while the other motor will run as a generator for the reason that the series coil of the latter is so connected as to cause the machine to over compound. The series coil of the machine running as a motor is so connected as to cause that machine to increase in speed under the increase in load. Consequently, by properly proportioning the series turns an approximately perfect balance of the voltage of the two sides may be obtained. It is stated that in practice the proportion of unbalancing which can be taken care of by such an arrangement, is equal to the combined rating of the two machines when used entirely to regulate their voltage, or to their combined rating less the power delivered to an outside system when the machines run partly as motors and partly for balancing purposes. It has also been found that this rating will maintain the voltages on both sides of the three-wire systems substantially equal when two motors are used partially for driving other machinery and partially for unbalancing purposes, no adjustment being necessary between the condition of no load and that of 50 per cent. overload.

LETTER TO THE EDITORS.

Hungarian Telegraphs and Telephones.

To the Editors of Electrical World and Engineer:

Sirs:—The book review appearing in your issue of January 31, 1903, on "Improvements in Hungarian Telegraph and Telephone Installations," contains several inaccuracies which I trust you will permit me to correct. This may perhaps be best done by the following statement as to the present service.

At present only the telegraph service is operated by dynamo currents, and the results during a period of two years of operation have been excellent. The current for 500 telegraph lines is supplied by a 2½-kw converter, but two others of the same size are held in reserve. These converters are supplied from the city alternating-current mains, but provision is made for utilizing direct current from the city mains should the alternating current supply be interrupted. To this end there is a 6-hp, direct-current motor, which may be connected to any one of the three rotaries. Finally, should the direct-current supply fail, a 6-hp gasoline engine is provided to replace the direct-current motor.

As generators there are thus three converters of 2.5 hp each, which may operate (1) as converters with alternating current, (2) of dynamos with direct current, (c) of dynamos driven by a gasoline engine. It is doubtful if there is any similar telegraphic plant so well equipped with respect both to generators and motive power to meet any emergency that may arise.

As to reliability of service, I may say that during the period of two years' operation of the plant no trouble has arisen and it has not been necessary to resort either to the direct current motor or gasoline engine.

With respect to the invested capital, the installation which at present is only utilized to half its capacity, did not exceed in cost the cost of the Meidinger batteries displaced. The installation, indeed, has exceeded our most sanguine expectations with respect both to convenience and economy.

I may finally add that duplex and simultaneous working have fully stood the test, and owing to the satisfactory results obtained in operation other similar installations will be made.

Budapest, Hungary. P. De Szalay,

Director General of Hungarian Posts and Telegraphs.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Large Three Phase Alternator.—An illustrated description of a 6,000 hp alternator of 75 revolutions built by a German firm for the Manchester tramways. The outside diameter is 32 ft. 10 in.; the stator weighs 60 tons; the frequency is 100 periods per second. The method of erecting the alternator is described.—*Lond. Eng'ing*, April 17.

REFERENCES.

Dynamos and Motors with Vertical Axle.—An illustrated description of dynamos and motors with a vertical axle, built by a French company for turbine connection in certain hydroelectric stations.—*L'Ind. Elec.*, April 10.

Gramme Ring.—K. R. Johnson.—A brief but highly mathematical article on oscillations produced in a Gramme ring.—*Phys. Zeit.*, April 1.

Lights and Lighting.

Low-Voltage Carbon Incandescent Lamps.—Weissmann.—An article in which he claims that it is by no means necessary to give up the carbon filaments hitherto used in order to obtain a higher efficiency, but that the same result may be obtained by using low-voltage lamps. With 220 or 110 volts it is necessary to use extremely thin and long filaments for the usual candle-powers. In practice abrupt changes of temperature occur, owing to sudden variations of the voltage, and these thin filaments are especially sensitive to such variations. The higher the surface temperature of the filaments, the greater will be the danger of particles being projected, this danger being the only practical limit of the intensity of incandescents. The quantity of light, however, depends only upon the mean temperature; for a thin filament the mean and the surface temperature are practically identical, whereas in thick filaments the internal temperature will be much higher, the higher the thicker the filament. The external temperature, and, therefore, the danger of destruction thus being the same, the thicker filament has a higher efficiency, its internal temperature being higher. This is the explanation of the author, who also points out that this agrees with experiments of Elihu Thomson and Weber. The economizing system designed by the author and Blondel, consists in diminishing in a suitable way the voltage of the supply current at the point of consumption, and using lamps with thick carbon filaments. For example, a 100-volt, 100-candle filament may be divided up into five 22-volt, 20-candle filaments. The transformation is secured by inserting a very small transformer between the supply mains and each group of lamps lighted simultaneously. An interrupter is placed in the primary circuit of the transformer, so that the latter, acting automatically with the corresponding group of lamps, will never work without load. It is said that in Paris several thousands of these lamps have already been installed, showing a saving as high as 40 or 60 per cent., as compared with high-voltage lamps.—*Jour. de Phys.*; Lond. *Elec. Rev.*, April 17.

Theatre Lighting.—A description of the electric lighting installation of the Chelsea Palace of Varieties in London. Electric light is used throughout, the current being supplied by two companies, one furnishing 100 volt, alternating-current, the other 200 direct-current. All lights throughout the whole of the auditorium and stage are so arranged that approximately one-half are in one company's mains and the remaining half on the mains of the other company. Liquid resistances are used for the dimmer, the cones being lifted by an arrangement of pulleys and "tracker wires" fixed on polished steel shafting and worked from the front of the switchboard by means of engine turned iron wheels, with suitable locking gear for operating any dimmer, independently or working the whole line simultaneously by means of the master lever. On the stage there is an equivalent of 1,600 incandescent lamps of 8 cp, in addition to four projectors and a cinematograph requiring 60 amp. The auditorium and shelter lighting consists of an equivalent of 1,000 incandescent lamps of 8 cp. and 8 arc lamps of 10 amp on the front.—Lond. *Elec.*, April 17.

REFERENCES.

Lighthouse.—Krell.—A long and detailed illustrated description of the new electric searchlight installation on the island of Heligoland in Germany. Three searchlights are mounted on a revolving platform symmetrically under angles of 120°, parabolic silver-plated glass reflectors being used; the platform makes four revolutions per minute.—*Elek. Zeit.*, April 16.

Street Lighting.—Some details, from reports of Bradley, of the street lighting system of the City of Westminster. Electric arc lamps were introduced some years ago, but experiments were also made with incandescent gas burners. Some comparative tables of cost are given.—Lond. *Elec.*, April 17.

Train Lighting.—Jacquin.—A long article, illustrated by diagrams, on the electric train lighting systems in use on the Prussian railways.—*L'Eclairage. Elec.*, April 18.

Power.

Power Transmission by Gas.—Burstall.—An abstract of a paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. and of the extended discussion which followed, on power transmission by gas. He thinks a great advantage of this system would be a better load factor. The efficiency of a gas transmission scheme which had been worked out for a distance of 80 miles came out at 90 per cent., taking the mechanical efficiency of the compressor at 80 per cent. The producer station should be placed as near the coal supply as possible. The gas would be distributed at pressures suitable for the distance to which it is to be transmitted, the tabulated result being that, at the moderate velocity of 30 ft. per second, a transmission distance of 80 miles could be obtained with a pressure of 44 lbs. per sq. in., and an efficiency of 90 per cent. The gas would be led to sub-stations and the mains would distribute it to customers at a low pressure. At these stations there would be placed large gas engines for the production of two or three-phase currents at a pressure of 5,000 to 15,000 volts, according to the size of the locality covered. The current required for lighting and traction would be obtained through converters at suitable places.—Lond. *Elec. Rev.*, April 17.

Small Water Powers with High Heads.—Reid.—An illustrated article on the development of such water powers for electric lighting. After calling attention to the fact that the power of small streams with high heads can, by means of storage of water, be multiplied many times whenever the maximum power is required for only a few hours out of the 24, he shows that the cost of developing and utilizing such powers will be low by reason of the small amount of water to be handled and because the water of such streams and the small amount of land required are generally valueless for any other purpose. Such plants are generally reliable in operation, safe and clean and do not require highly skilled attendance. The cost of light thus produced will usually be much higher than by the use of oil lamps, but this will be largely offset by the attendant advantages. But due attention should be given to the question whether the flow of the stream is regular.—*Cassier's Mag.*

TRACTION.

REFERENCES.

Three-Phase Traction.—Korda.—A very long illustrated paper read before the International Society of Electricians in Paris, on the Ganz system of high-tension, three-phase traction on the Valtellina line.—*Bull. Soc. Inst. Elec.*, March.

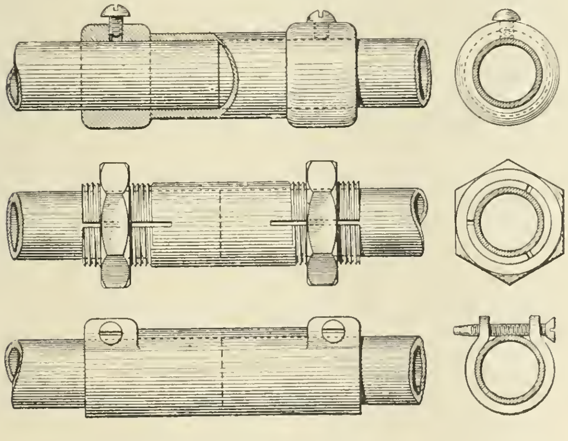
Accumulator Traction.—Bignami.—A well-illustrated description of the use of storage batteries on the trains of the Bologna-San Felice and Bologna-Modena Railways, which have been noticed before in the Digest.—*L'Eclairage Elec.*, April 4.

Multiple-Unit System.—De Fraz.—An extremely long illustrated description of the Sprague multiple-unit system.—*Bull. Soc. Int. Elec.*, March.

Railway Signals.—Harvey.—An illustrated article on signalling in single-line tramways, giving a brief review of hand-operated and automatic signal systems, the latter being again divided into two classes, namely those using the main trolley wire current to actuate them and requiring no additional signal wires, and those whose mechanism is operated by a shunt current, requiring two signal wires to be run the whole length of the section to be protected.—Lond. *Elec. Rev.*, April 17.

WIRES, WIRING AND CONDUITS.

Couplings for Unscrewed Conduits.—Munro.—An article in which he calls attention to the fact that the ordinary method of using slip couplings on a light gauge steel tube, is undoubtedly the cause of a large proportion of the accidents to lighting installations. On the other hand, unscrewed conduit systems have advantages over the screwed variety in several respects. He describes a method of making a junction between enameled tubes, which "makes a good job, but takes time," and afterwards describes three cheap and easy methods of joining enameled tubes, all three being said to be quite sound both electrically and mechanically. They are illustrated in the accompanying figures. In the first, the enamel is cut through by small, stout steel pinching screws with chisel or cone points, which also slightly distort the tube and force its cleaned outside surface hard against the cleaned interior of the coupling. In the second pattern the screw on either the coupling or the nuts is made on a slight taper, and the coupling is split along its whole length, or partially split in several places as shown. The action of screwing on the nuts compresses the cleaned surfaces into very close contact. In the third method two tengential steel pins are used which screw into small tapped lugs on the coupling. The action of "screwing them home" scrapes off the enamel and bites into the metal of the conduit, at the same time forcing the tube into compressive contact with the coupling. Any of these methods for insuring a strong and a continuous joint are said to be equally applicable to the bends and boxes of a complete system. Lond. *Elec.*, April 17.



CONDUIT COUPLINGS.

Electric Wiring.—An account of a discussion held before the Glasgow local section of the (Brit.) Inst. Elec. Eng. Chamen pointed out how bad workmanship often caused very serious trouble. One of the most serious troubles is the improper use of metal-sheathed tubing with slip joints. What are called "electric fires" are for the most part really gas fires, though started by electricity. Wood casing is dangerous if not properly dealt with, and in fact where there is any chance of its coming into contact with continuous moisture or dampness of any kind, it should not be used at all. It was pointed out by several speakers that nothing less than screwed tubing should be accepted; in dwelling houses, "compo" gas tubing should not be used. Coates said he had used Simplex tubing with perfect satisfaction, and always took care to insure metallic continuity by bonding with copper as well as having knees, T pieces and couplings screwed, the tubing itself being of course also screwed. Tidd pointed out that there is no danger if there is a thoroughly earthed continuous metallic sheathing all the way from the lampholder down to the company's mains; the whole of the trouble with fires is entirely due to inefficient earthing. Mavor thought there is now general agreement that there ought to be a continuous earthed metallic envelope over the conductors, and that the most satisfactory method of achieving this is the use of a concentric system, with the outer conductor connected to earth. He thinks the present methods of using metallic conduits to be not only dangerous, but unnecessary. Whatever method of wiring is adopted, every precaution should be taken to see that the workmanship is first class. In his reply, Chamen remarked that all now seem to agree that one should insist upon having only solid metal tube systems, where tube systems are adopted, jointed with screwed joints throughout.—Lond. *Elec.*, April 17.

ELECTRO-PHYSICS AND MAGNETISM.

Positive Ions.—Townsend.—A brief and highly mathematical article in which he refers to former investigations on the genesis of ions by the motion of negative ions through a gas, and to a recent extension of the theory, made so as to take into account any possible action of the positive ions. From the experiments which he has made, he has been led to conclude that the positive ions generated in a gas will produce others by collision with the molecules even when the electric force is less than that necessary to produce a discharge. He gives an outline of the method in which the theory has been verified experimentally, but it is of a too highly theoretical nature to be briefly abstracted.—Lond. *Elec.*, April 3.

Charge of Ions.—H. A. Wilson. An account of an experimental investigation of the charge of ions produced in air by Röntgen rays. The method used by him depends on the fact that the ions produced in air by Röntgen rays act as nuclei for the cloudy condensation of water vapor when super saturation exceeding a definite amount is produced by a sudden expansion. The mean value of the charge found by him is 3.1 divided by the 10th power of 10 in electrostatic units, and he concludes that his experiments establish the fact that the value of the charge is between 2 and 4 divided by the 10th power of 10 in those units. (From these figures it follows that one coulomb represents 10 to the 19th power ionic charges.)—*Phil. Mag.*, April.

Alternating Arc.—Guye and Monasch.—A long account of an experimental investigation of the alternating current arc of very small intensity between metallic electrodes. In such an arc three zones may be distinguished: first the unstable zone (long arcs) which is not suitable for quantitative measurements; second, the normal zone, in which the relations between effective e.m.f. and length of the arc is linear; third, the "critical" zone. If either the distance between the electrodes, or the current, is sufficiently diminished, the phenomenon of the critical zone is observed, it is characterized by a series of disruption discharge visible in a revolving mirror and acting on a coherer. This phenomenon is general for all pure metals which were investigated, but it does not take place between carbon electrodes nor between electrodes of commercial iron, nor in the case when one electrode is carbon and the other a metal. The presence of oxygen increases the phenomenon and the extension of the critical zone.—*L'Eclairage Elec.*, February 28, April 4.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrometallurgical Production of Iron and Steel.—Brief illustrated descriptions of the Conley, Harnet, Keller, Kjellin and Stas ous processes. In general it is concluded that the saving of fuel when using the electric furnace does not amount to much, as in the ordinary blast furnace, worked under the best conditions, one ton of iron can now be produced with 1,800 lbs. of coke and 1,400 lbs. of the total represent that required for combining with the oxygen of the ferric oxide in the ore. If the average price of coke is $5.25 per ton, the actual saving effected by using electricity as heating agent is only $2.50 per ton of iron produced, which would have to cover the cost of the electric power, and the briquette making. It is concluded that even when no special crushing of the ore and mixing with the fluxing, reducing and binding materials is required, as a preliminary to the operation of the electric furnace processes, competition with the ordinary blast furnace procedure is improbable. In countries where fuel is very expensive, water power abundant, and the necessary raw materials are found, these processes may have a limited field of usefulness. The blast furnace is the most perfect fuel consuming apparatus in general use, and is estimated to possess a thermal efficiency of over 70 per cent.—*Lond. Eng.*, March 13; reprinted in *Eng. & Min. Jour.*, April 4.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Internal Resistance of a Battery.—OATES.—In all the ordinary methods of measuring the internal resistance of a battery there is an error due to the cell running down, which error is claimed by the author to be reduced to a minimum in the two methods which he describes, and which require no special apparatus, are easily worked and are accurate within 0.1 per cent. or less. In the first he compares the potential difference of the given battery on open and a closed circuit by means of a potentiometer. In Fig. 1, the sum of the resistances, $r_1 + r_1$, is kept constant at say 15,000 ohms; *L* is a source of about 2 Leclanche cells, *S* a small adjustable resistance, *B* the cell to be tested, *r* a resistance, *G* a galvanometer, and *a, b, c,* mercury cups. The resistance, *A D*, is first adjusted, so that on joining *c* to *b* by a short circuit, there is no deflection. Then *a* is joined to *b* and immediately afterwards to *c*, the resistance, *A D*, being adjusted so that while *A C* has the old value, the drop in potential along *A D* is equal to that along *A a*. It is necessary to get the smallest possible deflection in the direction in which *B* alone deflects the galvanometer; then from the two values of the resistance, *A D*, in both cases the internal resistance of *B* can easily be calculated. The shorter the interval between the connection, *a, b*, and the connection, *a, c*, the more accurate the test; he adjusts this interval by making the connections between *a, b* and *c* by three legs of a copper wire of different lengths, so that on dropping the three arms into the cups, the cell is short-circuited automatically just before it is joined to the galvanometer. The second method consists in equating the drop in potential between the terminals of the cell, short-circuited through a small resistance, to a known fraction of the potential difference between the terminals joined through a large resistance; the simplest form of connections is shown in Fig. 2, in which *B* is the cell under test, *S* the small resistance, and $S + r_1 + r_2$ the large resistance. These two potential differences are equated by making an auxiliary (third) potential difference on a potentiometer equal to the first potential difference, and then making the second potential difference equal to the third, as will be seen from the diagram. Results are given of the test of a small storage battery in series with about 3 ohms; both methods agree and are certain within 0.1 per cent.—*Lond. Elec.*, April 17.

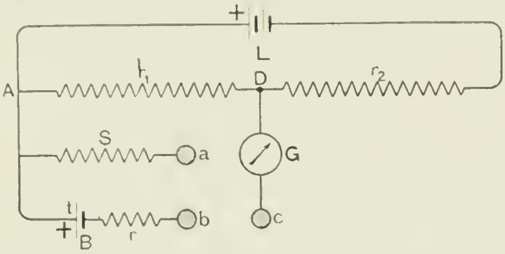


FIG. 1.—MEASURING INTERNAL RESISTANCE.

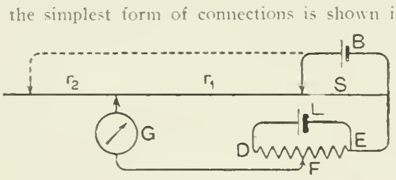


FIG. 2.—MEASURING INTERNAL RESISTANCE.

Measuring the Iron Losses.—SOSCHINSKI.—An article on the determination, by means of the wattmeter, of the "loss figure" ("Verlustziffer") in sheet iron. This figure is the loss in watts per kilogram of iron, at a maximum induction of 10,000 maxwells, a frequency of 50 per second, and at a temperature of 30° C. in the iron. The measurement is made in such a way that a piece of iron of a certain weight (at least 10 kilogrammes) and of a certain cross-section in a solenoid is subjected to the magnetizing action of an alternating current of 50 periods, the voltage at the ends of the solenoid being so chosen that in the iron cross-section there is a maximum induction of 10,000 lines, the energy consumed at the terminals of the coil being determined by a wattmeter. At the same time, the current and e.m.f. are measured and the energy per kilogram of iron is then determined. The author discusses mathematically the influence of a stray field which may exist in apparatus for this purpose. If in a piece of iron which is entirely covered with magnetizing windings, there is a stray field of the lines of induction—as is the case, for instance, in the apparatus of Richter and Epstein—then the measurement at a certain maximum induction gives a larger value for the "loss figure" than would be found if the same iron had been investigated at the same maximum induction in the form of a closed ring in which there is no stray field. In the case of a choking coil, there exists two causes of error acting in opposite directions, which may be made to balance each other, so that by properly choosing the dimensions of the core, a choking coil which is covered with windings only on the parallel cores, may be made to give the same loss as a closed homogeneous ring on which the windings are uniformly distributed. The final result of the author's investigation is that for measurements in practice sufficiently exact results are obtained with apparatus like that of Epstein or Siemens & Halske which have not the form of a homogeneous ring, and therefore have a stray field.—*Elek, Zeit.*, April 16.

REFERENCE.

Comparison of Small Resistances.—JAEGER, LINDECK AND DIESSELHORST.—A Reichsanstalt paper on two sets of comparisons of low resistances (of the order of ten-thousandths of an ohm, etc.) by means of the Thomson potentiometer method. The arrangement of the measurements is described in detail.—*Zeit. f. Instrumentenkunde*, No. 2, 3.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy in Fixed Direction.—BRAUN.—An article in which he first gives some historical notes on the wave lengths used by Marconi and by the author; and then he describes several experiments made for the purpose of sending the wireless telegraphy waves in a certain direction. The first of these was made by Zenneck; in the neighborhood of the vertical transmitting wire, *A* (i. e., at a distance of a few meters), there was a second parallel wire, *B*, of about the same length; if the latter was insulated from earth, messages arrived in the receiver station at a distance of about 10 km, this receiver station being in the direction of, and in line with a straight line from *A* to *B*. If, however, *B* was earthed, the messages no longer arrived at this station, but were transmitted in the opposite direction, namely, in the direction from *B* to *A*. A second method is the following devised by Braun; the receiver wire is not vertical like the transmitting one, but inclined about 5 m in 60 m; the receiver wire and the transmitter wire are, however, in the same plane; in this case only the vertical component of the arriving wave is utilized in the inclined receiving wire, and a correspondingly small e.m.f. is induced in that wire; but as one may consider the horizontal component and the length of the wire as nearly equal—which is sufficiently accurate for the resonances in straight wires, which are not very sharp—it follows that the electric wave propagated along the wire and the ether wave passing over it will be in phase, and there will be resonance. It follows that with an inclined receiver wire it is more important than with a vertical wire, that the length of the wire is in the right proportion to the wave length; if the inclined wire is turned out of the transmitted wire plane, the signs, if received at all, are diminished. These conclusions have been proved to be correct in practice. A third method was devised by Ligsfeld: at the receiving end he uses two parallel vertical wires, each of one-quarter wave length, which are connected together by a horizontal wire of one-half a wave length; in the center of this latter wire the coherer is provided. If the plane of these three wires coincides with the direction of propagation of the wave, the signs received are a maximum; if the plane is perpendicular to the direction of propagation, no signs are received.—*Phys. Zeit.*, April 1.

Glasgow.—A long illustrated article on the reconstruction of the National Telephone Company's Glasgow system, in which 24 exchanges are now in full working order, and upwards of 12,000 subscribers' instruments connected. After having had the call wire system in use in Glasgow for 10 years, it was decided to reconstruct the whole of the important switchboards in this district. The method adopted is an adaptation of the "ringing through" principle to the central battery signal system, used in connection with multiple switchboards fitted with branching jacks. Diagrams of the connections are given and one of the largest exchanges is described.—Lond. *Elec.*, April 17.

REFERENCE.

Wireless Telegraphy.—Guarini.—The first part of what appears to become a long illustrated serial on "wireless telegraphy in the United States."—Lond. *Elec. Rev.*, April 17.

MISCELLANEOUS.

British Engineers in Italy.—A full account of the recent visit of 130 members of the (Brit.) Institution of Electrical Engineers to Italy, some notes of which were already given in last week's Digest. On the Valtellina three-phase railway, the train went at full speed of 60 km per hour most of the time, the acceleration at starting being regular and smooth and its changes being hardly noticeable. The actual work of the motorman is made as simple as possible, all the operations being performed by two movements; the first is to put the controller handle either to half or full speed, and the second to open the valve of the compressed air system, which causes the liquid to rise slowly in the water rheostat, and the train then begins to move; when the resistance is all cut out, the motor is short-circuited automatically. In descending inclines no attempt is made to return energy to the line, chiefly because there are very few other trains to use it, and the sudden addition to the power supplied of something like 200 kw, would cause inconveniences; the superabundance of water at present renders the recovery of energy a matter of no moment, and the trolley is, therefore, simply lowered, while the train is coasting. Como and Volta's tomb at Camnazo were also visited. The visitors then inspected the Thomson-Houston railway system with its power house at Tornavento; the current used in the motors is 650-volt, direct-current, and is collected from a third rail. The next visit was made to a modern silk-weaving factory at Merate, which is equipped with electric motors throughout; two sets of shafting driven by separate motors of 10 hp, are used for the warping machinery; four other motors of 4 hp each are sufficient for the small machines adjoining each loom. Each loom is separately driven by a ¼hp motor, sometimes placed on a bracket and driving through spur gearing transmitting the motion by a belt or bicycle chain. One of the principal objects of employing single motors below the level of the work instead of overhead shafting is that of cleanliness; it is important with such valuable fabrics as silk to avoid the possibility of spoiling them with oil from overhead bearings; there are in all 335 looms. The transmission system of the Edison Company of Milan was then visited and attention is called to an apparatus installed at the Merate sub-station, for regulating the voltage of supply; the arrangement is that of automatically cutting out or in certain of the windings on the 3,600-volt side of the 500-kw transformer; the mechanism consists of a small three-phase motor controlled by a voltmeter relay in one or the other direction, according to the value of the pressure, and thereby actuating the sliding contacts connected with the transformer windings. Various electrical manufacturing plants in Milan were visited, among them the rubber and cable factory of Pirelli; also the Royal Technical Institute. The official visit was concluded by a banquet given to the Institution of Electrical Engineers by the Associazione Ellettrotecnic Italiani.—Lond. *Elec.*, April 17.

English Consulting Engineers.—An editorial referring to a recent remark of George Westinghouse, who contended that in many of the larger electrical schemes at present contemplated in England, especially in the electrification of railways, it will be more economical and advantageous for purchasers to place their entire contract in the hands of one firm of contractors, who act on their advice, and to take their standard designs, than to employ a consulting engineer to draw up the scheme, divide the contracts into sections and distribute them among several contractors. This statement has been under some discussion in the Lond. *Eng'ing* and this discussion is here summarized. It is not doubted that the formation of such firms as Westinghouse, Church, Kerr & Co., which are organized for carrying out complete schemes in all their details without outside assistance, may interfere to a large extent with the position which English consulting engineers have hitherto held as intermediaries between the purchaser and manufacturers. There is, however, the objection that any contracting firm, attached to a manufacturing firm, is limited to the standard designs of the latter, while in some cases standard machines may not be the best ones for the purpose. It is said that the immediate future would not seem to require so large a body of consulting engineers in England as the system of municipal trading has in the past necessitated in that country.—Lond. *Elec. Rev.*, April 17.

REFERENCE.

Manufacturing Plant.—An illustrated description of the Queen's Engineering Works, at Bedford, at which special machinery is made, such as steam dynamos, centrifugal pumping engines for the British Admiralty, small electric gear for the mercantile marine, and machinery for large central stations.—Lond. *Elec. Rev.*, April 17.

New Books.

Conductors for Electrical Distribution. Their Materials and Manufacture. By F. A. C. Perrine, A. M., D. Sc. New York: D. Van Nostrand Company. 287 pages, illustrated, with 5 charts in cover pocket. Price, $3.50.

Dr. Perrine's large experience as manufacturer, teacher and engineer is a sufficient guarantee of the practical value of the present volume. It is a most interesting and complete account of the manufacture of electrical conductors, their calculation and erection, which meets a real need in the engineer's library. There are plenty of books which treat of line computation, some of them much more fully than the one before us, but Dr. Perrine has gathered a great mass of practical information about the materials of line construction which cannot be duplicated elsewhere, and has utilized it most skillfully. The first half of his book is devoted wholly to the conducting materials and their practical manufacture into wires and cables insulated and uninsulated. Here the author draws directly upon a very wide personal experience, and the first two chapters in particular are full of facts and figures important to the engineer. The description of the processes of wire and cable manufacture are singularly clear and complete, giving an insight into many details which affect the quality of the product and generally escape the notice of the engineer.

Chapter VII takes up the calculation of circuits in general, and gives besides the ordinary formulæ many valuable data concerning the heating of covered conductors, and in connection with the theory provides some simple wiring charts, which may be found—until they are lost—in a pocket on the inside of the back cover. Chapter VIII is devoted to the discussion and amplification of Kelvin's law of maximum economy of conductors. It is well worked out and has a rich academic flavor, but just why nineteen valuable pages in a work intended to be practical should be devoted to a theorem inconvenient to apply and useless when applied, we do not quite comprehend The fundamental trouble with it is that the quantities concerned most directly are independent, variable, following no known law, and having different values at different epochs. Until one can determine the price of copper and the effect of competition with respect to time, he had better leave Kelvin's law to the classroom.

In full compensation for this infliction, Dr. Perrine provides in Chapter X a very beautiful and important graphical treatment of the calculation of alternating-current lines. It is altogether the neatest thing in the book, and one thing especially to be commended from the instructional point of view is the separation of the constants of the line from those of the apparatus during a part of the discussion. The apparatus is in many instances a much more important factor than the line. The succeeding chapters on pole lines and insulators are also most valuable, taking up as they do many matters not usually considered and still of great practical importance. The final chapter on underground conductors is by compari-

[illegible] rich in practical details, but still most instructive as a review of the state of the art. The time is hardly ripe for a complete practical discussion of underground lines, but from the present outlook experience will accumulate very rapidly from now on.

On the whole Dr. Perrine has produced a most meritorious and valuable work, covering ground heretofore almost untouched, and full of practical data, the importance of which can hardly be overestimated. It should command immediate personal attention from the engineering fraternity.

BOOKS RECEIVED.

Experiments with Vacuum Tubes. By Sir David Salomons, Bart. M. A. 40 pages, 54 illustrations. Price, 2 shillings.

How to Become a Competent Motorman. By Virgil B. Livermore and James Williams. New York: D. Van Nostrand Company. 232 pages, illustrated. Price, $1.00.

Telephone Lines. Methods of Construction, Overhead and Underground. London: Whittaker & Co. By Walter C. Owens. 390 pages, 265 illustrations. Price, 5 shillings.

Electrical Problems. By Prof. William L. Hooper. Boston: Ginn & Company. 170 pages, illustrated. Price, $1.25.

Annuaire Pour L'An, 1903. Publie par le Bureau des Longitudes. Avec notices scientifiques. Paris: Gauthier Villars. 668 pages. Price, 1.50 francs.

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Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Annual meeting, May 19. Papers: "The Experimental Basis for the Theory of the Regulation of Alternators," by B. A. Behrend; "The Heyland Motor," by C. A. Adams, Jr.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association. F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

Iowa Telephone Association. Secretary, C. C. Deering, Des Moines, Iowa.

Kentucky Independent Telephone Association. Secretary, H. K. Cole, of Lancaster, Ky.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich. July 15, 1903.

National Electric Light Association. Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

New York Electrical Society. Secretary G. H. Guy, 104 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

Objections to the Proposed Cable Vocabulary.

As already noted in these pages, a strong opposition has developed in the United States to the proposed limitations of cable vocabularies. A meeting of the signers of the protests to be presented to the International Telegraph Conference at London on May 26th, was held at the New York Chamber of Commerce last week, Mr. Henry Hentz presiding, and Mr. Howard Ayres, of the China & Japan Trading Company, acting as secretary. The following preamble and resolutions were unanimously adopted:

Whereas, it is anticipated that, at the conference of the International Telegraph Convention of Berne, to be held in London, May 26th, 1903, an attempt will be made to adopt for compulsory use the official vocabulary prepared by the bureau at Berne; and

Whereas, it is apparent that the official vocabulary is not sufficiently comprehensive and is inadequate to commercial needs; and

Whereas, the enforced use of the official vocabulary would make necessary revision to an insufficient medium of codes now in use at great labor and expense an unjustifiable burden upon commerce, as expressed by the Chamber of Commerce of the State of New York in their protest, passed at the meeting held April 2d, 1903; therefore be it

Resolved, that the signers of the petition for the withdrawal of the official vocabulary now in meeting at the rooms of the Chamber of Commerce, New York, protest against the compulsory use of that or any fixed list of ciphers; and be it further

Resolved, that this meeting express to the International Telegraph Convention its conviction that the existing conditions demand not restriction, but a broadening of cable code facilities and that this meeting is strongly of the opinion that properly constructed systems of roots and terminals are a necessity in business telegraphy; and be it further

Resolved, that the chairman of this meeting appoint delegates to formally present these resolutions and our protests.

The following interests were represented: Standard Oil Co., China & Japan Trading Co., American Trading Co., Brown Bros. & Co., the Wall Street Journal, W. R. Grace & Co., Carnegie Steel Co., Henry Hentz & Co., Bowring & Co., Boston News Bureau, Carlton & Moffatt, Westinghouse Companies, Guitterman, Rosenfelt & Co., George Hamilton, Fearon, Daniel & Co., Walker & Hughes, Philadelphia News Bureau, A. O. Probst, American Institute of Marine Underwriters, Dow, Jones & Co., H. W. Doremus & Co.

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Electricity for Gas Works Operation.

An interesting gas power plant is now being installed at the works of the Milwaukee Gas Light Company, Milwaukee, Wis. The company is erecting a new gas works which will be one of the largest in the country, and will embody the most advanced practice in modern gas engineering. Although no electricity will be generated for outside lighting, a gas engine-driven electrical plant will be employed for furnishing motive power to the various auxiliaries throughout the works, all of which will be operated by electric motors. A large machine shop will also be operated by electric motors. Coal will be unloaded from boats elevated to the storage bins by electrical hoists and conveyors, the retorts will be charged and drawn by electrical appliances, and the final disposition of the coke will be accomplished by means of electric power apparatus. The entire electrical distribution system will operate at 250 volts direct current from a central power generating plant, employing gas engines connected directly to the gas mains.

The present equipment comprises one 250-hp Westinghouse horizontal double-acting gas engine, driving a 150-kw generator, and three 125-hp vertical engines, belted to 75-kw generators. Provision has been made for extension of the equipment with a second power unit of the former type. The 250-hp engine is of the new horizontal type recently introduced by the Westinghouse Company for general power work. Its principal features are a pair of horizontal cylinders arranged in tandem, and operating upon the double-acting principle, single-crank and water-cooled pistons, cylinders and combustion chambers. The engine is particularly adapted to generator driving by reason of its excellent speed regulation due to the method of governing employed, which at each stroke proportions the explosive charge to the load, but maintains at all times a mixture of constant quality.

S. K. C. Circuit Breaker.

The circuit-breaker illustrated herewith embodies several features which distinguish it from similar devices. Prominent among these is the independent opening action. The breaker cannot be closed on an overload, for should an attempt be made to do so, the closing toggle will be automatically disconnected from the operating handle and the jaws will open, regardless of the pull which is being applied to the handle, the instant that sufficient current passes through the carbon contacts to operate the tripping device. Thus the danger resulting from a circuit-breaker being forced in upon an overload is eliminated. To trip by hand, the closing action is simply reversed; that is, the operating handle is pushed up.

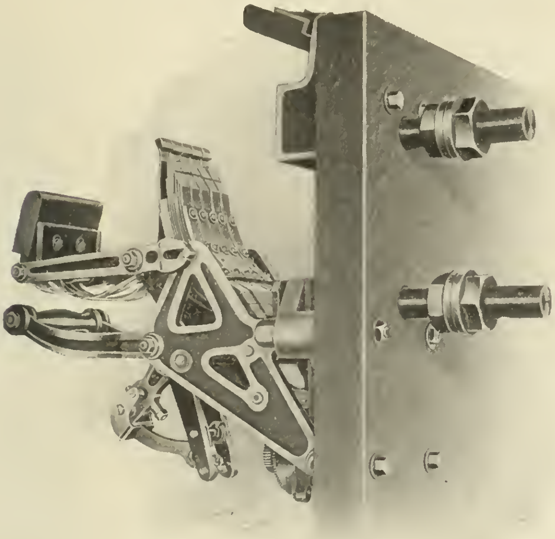

FIG. 1.—CIRCUIT-BREAKER OPEN.

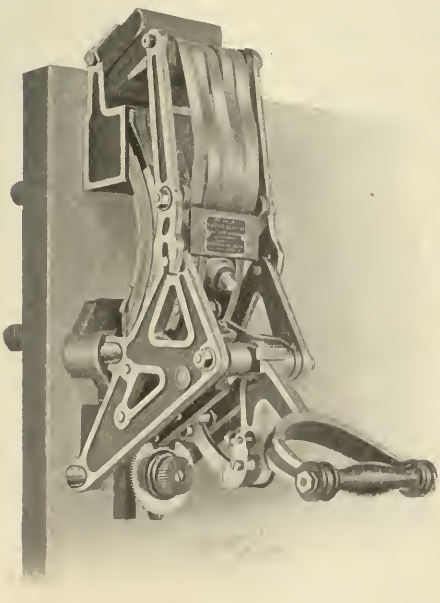

FIG. 2.—CIRCUIT-BREAKER CLOSED.

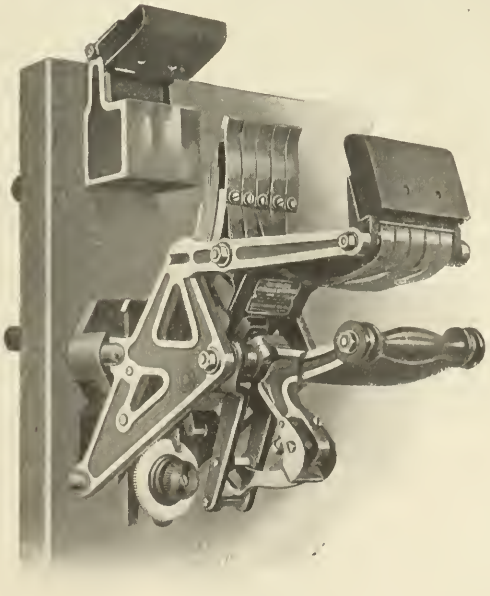

FIG. 3.—CIRCUIT-BREAKER OPEN.

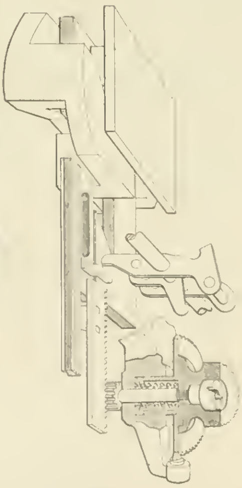

FIG. 4.—DIAGRAMMATIC VIEW OF CIRCUIT-BREAKER.

By an ingenious arrangement of the iron core and the magnet coil, two turns are made around the core in a limited space. The iron core consists of two parts, one fixed and the other movable, which are so arranged as to have but one air gap in the circuit. The movable portion of the core operates the tripping device, as can be seen in Fig. 4.

The main contact blocks are bridged by a sectional laminated copper arm, each section of which may be adjusted separately to secure the best contact, which adjustment is very simply accomplished. The main contact blocks are fastened to the marble base independently of the studs, which may be of any length to suit the switchboard construction.

An objection to circuit-breakers made with fixed carbon blocks with parallel faces, is that these in receiving the full impact when the breaker is closed, often fracture from the blow. In the present circuit-breaker these carbon blocks have a certain amount of spring-actuated movement and come together with a sliding action, as can be seen from the illustration, which renders their breaking impossible from the cause noted. The surfaces are unusually large, and the rubbing action taking place between them when the breaker is opened or closed insures clean contacts. As will be seen from the illustrations of the breaker opened, Figs. 1 and 3, a long break between the carbons is secured with a comparatively short movement of the main contact arm, and arcing occurs at a safe distance from all metal parts. In addition to the shunt circuit through the carbon contacts, there is also an auxiliary shunt composed of smaller copper arms, which remain in contact momentarily after the main contacts are opened, thus further protecting the latter. The contact arms, both the main and the auxiliary, are clearly shown in Fig. 1.

The setting device consists of a rack having a projecting bracket upon which rests the movable section of the magnetic core, and a pinion, engaging therewith, at the end of a short shaft, which carries on its outer end a helical spring, a notched dial and an insulated knob, the arrangement of these parts being shown in Fig. 4. By rotating this dial, the air-gap in the tripping magnet may be varied and a fine adjustment secured. The operation of setting consists simply in pushing the knob, so that the dial is free from the index pin holding it secure, and rotating it until the figure indicating the desired tripping point is opposite the index pin. On releasing the knob, the dial springs out and locks itself in the pin. The large diameter of the setting dial gives, on its periphery, a scale approximately nine inches long.

These circuit-breakers operate on either direct or alternating-current circuits and are made in capacities from 200 to 3,000 amp. They were designed by the engineers of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and are being put on the market by that company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was offered freely, but there was not much demand, the closing price being 4¼ per cent for 60 to 90 days and 4½ per cent for four, five and six months. The stock market was dull and narrow and of a professional character. There was, however, some increase in the investment buying of both bonds and stocks, due, in part, to the easy condition of the money market. The market in general was a variable one and the fluctuations were confined to narrow limits. The traction stocks seemed to receive about as much attention as any other portion of the list, this fact being due not only to the franchise tax decision, but to the development in connection with the hearing of a libel suit growing out of the charges recently brought against the management of the Metropolitan Street Railway Company. The charges against the company appear to have been utterly discredited, and the libel suit has been dismissed for good. Manhattan was well supported in the face of the adverse decision of the Court of Appeals on taxing franchises. Although the whole group was heavy at first, they all, including Brooklyn Rapid Transit, developed a tendency to recover after the news had been announced that the Court of Appeals had decided against the companies. United States Steel stocks were relatively firm and some strength was exhibited by American Smelting & Refining; on the other hand, Amalgamated Copper was almost entirely neglected. Metropolitan Street Railway touched 129 at one time during the week, but recovered and closed at 133½, being a net gain of 3¾ points. Brooklyn Rapid Transit closed at 66, a net gain of 1 point, the lowest quotation being 64¼. General Electric was very quiet, only 1,348 shares having been dealt in, the closing price being 193½. Westinghouse common closed at 210, and first preferred at 195, the first being a net gain of 3¾ and the latter a net loss of 15 points. Western Union lost ½ point, closing at 85. Following are the closing quotations of May 5:

NEW YORK.

	Apr 28	May 5		Apr. 28.	May 5
American Tel. & Cable	75	80	General Electric	192⅝	192
American Tel. & Tel	160	158	Hudson River Tel	..	..
American Dist. Tel		31	Metropolitan St. Ry	130¼	134¼
Brooklyn Rapid Transit	65¾	66¼	N. E. Elec. Veh. Trns	..	¼
Commercial Cable	..	.	N. Y. & N. J. Tel	.	..
Electric Boat	20	22	N. Y. E. V. T. Co	..	..
Electric Boat pfd	35	37	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1¼	1¼	Western Union Tel	85	85¼
Electric Vehicle	12	11¾	Westinghouse com	195	210
Electric Vehicle pfd	15	15	Westinghouse pfd	195	210

BOSTON.

	Apr 28.	May 5		Apr. 28	May 5
American Tel. & Tel	160⅞	158¾	Western Tel. & Tel. pfd	96	96
Cumberland Telephone	..	..	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum		..	New England Telephone	136	138
General Electric	..	..	Westinghouse	95	.
Western Tel. & Tel	19	19	Westinghouse pfd	95	.

PHILADELPHIA.

	Apr. 28	May 5		Apr. 28.	May 5
American Railways	..	49½	Phila. Traction	97½	97½
Elec. Storage Battery	74	74*	Phila. Electric	7⅛	7⅛
Elec. Storage Battery pfd		74*	Pa. Electric Vehicle	..	..
Elec. Co. of America	8⅞	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Apr. 28.	May 5		Apr 28.	May 5
Central Union Tel	.	..	National Carbon pfd	96	97
Chicago Edison	..	..	Northwest Elev. com	..	..
Chicago City Ry	205	206½	Union Traction	6¼	5½
Chicago Tel. Co	..	..	Union Traction pfd	33	32
National Carbon	24¼	24			

*Asked.

WESTINGHOUSE ELECTRIC.—A special telegram from Pittsburg of May 2 says: Westinghouse Electric second preferred closed at 105½ bid, a net advance from the low price of the week of more than $10 a share. The basis for the advance was a rumor that the company was about to issue a portion of the $7,000,000 treasury stock, but an authoritative statement relating thereto was not obtainable until after the market closed. A prominent officer of the company made the following statement: "I believe the Westinghouse Electric and Manufacturing Company will shortly issue some additional stock from the $7,000,000 still unissued. At least the advisability of this plan is now under discussion. The authorized capital of the company is $25,000,000 and the issued capital is $18,000,000. The sales for the year ending March 31, 1903, were $24,000,000, an increase of 30 per cent. over the sales for the year ended March 31, 1902. The earnings from the sales were over $4,500,000, and after writing off large amounts and paying dividends and interest the present surplus is upward of $8,000,000. In case the company were to issue to the stockholders at a favorable price $4,500,000 out of the $7,000,000 stock now in the treasury, the entire capital issued would yet be only one half that of the General Electric Company, with its capitalization of $45,000,000."

ELECTRIC COMPANY OF AMERICA.—At the annual meeting of the stockholders of the Electric Company of America, held a few days ago, President Snowden presented the annual report showing net earnings of $349,840 in 1902, as compared with $281,382 in 1901, a gain of 24 per cent. The surplus account at the end of 1902 showed a credit of $153,776. The company has no floating or bonded indebtedness and the interest charges on some of the underlying corporations have been reduced by payments and refunding operations. The plants operated were stated to be in the highest condition of efficiency. The directors of the company were unanimously re-elected. The earnings for the first three months of 1903 were $91,280, an increase of $16,607, or 22 per cent. over the corresponding period of 1902. The income account for the year ended December 31, 1902, compares with the three previous years as follows:

	1902	1901.	1900	1899.
Net earnings	$366,587	$281,232	$374,538	$407,975
Other income	26,956	198,954	36,156	633,369
Total income	$393,543	$480,186	$410,694	$1,041,344
Charges	41,064	.....	...	....
Balance	$352,479	$480,186	$410,694	$1,041,344
Dividends	203,980	306,038	406,281	202,419
Surplus	$148,499	$174,148	$4,413	$838,925
Previous surplus	916,194			
Total surplus	$1,064,693			
Extra div. paid June, '02	610,917			
P. & L. surplus	$453,776			

AMERICAN BELL TELEPHONE.—The American Bell Telephone Company has filed a certificate of condition as of March 31, 1903, which we compare with statement of March 25, 1902:

Assets:	1903.	1902.
Cash and debts receivable	$5,000,000	....
Stock of Amer. Tel. & Tel. Company	27,124,800	32,131,800
Total	$32,124,800	$32,131,800
Liabilities:		
Capital stock unexchanged	$7,000	$10,700
Debt	10,000,000	10,000,000
For exchange of shares outstanding	7,200	10,700
Balance outstanding assets	22,110,400	22,110,400
Total	$32,124,800	$32,131,800

On March 31, 1903, there were 72 shares of Bell stock not exchanged in the hands of nine stockholders. Charles W. Amory, Alexander Cochrane and Henry Showe as trustees for the American Telegraph & Telephone Company, own 258,686 shares, as against 258,651 last year.

MISSOURI EDISON COMPANY.—It is reported from St. Louis that plans for the absorption of the Missouri-Edison Electric Company by the North American Company have been about completed. The New York corporation, it is said, is in actual control of the Missouri-Edison, and has been for some time. The terms upon which the deal was made have not been made public as yet. It was stated on good authority, however, that the stock is taken on a basis of $50 for the preferred and $25 for the common.

BIRMINGHAM (ALA.) LIGHT & POWER.—A meeting of the stockholders of the Birmingham Railway, Light and Power Company., held at Birmingham, Ala., resulted in an increase of the capital stock to $6,000,000. This is an increase of $1,000,000, all preferred stock. A dividend of 1½ per cent on the common stock was suggested, and will be issued July 1. The new capital stock will participate after July 1. The cash derived from the increase will be used in extensions and improvements.

ELECTRICAL PRODUCTION.—It is noted by the financial papers that while the General Electric Company has transacted a business of $36,000,000 the past year upon a capital of $45,000,000 stock, the Westinghouse Company has done a business of $24,000,000 upon a capital of $18,000,000, that is, sales have exceeded the issued capital by one-third.

MONTREAL POWER BONDS.—The entire issue of Montreal Heat, Light & Power Company's 5 per cent. thirty-year bonds, amounting to $3,400,000, offered by N. W. Harris & Co., of New York, and the Bank of Montreal, has been disposed of. These bonds were issued for the purpose of the plant of the Lachine Hydraulic Power Company, as already noted in these pages.

GENERAL ELECTRIC STOCK DIVIDEND.—According to advices from Boston, it is stated by men high in the management that the General Electric Company has in mind the payment of a 10 per cent. stock dividend this year if business conditions continue as at present, and there are no signs of a let-up at the present time. The company is extremely liberal in its charges to depreciation, yet earnings show 25 per cent. for its stock and the management believes that stockholders should benefit from these large earnings to a greater extent than 8 per cent. per annum. As the directors are not in favor of increasing the cash dividend the only way that the stockholders can derive benefits is in the shape of stock dividends. While there has been no definite decision in regard to the matter, it is understood that the directors have informally talked it over and this method meets with the general approval of the members of the board.

FAILURE OF HELIOS-UPTON COMPANY.—Norman W. Bingham, of Somerville, Mass., and Edward Davis, of Philadelphia, have been appointed by Judge Colt in the United States Circuit Court, at Boston, receivers of the Helios-Upton Company, a New Jersey corporation, with places of business at Peabody, Philadelphia and Chicago, and engaged in the manufacture of electrical appliances. The receivers were appointed in a suit brought by King Upton, of Salem, a creditor with a claim exceeding $76,000 and the largest stockholder in the corporation. The debts of the company, it is alleged, exceed $235,000, and it is unable to pay them promptly. The receivers, who are appointed to conserve the interests of the creditors and the stockholders, are authorized and directed to carry on the business. Each gave a bond for $25,000.

Commercial Intelligence.

THE WEEK IN TRADE.—There was some unsettled feeling in the trade and industrial situation, due to weather conditions and labor disturbances. General business and crop conditions, however, remained favorable. Cold weather and snow in the West checked farm work; interfered with retail distribution; retarded re-orders and did some damage to winter wheat. In the East, however, opposite conditions were noted. There the weather was springlike, which gave a needed stimulus to retail distribution. Strikes are numerous, though few of them are of long standing, the tendency being for employers to concede most of the demands or submit them to arbitration. The gross railway earnings for the first three weeks of April promise to exceed those of a year ago by 14 per cent., and the net returns so far received for March are extremely favorable. Wholesale trade is seasonably quiet. In the textile trade the strike of Lowell cotton goods employees still continues, while the abnormal condition of cotton prices checks large operations. Pig iron was generally dull, except at Pittsburg, where a quite heavy movement was reported. Steel billets are as scarce as ever, and structural material, plates, sheet bars and rails are in active request at firm prices. Some other metals are weaker, lead being marked down 30 cents per hundred pounds. Copper is also lower, both at home and abroad, and the market was very weak. The quotations of the Metal Exchange are 14¾ to 15c. for Lake and electrolytic, and 14½ to 14¾c. for casting stock. The business failures for the week ending April 30, as reported by *Bradstreet's*, numbered 173, against 132 the week previous, and 174 the corresponding week last year.

ALLIS-CHALMERS GAS ENGINES.—It was stated last week by Mr. E. D. Adams, New York member of the Executive Committee of the Allis-Chalmers Company, that the Allis-Chalmers Company may soon have to double the size of their great works, although the new works, which have just been completed, cost between $2,000,000 and $2,500,000. The taking of a contract for the exclusive construction of German gas engines by the Allis-Chalmers Company is responsible for the great project. The company has secured the sole right for building and erecting the engines of a firm in Nüremberg and Augsburg for the United States, Canada, British Columbia and Mexico. The German manufacturers have produced an engine, says Edwin Reynolds, consulting engineer of the Allis-Chalmers Company, which is apparently destined to revolutionize many lines of manufacture. The principal feature is the use of the gas generated by the fuel in blast furnaces for supplying heat and power, instead of operating engines as now built with the usual application of fuel and steam. It is anticipated that there will be a great demand for the new machines, in other fields as well, such as the electrical. A member of the company speaks with the highest praise and satisfaction concerning the German invention. He says that a 2,000-hp unit will be built at the Milwaukee shops for exhibition at the St. Louis Fair.

HOOSICK RIVER WATER POWER.—The Schaghticoke (N. Y.) Electric Company has just been incorporated by George E. Greene, S. E. Gibson, E. H. Libby, Frank H. White and H. J. Greene. The capital stock is placed at $30,000 in certificates of incorporation. It is understood that the capital stock will be largely increased. The main object of the company is to develop a water power about one mile below Schaghticoke village in Rensselaer County on the Hoosick River. The river at that point runs through a deep narrow gorge and winds around a peninsula for over a mile, so that at the narrowest point of land or at the neck of the peninsula and on the south side the river flows within 300 ft. of its course on the north side, but the fall between the two points is 35 ft. The company proposes to tunnel this neck and to build a dam 35 ft. high just below the tunnel, which will give a 70-ft. head. It is claimed that 5,000 hp can be developed at a very moderate expense. A large amount of land and water rights have already been acquired.

YORK ELECTRIC & MACHINE COMPANY, of York, Pa., proposes to furnish a complete equipment for the manufacture of incandescent lamps "according to the latest developments, sacrificing nothing in point of quality while attaining a minimum cost of production." This includes machinery for accomplishing or greatly assisting every operation in the glass room, as well as the necessary machinery and apparatus for other parts of the factory. Mr. J. E. Graybill, of York, is the president of the company; Mr. J. P. Trimmer treasurer, and Mr. Paul McJunkin secretary. Mr. Louis A. Drexler, of Braddock, is also one of the directors.

THE WHITE MOUNTAIN PAPER COMPANY has recently purchased from the Westinghouse Electric & Manufacturing Company three 1,000-kw and one 300-kw, three-phase, engine type alternators, which are complete with exciters, and are to be direct-connected to Hamilton-Corliss engines installed in its paper mill at Portsmouth, N. H. The various machines in this mill will be operated by Westinghouse induction motors, aggregating 5,500 hp. When this apparatus is in operation it will comprise the largest individual electrical installation in a paper mill in the world.

LIGHTING A CLEVELAND STORE.—Mr. J. Harkness Brown has recently closed a contract with the Nernst Lamp Company, of Pittsburg, Pa., for over 1,500 Nernst lamps, which are to be used for lighting his large department store on Euclid Avenue, Cleveland, Ohio. The lamp is especially fitted for illuminating dry goods stores, not only for the reason that 90 per cent. of the light is thrown to the counters and floors where it is most needed, but also on account of the daylight quality of the light, rendering a correct determination of color possible.

TUERK FANS FOR VARIOUS FOREIGN COUNTRIES.—E. B. Latham & Co., 39 Vesey Street, New York, general and export agents for the Hunter Fan & Motor Company, of Fulton, N. Y., have lately secured several substantial orders for Tuerk alternating-current ceiling fans for shipment to India, Brazil, Japan, England, Germany and Chili. Orders sent from the first two countries have been considerable. As regards domestic trade the South is the largest buyer at present. An order has also been received last week for 200 direct-current ceiling fans for shipment to Providence R. I

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed a contract with the Savannah Electric Company, Savannah Ga., for the installation of a battery of "Chloride" accumulators having a capacity of 480 amp. for regulating the rapid fluctuations on their railway circuit. This battery is also to be used in connection with the lighting system, and is operated in connection with a specially wound motor-driven booster. The lead-lined tanks for this installation are made sufficiently large to double the capacity of the battery when an increase is necessitated.

THE PACIFIC ELECTRIC RAILWAY COMPANY, of Los Angeles, has closed a contract with the Westinghouse Electric & Manufacturing Company for four 100-hp and three 30-hp induction motors, which will be used to operate the auxiliaries, including the air-circulating pumps in the steam power electric generating plant in Los Angeles. The contracts for the main engines and condensing apparatus were placed through Charles C. Moore & Co., of San Francisco.

MEXICAN HYDRAULIC PLANT.—An extensive hydraulic plant is to be constructed on the Tequisquiapam River in the vicinity of Queretaro. The Compania Explotadora del Tequisquiapam will undertake the work. The plant will generate the necessary current for the purpose of operating the interurban railway, which the before-mentioned company is constructing between Queretaro and Tequisquiapam.

AUSTRALIAN AGENCY.—The Niles-Bement-Pond Company, 136 Liberty Street, has appointed the electrical engineering and contracting firm of Noyes Brothers, of Sydney and Melbourne, as its exclusive representative in Australia. The Noyes people also represent the Australian interests of Westinghouse, Church, Kerr & Co., J. G. Brill Company, and Billings & Spencer.

ELECTRICAL EQUIPMENT FOR PERUVIAN MINES.—The Allis-Chalmers Company, Broad Exchange Building, New York, will shortly let the electrical contract for the electrical equipment of the Cerro de Pasco copper and silver mines, Peru, now being developed on an extensive scale by American capitalists headed by J. B. Haggin, Mills Building, New York.

DE FOREST WIRELESS TELEGRAPHY.—Dr. Lee De Forest has just returned from a trip through the West and to the Pacific coast. At Cape Flattery, the extreme northwest point of the United States, a site has been secured for a transpacific wireless telegraph station. Here three towers 245 ft. high will be erected in a triangular arrangement, supporting three vertical screens of wire. The power of this station will be 90 hp and it will operate with similar stations at Dutch Harbor, which will be a relay of a station at Nome, Alaska. The service will be carried westward to Kamschatka and Japan. Work is now actually under way at Cape Flattery and it is estimated that the station will be ready for operation in September. Contracts for the work have been placed in the hands of the Kilbourne & Clark Company. An exact duplicate of this Cape Flattery station is to be erected near the Administration Building upon the Exposition grounds at St. Louis. Work upon this station is already under way. Mr. G. H. Barbour, the chief engineer of the company, is now in St. Louis supervising the work. One of the three towers at St. Louis will be larger than the others and will be surmounted with a visitors' gallery. High speed elevators will convey visitors to the top of this tower. Certain novel electrical effects will be tried in connection with it. At the top of each there will be a crown of incandescent lights and a series of large Geisler tubes will be attached to the top of the antenna screens. As the voltage will be from fifty to seventy-five thousand, very weird and beautiful effects will be obtained whenever the transmitting key is operated. Arrangements have been made with the *St. Louis Dispatch* and *Post Dispatch* for the transmission by wireless of the fair news each day into the city. This station is also expected to operate with the De Forest station at Chicago. As a result of the successful demonstration between Armour & Co.'s stock yards and the executive offices over the heart of Chicago, Armour & Co. have given the American De Forest Wireless Telegraph Company contracts to connect their Omaha and Kansas City plants. Contracts have been let for the erection of the towers at each of these stations and 20 hp is the equipment to be installed at each place. At the Kansas City plant the Armours have two dead brick stacks 175 ft. high. These are to be capped with four tripods 75 ft. in height, making a total of 250 ft. The operating station at Kansas City is to be located on the roof of the packing house midway between these stacks. Alternating current will be obtained direct from the packing house dynamo. Ground has been broken at North Evanston, Chicago, for the erection of a single tower 200 ft. in height for the Lake Michigan station. This station is to cover the lake as far as Mackinaw and long-distance overland experiments will be made from this point, with a view of connecting the Armour stock yards in South Chicago with their plants at the other two stations. If these tests are successful, the De Forest Company will connect the Armour plants at Fort Worth, Texas, Fort Smith, Ark., Kansas City, East St. Louis, Chicago and Omaha.

STEAM TURBINE INSTALLATION.—The Rome Brass and Copper Company, Rome, N. Y., have just placed an order with Westinghouse, Church, Kerr & Co. for a steam turbine power equipment for a new rolling mill at Rome, N. Y. The present properties of the company are located upon the banks of the Mohawk River, at Rome, N. Y., and comprise a number of rolling mills and other buildings, scattered over a considerable area. The manufacturing facilities afforded by these mills being inadequate, the company has under way a number of new mills located at a short distance from the old plant, and arranged with special reference to the ultimate centralization of motive power. One of the new shops will be operated entirely by electricity from an adjoining power-house, where the boilers and turbine machinery will be located. The entire mill will be operated from one turbine, no relay being provided. The power unit consists of a Westinghouse steam turbine direct-connected to a 400-kw Westinghouse 3-phase turbo generator. The present arrangements for boiler and condenser machinery are still incomplete, but it is probable that the turbine will operate under 150 lbs. steam pressure, 26" or 28" vacuum, and possibly a moderate amount of superheat. The generator will furnish current at 440 volts and 60 cycles, which will be used at this voltage upon the motors driving the rolls in the mill. Each roll will be independently driven by a Westinghouse induction motor of suitable capacity.

GERMAN STEEL FOR UNITED STATES NAVY.—The General Supply & Construction Company, Maritime Building, New York, has secured the contract for the furnishing of steel to be used in the construction of the machine shops, etc., of the new navy yard at Charleston, S. C. The material will be of German manufacture, the government officials having decided to utilize foreign steel owing to better prices and more favorable terms of delivery than from American mills. This will be the first instance of foreign steel being used in the erection of United States Government buildings, though, as previously noted in these columns, considerable European structural material has been ordered recently for various building operations throughout the East, South and Middle West. The present contract calls for about 1,000 tons. Delivery is to be made in four weeks. The General Supply Company is now figuring, on behalf of foreign mills, on the contract for the structural material for the large plant about to be constructed in Beverly, Mass., by the United States Shoe Machinery Company. More than 10,000 tons of steel will be employed. The Beverly plant will be operated largely by electricity.

EUROPEAN ELECTRICAL INTERESTS.—A cable dispatch in the *New York Herald* of April 29 from Berlin says: Important negotiations will be concluded in this city within a few days for the organization of an international electrical trust, embracing the American General Electric Company, the British Thomson Houston Company and a newly formed German electrical trust, the Allgemeine Electricitats Gesellschaft, and the Union Company, of this city. Messrs. Potter and Clark, of the General Electric and Thomson-Houston Companies, will arrive here shortly to confer with the German leaders. The new electrical trust purposes to obtain control of the British and Continental markets. It already controls the Union Company, of this city, which was recently fused with the German General Electric Company, under the leadership of Herr Rathenau. To contest the trust Siemens & Halske and the Schukert Companies recently formed a combination, and it is likely that the Westinghouse Company will form an alliance with these companies, as Mr. George Westinghouse is due here shortly.

KOBE, JAPAN, EXHIBITION.—At this excellent exhibition opening on April 19, Messrs. L. J. Healing & Co., of Yokohama and Kobe, have on view a display of British electrical apparatus. Messrs. Hunter & Co., of Kobe and Osaka, have an exhibit of electrical apparatus, machinery, etc. German searchlights from Nuremberg are also on view. Messrs. H. Isono & Co., of Tokyo, Yokohama and Osaka, show a model of a Parsons turbo generator from Newcastle-on-Tyne. The Mitsui Bussan Kaisha show an English engine and dynamo. The Mitsui Shibaura Engineering Works, of Tokyo, show motors and generators of home construction. American electrical apparatus is not noted as cutting any figure at all.

THE AMERICAN RIVER ELECTRIC COMPANY, whose incorporation was noted in this department last week, has closed contracts with the Westinghouse Electric & Manufacturing Company for two 2,000-hp revolving field three-phase engine generators. Deliveries are promised in five months. These generators will be direct-connected to two impulse wheels operated under a head of 590 ft. of water, which will be obtained from the American River near Placerville. Electric power will be transmitted 75 miles to Stockton at 40,000 volts. A part of the pole line is under contract.

PITTSBURG CARBORUNDUM COMPANY.—As already intimated in these pages, the Carborundum Company of Pittsburg, has practically decided to erect a plant in the German Empire, in order to compete with the German manufacturers, as the proposed high tariff and the cost of shipment promises to cut down profits to a large extent. Large shipments are made to Germany from the plant at Niagara Falls, but German manufacturers have been adopting American methods and competition is becoming more keen.

AMERICAN CONDUIT FOR RUSSIAN TELEPHONE SYSTEM.—Some details are to hand regarding the important contract recently secured for American conduit to be installed in connection with the municipal telephone system in St. Petersburg, Russia. The value of the contract is about $3,000,000. The American Vitrified Conduit Company, New York, will ship the conduit. There will be about 6,000,000 ft. of four-way conduit, which will represent a weight of some 25,000 tons.

SPRAGUE ELEVATORS FOR AUSTRALIA.—The Sprague Elevator Company, 52 Broadway, New York, has recently secured some substantial contracts for electric elevators for passengers and freight service in Australia. Edge & Edge, of Sydney, have taken a contract for elevators in the new warehouse of W. S. Friend & Co., in that New South Wales city. Sprague elevators have also been ordered for installation in the new premsies of the Adelaide Steamship Company.

THE H. O. S. ENGINEERING COMPANY, of 277 Broadway, New York City, has secured the contract for the new switchboard of the Trenton (N. J.) Street Railway Company, consisting of 14 panels. It has also secured a number of orders in New York City, and in order to facilitate its deliveries has taken a store room at 88 Warren Street, where it will carry a complete line of knife switches and panel boards.

THE NORTHERN WIRE & CABLE COMPANY has incorporated with a capital of $300,000 full paid, and will at once erect a plant in Milwaukee for the manufacture of lead-covered telephone, telegraph and power cables and wires. It is now in the market for the factory power equipment. J. B. Adams is general manager, with offices in the Wells Building, Milwaukee.

VERA CRUZ LIGHTING PROJECT.—An electric lighting plant is to be built in Acatlan, State of Vera Cruz, Mexico.

General News.

THE TELEPHONE.

WAYCROSS, GA.—The Bell Telephone Company has bought out the Southern Telephone Company, of Waycross. Several thousand dollars worth of improvements are being made.

PAYETTE, IDA. The Rocky Mountain Bell Telephone Company has decided to make an extension from this city to the mouth of Big Willow canyon, a distance of twenty-eight miles.

BYRON, ILL. The Byron Telephone Company has increased its capital to $10,000.

FREEPORT, ILL.—The Stephenson County Telephone Company has changed its headquarters from Chicago to Freeport.

WAUKEGAN, ILL.—The Chicago Telephone Company is preparing plans for a new exchange building in this city to cost $50,000.

HILLSBORO, ILL.—The stockholders of the Mutual Telephone Company, of Hillsboro, have voted to increase the capital stock of the company to $10,000 and to bond the property for half that amount.

RUSHVILLE, ILL.—The Rushville, Pleasant View & Browning Telephone Company has been incorporated with a capital stock of $2,400, the incorporators being M. W. Greer, M. S. Strong and S. R. Carey.

UNIONDALE, IND. The Uniondale Telephone Company erected by and used almost exclusively by farmers is extending its lines to Zanesville and Markle.

VINCENNES, IND.—The Knox County farmers' telephone companies are being connected with the Vincennes Company and soon the city wires will reach nearly a thousand farmers.

LOOGOOTEE, IND.—The Loogootee Telephone system, damaged by fire recently, has again been put in operation. The system has been greatly improved and connection made with the Home Telephone Company's lines at Washington, Ind.

INDIANAPOLIS, IND.—It is now definitely assured that Indianapolis and Chicago will have independent telephone connection by fall. The independent people are pushing work in Chicago and expect to have their city system in operation by July. They will build lines radiating from that city and will connect with the New Long Distance Company at Lafayette and other points further east.

INDIANAPOLIS, IND.—At the annual meeting of the stockholders of the New Long Distance Telephone Company, the old board of directors was re-elected which in turn organized and re-elected S. P. Sheerin, president; A. F. Ramsey, vice-president; H. B. Sale, secretary, and A. H. Nordyke, treasurer. The report of the secretary for the fiscal year showed $16,602.49 carried to surplus, after the payment of expenses of every kind (including quarterly 1 per cent. dividends) which, added to the $14,085.77 surplus of last year, makes the present total surplus $30,688.26.

SULLIVAN, IND.—A delegate meeting of representatives of all the telephone companies in this county was held here on April 25 at which arrangements were made for unifying and installing a complete county service. A conservative estimate shows that it will give Sullivan direct communication with 12,000 telephones in this and adjacent counties. Under the agreement the local company will operate all telephones in Hamilton Township. The general exchange will be located in Sullivan and the arrangement will give free service with all telephones in Crawford County, Ill., Green, Davies and Clay counties, Ind., and connection with the independent system will give free service in Vigo and Knox counties.

INDIANAPOLIS, IND. The following new telphone companies have been recently incorporated. The Sulphur Springs Telephone Company, capital stock $7,000, John W. Whitworth, Samuel Allen and others are directors; the Macey Telephone Company, capital stock $2,000, Charles M. Snepp, Thos. Y. Savage and E. B. Sutton are the incorporators; the Mount Lebanon Telephone Company, capital stock $3,000, Emanuel Smith, Wm. Andis, Jr., and George Potts, all of Greenfield, are the incorporators; the Mooresville Telephone Company, of Mooresville, Morgan County, filed amended articles of incorporation and increased its capital stock $12,000. This company will make extensions and install a new switchboard. D. B. Johnson, O. H. Mills and A. S. Wheeler are the officials. The local Union Telephone Company, of Washington County, to establish and operate a telephone system in Washington County. The capital stock is $10,000. T. T. Morris, L. B. Palkwood and Wiley Stewart, of Washington, are the directors.

OSCEOLA, IA.—The Crescent Mutual Telephone Company, of Osceola, has been incorporated with a capital stock of $400.

DES MOINES, IA.—The New Sharon Independent Telephone Company has been incorporated with a capital stock of $24,000.

WASHTA, IA.—The Farmers' & Merchants' Telephone Company, of Washta has increased its capital stock from $3,000 to $5,000.

DAYTON, IA.—The Dayton Telephone Company has decided to expend about $3,000 in the improvement and the expansion of its service.

MUSCATINE, IA.—The Muscatine and Louisa County Telephone Company, of Muscatine, has filed articles of incorporation, capital $25,000. J. H. Letts is president, and D. H. Wilbrook, secretary.

BALTIMORE, MD. The subscribers' suit against the Maryland Telephone & Telegraph Company has been dismissed by the Circuit Court. An injunction was sought to restrain the company from charging more than was prescribed by the ordinance of July 1, 1896, viz.: $4 per month for business and $3 per month for house service.

LANSING, MICH. The Macon Telephone Company has been incorporated with a capital stock of $2,000.

BROOKLYN, MICH.—The Brooklyn & South Norvell Telephone Company has filed articles of association.

CAPAC, MICH.—The Capac Telephone & Messenger Company has been incorporated with a capital stock of $15,000.

HOWELL, MICH.—The Livingston County Mutual Telephone Company has increased its capital stock from $10,000 to $50,000.

KALAMAZOO, MICH.—Mr. P. C. Burns, president of the American Telephone Company, of Chicago, it is stated, has purchased 12,000 shares of the stock of the Citizens' Telephone Company, of Kalamazoo, and is thereby the largest single stockholder in that company. The company is now engaged in laying conduits.

HUTCHINSON, MINN.—The Hutchinson Exchange Company has decided to construct a line from this city to Minneapolis.

MADELIA, MINN.—The Madelia Telephone Company has been organized with a capital stock of $3,500. The officers are: President, J. J. Keber; secretary, Charles Sundberg; treasurer, L. M. Olson.

MANKATO, MINN.—The Minnesota Valley Telephone Company intends to extend its lines from Mankato to Sioux Falls, S. D., during the summer. The Twin City Telephone Company expects to build a line from Lyle to the Twin Cities. It is also reported that an independent telephone line is projected from Austin westward to Sioux Falls.

LINCOLN, NEB.—The Hebron Home Telephone Company has filed articles of incorporation. The incorporators are Charles M. McNeill and A. H. Hawes. The capital stock is $25,000.

BEDFORD, NEB.—The Bedford County Telephone Company has increased its capital stock from $5,000 to $20,000. The work of stringing about twenty miles of new line is now in progress between Bedford and Morrison's Cove.

WIMBLEDON, N. D.—Business men of this place recently organized an electric light and telephone company for the purpose of furnishing electric lights to the village and to establish a telephone system throughout the county.

IRONTON, OHIO.—The Ohio Valley Telephone Company has been organized with a capital of $200,000 to consolidate the independent lines between Charleston, W. Va., and Cincinnati. It will enter Cincinnati with a line from Portsmouth and will extend to Lexington, Ky., Lebanon, Ohio, and Wilmington, Ohio.

PITTSBURG, PA.—The Bedford-Fulton Telephone Company has been incorporated with a capital of $5,000. T. A. Holmes is one of the directors.

MEMPHIS, TENN.—It is proposed to erect a telephone line along the St. Francis levee system from New Madrid to Memphis. Chief Engineer H. M. Pharr, of the St. Francis levee board is drawing the plans.

SALT LAKE CITY, UTAH.—The strike of the telephone girls of Butte is over and the girls have been reinstated without prejudice. Manager Murray, of the Rocky Mountain Bell Telephone system, learning that there would be a beligerant demonstration of the strikers at Butte, the eleven girls who were taken from here to replace the strikers were sidetracked by the manager at Dillon. At this juncture a settlement of the strike was reached and the girls have returned. Miss McDermott, whose dismissal as chief operator was the immediate cause of the strike, has resigned and it is stated that there is still considerable dissatisfaction, which may result in another strike, over the manner in which she was treated.

RICHWOOD, WIS.—The Richwood Telephone Company, with a capital of $1,000, has been incorporated by John Thaner, E. Krueg, H. Jouger and Frank Petri.

ELECTRIC LIGHT AND POWER.

NEW WINDSOR, COLO.—The Board of Trustees has granted E. I. Raymond and H. C. Branch a franchise to construct and maintain an electric light and power system in the town of Windsor.

WASHINGTON, D. C.—Local press reports state that the Great Falls Power Company will be ready within a few weeks to let contracts for its plant, which will cost about $2,500,000. Allen L. McDermott, president Washington Railway & Electric Company and other stockholders of this road are reported interested.

LOUISVILLE, GA.—The citizens have voted to issue $20,000 bonds for an electric light plant and water works.

EAST POINT, GA.—Judge R. F. Thompson, of East Point, is on a committee to investigate the price of lights and report to the town.

ATLANTA, GA.—O. H. Sheffield, an electrical engineer of Atlanta, visited Anderson, S. C., recently representing a company proposing to develop 5,000 horse power at Cherokee Falls in Abbeville County, S. C. It is proposed to sell electric power to Anderson and other towns.

ATLANTA, GA.—It is reported that negotiations are now on between the Bull Sluice Electric Company and various manufacturing concerns looking to the establishment of a number of the latter near the big electric plant. It is estimated that nearly half of the power will be thus utilized.

LEWISTON, IDA.—The surveyor of the Crackerjack mine is at work preparing plans for an electric plant, the power for which will be generated on Lake Creek.

REXBURG, IDA.—The Snake River Electric Light & Power Company, Ltd., of Rexburg, has been incorporated with a capital of $100,000, by Jas. H. Wilson, John H. Hendricks and others.

BELVIDERE, ILL.—The citizens have voted to issue $25,000 bonds for a municipal lighting plant.

CENTRALIA, ILL.—The Merchants' Light Company has been organized to construct an electric light plant.

QUINCY, ILL.—The Independent Electric Light & Power Company, which recently secured a franchise, has purchased property, and will soon erect a power house.

SAYBROOK, ILL.—It is proposed to construct an electric light plant to cost about $6,000. Private parties are also talking of putting in a plant. Nothing definite has been decided on.

SPRINGFIELD, ILL.—The plants of the Springfield Gas Company, the Springfield Electric Light, Heat & Power Company, the People's Hot Water Heating & Electric Company and the Consolidated Railway Company are reported about to be absorbed by an Eastern syndicate, which contemplates extensive improvements.

LOOGOOTEE, IND.—The Town Council has taken steps toward the erection of an electric light and water works.

BLUFFTON, IND.—The Council has awarded to the Olds Construction Company, of Ft. Wayne, the contract for a complete incandescent and street lighting plant for $4,050.

ELKHART, IND.—Owing to increase in its business and the necessity of providing additional space for static and rotary transformers, etc., to receive power from the St. Joseph & Elkhart Power Company, the Elkhart Electric Company, of this city, will shortly make a substantial addition to its present power house.

WABASH, IND.—The Council has received a proposition from the Wabash Electric Light Company whose franchise will expire on July 1 for a renewal of the electric lighting contract for five years. The company proposes to install 100 arc lights at $80 per year each with $70 per year for an additional 25 lights or an average of $78 per year for the 125 lights.

ELKHART, IND.—The St. Joseph & Elkhart Power Company has, during the past week, commenced work on the erection of its transmission line between the cities of South Bend, Elkhart and Mishawaka, and the expectations are that the line work will be finished in about two months. The purpose of this company is to furnish power and light in the above named cities and vicinities from a large water power plant located about midway between the cities of South Bend and Elkhart.

GUTHRIE CENTER, IA.—Luther L. Pennock, City Clerk, writes that the citizens voted to grant the Guthrie Center Electric Light Company a franchise for an electric light plant.

DULUTH, MINN.—Bids will be received May 11 by the Common Council for $40,000 bonds to be used for extending, improving and enlarging the water and light plant. H. W. Cheadle is City Clerk.

CAPE GIRARDEAU, MO.—The Cape Girardeau Waterworks and Electric Light Company has increased its capital stock from $100,000 to $150,000.

BOZEMAN, MONT.—The county commissioners have been asked for a franchise for an electric lighting and water plant at the town of Belgrade.

POTSDAM, N. Y.—The Municipal Lighting Committee, in a report to the Board of Trustees of this village, find that a municipal lighting plant operated by the water power owned and controlled by the village is feasible and practicable.

LUMBERTON, N. C.—The town of Lumberton has voted for electric lights.

SANFORD, N. C.—The Campbell Electric Light & Power Company, of Sanford, has been purchased by A. F. Spencer, of Ansonia, Conn.

BAKER CITY, ORE.—The management of the White Swan Mines Company, Limited, will establish an electric plant to be run by water power, and by extending the wire line will run all its machinery by electricity.

BAKER CITY, ORE.—The Red Boy Gold Mining Company will push to completion the work commenced last year of installing a large electric power plant and will utilize the waters of Olive Lake. A dam fifty feet high will be constructed and will furnish, it is estimated, 2,000 horse power. This power will be sufficient for the operation of the mines and will also be utilized for an electric railway system.

SHENANDOAH, PA.—The People's Electric Light, Heat & Power Company has been incorporated with a capital of $20,000.

COLUMBIA, TENN.—The Senate has passed the bill authorizing Columbia to issue $25,000 electric light bonds.

SPARTA, TENN.—The Sparta Electric Light and Power Company will put in a day circuit to supply manufacturing houses.

MT. PLEASANT, UTAH.—A local company has secured a franchise for the construction and operation of an electric lighting and power plant.

RICHFIELD, UTAH.—An electric power plant will be installed in Sevier County in the near future, the power for which will be secured from a hydraulic canal near Joseph City, where a fall of seventy feet is available.

ALEXANDRIA, VA.—Fred. Russell has petitioned the City Council for a franchise for an electric light plant.

RANDOLPH, WIS.—Bonds to the amount of $5,000 have been voted for an electric light plant.

MILWAUKEE, WIS.—In his annual message Mayor Rose recommends that bonds to the amount of $250,000 be issued for a municipal electric light plant, in accordance with the wish of the citizens who voted in favor of the project.

FT. STEELE, B. C.—South Dakota capitalists have applied for a water right on the Bull River Falls, where they will establish a large plant which will supply sufficient electric energy for surrounding camps.

ROSSLAND, B. C.—It is reported that the Inland Light & Power Company, of Rossland, incorporated with a capital of $15,000 will construct an electric plant on Wild Horse Creek. K. L. Burnet and J. S. Clute are among the incorporators.

REGINA, N. W. TER.—The City Council has decided to construct a system of water works, electric lighting and drainage. John Galt, of Toronto, Ont., will act as consulting engineer.

THE ELECTRIC RAILWAY.

SAN JOSE, CAL.—George W. Elder, of San Francisco, has secured the contract for the construction of the San Jose, Saratoga & Los Gatos Electric Railway. The road will be [illegible] miles long.

MOLINE, ILL.—The Moline, East Moline & Watertown Railway Company has been granted a franchise for the extension of its lines through Rock Island County.

LINCOLN, ILL.—The Lincoln Electric Railroad Company has been incorporated, with a capital stock of $6,000. The incorporators are D. H. Harts, E. G. King, A. D. Cadwallader.

VINCENNES, IND.—The Citizens Street Railway Company announces that it will build a new power house this year.

RICHMOND, IND.—The Union Traction Company of Indiana will extend its lines from Anderson to Richmond and ultimately to Cincinnati.

TERRE HAUTE, IND.—The City Council has granted a 30-year franchise to O. F. Adams and H. D. Falls, known as the Brazil Electric Company, for an electric railway.

FT. WAYNE, IND.—The Ft. Wayne & South Western announces that the interest of the McKinley syndicate in the proposed Ft. Wayne & Southern Railway, which was to build from Marion to Huntington has been sold to the Union Traction Company.

SIOUX CITY, IA.—The plans for improving the property of the Sioux City Traction Company have been approved by the directors of the company. In all it is planned to expend about $1,500,000.

COLUMBIA, KY.—The Columbia Interurban Railway Company has been organized here, with $15,000 capital stock subscribed. The officers of the company are Prof. W. K. Azbill, president, Capt. W. W. Bradshaw, vice-president, C. S. Harris, secretary; Judge J. W. Jones, treasurer.

WORCESTER, MASS.—W. H. Tyler, one of the promoters of the Worcester, Sterling & Leominster Street Railway Company is to build the line from Worcester to Leominster for the Worcester Consolidated Street Railway Company.

JERSEY CITY, N. J.—The United States Alternating Current Traction Company, Jersey City, capital $50,000, has been incorporated.

ASBURY PARK, N. J.—It is said that the entire overhead equipment of the Atlantic Coast Electric Railway Company's line between Asbury Park and Pleasure Bay is to be reconstructed.

JAMESTOWN, N. Y.—The Common Council has granted a franchise to the Jamestown & Warren Traction Company.

DUNKIRK, N. Y.—The Buffalo, Dunkirk & Western Railroad Company has applied for a franchise in Silver Creek.

AUBURN, N. Y.—The Syracuse & Auburn Railway Company is preparing to make extensive additions to its plant in Franklin street.

PREBLE, N. Y.—A Mr. Conan, of Syracuse, has applied for a franchise here. Mr. Conan is said to represent a company that plans to build an electric railway to connect Syracuse and Cortland.

OYSTER BAY, N. Y.—The Highway commissioners of Oyster Bay have granted two trolley franchises—one to the South Shore Traction Company and another to Wilkins K. Putnam for a cross island route.

ELLICOTTVILLE, N. Y.—The Ellicottville, Mansfield and East Otto Railroad Company has been incorporated, capital $300,000. Directors: Charles G. Locke, Randolph; Owen S. Lang and T. H. Holmes, East Otto.

GLENS FALLS, N. Y.—The Hudson Valley Railway Company has acquired the property and franchises of the North River Railway Company, which was organized to build an electric railway from Saratoga to Glens Falls. The directors of the North River Company have resigned and have been succeeded by the directors of the Hudson Valley Company, who have elected the following officers: Addison B. Colvin, president; John W. Herbert, vice-president; George A. Holmes, secretary, and Dr. John P. Munn, treasurer.

SARATOGA SPRINGS, N. Y.—The Hudson Valley Railway is building an addition to its Queensbury power station, 40 ft. x 40 ft. The company will install an 850-hp Corliss engine, which will be coupled directly to a 500-kw generator. When the water power station is finished and in operation the company will put its high tension line from Warrensburg to Waterford in operation. The power from the Saratoga extension will be furnished from Warrensburg, Queensbury and Saratoga, and from a transformer station at Wilton.

SALISBURY, N. C.—The Salisbury Street Railway is reported to have been purchased by Boston capitalists, who will complete the line to Spencer.

UNIONTOWN, PA.—The Webster Monessen, Belle Vernon & Fayette City Electric Railway Company recently secured a charter for the extension of its lines from Monessen to Uniontown via Star Junction, Flatwoods, Buena Vista, Juniataville and Oliver. Three hundred thousand dollars in bonds have been deposited with the Fayette Title and Trust Company. S. M. Graham is president of the railway company.

NASHVILLE, TENN.—The plan for merging the Gallatin & Nashville Railway and the Nashville & Columbia Railway Company into tbe Tennessee Interurban Railway was ratified by the stockholders recently.

CHARLESTON, W. VA.—The Kanawha Water & Light Company is to apply for a franchise to build a street railway in Charleston.

JANESVILLE, WIS.—The Council has granted the Janesville Traction Company a franchise.

CHEYENNE, WYO.—Thomas Carlon, of Denver, representing Indiana capitalists, has applied to the Council for a franchise to construct an electric railway here.

THE AUTOMOBILE.

AUTOMOBILES AT ST. LOUIS FAIR DEDICATION. Automobile service was conducted during the World's Fair dedication days between King's Highway and the World's Fair grounds by the Interstate Transit Company. A big tent was erected at King's Highway and McPherson Avenue and the company's machinery was moved there temporarily. Twelve or fifteen automobiles, each carrying from 12 to 14 persons were used. Immediately after the close of the dedication exercises the machinery was returned to the company's buildings at Eads Bridge and the service across the bridge, for which the company was organized, was resumed. The company has secured a long term franchise to run its automobiles across the bridge, and has ordered 10 new machines, which are now in transit.

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NEW INDUSTRIAL COMPANIES.

THE ARTIFICIAL ABRASIVE COMPANY, of Wilmington, Del., has been incorporated, capital $100,000.

THE BINGHAM TRAMWAY COMPANY has been incorporated in Jersey City to build tramways. The compary's capital is $50,000.

THE AMERICAN PLATINUM WORKS, capital $70,000, has been incorporated by Theodore Koch, Charles Engelhard and Lyman E. Warren.

THE FUEL GAS MACHINES COMPANY has been incorporated in Jersey City to manufacture gas plants, pumps, engines, etc. The capital stock is $1,500,000.

THE BROOKLYN AUTOMOBILE COMPANY, of Brooklyn, has been incorporated, capital $25,000. Directors: L. A. Hopkins, S. H. Hunt and L. B. Adams, Brooklyn.

THE MOFFETT ELECTRIC RAILWAY BEARING COMPANY, capital $3,000,000, has been incorporated by Samuel B. Thropp, Jr., John Holran, Jr., and George B. Saddler.

THE JOHNSON ELECTRIC COMPANY, of New York, capital $10,000, has been incorporated. Directors: L. F. Johnson, Chicago; E. R. Hunckel and H. A. Russell, New York.

THE CORTLANDT ELECTRIC CONSTRUCTION COMPANY, New York; capital, $5,000, has been incorporated. Directors: W. J. Berg, W. W. Benjamin and J. S. Lawson, Brooklyn.

THE ELECTRIC AND GAS SECURITIES COMPANY, of Yonkers, capital $200,000, has been incorporated. Directors: E. W. Wheelock, W. C. Dodge and P. F. W. Ruther, New York.

THE METROPOLITAN ALUMINUM MANUFACTURING COMPANY, of New York, has been incorporated with a capital of $25,000. Directors: Harry Baum, Adolph Selikowitz and M. L. Wall, New York.

THE COMMERCIAL MOTOR COMPANY has been incorporated in Jersey City, N. J., for the purpose of manufacturing motors. The capital stock is $250,000, and the incorporators are Geo. D. Gregory, Francis P. Page, Harry G. Derby, Thayre McLaren, A. W. Chamberlain.

THE GENERAL CONSTRUCTION COMPANY, of Ft. Wayne, Ind., has incorporated with $50,000 capital stock. Directors: George W. Beers, S. M. Foster, S. S. Fisher and others. The company proposes to take contracts for the construction of electrical plants and systems including telephone and interurban railroads.

THE LOOMIS-PETTIBONE GAS MACHINE COMPANY, capital $2,000,000, has been incorporated to manufacture machinery for production of gas and electricity. Incorporators: Burdette Loomis, Sr., of Hartford, Conn.; Burdette Loomis, Jr., and Hawley Pettibone, of New Rochelle, N. Y., and Benjamin Guggenheim, of New York City.

THE JONES-HOGUE CONSTRUCTION COMPANY has incorporated at Indianapolis, Ind., to do electrical and mechanical engineering and construction work of railway and power plants. The incorporators are H. W. Jones and George A. Hogue, of Cleveland, O. L. L. Green and E. E. Elliott, of Indianapolis. At present the company will limit its interests to the building and equipping of electric railways.

THE UNITED LIGHT, POWER AND TRACTION COMPANY, of Buffalo, N. Y., has been incorporated to carry on the business of electrical and civil engineers to manufacture electricity for light and heat and power, to construct bridges, buildings, machinery, railroads, tunnels, subways, docks, waterworks, gas works and canals. The capital is $500,000 and the directors are Louis B. Grant, Ashley T. Cole, William J. Bagnell, Charles T. Lark, Richard F. McKiviry and Charles H. Werner, of New York City, and Joseph B. Mayer, of Buffalo.

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LEGAL.

SALT LAKE WATER AND ELECTRICAL POWER COMPANY.—An important decree of the district court at Salt Lake City orders the sale of the property and intangible interests of the Salt Lake Water & Electrical Power Company for the satisfaction of judgments against the company aggregating $500,000. A receiver has been appointed and the proceeds of the sale will be divided among lien and bondholders.

TICKER NEWS OWNERSHIP. The decision of the United States District Court of Milwaukee granting an injunction restraining Hadden, Rodee & Company, a local commission house, from using or acquiring quotations of the Chicago Board of Trade has been confirmed in the United States Circuit Court of Appeals by Judges Grosscup, Jenkins and Baker. The decision is of importance in that it upholds the board's right to maintain an action to protect its quotations, notwithstanding the sale of the right to the telegraph companies to distribute the same.

BULLOCK COMPANY INDUCTION MOTORS. On Saturday, May 2, 1903, the U. S. Circuit Court for the Southern District of Ohio issued a restraining order against the Bullock Electric Manufacturing Company, of Cincinnati, restraining it from manufacturing or dealing in alternating current polyphase induction motors, which, it is held, are infringements of the Tesla patents of May 1, 1888, now owned by the Westinghouse Electric & Mfg. Company.

A STOCK QUOTATION DECISION. At Buffalo, N. Y., on April 29, Judge Hazel, in the United States District Court, handed down his decision in the suit brought by the Board of Trade of Chicago against the Consolidated Stock Exchange, of Buffalo, and others. The decision is in favor of the defendants. A motion by the plaintiff for a temporary injunction is denied. The plaintiff wanted a temporary injunction restraining the defendant from using "continuous" market quotations in Buffalo as published on the Exchange floor in Chicago. The basis of the application, according to the decision, was a contract between the complainant and several telegraph companies, and the alleged unlawful use by the defendants of the quoted market prices. The relations established by the contract, the decision states, restrict the publication by the telegraph companies of "continuous quotations" to companies and individuals who are their patrons and subject to certain stipulated contracts.

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PERSONAL.

PROF A. G. BELL is the subject of an excellent front page, full-page portrait in the *Scientific American* of May 2.

MR. ANGUS S. HIBBARD, general manager of the Chicago Telephone Company, has been made second vice-president.

MR. HARRY DIXON, of Wickford, R. I., bought recently the commercial electric lighting plant of the Wickford Worsted Mills.

MR. WM. STANLEY, JR., has sailed for Europe, although it is not long since he returned to this country from that part of the world.

DR. THOMAS ADDISON, district manager of the General Electric Company, with headquarters in San Francisco, has returned to that city after visiting New York.

PATTISON BROS., the consulting electrical engineers, New York City, have moved uptown and have taken offices in the famous "Flatiron" Building, at Fifth Avenue and Twenty-third Street.

MR. JOSEPH B. HALL, recently sales representative of the Power & Mining Department, General Electric Co., Chicago, is now chief engineer of the McGuire Manufacturing Co., of the same city.

MR. H. F. HILL will, it is understood, be appointed general manager of the Central Union Telephone Company, as a result of the changes due to and consequent upon the resignation of Pres. John I. Sabin.

MR. T. W. SEAMAN, treasurer of the Westinghouse Electric & Mfg. Company, is a director in the new Gibraltar Trust Company, recently formed in New York with a capital of $500,000 and a surplus of like amount.

MR. T. A. EDISON is reported to be developing for some people interested in the subject a method of dry placer mining, employed devices similar to those worked out in his magnetic ore crushing and cement making processes.

MR. H. L. CANFIELD, who controls the interests of the Delphos, Ohio, Electric Light & Power Company has been granted a 25-year franchise by the City Council for a telephone system, and will install an up-to-date exchange plant.

MR. J. F. STAUFFER.—We regret to learn as we go to press the news of the death of Mr. J. F. Stauffer, president of the Geo. C. Towle Mfg. Co., of Lancaster, Pa., well known as manuafcturers of stationary motors, electric fans, etc.

MR. A. MEYER, president of the Crescent Company, Chicago, sailed on the steamship *Statendam*, April 22, for a European trip, his intention being to introduce the cord adjuster, soldering stick and other specialties made by this company, to the dealers in Europe.

MR. GORDON, of the turbine department of the British Westinghouse Electric & Manufacturing Company's Manchester works, who has been on this side for some weeks past studying the building of turbines at the Westinghouse plants, Pittsburgh, has sailed for home.

MR. B. A. BEHREND, the chief electrical engineer of the Bullock Electric Mfg. Company, of Cincinnati, is the worthy subject of the company's illustrated portrait biographical calendar for May, just issued. He was born in Pomerania in 1875 and left the Oerlikon service in 1899, coming to the United States.

E. P. ROBERTS & CO., consulting engineers, Electric Building, Cleveland, O., announce that owing to the increasing demands of their Eastern business they have opened a branch office at 25 Broad Street, New York City. This office has been placed under the management of William C. Andrews, E. E., Eastern representative of the company, as already announced in these columns.

MR. WILLIAM H. NISBET, of Sidney, N. S. W., formerly superintendent of motive power of the Queensland government railways, who now represents the Westinghouse Air Brake interests in Australia, is at present in this country for the purpose of making arrangements to represent other American concerns seeking business in the Antipodes. Mr. Nisbet is a guest at the Holland House.

MR. T. J. COPE, 3244 N. 15th St., Philadelphia, the well-known contractor and manufacturer of appliances for telephone cable and conduit work, has recently returned from an extended trip through the West, including a number of cities where he is installing cables. Mr. Cope also reports the sale of large quantities of Cope cable racks, and conduit rods on this trip. He finds great activity in the telephone field.

MR. LOUIS T. GRANT, managing engineer of the firm of Michael, Gaspar, Grant & Co., Ltd., Manila, P. I., writes us confirming the news of the recent White, Swift, Westinghouse street railway deal there, as already noted in Iloilo [illegible]. He also states that [illegible] electric light plant has been installed in the city of Iloilo, which is doing well. There are several electric railway projects afloat in the provinces. The city of Manila has a new tramway and the [illegible] system just installed and giving good service.

NEW YORK ELECTRICAL SOCIETY.—At the meeting of the New York Electrical Society last week the following-named gentlemen were elected to membership: N. B. Trethewey, C. G. Young, Jeremiah J. Kennedy, Morris Hoopes, Percy [illegible] Cowing, Fred W. [illegible], John H. N. Vanzandt, F. H. Foster, Frank I. Hill, Wm. D. Bruning, Wilson S. Howell, Frederick Arthur Coates, Joseph W. Tracy, Martin J. Insull, George F. Conkling, Eugene P. Lyle, John D. Kelly, Anthony F. Nimmo, Harry C. Hall, J. T. Bentley and R. R. Hutton.

MR. D. H. ERWIN, of Muskegon, Mich., has a franchise for the construction of 4 dams on the Muskegon River between Big Rapids and the Newaygo County line, two of them 14 feet head and one a 18-foot. Each of these dams will develop at ordinary stages of the river five or six thousand horse-power. It is understood that Grand Rapids and Eastern capitalists are behind the project, and that work will be commenced at once on the first dam, and rushed to completion, as the promoters claim to have a ready market in Grand Rapids for the entire output of one dam.

MR. J. B. ORR, the commercial partner resident at Rio de Janeiro of James Mitchell & Company, sailed May [illegible] for home, after several weeks visit to the United States. Mr. Orr, while here, made arrangements for the extensive importation into Brazil of American cotton making machinery. Hitherto that market has been taken care of exclusively by British manufacturers. The Mitchell firm will handle the looms of the Northrup Loom Company, of Hopedale, Mass. The machinery will be in many instances electrically operated. Mr. Orr also placed orders for several small electric lighting plants to be installed in Rio and vicinity.

BARON VON RHEINHABEN, the Prussian Minister of Finance, has sailed for New York from Bremen on the North German Lloyd steamer *Kaiser Wilhelm der Grosse* to remain six weeks in America, for the purpose of studying the economic conditions of the United States. He will bring with him Commercial Councilman Boeker, an ironmaster of Remscheid, Prussia, and Frederick von Versen, Deputy Consul General of the United States in Berlin. The Baron does not speak English fluently, and von Versen will act as his interpreter. The Baron is especially interested in iron and in railroad and water transportation. He will visit Pittsburg, the electrical works at Niagara, the Erie Canal, the Welland Canal and the Sault Ste. Marie Canal.

MR. T. TAIT, the recently appointed Commissioner of Victorian Government Railways, Australia, left Vancouver, May 1, by the Canadian Pacific steamship *Miowera*, for the purpose of assuming his new position. Mr. Tait is a Canadian and was formerly connected with the Canadian Pacific Railroad. Before sailing he secured considerable data at the request of the Victorian Government, regarding American electric traction methods, etc., as it is proposed to convert electrically the horse and cable car system in Melbourne. The Sydney electric traction system is built and operated by the New South Wales Government under the supervision of the railroad commissioners of that state, and it is anticipated that the Melbourne system will be converted and worked by the Victorian Government under the direction of Mr. Tait and his associates.

BELL TELEPHONE APPOINTMENTS.—The following named gentlemen have been elected vice-presidents of the American Telephone & Telegraph Company: E. J. Hall, vice-president and general manager of the New York Telephone Company; George W. Cumming, formerly vice-president of the Erie Railroad; General Thomas Sherwin, president of the New England Telephone Company; C. J. French, general manager of the American Bell Company. They will retain their respective positions with the sub-companies. L. T. Richardson, solicitor for the Central Union Telephone Company will be elected president, succeeding General Sabin, who returns to take exclusive charge of the Pacific Coast Telephone Company. Arthur D. Wheeler, a director of the Chicago Telephone Company, will be elected president of that company, succeeding General Sabin.

MR. G. MARCONI arrived in Rome recently from London, and a new agreement between him and the Government has been made public. The agreement will include the establishment of a system of twelve stations of the average range of 300 kilometers. All the stations will be ready a year from next July. Two of them are to be an augmentation of those already erected at Punta di Vela and Montemario, and will be exclusively for military use. The others, for both military and commercial use, will be erected at Capo di Leuca, near Gaeta, at Elba, and at Asinara. Under the new agreement Signor Marconi cedes his apparatus to the Government free of charge, but with the following stipulations: Receipts from the coast stations are to be paid in to the National Treasury; receipts from dispatches sent from ships provided with the Marconi apparatus will go to the Marconi Company; moreover, the State will receive a fixed tax of one lira per message above the usual cost of telegrams.

MR. WILLIAM KENT. We note with pleasure that Mr. William Kent, of New York City, has been selected for the position of Dean of the L. C. Smith College of Applied Sciences of Syracuse University. Mr. Kent is a man of thirty years' practical experience, and occupies a high position in the engineering world. He was born in Philadelphia, March 5, 1851. He was graduated from the Central High School of Philadelphia in 1868, and from the Stevens Institute of Technology in 1876. He married in 1879 Miss Marion W. Smith. Mr. Kent was editor from 1877 to 1879 of the American Manufacturer and Iron World of Pittsburg, after which, until 1890, he held the position of mechanical engineer and superintendent in various iron, steel, and boiler concerns. Since 1890 he has been a consulting engineer, and in 1895 became associate editor of *The Engineering News*. Mr. Kent is a member of the American Institute of Mining Engineers, American Society of Mechanical Engineers and a Fellow of the American Society of Applied Sciences. He is the author of "The Strength of Materials," "Strength of Wrought Iron and Chain Cables," and various works on similar subjects.

Trade Notes.

THE RUSHMORE DYNAMO WORKS have removed their office and works to Plainfield, N. J.

THE WARREN ELECTRIC MANUFACTURING COMPANY, Sandusky, Ohio, has shipped a 3,000-light dynamo to the St. Louis Exposition.

FISH PAPER.—We have an inquiry for "fish paper" or "fish board" for electrical insulating purposes, and shall be glad if any of our readers can inform us where and by whom it is made.

THE AMERICAN TIN PLATE CO. has just sent its 25th order for oil filters to the Burt Mfg. Co., Akron, Ohio, making thirty filters now in use in its works.

SIMPLEX ELECTRICAL COMPANY has moved its Chicago office to 1114-16 Monadnock Block, and its warehouse to the basement, N.W. corner of Dearborn and Harrison Streets. Mr. H. R. Hixon is Western selling agent.

ALLIS-CHALMERS COMPANY, Chicago, announces that after May 1 the general offices of the company in that city will be located in the New York Life Building, corner La Salle and Monroe Streets, on the fourteenth floor.

REFINING METALS. The New York office of Croselmire & Acker is now located at 10 East 23d Street. This company has headquarters in Newark, N. J., where it refines metals, making a specialty of platinum for electrical work.

LAMP FACTORY ON PACIFIC COAST.—The Charles L. Sloane Company has leased two 50x100-foot floors in the new Kahn building in Oakland, Cal., which will be occupied by the company's incandescent lamp factory. About 300 employees will be required at the new plant.

MESSRS. ROSSITER, MACGOVERN & CO., on May 1st moved their offices to the Whitehall Building, Battery Place, New York, where they are occupying about 2,400 feet of space, and where they will be pleased to welcome their friends. Incidentally it may be mentioned that the finest view obtainable of the New York harbor is from the windows of this firm.

YOST ELECTRIC MFG. COMPANY, of Toledo, Ohio, makers of the Yost socket, state that owing to the great number of orders and inquiries from the Eastern territory, they have found it necessary to open an office in New York City, located at 120 Liberty Street, under the management of Mr. George A. Amble.

THE SOUTHWEST ELECTRICAL COMPANY, of San Bernardino, Cal., we are informed by Mr. J. H. Curtis, 482 Third Street, proposes to develop along the line of construction work, installing plants, erecting pole lines, constructing roadbeds and tracks, etc. It does not intend, at least for the present, to go into any line of manufacturing.

THE CENTRAL ELECTRIC COMPANY, of Chicago, reports that so far this spring it has received more orders for Stombaugh guy anchors than ever before. It attributes this to the fact that the Stombaugh is easy to install, is cheap, will stand a great strain, and will give satisfaction in general. A descriptive pamphlet will be sent upon application.

MR. GEORGE T. HANCHETT has removed his office from 116 Nassau Street to the Engineering Building, 114-118 Liberty Street, New York. At this location he is continuing his engineering business, having largely increased his laboratory facilities. Mr. Hanchett's specialty is electrical and mechanical machine design and electrical testing and reports on materials, apparatus and installations.

THE ELECTRIC APPLIANCE CO., Chicago, states that it has served notice on all alternating current electric lighting plants that it has instituted a vigorous campaign against them on the subject of Gutmann watt-meters. If there is an alternating plant in the United States not receiving this meter literature, it is an oversight which the company says will be promptly corrected if notification is sent in.

REMOVAL. The Mica Insulator Company, Ltd., of Stansted, Essex, England, has removed its works to Blackhorse Lane, Walthamstow, London. The necessity for making this change was occasioned by the increase in the company's business and the desirability of choosing a location more convenient for transportation and prompt deliveries. The new works were specially built to meet the company's requirements.

SPRAGUE GENERATORS.—Bulletins Nos. 101 and 102 of the Sprague Electric Company, New York, relate to direct-current generators of the single field coil type and of the split pole type, respectively. The machines of these two types are very clearly illustrated and the detail views show in a very clear manner the construction of the machines. The two bulletins are gotten up in the company's usual artistic manner.

CHANGE OF FIRM NAME.—The business conducted by Mr. H. E. Maxfield, resident agent for Lawrence centrifugal pumps at 39 Cortlandt Street, New York, has been changed and will now be known under the firm name of H. E. Maxfield & Co., with offices at 136 Liberty Street. All inquiries for centrifugal pumping machinery, house pumps, hoisting engines and general machinery will be given prompt attention.

PHONO-ELECTRIC WIRE. Large export sales of the Phono-Electric wire of the Bridgeport Brass Company are reported. It has already attained great popularity abroad. Orders have been received from the Dublin United Tramways, Glasgow Corporation Trams, Walsall Corporation Tramways, and many of the large street railway companies of Great Britain are reported to be using it. The sales in the United States are also continuously on the increase.

THE BASSETT-PRESLEY COMPANY, Cleveland, O., dealer in iron and steel supplies of all kinds is preparing to take up the sale of telephone supplies such as bare and insulated wire, cross arms, insulators, bolts, rivets, etc. The company is erecting one of the largest warehouses in the West in which the entire business will be located. The establishment is situated on Clifton

Street, near the Cleveland & Pittsburg Railway, and the building is 360x150 feet of brick and steel and two stories high.

THE EMPIRE WIRE COMPANY, which was organized about one year ago and took over the business of C. M. Garrison, Spargo Wire Works Company, and Empire Insulated Wire Company, all of 100 William Street, New York City, the latter two having factories at Rome, N. Y., has found it necessary to increase its capacity for the manufacture of magnet wire in order to handle its rapidly growing trade. To do this it has taken over the mill of the Granite State Electrical Works, at Lisbon, N. H., which has been thoroughly remodeled and equipped with new modern machinery and placed in charge of a man who has been assistant superintendent for the Empire Wire Company and the Empire Insulated Wire Company for several years. It is now turning out from this mill a wire, the quality of which is equal to that which it has heretofore made at its old factories. To look after the requirements of its western trade, the company has opened an office and stock-room at 60 West Van Buren Street, Chicago, Ill., in charge of Mr. A. D. Forney. On May 1st, the general offices of the company were moved to 92 William Street, New York City.

HARRISBURG ENGINES.—Mr. W. R. Fleming, president and general manager of the Harrisburg Foundry & Machine Works, in a circular letter makes the following very interesting announcement: "The Harrisburg Foundry & Machine Works have received a contract for one of their latest standard compound engines from a source which would seem to reflect even higher credit upon the products of this concern than from almost any other source among their many high class purchasers. This order comes from the United States Government for a model machine to be used in a new bureau created by the Government, to be known as the National Bureau of Standards. In this bureau will be tested and displayed the highest examples of engineering appliances produced in the United States. The Harrisburg engine will be used for driving electric generators to be made by the General Electric Company, and the capacity is about 150-hp. It is not the size of the contract so much that makes this sale remarkable, as it is the fact that Harrisburg machinery was selected by experts employed by the Government to use as an example of the highest art of its kind. It is also interesting to note that the order was received at a price very considerably higher than other makes of machinery for which much was promised, but it did not satisfy the severe requirements made necessary by the Government's purpose in establishing a Bureau of Standards."

SMOKELESS COMBUSTION.—The question of smokeless combustion is always an interesting one to the managers of electrical power stations. The Duluth Stoker Company, Duluth, Minn., manufactures a stoker which possesses many features of interest to engineers. Briefly, it consists of an endless belt of grate bars, the bars lying crosswise in the furnace parallel to each other and are carried by two endless chains, one on each side of the furnace. An independent engine is usually installed to drive each line shaft, and from two to eight stokers may be driven from any one shaft, as circumstances demand. The economy of these stokers is stated to be due, in part, to the fact that the heating surfaces are kept free from soot deposit, rendering them capable of readily absorbing the intense heat generated by the stoker fire. The body of the stoker is composed almost entirely of structural steel and the driving gear is enclosed in an oil-tight and dust-proof casing, insuring easy working and freedom from destructive wear. An illustrated pamphlet describing these stokers has recently been issued by the company, a copy of which may be obtained on application.

ALBERT FRANK & COMPANY, general advertising agents, have removed their offices from the Empire Building to the Broad Exchange Building, 25 Broad Street, New York. This change of location was necessary to obtain more room to transact the steadily increasing volume of business of the company. The new offices occupy a floor space of over 3,000 feet or nearly twice the area of the old ones. They have been fitted up with all of the latest office facilities and improvements that are essential for the rapid dispatch and accurate handling of business. The filing room has received special attention. In it all leading publications of this and foreign countries will be carefully preserved in a systematic manner, so that, at a moment's notice, any copy will be readily obtainable. The new location is in the heart of the financial district. It will be remembered that shortly after the death of Albert Frank, the founder of the agency, the surviving partners, James Rascovar and Collin Armstrong, organized the business as a corporation with the first named as president and the last as treasurer. Since then the company has developed its commercial department extensively, and has increased its facilities for placing advertisements in all parts of the world.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 28, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

726,241. ELECTRICAL COOKING APPARATUS; James I. Ayer, Malden, Mass. App. filed Sept. 10, 1900. The bottom of the cooking utensil has a flange which fits over a circular heating surface and a latch for fastening it in place thereon.

726,269. ELECTRIC TRACK CIRCUIT AND METHOD OF INSULATING SAME; Edward A. Everett, Detroit, Mich. App. filed Feb. 10, 1902. The surface of the ties beneath the rails and the joints between the rails are coated with oil.

726,272. STORAGE BATTERY; Fritz A. Feldkamp, Newark, N. J. App. filed July 8, 1902. The electrode consists of sheets of fabric upon which the active material is spread and thin sheets of lead against the faces of which the fabric is secured by stitching.

726,274. SECONDARY BATTERY; Pietro Figuccia, Boston, Mass. App. filed May 22, 1902. The grid is composed of a series of parallel bars, each having a longitudinal groove in its two opposite faces, containing the active material.

726,292. BURGLAR ALARM SYSTEM; Edwin T. Holmes, New York, N. Y. App. filed July 18, 1900. To insure calling attention to an alarm, a clock work is set in operation which repeats the signal for a considerable period of time.

726,293. EXHAUSTING LAMPS; John W. Howell, Newark, N. J. App. filed Nov. 9, 1897. The method consists in pumping off the air from the bulb, closing the connection between the pump and bulb without the aid of heat, volatilizing the chemical within the bulb to absorb the remaining gases then sealing the bulb.

726,301. ELECTRIC RECORDING SYSTEM; Joseph C. Huss and George W. Schilling, Philadelphia, Pa. App. filed Dec. 18, 1902. A device used as a guard over workmen to show when certain operations were performed and the period of the performance.

726,302. ELECTRICAL CONTROL OF ELEVATORS; John D. Ihlder, Yonkers, N. Y. App. filed April 11, 1902. The arrangement includes the use of controlling circuits of different potentials, each of which controls the other in such manner that control of the car from the stations is prevented after the car has come to rest.

726,303. MOTOR CONTROLLING APPARATUS; John D. Ihlder, Yonkers, N. Y. App. filed May 5, 1902. Apparatus for controlling induction motors consisting of fixed and variable resistances in the three-phase secondary circuit and means for short circuiting the variable resistances without varying the fixed resistances as the motor starts.

726,307. AUTOMATIC CONTROL SYSTEM FOR ELEVATORS; Benjamin N. Jones, East Orange, N. J. App. filed Jan. 13, 1903. In a push button system means are provided to prevent outside interference with the car after it has stopped at its destination and before its passenger has alighted from the car and closed behind him the door of the landing.

726,327. SWITCH REGULATOR; Walter S. Moody, Schenectady, N. Y. App. filed Aug. 21, 1902. A switch having its neutral position between two operative positions and a lock for preventing the movement of the switch into one of the operative positions without first moving it into the other.

726,328. FIXTURE FOR VACUUM TUBE LIGHTING; Daniel M. Moore, Newark, N. J. App. filed April 15, 1898. A socket for the end of the vacuum tube in which the clamps and connections are hidden from view.

726,331. ELECTRIC CUT OUT; Lewis J. Mulvaney, Kingsbridge, N. Y. App. filed Sept. 8, 1902. Details.

726,347. FASTENING FIELD MAGNETS TO SPIDERS; Henry G. Reist, Schenectady, N. Y. App. filed Oct. 18, 1901. The laminated pole piece is clamped to a base plate and the latter clamped to the ring of the spider.

726,360. MICROPHONE OR MICROPHONE-TRANSMITTER FOR ELECTRICAL SOUND TRANSMISSION; Friedrich Wilhelm Senkbeil, Offenbach-on-the-Main, Germany. App. filed Jan. 11, 1902. (See page 800.)

726,361. ELECTRICAL SWITCH LOCK; Christopher A. Shea, Philadelphia, Pa. App. filed Feb. 12, 1902. The train automatically locks the switch mechanism of a railway track.

726,364. ELECTRIC FURNACE; Ernst A. Sjostedt, Sault Ste. Marie, Canada. App. filed Sept. 20, 1901. Details.

726,366. DOOR BELL ATTACHMENT AND BURGLAR ALARM; Elbert Snedeker, Brooklyn, N. Y. App. filed March 26, 1902. By suitable switching devices, the bell can be used either as a door bell or burglar alarm.

726,368. ELECTRICAL DISTRIBUTION AND SELECTIVE DISTRIBUTION; John Stone Stone, Boston, Mass. App. filed April 4, 1894. A number of receiving circuits are tuned for different frequencies, each therefore responding only to that frequency of a number impressed on the transmitting circuit for which it is tuned.

726,370. SAFETY DEVICE FOR ELECTRIC ELEVATORS; August Sundh, Yonkers, N. Y. App. filed Sept. 12, 1902. The motor armature and the brake are in separate circuits controlled by a single switch.

726,391. MEANS FOR VARYING DELTA-CONNECTED VOLTAGES; Albert H. Armstrong and Jonathan E. Woodbridge, of Schenectady, New York. App. filed April 28, 1903. One or more sections of each secondary of a three-phase transformer is cut in or out.

726,413. TRANSMITTING AND RECEIVING APPARATUS FOR HERTZIAN WAVES; Eugene Ducretet, Paris, France. App. filed Nov. 1, 1901. The number of spirals in a solenoid in the receiving and transmitting circuit is adjustable by means of a sliding contact.

726,445. MEANS FOR CONNECTING MULTIPHASE WINDINGS; Walter S. Moody, Schnectady, N. Y. App. filed Feb. 3, 1902. The connection of multiphase windings in delta in such a manner that varying voltages may be obtained therefrom.

726,468. PROCESS OF FORMING ACCUMULATOR ELECTRODES; Gordon J. Scott, Philadelphia, Pa. App. filed Feb. 28, 1902. Consists in separating the electrodes during the forming operation by a baffle interposed between the electrode in such a manner that it will enable current to pass directly from one electrode to the next through the baffle and will permit the electrolyte to pass from one electrode to the other, but compel its passage to be along devious paths.

726,476. ELECTRICAL DISTRIBUTION AND SELECTIVE DISTRIBUTION; John Stone Stone, Boston, Mass. App. filed April 4, 1901. Combination patent of method patent 726,368 preceding.

726,489. MECHANISM FOR CONTROLLING ELECTRIC CIRCUITS; George A. Tate, Chicago, Ill. App. filed Nov. 25, 1901. A circuit breaker is in a circuit controlled by an indicator in the main circuit.

726,486. INSULATING MATERIAL; Willis R. Whitney, Boston, Mass. App. filed May 4, 1900. Consists of very thin sheets of flint glass cemented together by a flexible binding material.

726,497. CARBON HOLDER FOR ELECTRIC ARC LAMPS; Harry P. Bayley, Chicago, Ill. App. filed Jan. 2, 1902. Details.

726,513. RAILWAY SIGNALING DEVICE; Edwin M. Cutting, Oakland, Cal. App. filed Aug. 19, 1902. A signal disk half of one color and half of another, operated in connection with blinders which cover either part and disclose the other.

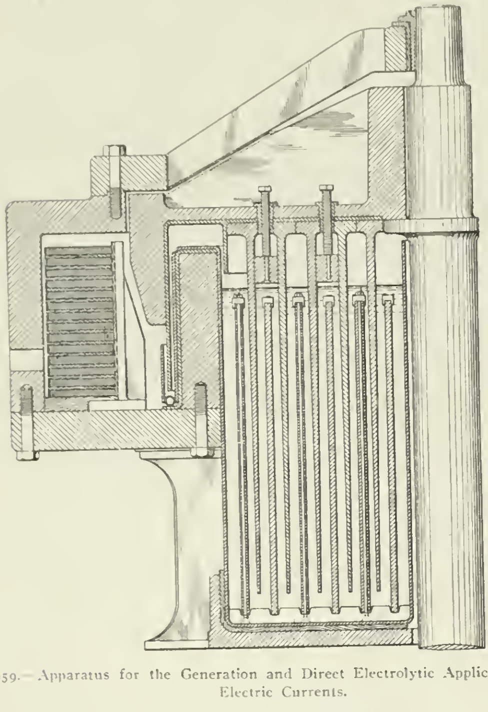
726,536. MECHANISM FOR DRIVING SHAFTS AT VARIABLE SPEED BY MEANS OF ALTERNATING CURRENT MOTORS; Otto Holz, Schenectady, N. Y. App. filed Aug. 15, 1902. A power shaft and a shaft to be driven, with intermediate connecting mechanism comprising two independently rotatable members, a closed winding on one member, a primary winding on the other, a direct current exciter for the primary winding driven by the power shaft and means for connecting one member to the power shaft and the other to the driven shaft.

726,548. CHARGING DEVICE FOR STORAGE BATTERIES; Hermann Lemp, Lynn, Mass. App. filed July 20, 1901. A charging station for electric vehicles comprising a casing containing the current supply devices and having a locked door the key to which is carried by the cabman.

726,566. PRINTING TELEGRAPH SYSTEM; Wm. P. Phelps, Merchantsville, N. J. App. filed March 6, 1902. The auxiliary main line which is used to actuate the press-shifting apparatus in double-type wheel printing systems is also utilized to convey currents from the transmitter to drive a spring winding apparatus by which the type wheels of the printers are rotated.

726,587. TROLLEY WHEEL; Charles S. Stanton, Hartwick, N. Y. App. filed Aug. 20, 1902. Details.

726,593. ELECTRIC CONTROL MECHANISM; Elihu Thomson, Swampscott, Mass. App. filed Oct. 29, 1900. An automatic device for cutting out resistance is connected with a hand controller in such a manner that the latter is locked while the resistance is being cut out and only unlocked after the resistance has been removed.



726,659.—Apparatus for the Generation and Direct Electrolytic Application of Electric Currents.

726,599. THIRD RAIL SUPPORT FOR UNDERRUNNING THIRD RAIL ELECTRIC RAILWAYS; Leonard Wheeler, Wheaton, and John T. Murphy, Chicago, Ill. App. filed Feb. 24, 1903. A screw carried by the supporting bracket bears laterally against the third rail to hold it in its seat.

726,600. RAIL CONTACT SHOE AND SUPPORT THEREFOR; Leonard Wheeler, Wheaton, and John T. Murphy, Chicago, Ill. App. filed Feb. 24, 1903. The shoe is arranged to co-operate with either an over or under contact third rail.

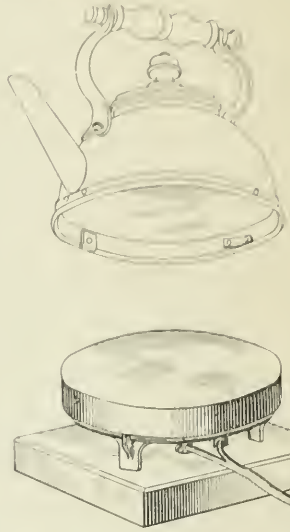
726,605. FUSE BOX; Elmer A. Wilson, Niles, Ohio. App. filed May 13, 1901. Details.

726,651. ELECTRIC WIRE SUPPORT; Beauregard Cullen, New Albany, Ind. App. filed July 14, 1902. Details.

726,659. APPARATUS FOR THE GENERATION AND DIRECT ELECTROLYTIC APPLICATION OF ELECTRIC CURRENTS; Francis E. Elmore, London, England. App. filed Jan. 10, 1902. An electrolytic cell is built into the same structure with a unipolar dynamo, the armature of the latter being directly connected with the electrodes of the cell.

726,687. MAGNETO; Chas. W. Holtzer, Brookline, Mass. App. filed Feb. 16, 1901. Details.

726,691. TELEGRAPH SYSTEM; Charles K. Jones, Tuscumbia, Ala. App. filed May 14, 1902. An alarm is sounded at a local station in the event of the main line being left open.



726,241.—Electric Cooking Apparatus.

726,704. RECTAL OR VAGINAL SPECULUM; Otto H. Kohlhass, Calumet, Mich. App. filed Dec. 29, 1902. An instrument by which cautery and other operations can be performed in the rectal or vaginal passages.

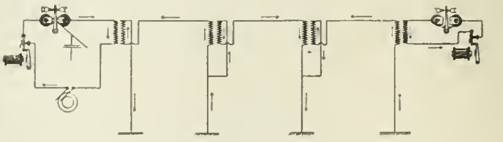
726,721. THIRD RAIL GUARD FOR ELECTRIC RAILWAYS; Jacob Martin, New York, N. Y. App. filed Jan. 23, 1903. A flexible cover over the third rail is opened by a plow as the car moves along to admit the collecting device.

726,725. SYNCHRONOUS CODE TELEGRAPHY; Edwin F. Northrup, Philadelphia, Pa. App. filed Oct. 10, 1902. Consists in sustaining upon a circuit a succession of periodic impulses and forming the characters of a Morse code by changing the phase of a number of impulses for each element the characters of the code being independent of a preselected number of impulses, but dependent upon the relation between the number of impulses modified to form one element and those modified to form another element.

726,734. ELECTRIC CIRCUIT; Edwin F. Northrup, Baltimore, Md. App. filed Sept. 27, 1901. To protect the terminal instruments of a telegraph circuit from disturbance from foreign or induced currents the line is divided into sections in each of which at a given instant the current flows in the opposite direction to that in an adjacent section and neutralizes the inductive effects of one section upon another.

726,736. SYNCHRONOUS CODE TELEGRAPHY; Edwin F. Northrup, Philadelphia, Pa. App. filed Oct. 10, 1902. Apparatus for carrying out the preceding method.

726,750. MEANS FOR PRODUCING SYNCHRONOUS MOTION; Louis M. Potts, Baltimore, Md. App. filed Dec. 10, 1901. Maintaining synchronism by closing and opening at definite intervals a shunt circuit of resistance, capacity or self-induction, around the motor armature or around a resistance in series therewith.



726,734.—Electric Circuit.

726,831. METHOD OF CONNECTING MULTIPHASE WINDINGS; Walter S. Moody, Schenectady, N. Y. App. filed Feb. 3, 1902. The method corresponding to the apparatus covered in patent 726,445.

726,832. LOCKING DEVICE; Charles F. Ritchel, Bridgeport, Conn. App. filed Oct. 13, 1902. A device for fastening metallic parts to porcelain bases.

726,835. TELEPHONIC APPARATUS; Frank W. Wood, Newport News, Va. App. filed Aug. 1, 1902. (See page 800.)

726,836. TELEPHONIC APPARATUS; Frank W. Wood, Newport News, Va. App. filed Aug. 7, 1902. (See page 800.)

Electrical World and Engineer

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ELECTRICAL WORLD AND ENGINEER.

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

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NEW YORK, MAY 16, 1903.

CONTENTS.

Editorial 819
Progress of the Work for Union Engineering Building 822
N. E. L. A. Special Train for Chicago 822
International Electrical Congresses 822
Branly-Popp Aerial Telegraphy System. By Henry Hale 823
Boise, Idaho, Transmission Plant 825
Field Coil Formulas. By Thorburn Reid 826
Safety Devices in Central Stations and Sub-Stations 828
Wireless Telephony on Ferry Boats. By A. Frederick Collins 829
Operation of Berlin Electric Roads 830
The Storage Battery in Transmission Plants. By H. S. Knowlton 831
Heating of Electrical Conductors in Liquid Baths 831
Electricity and Seismic Phenomena 832
Chicago Discussion of Central Station Tendencies 832
How to Produce Gravity Experimentally. By Robert Stephenson, C. E. 833
New Telephone Patents 834
Recent Electrochemical Developments. By Clinton Paul Townsend 835
Electricity at New York Military Tournament 835
Current News and Notes 836
LETTERS TO THE EDITORS:
  Parallel Operation of Direct Connected Alternators. By Frdr. W. Knopfe 836
  The Vancouver Power Plant. By K. G. Dunn 837
  Fuel Consumption in Central Stations. By Joseph E. Lockwood 837
Digest of Current Electrical Literature 838
New Books 842
New Westinghouse Electric Train Control and Couplers 843
A Long Trolley for Canada 843
A Twenty-Ton Switching Electric Storage Battery Locomotive 844
Switchboard Speed Control of Water Wheel Governors 844
Pillsbury Alternating Current Ceiling Fan 845
DEPARTMENTS:
  Financial Intelligence 846
  Commercial Intelligence 847
  General News 849
  Trade Notes 853
  Record of Electrical Patents 853

THE UNION ENGINEERING BUILDING.

Last week we were able to lay before our readers some of the details connected with the magnificent gift of one million dollars to build a home in this city for the four national engineering societies and the Engineers' Club. As will be seen from our pages this week, the news has been acted upon promptly by the great bodies affected, and, having thanked Mr. Carnegie in an informal but enthusiastic manner, they are now proceeding to give due official form and validity to acceptance by the entire membership.

No one event has ever meant quite so much to the engineering professions in America as this recognition of them by one who gladly admits that to them he owes much; and we can but believe that the course of events will thoroughly justify Mr. Carnegie in the trust he has laid upon his fellow-members and friends, and witness the creation of a great, noble, enduring and useful engineering center. The best proof of the impression made upon engineers in general and of their eager readiness to carry out the plan, is shown by the remarkable unanimity of the engineering press of the country. With but one exception and that due apparently to an utter want of comprehension of what has been given and what is intended, the technical press has united in praise of the movement and in urging upon the bodies and the individual members to be prompt in putting through the necessary plans for executing the project, so long a faint, vague hope but now destined to splendid realization.

That any society should fail to accept its share of the gift is dismissed by everybody as incredible. The possible exception would be the Civil Engineers, because they have a house of their own, and would naturally be loath to give it up. But the building they have is confessedly in some respects a failure. It is rather inaccessible and far away from the social and club center of the city. There is Mr. Gould's stable in front of it, ornate it is true, but hardly good company. The one large auditorium is a very poor place for meetings, with bad acoustics and susceptible of no change of size to accommodate varying audiences. The library is admirable, but to-day it does not and cannot represent engineering as will the federated libraries under the one roof of the union building, each section probably with its own staff and each having more money to spend on its legitimate specialties because of avoiding duplication. Besides, the great New York Public Library will be just across the way, and it is altogether fit and seemly that the joint engineering library should be near that literary heart of the city. Under all the circumstances, there is every reason why the Civil Engineers' Society should come in, and not one for staying out. If its members decide to go on alone, it will be a pity, but the plan will be carried out, of course, just the same, and under the terms of Mr. Carnegie's gift and his statements, the other bodies will have just that much more to spend for themselves and others.

We trust and believe that all branches of engineering will now be brought together for the specific purpose of erecting the building, and we would like to point out that every member in perhaps all of the societies will have an opportunity to prove his own generosity by gifts of money and service. Mr. Carnegie has made the whole thing the easiest in the world to execute by advancing also the money, without present interest, to finance the acquisition of the land by the four societies, but the American Institute of Electrical

Engineers, for example, will be all the better able to discharge its mission if it goes into the new home free of debt, meeting any other society on at least an equal footing as to funds and finances, and excelling them all in number and quality of membership.

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THE CHICAGO CONVENTION.

Our readers will have gathered from the various items that have appeared in our columns that the Chicago convention of the National Electric Light Association will be one of the very best that has ever been known by that useful body. The Association officials have prepared an excellent programme, as will have been noted, while there is every indication that the attendance will be unusually large, if only for the reason that a larger membership can be drawn upon from all parts of the country. Indeed, this increase of membership in the Association is one of the most striking features of its recent history, and we believe that the Chicago convention will do much to invite into fellowship many who have not yet joined. The influence and utility of such an organization depends to no small extent upon its representative character, by which we mean not merely numbers, but quality. In both respects, the Association certainly stands to-day at a higher point than ever, and from the earnest spirit characterizing the work for the Chicago meeting, we draw the brightest auguries for the future. Mr. Ferguson, himself a central station man of the finest type of experience and ability, and a worthy successor to the able presidents already furnished from the Chicago Edison Company, may well feel gratified at the condition of the Association.

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THE VANCOUVER POWER PLANT.

It gives us great pleasure to present in another column a communication from Mr. K. G. Dunn regarding the very unusual hydraulic conditions encountered in this transmission system. We did not at all intend to be censorious in our recent comment, and are glad that it has brought out exactly the information which we desired. In brief, the engineers were confronted with the serious alternative between about seven miles of flume in a peculiarly treacherous soil and about two miles of costly tunnel. The latter was wisely chosen, we should think, since it gave better security against interruptions of service; and substituted a charge substantially fixed for a large and dangerous depreciation and maintenance charge. Incidentally, it gained a certain amount of useful storage capacity. Taken altogether, it is a particularly interesting study in hydraulics presenting a condition which is, so far as we remember, unique. Power transmission problems demand sometimes great finesse in the engineer, who must not hesitate to leave the beaten path whenever by so doing he can get around a difficulty. The treatment of such cases cannot be carried out on a well-defined system, but must be symptomatic, as our medical friends say. The detailed investigation of an instance like that before us is more instructive than the examination of half a dozen conventional plants carried out on canonical lines and requiring no special adaptations. As the development of water powers goes on, the number of difficult cases steadily increases, and powers hitherto unavailable are certain to be conquered and put into harness. Expedients like the Coquitlam tunnel and the great span across the Carquinez Straits are the results of necessity, enforced by the gradual occupation of the easier powers; and as time goes on we are likely to see more and more notable feats of engineering.

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TYPES OF TRANSFORMERS.

We note in the Digest a controversy on transformer design between Messrs Niethammer and Eborall which presents some points of interest. The latter contends that the shell type does not permit of both good efficiency and good regulation under inductive load; to which the former replies that as a matter of fact several large companies actually produce transformers up to the very largest sizes having regulation better than 3 per cent and efficiencies of 98 per cent or so built on the shell plan. To which Eborall retorts that these companies, particularly the two great American ones, cling to this out of date type because it is cheap, and especially because in American practice rotaries are systematically used, so that there is no need of transformers which regulate well on inductive loads of power factor 0.5 or less.

It is far from our purpose to defend the shell type of transformer, but this last argument calls for comment. We are inclined to the opinion that some American engineers are perhaps overfond of rotaries, but if the choice were between the universal use of these and a power factor of 0.5 without them, we do not see how any engineer in his right mind could think for a moment of the latter alternative. Many of our American power transmission plants are operated without rotaries, but we have yet to hear of one with so bad a power factor. We are tempted to inquire what sort of induction motors the Continental makers are turning out, if that be the kind of power factor resulting from their use. To our knowledge some of the Continental makers do build induction motors of singularly high power factors, and we are, therefore, forced to the conclusion that other makers must turn out extremely bad ones. Certainly in American practice, a plant with a power factor of 0.5 would be considered uniquely bad and a monument of incompetent engineering. When American manufacturers have to build transformers to meet such a specification, American engineering will have become a byword and a reproach.

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THE HEATING OF OIL SUBMERGED WIRES.

The experiments of Prof. Perkins referred to on page 831 of this issue, illustrate the variations which may occur in the temperatures of submerged wires carrying electric currents. It is well known that a wire immersed in a liquid possesses relatively large thermal dissipation: i. e., will carry a relatively powerful current without overheating. The heat thus dissipated is almost entirely carried away from the wire by convection, the process of pure thermal conduction in liquids being very slow. That is to say, the thermal conductivity of liquids is relatively very small in comparison with the thermal conductivity of metals. The heating of the layer of liquid immediately in contact with the wire, by the ordinary process of conduction, has the effect of expanding that layer, and thus of setting up convection currents in the liquid, whereby the newly forming layers of liquid around the wire are enabled to absorb heat continuously. When, however, the process of convection is artificially accelerated by stirring, the rate of escape of heat from the wire may be greatly increased. In the experiments referred to, the thermal dissipation during stirring appears to have been seventeen times greater than during the period of non-stirring, when the oil was left to its own natural convection. The ratio of increase in thermal dissipation accompanying stirring would naturally depend upon the geometrical distribution of the parts, the rate of stirring, and the thermal properties of the liquid. In general, it would offer a complex hydrodynamical problem for solution.

It might be possible to construct on this principle a fairly simple form of stream indicator, such as might be used to measure the rate of flow in rivers at different depths below the surface. A short horizontal wire might be held insulated between the prongs of a fork, so as to permit of being submerged to different depths. A portable storage battery and rheostat would enable the strength of current through the wire to be controlled. With the aid of a portable voltmeter and ammeter, it should be readily possible to observe the current strength required to raise the resistance of the wire, by a certain percentage, which would depend in its turn upon the temperature elevation of the wire. The electric power absorbed by the wire, for a given temperature elevation, would increase when the rate of flow of the water past the wire increased, and could be interpreted to indicate, in feet or meters per second, by reference to a table. The apparatus should be dead-beat, swift and capable of a wide range. With such an apparatus the streams in different parts of river bed might be capable of rapid measurement. A similar piece of apparatus might also be made to serve as a dynamometer or wind measurer in the atmosphere. It is well known that the thermal dissipativity of a wire carrying a current in air is largely dependent upon the breeze blowing past the wire. Owing, however, to the essentially unstable and variable condition of the ordinary breeze, both in velocity and direction, the readings of the air-current measurer would probably be less steady and permanent than those of the water current measurer.

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A Preliminary Study for a New Standard of Light.

An article of the above title, by Mr. J. E. Petavel, has recently been printed in the London *Electrician,* and a preceding paper by the same author on a similar topic was communicated to the Royal Society in 1899. In that paper the author quoted experiments to show that the voltaic arc-crater was not a suitable standard source of light, the intrinsic brilliancy of the crater varying in different measurements from 136 to 160 candles per square millimetre. The temperature of the crater under corresponding limits was supposed to vary between 3935 and 4018° C., taking an empirical formula, in which the temperature varies as the 6.9th root of the intrinsic brilliancy. Put in another way, the intrinsic brilliancy of the crater is taken as increasing nearly as the seventh power of the temperature. This is even a more sensitive relation than that of the intrinsic brilliancy of an incandescent lamp filament, which is taken as increasing as the sixth power of the terminal voltage. The conclusion arrived at in the paper is that the arc crater is worthless as a standard source of light. This is not to be wondered at, because, assuming that the temperature of the crater were rigidly constant, and that the intrinsic brilliancy of its surface were likewise constant, the observer can only perceive that brilliancy through the arc flame: i. e., through the vapor and mist of the arc. The luminescence and absorption of these gaseous bodies are no doubt liable to rapid variation, and they may seriously affect the photometer.

On the other hand, the paper described a number of observations tending to show that the Violle molten platinum standard of light was much more reliable. A small bar of platinum is suitably screened so as to admit to the photometer only the light from a measured surface of the heated platinum. The platinum is heated either electrically in one form of apparatus, or by the oxyhydrogen blow pipe in another. After the platinum has been melted, it is allowed to cool off slowly. The intrinsic brilliancy of the glowing surface falls rapidly until the freezing temperature of about 1770° C. is reached. Here the intrinsic brilliancy remains uniform, apparently, until the entire active surface has frozen, and the process of congelation with uniform brightness may last nearly a minute. The conclusion was reached that such a standard light source had a probable variation not exceeding one per cent.

In the more recent paper the author discusses the various means of measuring the temperature of a hot body, such as a bar of molten platinum. He concludes that the only reliable method involves the measurement of the relative intensity of the radiation of two different emitted wave lengths. An experimental study of the properties of screens at various temperatures between 1000° and 1700° C. shows that while glass becomes more transparent to the total radiation as the temperature rises, black fluorspar becomes more opaque. Consequently a pair of thermo-electric coils connected in opposition series with a galvanometer, one illuminated by the arc through glass and the other through black fluorspar, produce zero current and galvanometer deflection at one particular temperature. Under definite conditions, the author regards this temperature as definitely reproducible.

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The Metric System in Great Britan.

The last number of the *Journal* of the British Institution of Electrical Engineers contains a very interesting discussion on the subject of the metric system of weights and measures, held on the 22d of January last. A short paper was read by Mr. Alexander Siemens on the subject, favoring the general and universal adoption of the metric system. The gist of the paper was that international communications, as well as national convenience, rendered a universal systematic system of weights and measures eminently desirable; that the metric system has been successfully adopted by all or nearly all of the civilized nations of the world, except the English-speaking nations; and that no nation that has adopted the metric system has reverted to its primitive savage customs of metrology. Against this presentation, the war-horses of the British inch trotted forth to battle. It was pointed out as an unanswerable argument against the metric system that Napoleon Bonaparte objected to the metric system, and did not think it would work. No one disputes that the Little Corporal was a great soldier, and a man of strong views. But what bearing his preference for the ridiculous then existing French medley of weights and measures over the then new-fangled metric system has on the existing case, it is difficult to see. The old French medley is dead and unressurrectible. So is Bonaparte. In view of events in French history during the last century, it would probably be hard to find a hundred Frenchmen who would now seriously agree with Bonaparte's views on this subject, as quoted.

The conservatives in debate clung not only to British measures, but also to the British pound, shillings and pence, and in the main, for the same reasons. This to Americans will be a flaw in the armor, for practically every American admits that the decimal United States currency is far more simple, logical, rational and scientific than the guinea, pound, crown, florin, shilling, penny, farthing, mite system. It is quite true that an American who writes down his wealth as ten thousand dollars, can by an accidental shift of the decimal point, make himself appear a millionaire. Nevertheless, such errors are very uncommon in good faith. Since then the devotees of the league, mile, furlong, pole-or-perch, rod, link, fathom, yard, foot, inch, mil, barley corn system advocate the retention of the British coinage for substantially the same reasons as for the grand old linear jumble. And since we all know, on this side of the Atlantic, that the decimal coinage is incomparably better, is it not reasonable to suspect that the arguments for the retention of the linear jumble, which we, too, retain as a national fetish, may be similarly unsound?

One gentleman is reported deprecating the use of decimals in currency as compared with the pound, shilling, pence system, because the decimal system "gets rid of a perpetual opportunity of doing a little mental arithmetic." This seems to have been spoken in earnest, and not as a joke. The dollar, cent system is too easy, it would seem. What a blissful example of the principle of "how not to do it" and how beautiful a realization of the majesty of needless labor. Let us make things hard, and keep them hard, that we may have to take extra time to do them, and make education burdensome to every succeeding generation. Wonderful, indeed, is the influence of conservatism! There is no fallacy or superstition so gross that conservatism will not enshrine it. Taken as a whole, the discussion seems to show that there is a large and growing section of electrical engineers in Great Britain who favor the advent of the international metric system.

Progress of Work for Union Engineering Building.

On the evening of May 7, in accordance with invitation, the boards of direction of the several bodies interested, as well as some other members of the different societies, held an informal meeting at the house of the American Society of Civil Engineers, to consider the gift of $1,000,000 from Mr Carnegie for a Union Engineering Building Sixty five gentlemen were present, including President A Noble, of the Civil Engineers, Dr A. R Ledoux,, of the Mining Engineers; J M Dodge, of the Mechanical Engineers; C. F. Scott, of the Electrical Engineers, and J. C. Kafer, of the Engineers' Club. The meeting organized with the election of Mr Noble as chairman and the appointment of Mr T. C. Martin as secretary.

A very free, frank and open discussion of the subject, its advantages and its possible objections, was had, lasting about three hours.

The president of the American Society of Mechanical Engineers, Mr. James Mapes Dodge, reported that at a meeting of their council in the afternoon, the formal resolution proposed in the letter of W. A. Redding, Esq., May 1st, had been adopted, and a committee appointed comprising Prof. F. R. Hutton, C. Wallace Hunt and himself. This committee is to act first as a conference committee, and is authorized to make such changes in harmony with the spirit of the resolution adopted as may be deemed advisable upon conference with committees of the other bodies. The same committee is to be retained as a permanent committee.

The president of the American Institute of Electrical Engineers stated that the board of directors had endorsed the resolution proposed by Mr. Redding, and had appointed a conference committee, comprising Mr. Calvin W. Rice, Mr. T. C. Martin and himself, with instructions to report back a definite form of resolution which should be adopted. He further stated that it was expected by the board that final action would be taken on May 19, as there was a board meeting and also an annual meeting of the Institute on that day.

The president and the secretary, Dr. Raymond, of the American Institute of Mining Engineers stated that their institute would have a board meeting on the following day. Both of the gentlemen, however, were in hearty accord with the plan, and said that they considered it not a question of whether they should come in, but of the best ways and means of doing so.

The American Society of Civil Engineers will probably have a board meeting within the present week. One of the past ex-presidents, Mr. George S. Morison, stated that as they already had a building the conditions were different with their society; but after giving the matter careful consideration, he was of the opinion, speaking for himself, that the relations which they should sustain to the general engineering interests were such that leaving aside their own individual preferences, the society should join with the others.

Representatives of the Engineers' Club expressed hearty accord with the general scheme. Mr. Kafer stated that delegates to the conference would be appointed at the meeting of the officers on May 11. He also stated during the evening that Mr. Carnegie had generously undertaken to finance the land for the societies, and that interest at the rate of 4 per cent. on the land investment would not be asked by Mr. Carnegie until the building itself was finished. Mr. Carnegie's financial agent, Mr. R. A. Franks, had already paid out for them $50,000 in options on the property on West Thirty-ninth Street, which now represented a buying price of $517,000.

Resolutions were adopted without a dissenting vote, expressing appreciation and thanks to Mr. Carnegie for the generous offer which he has made, and a cablegram of gratitude to him for his offer drafted by Mr. Morison was adopted and sent. The resolutions read as follows:

At an informal meeting held on the evening of May 6, 1903, at the house of the American Society of Civil Engineers, attended by members of the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Engineers' Club of New York City, it was resolved.

I. That those present hereby signify their profound appreciation of the recent action of Mr. Andrew Carnegie in donating to the cause of engineering, and in recognition of the engineering profession, the sum of $1,000,000 for the erection of a Union Engineering Building; and also for otherwise making it possible to accept and utilize this sum by his liberal, unencumbered and prompt co-operation in financing a suitable site.

II. That it is their firm belief that the result of this initiative will be potent for good and of far reaching inclusiveness, greatly increasing the effectiveness of the engineering profession, both technically and socially, and with corresponding benefits to the industrial arts and the world at large.

III That they hereby tender to Mr Andrew Carnegie their gratitude for his generous offer.

It was agreed that the Conference Committee, consisting of three representatives from each of the five bodies, should be called to determine upon the next steps and the next action by the several bodies.

Since the above was prepared, the officers of the American Institute of Mining Engineers have met and have appointed Dr. A. R. Ledoux, Charles Kirchhoff and Theodore Dwight as their conference delegates. At a meeting of the board of the Engineers' Club on May 11, Messrs. J. C. Kafer, W. H Fletcher and W. A. Redding were appointed conference delegates.

Mr. C. F. Scott has called the conference for Friday evening, May 15, at the Engineers' Club. In the meantime, every member of the American Institute of Electrical Engineers has been fully advised on the subject, and an active campaign is in preparation to give the Institute its proper place in the work of carrying the scheme to its fulfilment. In addition to the literature already circulated, a large amount of interesting and pertinent data will also be given in the current *Bulletin* of the Institute.

N. E. L. A. Special Train for Chicago.

Mr. C. O. Baker, Jr., master of transportation for the National Electric Light Association, has issued the following special circular of information: "Arrangements have been made with Mr. M. C. Roach, general Eastern passenger agent New York Central Railroad, for a special train of Pullman cars for use of Eastern members and delegates attending the twenty-sixth convention of the National Electric Light Association, to be held at Chicago, May 26, 27 and 28.

"This train is scheduled to run by New York Central & Hudson River Railroad and Michigan Central Railroad, leaving New York Sunday, May 24, at 12.50 P. M.; Albany at 3.50 P. M.; Buffalo (Central time), 10.50 P. M.; Boston via Boston & Albany, at 10.45 A. M., arriving Chicago 2.50 P. M., Monday. Fare from New York, $22; return, $6.70; double berth in sleeping car, $5; drawing-room, $18.

"Replies from former circular regarding transportation indicate an unusually large attendance, and as space on this train is limited, it is suggested that those desiring accommodations apply quickly to M. C. Roach, General Eastern Passenger Agent, 1216 Broadway, New York, and members from Boston and vicinity should apply to J. L. White, City Passenger Agent, 366 Washington Street, Boston."

In view of the numerous inquiries reaching us we would advise our Eastern readers going to the convention to secure their accommodations as quickly as possible.

Mr. James Wolff has been appointed by President Ferguson as chairman of the local reception and entertainment committee for the convention of the National Electric Light Association.

This committee has arranged to have a general reception in the Auditorium parlors on Monday evening, May 25, from 8.30 to 10.30. Arrangements are also being made for a tally-ho party on Tuesday morning for the ladies attending the convention, to drive to the Washington Club, where they will have luncheon. After luncheon they will drive through the South Parks, returning to the hotel in the afternoon. A matinée party at one of the theatres is contemplated for the ladies on Wednesday afternoon.

International Electrical Congress.

It is probable that the International Electrical Congress will be held at St. Louis during the week of September 12-17, 1904. This will accommodate the college men and the foreigners as to time, and will allow those who care to stay over and attend the International Congress of Arts and Sciences, which occurs the following week. It now seems probable that most of the national electrical associations will also assemble in St. Louis during this week. The Exposition Company will accommodate all of the latter with free convention halls, and, on certain special electrical days during this week, free admission to the grounds will be granted. Advices from abroad point to a large attendance during congress week. A party of 40 Italian engineers has already arranged to be present at that time.

Branly-Popp Aerial Telegraphy System.

By Henry Hale.

ONE of the most interesting systems of wireless telegraphy in Europe is that known as the Branly-Popp system. Dr. Branly, to whom the art of wireless telegraphy owes its being through his discovery of the principle of the coherer, some time ago devised a new form of coherer, based upon the simple contact of a polished and an oxydized metal surface. Since then this form of coherer has been improved and brought to a practical shape, and forms the base of the new system of wireless telegraphy.

To obtain the contacts of oxydized and polished metal he has arranged the coherer in the shape shown in Fig. 1. An upper disc of metal has fixed into it three rods of tempered steel, tapering and pointed at the ends. The points of the rods are somewhat rounded off and given a high polish, after which they are given a very thin layer of oxide by heating in air to a suitable temperature. The use of three rods is adopted to give the coherer a convenient and practical shape and serves to afford three separate contacts to secure good working. The tripod thus formed is placed upon a disc of steel, which has been given a high polish.

The coherer effect under the action of the waves thus takes place between the points and the highly-polished surface, and upon striking or tapping the coherer, it comes back to the state of non-conductivity. It was found that the shock required to bring back the coherer was much slighter than in the ordinary case and this gave Dr. Branly the idea of mounting the coherer directly upon the Morse receiver, when the striking arm of the armature is all that is needed to restore the coherer after the signal has been registered. The new receiver thus forms a compact and extremely simple instrument, as will be observed in Fig. 2, which shows the coherer enclosed in a cylindrical glass case and mounted upon a small platform, which is supported on a column. The inner end of the platform serves to hold the lower tapping-screw of the instrument. Each time the arm taps the lower screw a shock is given to the coherer, which is sufficient to bring it back to a non-conducting state. The upper tapping-screw is insulated from the body of the instrument and is connected to one pole of a battery (a cell of 1 volt or ½ volt is sufficient); below, it touches a platinum disc which is mounted on the armature lever. From the disc (which is insulated) the current passes by a flexible wire through the coherer and a sensitive relay back to the battery.

When a wave reaches the receiving station the coherer becomes conductive; the battery operates the relay and the latter the Morse register, as usual, through a secondary circuit. The armature lever is attracted to register the signal, and at the same time the current is broken between the screw and the disc. When the lever strikes the screw the shock restores the coherer. Finally, the lever rises, again making the contact between the screw and disc, the circuit being now broken at the coherer and ready to receive a second signal.

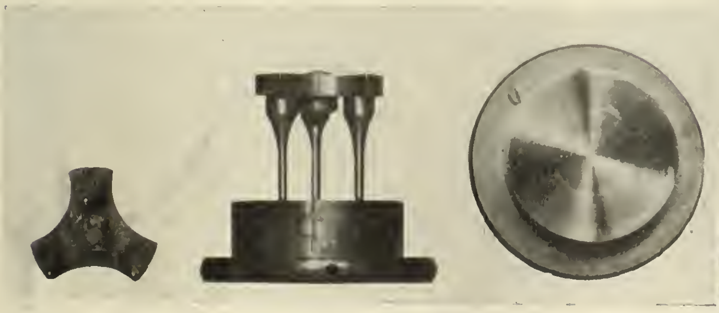

FIG. 1.—COHERER.

The independent striking device ordinarily employed with a coherer requires a certain time to act, which thus diminishes the speed of receiving the messages. In the present case the striker is dispensed with and consequently a gain in speed has been secured. Experiments show that the receiver can take down as many as 35 words per minute, which is much faster than ordinary. Besides, the new coherer has proved to be much more sensitive than the usual type with metal filings, and some experiments made by Dr. Branly to compare different coherers show that it is from 5 to 7 times as sensitive. This renders the new system particularly adaptable in the matter of transatlantic messages, and experiments are soon to be made in this line.

A company has been formed in Paris to operate the new system, headed by M. Victor Popp, an engineer of note, and promoter of various enterprises. At present there are two different schemes under way. The first is to provide for a system of communication throughout the City of Paris between a central station and subscribers, which will be somewhat novel; the second is to build a number of maritime stations at different points on the coast of France. Both these projects are of great interest, and will no doubt lead to important developments in the future. For the Paris system it was first necessary to erect several stations in order to prove that the signals could be sent without difficulty over the city. At present there are four different posts already established in different parts of the central district, one being at the company's main offices, the second near the Bourse and the other two at newspaper offices.

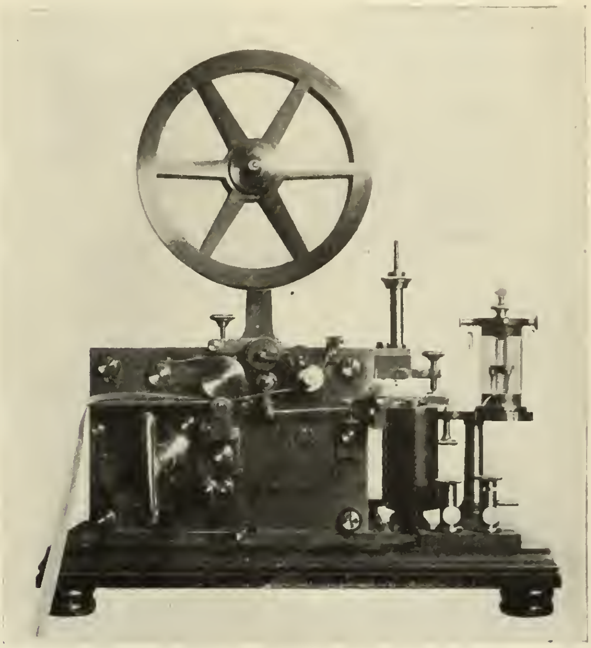

FIG. 2.—BRANLY RECEIVER WITH COHERER.

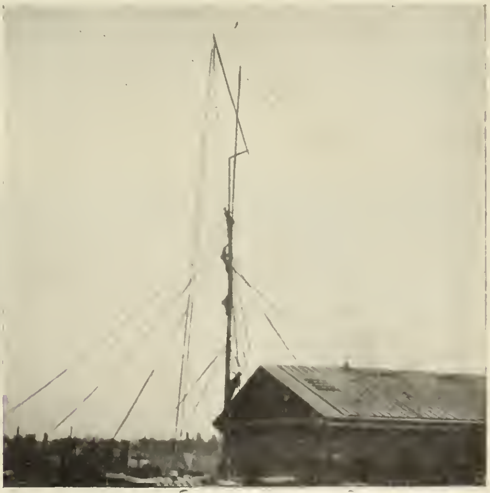

FIG. 3.—MAST ON MAIN STATION NEAR THE MADELEINE.

These stations have masts over 100 ft. high, mounted on the roofs. Since they have been installed there has been no difficulty in sending and receiving the signals between the stations, as was preducted by some, and they are now in constant communication throughout the day. Seeing that there is no practical difficulty, the next step will be to fix a central station in the central part of the city, analogous to that of a telephone system. Over the town will be located some 30 or 40 receiving stations, each forming the center of a district. The central station will receive telegraphic and telephone news of all the leading events of the day, as they occur. For business purposes, the stock quotations, markets and operations of the Bourse will be the most important, then political and social news, such as makes up an ordinary newspaper, but the subscribers will have the advantage of receiving this at all hours of the day. Each of the subscribers will not, of course, be provided with a receiving station, but it is proposed to carry the news from the branch offices to the residences by means of messenger boys mounted on bicycles.

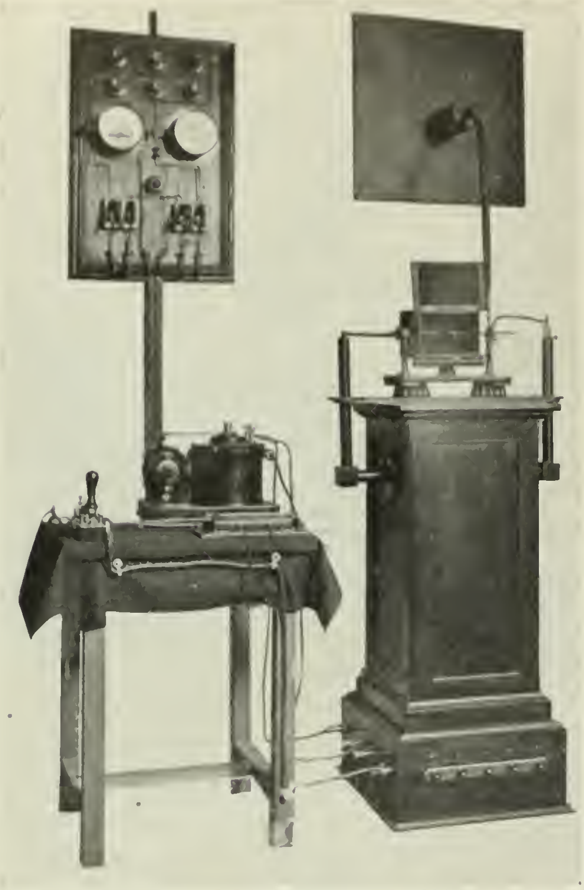

FIG. 4.—TRANSMITTER FOR 30 MILES DISTANCE

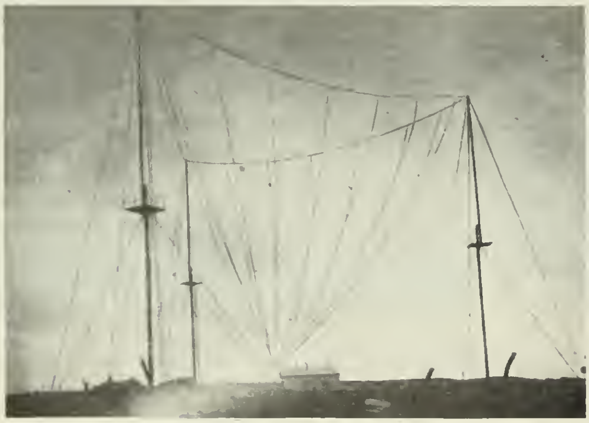

FIG. 5.—MAST SYSTEM AT CAP DE LA HAGUE.

The mast, which is mounted on the roof of the company's offices at Place de la Madeleine, shown in Fig. 3, is 115 ft. high, and communicates with similar masts placed on the three other buildings. The transmitting outfit is shown in Fig. 4. The table on the left contains the usual transmitting key and the mechanical interrupter for the induction coil, operated by a small motor. The large box on the right contains the induction coil, having its condenser mounted in the base, while on the top are the spark-balls and the cable which goes out to the mast. The receiving outfit includes the register and coherer shown in Fig. 1, with its battery and a Claude relay. The coherer enclosed in a glass case is protected from the air and a flexible wire attached to the tripod allows it to be lifted off the base when out of action.

The system thus proposed is certainly a novel one and it is expected to carry it out in the near future. To send in the news from the outlying districts and especially the news of the races, which are followed with great interest, a special form of automobile van has been built. It is equipped with a high bamboo mast, which is mounted in a socket on the roof and braced by wires. The mast can be quickly set up or dismounted. The interior of the van forms a traveling station, and has transmitting instruments of the abovementioned type. The gasoline engine of the automobile is used to drive a small dynamo, which serves to keep charged a set of accumulators for the current supply. At the time of the races, or on hearing of any special event, accidents, etc., within a radius of 10 or 20 miles, the automobile is always ready to go to the spot and send in the news.

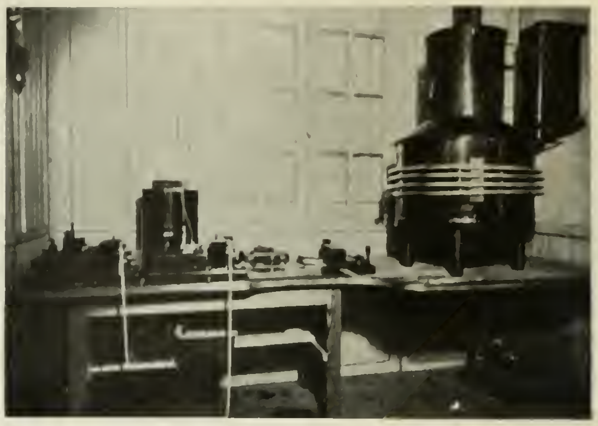

FIG. 6.—SYNTONIZING APPARATUS, CAP DE LA HAGUE.

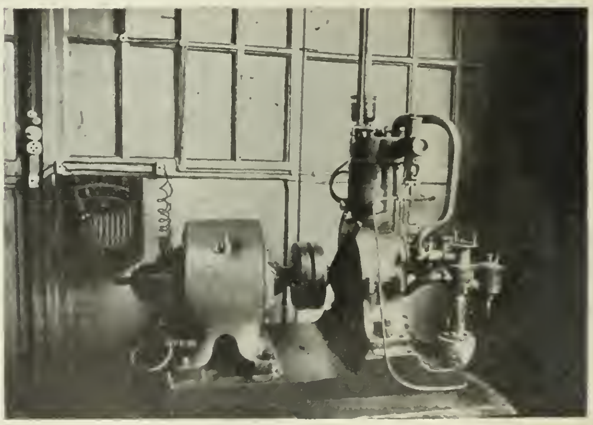

FIG. 7.—CAP DE LA HAGUE MARITIME STATION.

The maritime project has been commenced by the construction of a large station at Cap de la Hague on the north coast of France, near Cherbourg, which is illustrated in Figs. 5 and 9. The post is equipped with three masts 130 ft. high (Fig. 5) which form a triangle of 130 ft. on a side. At the center of the triangle is the station building, which has four rooms, one of which contains the apparatus for transmitting and receiving. The station (Fig. 6) will use the above-described apparatus with the addition of a new syntonizing system devised by Dr. Branly, a description of which has not yet been made public. This station will receive telegrams from the ships provided with Marconi and Slaby-Arco systems and will also connect with the different Marconi stations in England and Ireland. A second post of the same character is being built at Cape Gris Nez on the Channel near Boulogne, and these two posts will cover the Channel from the Holland frontier on the east, and extend westward to the ocean at a distance of 900 miles from Cherbourg. The syntonizing apparatus, which can be regulated for different lengths of waves, will thus permit of receiving all the signals transmitted by posts within a distance of 900 miles. The second room contains a generating set to supply the current (Fig. 7), consisting of a 5-hp gasoline motor, driving a small dynamo to charge storage batteries contained in the third room (Fig. 8).

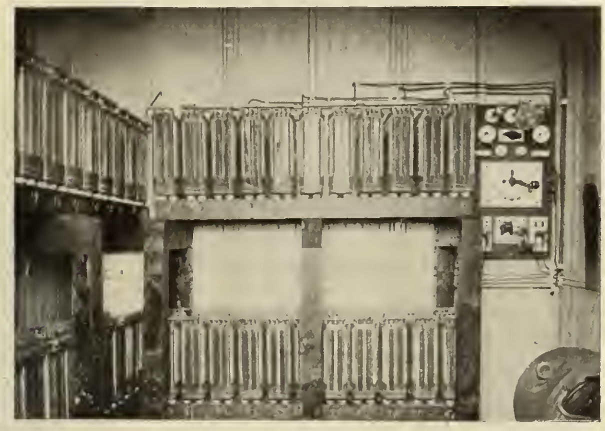

FIG. 8.—ACCUMULATORS.

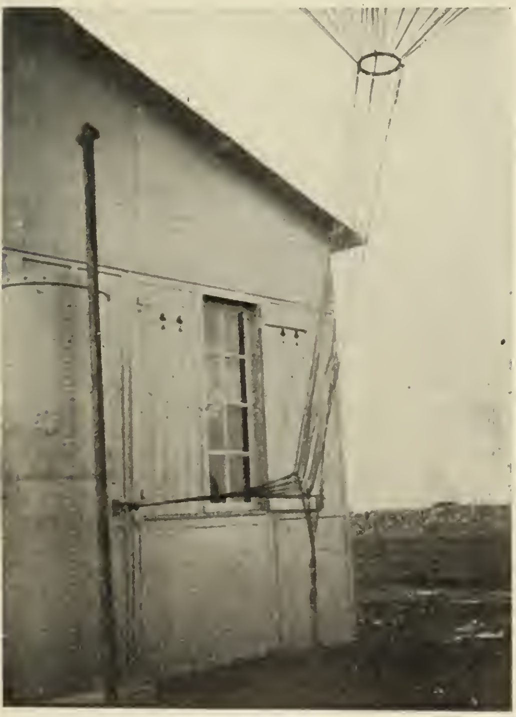

FIG. 9.—MAST WIRES ENTERING STATION.

The tops of the masts are connected by a steel cable, which serves to support the 15 mast wires, which are attached at regular intervals. All the mast wires are brought to the center at the station (Fig. 9). The post at Cap de la Hague is situated only 300 ft. from the government telegraph post, which is also provided with a mast. In this way the messages which are received can be transmitted at once to Paris or throughout the country. After the station is in working order an attempt will be made to send messages across the Atlantic, and Dr. Branly thinks that this can be easily done with the new receiver. The two stations will no doubt be followed by others along the coast of France.

Boise, Idaho, Transmission Plant.

The water power plant of the Boise-Payette River Electric Power Company, shown in the accompanying illustration, is located on the Payette River, Idaho, near the Horseshoe Bend, a distance of about 27 miles northwest of Boise, Idaho. This plant, including transmission lines to Boise and Pearl, and a distributing sub-station, was installed at an approximate cost of $350,000.

The water is taken from the Payette River at Horseshoe Bend, a distance of three miles above the power house, and carried through a large canal. The head or fall of water gained in this distance is 20 ft. at the power house. The water power is derived from two 1,200-hp water wheels direct-connected by means of flanged couplings to two 1,000-hp rotating field polyphase generators. The exciters are of the engine type class, direct-connected to the generator shaft. The electric power is generated at a potential of 500 volts, and raised to 23,000 volts through self-cooling oil transformers. It is transmitted at this voltage over three lines of No. 2 stranded aluminum cable, a distance of 23 miles to Boise, where the voltage is reduced by step-down transformers and distributed through the local circuits in Boise at 2,300 volts for light and power for commercial purposes, and to a converter sub-station for the operation of the street railway system.

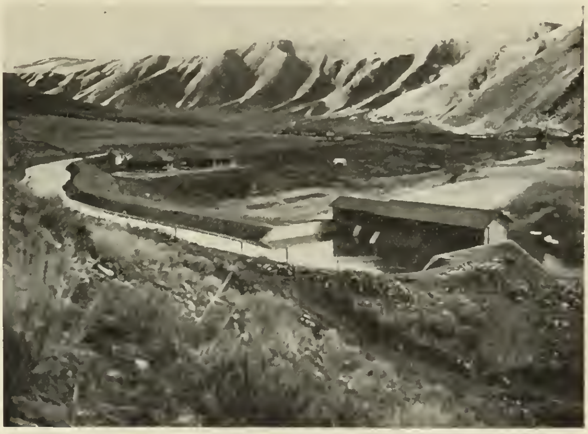

FIG. 1.—GENERAL VIEW OF STATION AND CANAL.

From the power house on Payette River the pole line for a distance of 12 miles is of double construction, two independent circuits being carried on the same pole. One of these circuits branches to the mining camp of Pearl, where the power is used for the operation of the mines in driving compressors, electric hoists, and for general power purposes. At Pearl is located the famous Checkmate and California mines. The latter has recently encountered a large body of ore carrying very high values. These mines are making preparations for operating their properties entirely by electric power.

The power house is designed for three generator units of 1,000 hp each and provision is made for future extensions when necessary. The canal (Fig. 1) has a carrying capacity sufficient to generate 5,000 hp. After the water passes through the turbines it is again delivered to the river without loss and taken out below for irrigation purposes.

Fig. 2 gives an exterior view of the power house, and Fig. 3 an interior view, showing the generator switchboard and lightning apparatus.

The net weight of the generators complete is 65,000 lbs; the rotating field weighs 17,500 pounds and it required 20 horses to haul this piece of apparatus from the railway station at Emmett over the mountain to the power house, a distance of 14 miles. The diameter of the rotating field is 12 ft. The generators are set on deep concrete foundations and direct-connected to the water wheels in the manner mentioned above.

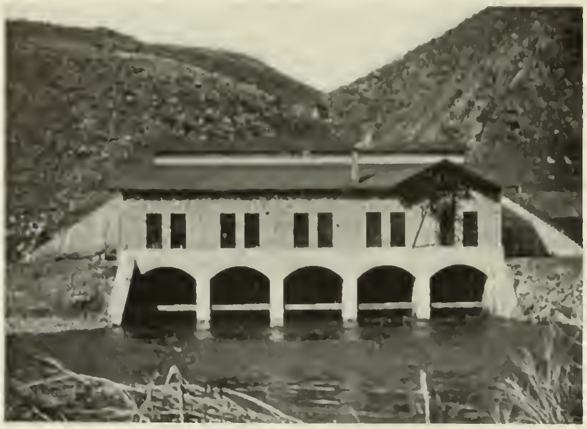

FIG. 2.—EXTERIOR VIEW OF POWER HOUSE.

The development of the distant water powers and transmitting power to mining camps, which are located a distance from fuel supply, and in some cases water supply, has made it profitable to develop mining properties with the use of electric power, that would not have been profitable were they compelled to haul fuel any great distance.

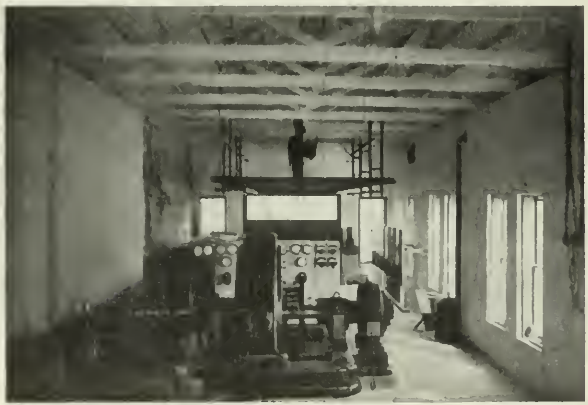

FIG. 3.—INTERIOR VIEW OF POWER HOUSE.

The entire electrical installation was furnished by the Westinghouse Electric & Manufacturing Company, and the water wells were supplied by the James Leffel & Company, of Springfield, Ohio.

Auto Bus in London.

A cable dispatch from London of May 9 to a New York daily newspaper says: "The trial of the American automobile bus built for the London General Omnibus Company by the Fischer company this week was very satisfactory. The run was to Richmond and back. The journey, owing to the route chosen, must have covered twenty-five miles at least, and nothing was more remarkable than the ease and facility with which the huge vehicle was made to thread its way through the crowded traffic of Piccadilly Circus, Regent Street and Oxford Street. The new bus excited the liveliest interest on the road, and though things, both humorous and unprintable, were hurled at it by some of the more conservative whips, especially when their horses jibbed, the vehicle, it is fair to assume, has come to stay." The Fischer system combines the use of gasoline and electricity on the same vehicle, current being generated by the gasoline plant.

Field Coil Formulas.

By Thorburn Reid.

The calculation of the weight of copper, depth of coil, number of turns, size wire, etc., in a field coil is usually tedious work. In order to lighten this work as far as possible I deduced some years ago the following approximate equations and, having used them constantly in my work ever since, have found them to be as accurate as the practical conditions warrant.

They are based on the assumption that all the heat generated in the coil will be radiated from its outside surface only, the end surface and the inside surface being neglected. This assumption is sufficiently accurate for most field coils, although, if the depth of the coil is great as compared with its length (across wires), the heat emitted by the end surfaces may in some cases have to be taken into account also. However, even in such cases the end surfaces are often enclosed by non conductors of heat or are contiguous to other hot bodies, so that rather than to complicate the calculations by introducing more or less uncertain factors, it seems better in most cases to fix a constant of watts per square inch by experiment for each type of machine using the outside surface only.

The wire table issued by the American Institute of Electrical Engineers is used as a basis for weight and resistance of copper wire. In this table copper is assumed to weigh .3214 pounds per cubic inch and its resistance at 60° C. is .773 ÷ 10^6 ohms per cubic inch. The formulæ are all based on a temperature of 60° C., since the coil will usually nearly attain this temperature in practice, and should not exceed it much.

All dimensions are given in inches unless otherwise stated, and the following notation is used:

D = diameter of inside of coil. The clearance and insulation between the coil and the field pole are added to the pole diameter to obtain D.

f and k are the two dimensions of the inside of the coils wound on rectangular field poles and clearance and insulation must be allowed for as with D.

t = depth of coil; that is, the actual depth of insulated wire, and does not include any insulation that may be wrapped around the coil.

l = length of coil across wires.

n = ratio of the bare to the insulated diameter of wires.

P = weight of copper in the coil in pounds.

W = I^2R loss in the coil.

R = resistance of the coil in ohms.

w = watts per square inch of radiating surface.

N = number of turns in the coil.

I = current in coil.

d^2 = circular mils of wire used.

E = e.m.f. impressed on terminals of coil.

S = radiating surface.

In deducing the following equations, the wire is considered to be wound evenly in layers and in the case of rectangular poles no allowance is made for the rounding of the coil at the corners. It has been found in practice that the errors due to these assumptions are about compensated for by unavoidable irregularities in winding, so that the exact equations below give very accurate results when the winding is well done.

Most of the arithmetical work, both in deducing constants and in working out examples, was done with a 14-in. slide rule, since greater accuracy than this would give was not necessary.

The resistance of the coil being proportional to the total length of wire divided by its area, we have

$$R = \frac{.773}{10^6} \frac{N\pi(D+t)}{\pi/_4\, d^2/_{10^6}} = 3.092 \frac{N(D+t)}{d^2} \qquad (1)$$

$$d^2 = \frac{tln^2}{N} 10^6 \qquad (2)$$

$$W = I^2R = 3.1 \frac{N^2(D+t)}{tln^2} I^2 \qquad (3)$$

But W also equals the watts per square inch of radiating surface multiplied by the radiating surface, or $W = \pi wl(D+2t) = 2wl(f+k+4t)$ (4) and from (3) and (4)

$$t = .984 \frac{\left(\frac{NI}{10^3}\right)^2}{wl^2n^2} \frac{D+t}{D+2t} = .984 \frac{\left(\frac{NI}{10^3}\right)^2}{wl^2n^2} \frac{f+k+2t}{f+k+4t} \qquad (5).$$

Since the ratio of t to D or to $f+k$ will generally not exceed 3, the last terms of (5) will range from 1 to .8125, and reducing the constant .984 to .9 and making the last terms of these equations equal to one, the maximum error will not exceed 10 per cent., and the maximum error in final results will not exceed 3⅓ per cent., since only the radiating surface and the mean length of a turn are affected and these are functions of the pole dimensions plus the depth of the coil.

Equations (5) then reduce to one equation, which is

$$t = .9\,\frac{\left(\frac{NI}{10^3}\right)^2}{wl^2n^2} \qquad (6)$$

for both cylindrical and rectangular coils.

Since ampere turns are usually in the thousands, dividing them by 10^3 facilitates calculations.

Since $W = IE$, we have $N = \frac{E\,(NI)}{W}$ (7)

Also from (1), since $E = IR$, we have

$$d^2 = \frac{3.1\,NI\,(D+t)}{E} = \frac{2NI\,(f+k+2t)}{E} \qquad (8)$$

$$P = .3214\,ltn^2\,\frac{\pi}{4}\,(D+t) = .3214\,ltn^2\,\frac{\pi}{4}\,2(f+k+2t) \qquad (9).$$

Substituting values of t from (5), these become

$$P = .78\,\frac{\left(\frac{NI}{10^3}\right)^2}{wl}\,\frac{(D+t)^2}{(D+2t)} = .497\,\frac{\left(\frac{NI}{10^3}\right)^2}{wl}\,\frac{(f+k+2t)^2}{f+k+4t} \qquad (10)$$

Neglecting t in the final fraction, as before, and slightly changing the constants, we have

$$P = \frac{.8\left(\frac{NI}{10^3}\right)^2 D}{w\,l} = \frac{.5\left(\frac{NI}{10^3}\right)^2 (f+k)}{w\,l} \qquad (11)$$

The value of n^2 varies both with the size and with the make of the wire used. For machines above 4 or 5 kw I have found .85 to be usually sufficiently accurate for this factor, and in smaller machines .65 for 500-volt shunt-wound machines and .75 for 125 or 250-volt machines. The designer soon learns the best preliminary value for n^2 for any particular size of machine and make of wire, and as n^2 appears only in the equation for t, final results are only slightly affected by an error in its value.

The size wire given by formula (8) will generally lie between two sizes of wire given in the table, and it is sometimes desirable to wind the coil with two sizes of wire instead of using the size that comes nearest to the correct one. The following formula may be used to determine the proper number of turns of each size wire to be wound in the coil. This formula is based on the assumption that the mean length of a turn is the same for the two parts of the coil wound with the two sizes of wire. The error due to this assumption is practically negligible.

Let N = total number of turns in the coil, d^2 = the circular mils given by the formula, d^2_1 and d^2_2, the circular mils of the two nearest sizes of wire in the table, N_1 and N_2 being the corresponding number of turns of each size wire. Then $N_1 = \frac{d^2 - d^2_2}{d_1^2 - d_2^2}\,N$ (12) and

$$N_2 = N - N_1 \qquad (13).$$

Occasionally the series and shunt coils of a dynamo are wound one outside of the other and as the radiating surface is only the outside surface of the outside coil while the I^2R loss is developed in both, the question arises how much of the total depth of the coil must be assigned to each. First add together the ampere-turns required by the two coils and, by equation (6) find the total depth that is required for this number of ampere-turns. If but one coil of a single size wire were used the current density would be the same throughout the coil and this condition should be satisfied in proportioning the depth to the two coils, or d^2/I should be constant for the two coils. From (2)

$$\frac{d^2}{I} = \frac{t\,l\,n^2}{NI}\,10^6 \quad \text{or} \quad t = \frac{NI\,\frac{d^2}{I}}{10^6\,l\,n^2}$$

Since l and n are practically the same for the two coils, this equation shows that the depth should be divided in proportion to the ampere-turns in each coil, or $t_1 = \frac{t\,(N_1\,I_1)}{(NI)}$ (14) and $t_2 = t - t_1$ (15). Then, since with constant current density the I^2R loss will vary directly with the depth, $W_1 = \frac{t_1}{t}\,W$ (16) and $W_2 = W - W_1$ (17), whence N and d^2 can be determined from (7) and (8) for the shunt coil. In the case of the series coil I is known and N is obtained directly by dividing the ampere-turns by I, the size wire being such as will make the current density the same as in the shunt coil.

Equations (4), (6), (7) and (8) furnish the number of turns and the size wire to be used in the coil, while equation (11) gives the weight of copper in the coil directly without the necessity of determining the number of turns or the size wire.

The following equations are also convenient at times: $R = \frac{E}{I}$

$$\frac{d^2}{I} = \frac{t\,l\,n^2}{\left(\frac{NI}{10^3}\right)}\,10^3$$

The following examples were chosen at random from my files of data of actual machines, the dimensions having been taken from drawings and specifications and the results from reports of tests of the finished machines. They are not to be taken as examples of good design, as the value of w in all of them was lower than was advisable. They were chosen because I happened to have complete data both of dimensions and of results of tests.

EXAMPLE I.

Following are data taken from drawings and tests: $D = 8.75$; $l = 4.33$; $w = .383$; t = 3.1; $I = 2.97$; $N = 1{,}600$; $NI = 4{,}750$; $R = 8.815$; $E = 26.25$; $P = 96.5$; wire, No. 12 B. & S., diameter, .081, double-cotton-covered, to .091.

VALUES OBTAINED BY FORMULA.

$$d = \frac{.9 \times 4.75^2}{.383 \times 4.33^2 \times .85} = 3.34 \qquad (6)$$

$$W = 3.142 \times .383 \times 4.33 \times 15.43 = 80.5 \qquad (4)$$

$$N = \frac{26.25 \times 4{,}750}{80.5} = 1{,}550 \qquad (7).$$

$d^2 = 3.1 \times 4{,}750 \times 12.1/26.25 = 6{,}800$ (8). No. 12 B. S.

$$P = \frac{.8 \times 22.6 \times 8.75}{.383 \times 4.33} = 95.5 \qquad (11).$$

ERRORS.

In t, + 7¾%; in N, — 3¼%; in d^2, + 4%; in P, — 1%.

EXAMPLE II.

Data: $f = 4.52$; $k = 20.27$; $t = 1.08$; $N = 160$; $NI = 3{,}220$; $I = 20.1$; $R = .201$ at 44° C.; $E = 4.05$; $P = 90$; $I^2R = 81.3$; $S = 415$; w = .VTF. No. 4 B. & S., .204 d-c-c to .216.

VALUES OBTAINED BY FORMULA.

$$t = \frac{.9 \times 3.22^2}{.196 \times 7.122^2 \times .85} = 1.105 \qquad (6).$$

$$W = 2 \times .196 \times 7.122 \times 29.21 = 81.5 \qquad (4).$$

$$N = \frac{4.05 \times 3.220}{81.5} = 160 \qquad (7).$$

$d^2 = 2 \times 3{,}220 \times 27/4.05 = 43{,}000$ (8). No. 4 B. & S.

$$P = .5\,\frac{3.22^2 \times 24.8}{.196 \times 7.122} = 92.$$

ERRORS.

In t, + 2¼%; in N, zero; in d^2, — 3%; in P, + 2%.

EXAMPLE III.

$D = 4.15$; $l = 4.25$; $t = .93$; wire, No. 18 B. & S. s-c-c to .0443; $NI = 1{,}915$; $N = 2{,}000$; $I = .96$; $R = 20$; $E = 19.2$; $W = 18.45$; $S = 85$; $w = .217$; $P = 13.5$.

VALUES OBTAINED BY FORMULA.

$$t = \frac{.9 \times 1.915^2}{.217 \times 4.25^2 \times .85} = 1.00 \qquad (6).$$

$$W = 3.142 \times 6.15 \times 4.25 \times .217 = 17.8 \qquad (4)$$

$$N = \frac{19.2 \times 1{,}915}{17.8} = 2{,}065 \qquad (7).$$

$$d' = 3.1 \times 1{,}915 \times 5.15 / 19.2 = 1{,}590 \qquad (8).$$

$$P = \frac{8 \times 3.68}{.217 \times 4.25}\ .415 = 13.25 \qquad (11).$$

ERRORS.

In t, + 7¼%; in N, + 3¼%; in d, − 2¼%; in P, − 1¾%.

These examples, which were chosen absolutely at random, show what accurate results these approximate formulæ give, and long experience has shown that such accuracy is to be expected under most ordinary conditions. This is evidently ample for the conditions obtaining in practical work, since it is seldom possible to predetermine the ampere-turns or coil dimensions with any such accuracy. It must be remembered, however, that the care with which the coil is wound may have an appreciable effect on the results obtained.

Certain approximate laws, which are of assistance in preliminary design, are simply deducible from these formulæ. Thus, when coil space is limited, the depth of the coil is often an important factor and equation (6) shows that this varies practically with the square of the ampere turns and inversely with the watts per square inch and the square of the length of the coil. Equation (7) shows that the number of turns varies directly with the ampere-turns and the impressed e.m.f. and inversely with the I^2R loss in the coil and is independent of the shape of the coil and the size wire, except inasmuch as these factors affect the I^2R loss. Equation (8) shows that the circular mils in the wire used varies directly with the mean length of a turn and the ampere-turns and inversely with the impressed e.m.f. Finally, equation (11) shows that the weight varies directly with the square of the ampere-turns and inversely with the watts per square inch and the length across wires. Equation (11) is especially valuable in preliminary designs, since it enables the designer to quickly determine the weight of copper in the coil and the changes in weight due to changes in design, without going through the tedious calculations for determining the number of turns and the size wire.

I have not attempted to give any definite value for w, since it will vary with every type of machine and even with different sizes of the same type. Where there are no experimental data to go on, it may be taken to range from .5 to .75 for a rise of temperature of 40° C. These values are for machines that are not enclosed.

The Price of Gas at Peoria, Ill.

Because of an ordinance passed by the City Council of the City of Peoria on September 4, 1900, which provided that the maximum rate thereafter to be charged by any gas company doing business in the City of Peoria, should be 75 cents per thousand cubic feet, that the gas furnished should be of uniform 18-cp illuminating power at the point of consumption, and heavy penalties for violation of the ordinance, the Peoria Gas & Electric Company secured a temporary injunction against the enforcement of the ordinance, and thereupon instituted suit. The case was bitterly contested for more than 18 months, testimony of distinguished experts from all over the United States being adduced by both parties. The decision has just been handed down by special master in chancery I. C. Pinckney, named by Judge Humphrey, of the United States Court. The master's findings, which are of especial interest, are as follows:

First. That the exercise of the right claimed by the city must be reasonable.

Second. That the question of the reasonableness of such a right is for judicial determination; that is, that neither the city nor the legislature of the State itself has the right to fix a rate in such a manner that the courts cannot inquire into its reasonableness.

Third. That in determining the cost of the manufacture and distribution of gas, the depreciation of the plant and a reasonable interest on the money invested are proper elements in such cost.

Fourth. That a Federal question is clearly involved; because under the facts in evidence the enforcement of the ordinance would necessarily amount to a taking of the complainants' property without due process of law.

Safety Devices in Central Stations and Sub-Stations.

MR. Philip Torchio, in his paper with the above title, read before the April meeting of the American Institute of Engineers, gave the following list of characteristic features more or less generally adopted or considered desirable for insuring reliability of central station operation. While some of the safeguards given in the list may appear unnecessary and expensive refinements, and probably would be such for a large number of cases where continuity of service may not be considered absolutely essential. In the case, however, of the lighting and power of a large city, the conditions are different; and if for these conditions safety cannot be obtained in any other manner, refinements become of paramount importance.

GENERATING STATION.

1. Installation of storage battery on field exciter bus, at generating station.

2. Equipment of reverse current relays and circuit-breakers on exciter generators.

3. Equipment of overload relays with time limit and circuit-breakers, on motors of motor-generator exciter sets.

4. Separation and mechanical protection of generator leads of different generators. Also proper insulation and protection against capacity discharges of cable leads.

5. Connection of each generator to bus-bars by means of two oil switches in series, preferably arranged to close independently and open at the same instant.

6. Subdivision of bus-bars, in different sections, enabling operation of generators in different groups. Also selector switches on each generator, enabling the same to be operated on at least two sections of bus-bars.

7. Tie connections between different sections of bus-bars, enabling us to make, if desired, combinations of different sections or even one common bus-bar.

8. Overload and reverse current relays on generator switches, these being connected to signal lamps until they have proven their reliability for actual tripping of main switches.

9. Selector switches on feeders providing means of connecting each feeder to at least two selectors of bus-bars.

10. Duplication of oil switches on each feeder circuit, preferably arranged to close independently and open at same time.

11. Overload relays on each feeder, with a variable time limit, in inverse proportion to the amount of current.

12. Separation of all wiring and busses inside the station by means of ducts, fire-proof septums and grooves in walls, and proper protection against capacity discharges, by the use of good glass or porcelain insulators.

13. In connection with very high-voltage step-up transformers, provide low-tension synchronizing busses for generators and switches on the l.t. side of step-up transformers, thereby avoiding synchronizing on the h.t. side of transformers, or closing of h.t. switches on dead transformers.

14. Avoid installation of single-pole main switches for each phase of the circuit, and also synchronizing with one pole switch closed and synchronizing transformer across the gap of the other pole switch.

TRANSMISSION LINE.

15. Duplication of transmitting lines to important centers of distribution, selecting if possible different subway routes, or independent transmission lines.

16. Mounting of suitable end boxes on ends of cables at all terminals. Also possible equipment of spark arresters on each end of underground cables.

17. Protection of underground cables in ducts by the use of good fire-proof material.

18. Protection of cables in manholes, using preferably separate manholes for high-tension cables, with asbestos or iron covers on each cable, etc.

19. Protection of lead sheath of cables against electrolysis, either by laying cables in vitrified ducts and rubber-cushioned racks in manholes, thereby making the cable insulated from ground along its route, or laying heavy bare copper wires along the route of cables and connecting solidly to their lead covers in each manhole, these wires providing a secure metallic path for the current, which leaves the cable sheaths to return to the grounded bus at the railway station

via the wires suitably connected to the railway return feeders.

20. Protection of transmitting and receiving stations operating overhead transmitting lines by improved lightning arresters.

21. Grounding of neutral of three-phase transmission lines for very high voltages. (General practice in the California transmission plants.) In the case of very high voltages, this grounding seems a necessity.

22. Possibly grounding of neutral for lower voltages and underground cables. (This is done in several places, as for instance, in Chicago, on the 2,200-volt, 3-phase, 4-wire, 60-cycle system, as well as on the 9,000-volt, 3-phase, 25-cycle, star-connected system.) From the point of view of reducing strains on insulation, this grounding of neutral seems unnecessary for moderate voltages, though it could be made use of for locating accidental grounds on the system, and in indicating and eventually disconnecting the affected feeder, which would be troublesome to locate on a system without grounded neutral and operating several feeders from same bus-bars.

23. Avoid operation of high-tension lines at different frequencies when lines are mounted on same pole line. This to avoid doubling of strain on insulators when two wires of different lines become crossed.

SUB-STATIONS.

24. Separate lines entering sub-stations should preferably be operated independently, laying out independent h.t. busses and transforming apparatus on each line, the transformed current being delivered either to a common set of bus-bars or to independent sets of bus-bars, if the service will allow of this subdivision. In rotary sub-stations, while the rotaries operate in parallel on the direct-current side, they can be fed from independent h.t. lines not operated in synchronism. This allows feeding each sub-station from different groups of generators at the generating station, or even from different generating stations. In the case of alternating-current stations with transformers feeding into a common secondary set of bus-bars, the primary lines must necessarily be operated in parallel, and therefore from same bus-bars at the generating station. This prevents us from attaining the advantages of duplicate lines and independent sources of supply, as in the case of rotary sub-stations. For this reason, in alternating-current systems of secondary distribution, as extensively used in water power plants, the adoption of independent groups of generators and independent feeding lines to important centers of distribution is not common. In important cases it may be advantageous to subdivide the customers' supply on different circuits fed from independent lines and transformers operated from different sources of supply. The New York Edison Company operates at present the generators at its Waterside station in two independent groups and whenever a sub-station has more than one rotary converter in service, the several rotaries are divided among different feeders, fed from different groups of generators at the generating station. The rotary converters being operated in parallel on the direct-current side, the distribution of loads between different feeders and consequently between groups of generators is easily and perfectly accomplished. This distribution is regulated by the system operator at the station, who instructs each sub-station how to subdivide the loads among the rotaries. The system is laid out to still further subdivide the groups of generators, if the further addition of generators will make it desirable.

25. Receiving lines should be equipped with oil switches and overload relays with variable time limit in inverse proportion to amount of current. When more than one line is feeding a common h.t. bus or independent transforming apparatus operating in parallel on the l.t. side (for instance, rotary converters), each line should also be equipped with reverse-current relays, with variable time limit in inverse proportion to the amount of current, the time limit for these relays being a fraction of the time for the overload relay. Reverse-current relays without time limit are too sensitive to momentary irregularities on h.t. system and cause trouble on this account.

26. Inside the sub-stations all h.t. wiring and construction should be laid out along the same lines mentioned in case of generating station. Also, the low-tension apparatus and connections should be properly laid out, avoiding crowding and crossing of cables, keeping cables of different polarities separate, and protecting them by means of ducts, septums and pipes as much as possible.

26a. On very high-voltage receiving stations, the closing of h.t. switches on transformers subjects them to heavy strains which can, in most cases, be avoided by making alive the transformer from the low-tension side, if the common bus-bars are already fed from another set of transformers. In case of a single set of transformers, it may be advisable to leave the high-tension side of transformer closed all the time, especially in water power plants.

27. For protection of lines from overloads or short circuits on transforming apparatus of large capacities, oil switches with overload relays should be considered preferable to h.t. fuses. The switches should be of proper capacity and should be equipped with locking relays for overloads, exceeding the safe breaking capacity to avoid blowing up the oil switch. The breaking capacity of an oil switch will to a great extent depend not only on the character of load, but also on the amount of power back of the short circuit.

28. Compound-wound rotary converters and eventually also plain shunt-wound rotary converters operated in parallel on a common direct-current bus should be protected by some speed limit device to trip the alternating-current and direct-current circuit-breakers on the rotary, when speed exceeds the normal by a certain fixed percentage. The sample here shown is a speed limit device developed by the company with which the writer is connected, in conjunction with a firm which manufactures measuring instruments; adopting their standard mechanism for speed indicators.

29. It is desirable to protect the direct-current side of all rotary converters with circuit-breakers to operate in connection with the speed-limit device above mentioned, and also in connection with a reverse-current relay on the direct-current side of the rotary. This reverse-current relay should be equipped with a variable time element in inverse proportion to the amount of reverse current: direct-current overload relays seem to be unnecessary.

30. All relays at different points of the system and their time elements must be properly adjusted, to operate the different circuit-breakers in the proper order, so that if a trouble is once cleared by the opening of certain circuit-breakers, the other relays reset themselves in the normal position, leaving the rest of the system in operation.

31. Emergency connections between different generating stations are considered desirable and have found favor in connecting different water power plants and also in connecting large generating stations in the same city, as in New York.

32. Of first importance in a lighting situation in a large city is the equipment of storage batteries at every sub-station. One large New York company, for instance, has installed or under contract twenty-two 8,000-amp-hour, 135-volt batteries, and more may be installed in the future.

33. In closing this list of safeguards, it may be added that in all high-tension work great care should be used in applying tests to the apparatus, especially in making insulation tests on generators, cables, line and transforming apparatus. Break-down tests can be made on samples, but it is unwise to strain unnecessarily the insulation of the complete plant near the break-down point. Close inspection of the installation will finally give more satisfactory results than loose inspection and severe tests.

Wireless Telephony on Ferry Boats.

By A. Frederick Collins.

The results of my experiments in wireless telephony at Narberth, Pa., and at the proving grounds at Rockland Lake, N. Y., last summer have been published in prior issues of Electrical World and Engineer. These tests were the means to an end or rather means to the beginning of the end, for the test, last week, on the North River between the ferryboats *John G. McCullough* and the *Ridgewood,* both of the Erie Railroad system, were but the merest beginnings of what, I sincerely hope, the wireless telephone may come to be. Heretofore the question of what constituted a commercial wireless telephone has proven a stiff one, for the engineer as well as for the layman. To even a novice in the art, it was evident that its field was not to oust the efficient wire system now in use, any more than the wireless telegraph will supplant the wire system. Converting an experimental product into one of commercial utility does not necessarily mean the perfection of it first, and the application of it afterward, but in some, and in many instances a sphere of usefulness may be found in which the immediate utilization of it is of more use than a toy, and as it matures it will expand and fill the larger needs of practice.

This was my idea in the incipiency of the system under consideration. If I could not invent a system that would at once transmit articulate speech without wires a distance of ten miles, I could apply a method that would operate a thousand feet. Vessels in harbors offered exactly the ideal place, and hence the tests just made. To those persons who make an occasional trip across the river by ferry, the uses of a wireless telephone as a safety device will not be at once apparent, but to commuters who make round trips daily, for example, across the Hudson and East Rivers, New York, the fact that their lives are absolutely in the hands of the man in the pilot house is deeply impressed upon their minds.

There, high above them, the pilot scans, not the horizon nor even the sky line of the buildings, but the *first few hundred feet* ahead, keeping eyes and ears alert for a light, or a sound of another vessel—all of which is easy in the bright light of the day or even the darkness of the night if it is clear.

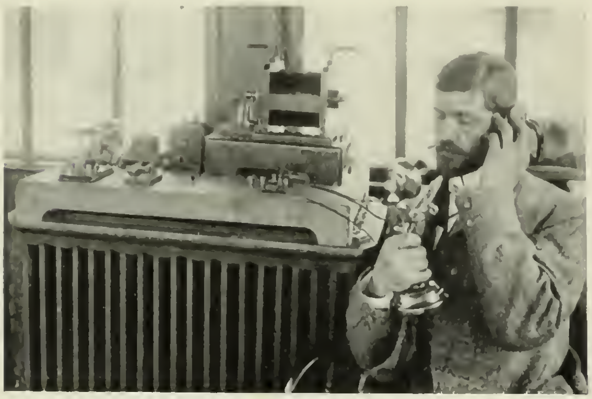

FIG. 1.—WIRELESS TELEPHONY ON FERRYBOATS.

But in a fog all this security is eliminated. It is impossible for a pilot to see the bow of his own vessel, much less a silent, moving craft, which may be running him down amidships. In foggy weather, whistles are sounded every fifteen seconds, but while a pilot may gain a fair idea of the position of another vessel by the blast of its whistle, it gives absolutely no indication of the direction it is going.

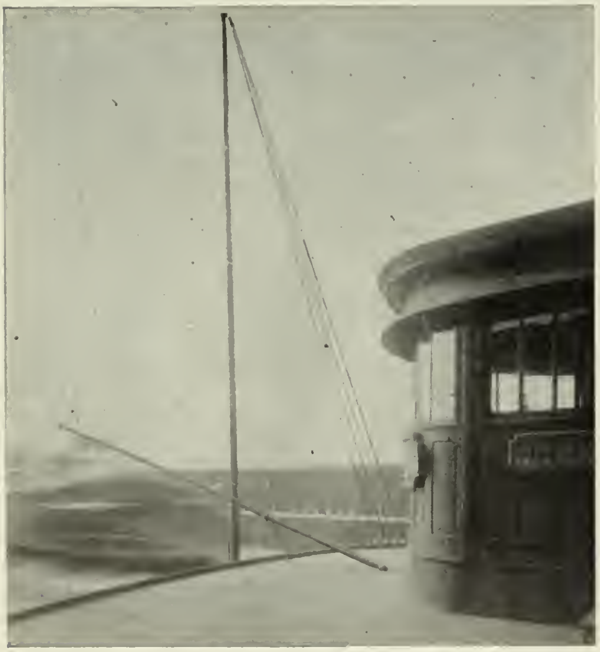

FIG. 2.—WIRELESS TELEPHONY ON FERRYBOATS.

It is here that the wireless telephone may prove of greatest service. When two vessels approach within a certain range, the captains can converse with each other and by each stating their position—by the compass—and their route all danger of collision should be avoided. This is only one of its many uses.

The reason the wireless telegraph is not as serviceable at close range as a wireless telephone is because it must be operated by expert telegraphers, whereas the wireless telephone can be used by any person. Where the distance between vessels is limited and their movements are unknown, there is no time for translating messages, in other words, the wireless telephone is a first hand instrument.

The tests were limited in distance to 600 or 700 ft. for the reason that only a small piece of copper tubing was used to earth the wires, whereas large surfaces should have been employed. The effective distance may be increased. At Rockland Lake a mile was covered under favorable circumstances and this may be repeated between boats with some experimenting. The distance I desire to attain is that sufficient to insure the prevention of collisions of vessels in harbors during bad weather, and with this idea in view I hope my system will act as a sort of condition of marine block signal system between ship and ship, or ship and shore.

Operation of Berlin Electric Roads.

A report from the United States State Department on results with the new electric roads in Berlin says: "The elevated and underground electric railway built by Messrs. Siemens & Halske, and opened for traffic in February, 1902, has proven a remarkable success, and after a single year of service has become the most popular of all interurban routes of travel. It carries passengers a distance of 3 miles in 10 minutes for fares ranging, according to the class of the car, from 2½ to 3¾ cents. Its traffic and earnings exceed by 80 per cent. the estimates of the builders when the enterprise was planned, and it has demonstrated that any device of reasonable cost, which is well equipped, safe and capable of shortening the time of transit between different portions of the city, will be promptly and liberally patronized. In one respect only the new line has encountered some difficulties. When the franchise was granted, it was necessary to obtain the consent of property holders in certain streets where overhead construction was to be used, and to these the promise was made that the jar and noise of passing trains would not be objectionable. But it is in practice very difficult to run a rapid train of three eight-wheeled cars over a track laid on aerial framework of steel without causing a vibration and resonance that may be disturbing to nervous people in adjacent buildings. So the new company found itself attacked in the courts and had to resort to all practicable means of deadening the vibration and reducing the noise of traffic. These experiments included, first, inserting three layers of felt between the rails and the wooden ties on which they are laid. This made some improvement, but did not satisfy the complainants nor the police. Next, in place of wooden sleepers, hollow iron girders were put beneath the rails and filled with loose sand, which, it was expected, would take up the vibration and thus deaden the shock. This, also, has been found partially effective, but not wholly satisfactory. A third plan has been to abandon the use of cross ties and instead lay the rails on long longitudinal wooden sleepers, with cushions of lead laid beneath the rails. Finally, the car wheels have been in some way lined with wood, so as to break the continuity and consequent resonance of a metallic structure. All these experimental remedies are still on trial, but no definite conclusion concerning them has been announced."

Postal Trolley Cars.

In accordance with a resolution passed at Pittsburg on May 8 by the Amalgamated Association of Street Railway Employees a telegram was sent to President Roosevelt, asking him to intervene to prevent the unlawful use of the United States postal system to hurt this union. Grievances were alleged by delegates because of the manner in which the United States mails were used in San Francisco and New Orleans during the time that the street car men were having trouble with their employers on account of organizing divisions of the union. The absurd assertion was also made that in San Francisco the letters of the street car men were held up, that some letters were opened and photographs were taken of the contents, and in many cases these photographs were posted by the employers at the various car barns. This was done, it is alleged, in order to deter employees from joining the unions. In New Orleans similar methods were alleged. It was also charged that during strikes street railway companies placed United States mail signs on cars not carrying mail, contrary to the ruling of the Postmaster-General, for the purpose of coercing the employees.

The Storage Battery in Transmission Plants.

By H. S. Knowlton.

FROM the earliest days of electric power transmission, continuity of service has been one of the prime requisites of commercial success. As the amount of power, voltage and distance of transmission has increased, the necessity of continuous and reliable service has become imperative. Given a great hydraulic electric plant transmitting thousands of kilowatts at potentials like 50,000 volts to points within a radius of 100 miles, it is self-evident that even a momentary interruption of service is fraught with the most disastrous possibilities, not only in heavy financial loss, but in danger to human life itself. The loss of time incurred in the shutting down and starting up of scores of factories, railway and lighting sub-stations, the possible ruin of electrochemical products, stopping of cars on railroad crossings, and the panic and confusion incidental to the sudden momentary triumph of darkness in theatres, concert halls or churches supplied with power through the central generating plant are difficult to measure in dollars. The loss of prestige which frequent shut-downs entail spells "ruin" in capitals if the situation is not bettered. Apparatus and devices which stand between steady continuous operation and temporary shut-downs are, therefore, worth the careful consideration of the progressive manager.

The use of the storage battery as a reserve in connection with the exciters of the alternators in large transmission plants is growing to be an important additional safeguard against break-downs. Normally it will float on the bus-bars while the exciters supply current to the alternator fields, stepping into harness and picking up the load instantly if the exciter voltage fails, in its rôle of "watch dog of the system." Ordinarily an exciter is regarded as a thoroughly reliable and staid piece of machinery, capable of operation on the continuous performance plan, and in many installations the provision for duplicate machines has been considered sufficient precaution against interruption. In the great modern installations above referred to, however, it is vitally important that anything in the nature of an interruption be absolutely prohibited. Every user of power from the housewife with her motor-driven sewing machine and the dental surgeon with his tiny mouth lamp to the stockholder of the largest factory or street railway system has the right to demand that the power paid for be made as nearly continuous as human knowledge and skill can insure it. The operation of the storage battery in connection with the exciters is best illustrated by a typical case.

Assume two 150-kw, 125-volt exciters in the plant, each being of sufficient capacity to supply field current to 17,500 kw in alternators at 80 per cent. power factor and 25 per cent. overload. We require 1,200 amp. at the exciter bus-bars in order that the system shall operate within certain specified limits of regulation. To supplement this installation, we add a reserve battery capable of discharging at the rate of 1,200 amp. for one hour, or 300 amp. at the 8-hour rate. A 70-cell battery is required, with two 20-point end cell switches. At 2.5 volts per cell the battery calls for a maximum of 175 volts when being charged with all the cells in series. If the exciters are capable of being driven by the turbines at 40 per cent. above normal speed, we shall obtain 175 volts, when using one of them for charging purposes.

When the battery picks up the load its voltage drops below 125 by an amount depending upon the discharge required. If, for example, the exciter bus load were 1,000 amp., the voltage would probably drop to about 118, remaining near that point until the station attendant can move the slider on the end cell switch to cut in more cells, thereby raising the voltage to 125. If the battery is called upon from time to time to maintain this rate of discharge, the end cell switch slider must be gradually moved up in order to maintain the voltage. Probably 60 cells would be the average connected across the exciter bus-bars.

Charging is accomplished by one of the exciters through the end cell switch connections, a double-throw switch being arranged to connect the positive terminal of any exciter to either the positive exciter bus or the end cell switch. As the battery charges, the end cells are gradually cut out of circuit by the attendant in order to keep the bus voltage at 125. If the charging current fails when nearly all the end cells are cut out, the battery would be charged at a lessened rate from the exciter bus-bars until the slider was moved to cut in the proper number of end cells to balance the battery and bus voltages. If the voltage of both the bus-bar and the charging exciter gives out during the charging period the battery voltage will fall off somewhat as the load is picked up, but the drop will not be great enough to cause any discontinuity in the field current of the alternators. The transfer of the exciter bus from one to another end cell connection is effected without break or short circuit by the construction of the slider. This is divided into two parts separated by a resistance, and one or both adjacent end cell connections are always covered. The resistance is low enough in value to prevent any serious diminution of the entire battery current, while it effectually prevents the short-circuiting of a single cell in the brief time during which two adjacent connections are spanned by the slider.

In large plants the end cell switches would preferably be motor-driven and operated by remote control from the main manipulating switchboard. The battery finds additional usefulness in operating miscellaneous direct-current motor and lighting circuits of the traveling crane and other auxiliary apparatus, and in the starting of the plant when the exciters are driven by alternating-current motors. It also assists materially in preventing or reducing the fluctuations of alternating-current voltage, which are often aggravated by corresponding fluctuations of exciter voltage and current if there is no battery installed.

In round numbers, such an installation would probably cost something like $17,000, and its proportion to the cost of the entire hydraulic and electric plant would be but one or two per cent. As a safety adjunct its value can best be determined by those who have had the experiences resulting from shut-downs as outlined above.

Heating of Electrical Conductors in Liquid Baths.

Prof. Charles A. Perkins has conducted a series of experiments with a view to obtaining constants applying to the dissipation of heat from bare conductors immersed in liquids, an account of which is printed in the University of Tennessee *Record*. Nine coils of iron wire were connected as indicated by the accompanying sketch. The current enters at *A*, one-third going by the path *A*, *D*, *B*, and two-thirds by the path *A*, *C*, *B*. At *C* the portion *A*, *C*, *B* divides and one-half goes by each path indicated. By this arrangement the coil, *A*, *C*, is heated four times as much as *C*, *B*, the coils, *A*, *D*, *B*, acting as the two arms of a Wheatstone bridge. Part of the wire near *D* is left straight, and a sliding contact, connected with a galvanometer can be adjusted to balance the heating of *A*, *C* by the current.

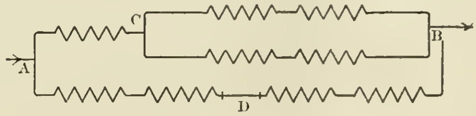

DIAGRAM OF CONNECTIONS OF COILS.

The wire was coiled into a helix and soldered at all joints. Wires from the same piece were brought from *A* and *B* and connected to the leads of a dynamo. The coils, *A*, *C* and *C*, *B*, were mounted vertically in a wooden frame and submerged in a jar of kerosene, and the balancing coils similarly mounted and submerged in a larger jar of kerosene, as close as possible to the first jar. The sliding contact at *D* is moved by a vertical screw, the upper end of which projects above the oil. The whole number of turns of the screw are counted by a toothed wheel, the fractions of turns being estimated. The screw has 17 threads to the inch. The sliding contact at *D* was soldered to one galvanometer wire, and to avoid thermo-electric currents, an iron wire from *C* was carried over into the second jar and soldered to the galvanometer wire near *D*.

The current was furnished by a storage battery or by a 125-volt dynamo, controlled by a bank of lamps and was measured by a Weston millivoltmeter and shunt. The current is assumed to divide between the different circuits in the ratio indicated, although the coils are adjusted to equality only by counting the numbers of turns.

The kerosene in the jar containing the balancing coils, *A*, *D*, *B*, was kept continually stirred by a fan on the shaft of a small electric motor. That in the other jar was stirred in some experiments and not stirred in others. The four spirals in *B*, *C* were distributed about the coil, *A*, *C*, and were 1 cm to 2½ cm distant from it. Any difference between the temperatures of these coils is no more than would be found between the conductor and a thermometer which would be assumed to give the temperature of the conductor, and any upsetting of the balance on passing a current through the network was due to the fact that the wire carrying the stronger current had not the temperature of the bath near it. To determine the amount of heating from the change in the resistance, the temperature coefficient of another sample of the same wire was determined. The stirrer employed was an annular strip of vulcanized fibre on the end of a wooden rod, and extended about three-fourths around the central coil, *A*, *C*, so that when drawn up and down by the hand it caused a fairly rapid circulation of the liquid close to this coil.

Prof. Perkins, in giving the results of his experiments, makes a comparison with results reported by Dr. Lindbeck, of the Reichanstaldt, in a set of similar experiments. In these latter, 0.1 watt per cm^2 raised the temperature 1.1° above the bath. The heating was not proportional to the watts, being less for higher currents. Stirring was of little or no advantage.

In Prof. Perkins' experiments, .01 watt per sq cm raised the temperature 1.03° above the bath when the latter was not stirred. The heating, so far as observed, was proportional to the watts. Stirring increased 17 times the number of watts dissipated with a given elevation of the temperature of the wire above the bath.

In his experiments Prof. Perkins calculated the total surface of the wire, while in the Reichsanstalt experiments the surface was taken to be that of the cylinder upon which the wire was wound. That the heating was found in the Perkins tests proportional to the watts dissipated may have been due to the small range of temperature employed or to the fluidity of the oil, which was ordinary illuminating oil, whose flashing point is about 200° F. The marked difference in the effect of stirring may be due to the fact that the coil was an open helix, so that on stirring a very free circulation of the liquid took place, as compared with what would result in a coil wound on a metal cylinder. It was frequently noticed that when a current upset the balance enough to swing the mirror of the galvanometer far off the scale, a few strokes of the stirrer would bring it back nearly to its zero position. In conclusion, Prof. Perkins states that the absolute value of his results applies only to the coils actually used, which were of the following dimensions: Diameter of wire, .015 cm; diameter of coils, 3 cm; number of turns per cm (about), three and one-half; watts per sq cm to cause a heating above the bath of 1° C., bath stirred, .1280; bath not stirred, .0077.

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Electricity and Seismic Phenomena.

Prof. E. Pilsudski, in the March issue of our Russian contemporary, *Electritshestvo*, discusses the connection of electricity with seismic phenomena. That seismic disturbances are accompanied by electrical manifestations has, he says, long been known, and was recently strikingly confirmed during the volcanic eruptions at Martinique. It was then observed that several minutes before the destruction of St. Pierre, telegraphic operation between the former and Fort de France was interrupted, owing to the passage of earth currents in the telegraph wires; the same occurred at Nice during an earthquake there on February 23, 1887, as well as other places. Some scientists, among others the late Gaston Planté, have held the opinion that seismic disturbances are produced by subterranean disturbances, in which electricity is the main factor; in other words, that they are the result of electrical discharges between strata of good conductivity separated by other strata of negligible conductivity, such as granite and silica. The discharges of such earth condensers generate great quantities of gases and vapors and these under great compression produce during expansion disturbances in the direction of less resistance; that is to say, radially toward the surface. In some instances the center of the disturbances has been located at not very great depths beneath the earth's surface, as in the case of the eruption on the Ararat. In these cases, the earth's surface was opened at many places and stones, vapor and mud escaped through the crevices. In some other cases, the gases escaping at the earth's surface produced intense fogs, and the air was filled with ozone—an evidence of electrical discharge—as occurred during the earthquake in Calabria.

Prof. Pilsudski considers that in addition to strong disturbances occurring at rare intervals, feeble electrical discharges are probably constantly occurring in the earth, and he suggests that a systematic study be made of the subject, particularly in regions where there are dip pits, as in the Transvaal and Caucasus mining regions.

Chicago Discussion of Central Station Tendencies.

At the meeting of the Chicago branch of the A. I. E. E. on May 5, the papers on "Tendencies of Modern Central Station Development," which had been presented at the New York meeting of April 24, came up for discussion. Mr. Peter Junkersfeld, recently elected local secretary, presided. A well-attended meeting attested to the importance of the subject and the great number interested in this branch of electrical engineering. The papers were abstracted, that on "Economical and Safe Limits in Size of Central Stations," written by H. A. Lardner, by Prof. P. B. Woodworth, that on "Safety Devices in Central Stations and Sub-stations," by Philip Torchio, by W. G. Carleton, and that on "Multiple versus Independent Operation of Units and Central Stations," by Peter Junkersfeld, the writer, himself. The discussion, which was participated in by many, brought out several important points, both in the construction and the operation of power plants.

Bion J. Arnold stated that he had always been inclined, as was well known, to the use of a single power house where this could be properly located as regards the supply of fuel, water, etc., with sub-stations operated by rotary converters. As regards the use of motor-generators versus rotary converters, European practice seemed to be the opposite of ideas generally accepted here. On a recent visit to Frankfort, Germany, he saw in operation a 1,000-kw motor-generator set. The motor was a single-phase one, although he had been assured previously that such a size was not feasible. Those on the continent claim that a better efficiency can be obtained from the motor-generator combination, or at least as low a cost of operation, as with rotary converters. This is because the generators are wound for a high voltage, and the motors work at the same potential, thus obviating the first cost—the expense of operation, the complication of step-up and step-down transformers and the necessary auxiliary apparatus.

As to the supply of current to a long line of railroad, he had modified some of his previous views as to the desirability and economy of one large alternating-current power house for a long length of road and had been forced to the conclusion that for a railroad with heavy traffic, a number of direct-current power houses scattered along the line were best.

W. L. Abbott, chief operating engineer of the Chicago Edison Company, called attention to an important problem in central station operation. To the operating man, a single day's supply of coal for such a plant involves no little thought. The supply of 1,000 tons of coal a day, as for instance to the Harrison Street station of the Chicago Edison Company, is no small matter. He called attention to the different operating conditions resulting from the use of different methods of handling coal which had been introduced successively as the output of the former station increased. At first fuel oil was used. Then coal, which was brought to the boiler room in wheel barrows. This was followed by the dump cart drawn by a horse, which in turn was superseded by the tramway and push car. All of these different methods have given way to modern coal-handling apparatus. When one considers that under the first method the cost of handling a ton of coal was approximately 40 cents, whereas now it is between 15 and 20 cents per ton, although this amount is still far greater than it ought to be, this will be seen to be an important item, especially when one considers that the daily average consumption is 600 tons. A saving of 10 cents per ton would be a material one, and is very satisfactory indeed when the amount handled is considered. The continuous supply of coal for one of the large modern central stations becomes a serious problem when one considers that the consumption of 3,000 tons of coal per day is the equivalent of two train loads. In large cities, where the congested condition of tracks causes irregularity in supply, no reliance can be placed upon the railroads. This irregularity of supply is further increased at the mines. As a station must be operated continuously, regardless of any irregularity in the coal supply, it becomes self-evident that ample facilities for the storage and the handling of coal must be supplied, and the advisability of the company having special terminal facilities as well as owning its own cars is not to be disregarded. It is self-evident that the handling of such a large amount of coal and ashes by hand is impossible, and that apparatus must be installed obviating the handling of the coal by workmen, not only because of the decreased cost, but also because it reduces the number of employees, and what is still more important, the possibility of trouble because of labor agitation. In cities where several power houses are located it is most economical to operate one large power house only.

Storage batteries are valuable adjuncts for these, as they meet sudden demands for power made on the power house because of sudden changes in the weather or because of a break-down at some station. The same may be accomplished to some extent by hand-fired furnaces, but this is impossible with automatic stokers. A great many power houses are now being built with apparatus for producing forced draft, as the draft may suddenly be doubled or even quadrupled, and the output increased to that extent, otherwise there would be a serious drop in the steam pressure where such a sudden demand is made. As a general thing, it may be said that the most wasteful and most extravagant piece of apparatus and the one which receives the least attention, is the boiler. At times a waste as much as 50 per cent. of the fuel used can be charged to the boiler, although half of this is quite readily prevented. As a consequence, it is necessary that the operating engineer give the closest attention to the boiler room. This is quite apparent in a plant consuming $3,000 or $4,000 worth of fuel a day, as a saving of 5 per cent. would be of great interest to those paying the bills.

In a general discussion which followed, Mr. Junkersfeld called attention to a number of interesting points which had been brought out in the discussion. He said that he was very much interested in the remarks made by Mr. B. J. Arnold concerning his conclusions that for railroad operation the best plan was to have direct-current power houses at frequent intervals rather than large alternating-current stations every 20, 30 or 40 miles, depending upon the size of the plant. It seemed to him that in the case of such plants, the element of unproductive investment and of unproductive labor would make it desirable to have as few a number of these as possible, provided they were located within the economical limits of voltage and possibly it would be well to have the plants further apart. He also called attention to the fact that the boiler room was not receiving its due share of attention as regards either design or operation. The boiler room investment amounted to quite an appreciable percentage of the total amount. Another important point in central station design which had been brought out in the discussion was the fact that storage batteries, although having a field of their own, could be superseded to quite an extent by the judicious use of forced draft in the boiler room. Quite an appreciable amount of storage battery capacity could be obtained at a reduced cost in this manner.

H. B. Gear, general inspector of the Chicago Edison and the Commonwealth Companies, called attention to the question of isolation or central control carried out through the 60-cycle distributing systems of both companies. The average feeders are carried along different routes, so that in case of trouble at any one point, other sections of the city are not affected. The same is true with the secondary system. Each transformer supplies a separate secondary system. The main secondaries are not more than 500 or 800 ft. long, and are supplied by two or three transformers at the most.

W. G. Carleton, assistant to the chief operating engineer of the Chicago Edison, discussed the troubles he had experienced on the 25-cycle distribution system. His experience had been the same as that of Mr. Torchio. Three-quarters of his trouble have occurred in the station, and were mechanical. The faults on the 9,000-volt lines were not due to any inherent weakness, but rather to mechanical injuries. He considered it advisable to separate the routes of different lines, even though they were operating in parallel at the stations. He referred to trouble which the company had experienced with currents going two or three miles along the lead sheath of the cables, and that this had been obviated by breaking the lead sheaths every half mile or so, and grounding them at the middle points.

J. R. Cravath stated that he had been impressed in looking over recent plans for turbine stations, with the enormous amount of boiler room required for one turbine unit. As one engineer had expressed it, power houses would almost have to be installed on the radial plan with the turbine in the middle. The relative location of boiler and turbine rooms to keep down the distances steam must be piped and provide for extension section by section on a uniform plan, is a serious problem in the design of such stations.

Bion J. Arnold, in reply to the remarks of Mr. Junkersfeld, then said that in advocating direct-current power houses located short distances apart, he had in mind heavy railroad service with trains requiring 1,500 kw, as for instance, on the New York Central.

The next Chicago meeting of the Institute, on May 19, will be devoted to papers and discussions by local telephone experts.

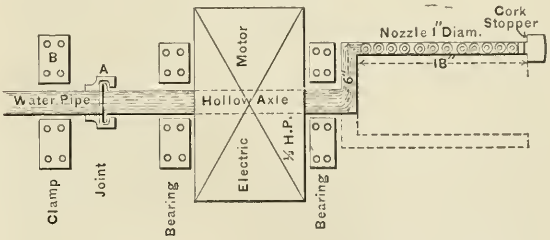
How to Produce Gravity Experimentally.

By Robert Stevenson, C. E.

The experiment described below is offered as a challenge to the scientific world to prove by the accepted laws of motion how the helicoidal motion produced is possible in free space.

Take an electric motor of any power from ½ hp upwards. Substitute a hollow for solid shaft, from 1½ in. upwards. Over the hollow axle fit a bent nozzle, as shown (by screw or otherwise). At the other end of the hollow axle have a free union joint at *A*. At *B* have the connecting water pipe clamped fast. Have bearings for the motor as shown. Have a water pressure sufficient to force a jet of water through pipe and hollow axle and nozzle, with a constant velocity of 100 ft. per second. Have a stop-cock close to, but behind the clamp *B* (not shown).

First Experiment.—Use water only, without the lead balls and cork, as shown in nozzle below. Fill the pipes with water due to pressure against stop-cock, but keep hollow axle and nozzle empty of water. Start the motor, and keep rotating at 100 r.p.m. Then open the stop-cock and let water jet through the nozzle, at the same time increasing the e.m.f. to keep up 100 revolutions. As this requires a large increase of force, it requires a little practice. But as this experiment is only qualitative, perfection is not required.



PRODUCING GRAVITY EXPERIMENTALLY.

I have found that to change the direction of momentum in this way requires power, although Kelvin, Tait, Maxwell and all the authorities deny it. That, in fact, is one of my discoveries. But if the rotation of the nozzle be kept up when the water is jetting through it at 100 ft. per second, the water after it leaves the nozzle describes a vortex, or corkscrew path in space; and that helicoidal path would continue forever, if there was no air or weight to affect it. That is how planetary systems are formed from rotating nebulæ.

Now empty the nozzle of water and place lead balls just large enough to fill the tube, as shown, and a stopper to hold them in place whilst the motor is rotating, before the water jet is turned on. When the water jet is turned on, the balls and stopper are projected into space, and the balls can be seen describing orbits round the axis of motion, or neutral line, without any attraction whatever; and that is how the planets move in their orbits in space, whilst the sun moves in the neutral line, or axis of motion that the water would have if it was allowed to project straight from the axle of the motor, which is the neutral line. And from that fact it is easy to calculate the sun's proper motion in space from a simple geometrical formula, without the use of the spectrograph. My rough calculation makes it about 13 miles per second. The same experiment can be made by using one ball and compressed air instead of water, provided the ball be given a longitudinal velocity of 100 ft. per second.

Owns a Coal Mine.

In a communication, Mr. George A. Hughes, owner of the Glendive (Mont.) Heat, Light & Power Company, writes us that he believes his to be the only electric light plant owning and operating a coal mine in the United States. The mine is located about 1½ miles from the station. The company owns 40 acres of land there and is now working in a four-foot vein. Eastern managers who have been "up against" the recent coal strikes and coal prices will rather envy Mr. Hughes, but few of them are in a position to duplicate his conditions, however much they might wish to do so.

New Telephone Patents.

From time to time there have been noted herein patents for various common battery circuit combinations in which two central batteries, both connected to the talking circuits have been used. These patents have been issued to various inventors all assigned to the Kellogg Switchboard and Supply Company The fundamental patent for this double battery system, pending for some considerable time, has just appeared, being part of the issue of May 5, 1903. This patent has been granted to Mr. Kempster B. Miller.

All earlier central energy systems had used a single battery for furnishing talking currents, this battery being so connected to the lines through repeating or impedance coils that it provided current indiscriminately to both calling and called for subscribers. Such systems are well covered by patents. Mr. Miller's system differs from these in the substitution of two central batteries, the circuits of the primaries and secondaries of the repeating coils being kept distinct conductively, one associated with each battery, and connected together inductively only.

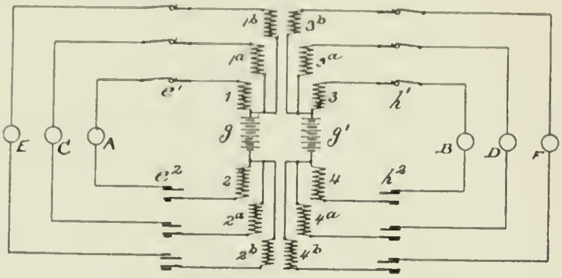


FIG. 1.—MILLER CENTRAL ENERGY SYSTEM.

The principle of this system is indicated in the diagram shown in Fig. 1. Herein *g* and *g'* are the two talking current batteries, to which are shown connected three pairs of telephone lines associated in inductive relation in pairs, by means of the several repeating coils. The windings, 1, 2, 3, 4, represent one such coil, 1 and 2 being the two parts of say the primary and 3 and 4 the secondary. When variations of resistance in the transmitter at station *A* cause corresponding variations in the current flow from battery *g* to the line, the resulting fluctuations in magnetization of the core of the repeating coil, 1, 2, 3, 4, induce co-ordinate varying alternating currents in the side of the circuit containing battery *g*, this battery acting solely as a conductor at this time. In Fig. 2 is shown one application of the system to practical operation. To the right and left respectively appear two subscriber's lines, while in the middle is shown a pair of connecting cords. The subscribers' signals are in circuit with both talking batteries, these being so poled as to their repeating coil connections that they may be used in series for signaling. The closing of the circuit between the two sides of the line at the subscriber's station causes the magnetic drop signal to fall. The signal circuit is wired to the line through a double cut-off jack and is, therefore, disconnected by the insertion of a plug in the jack. In its stead the repeating coil circuit is connected. As indicated in the figure, the repeating coil performs the additional functions of supervisory relays. To this end each end of the core confronts a relay armature controlling its own supervisory lamp circuit, the lamp glowing when the armature is attracted.

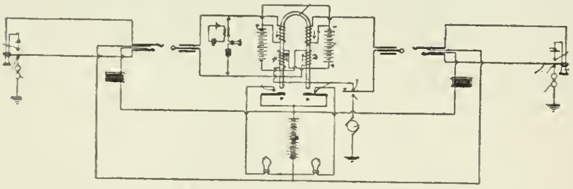


FIG. 2.—MILLER CENTRAL ENERGY SYSTEM.

As in other common battery systems, for best operating conditions the glowing of one lamp is desired when a connection is partially completed, or when the attention of the operator is desired, and the glowing of both lamps, when disconnection is desired. These conditions correspond to two widely different conditions of current upon the two lines, and in order to provide for them the primary and secondary windings are each divided, one part of each being on each leg of the core By connecting the windings on one leg in differential relation, when both subscriber's lines are receiving currents and these are substantially equal, a condition fairly obtainable in practice, the magnetic effect upon the core is nil When the current in either line ceases both armatures would be attracted except for the fact that they are polarized in such a manner that the proper one only is attracted, the other being repelled. When both subscribers return their telephones to the hook, the two batteries acting in series send current through one half of each coil and through the bells to ground, thus polarizing both ends of the core similarly and drawing up both armatures simultaneously.

A second very interesting patent of the issue of May 5 is entitled, "Means for Preventing the Disturbance of Telephone Circuits." C. J. A. Michalke is the patentee and he has assigned his patent to the American Siemens-Halske Company. The patent is most interesting to those dealing with grounded lines paralleling trolley or other power wires upon which an alternating weave is superimposed upon a direct current by the use of motors. In this system condensers are to be associated with the generator and with each motor to absorb the disturbing wave. Three methods of wiring the condensers are cited, these being shown in Fig. 3, *a* representing the generator, *d* the motors and *c* and *c'* condensers. In the first method these latter are connected directly to the machine terminals; in the second, the condenser is connected through the agency of a transformer; while the third is similar to the first except that an impedance coil has been inserted in the main line at each motor. It is difficult to state the merits of the various systems, but some experiments made by the writer some time ago would indicate that the second system could be made very effective, especially if the transformer is of considerable impedance. It would even seem better to omit the condenser from the secondary entirely and to make the secondary of low resistance and short circuit it.

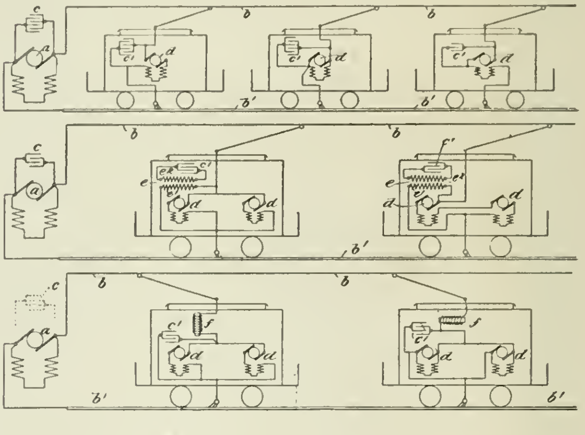


FIG. 3.—PREVENTING DISTURBANCE OF TELEPHONE CIRCUITS.

A third telephone patent of this week under the broad title, "Telephony," describes a "lock-out" party line system of unusual complication, a fault to which the failure of practically all previous "lock-out" systems has been due. This new system has been patented by W. E. Pembleton.

Two other telephone patents which have not as yet been noted are those respectively of C. W. Holtzer, entitled "Magneto," and of C. Van Riper, entitled "Telephone Pad." These patents both appeared in the issue of April 28. Mr. Holtzer's invention consists essentially of a clamp casting for securing in magneto boxes to support the rounded end of magneto permanent magnets so that they may be secure from disturbance during shipment or other rough handling. Mr. Van Riper's device is a shelf adjustable to the shelf of a telephone wall set carrying a roll of paper for memoranda, a straight edge for tearing off the paper and attachments for the directory and pencil. Mr. Van Riper also proposes to use the under side of the paper for advertisement purposes. This last seems hardly practicable as users would tear off paper in such irregular lengths that a confusion of matter would most likely occur at frequent intervals.

Recent Electrochemical Developments.

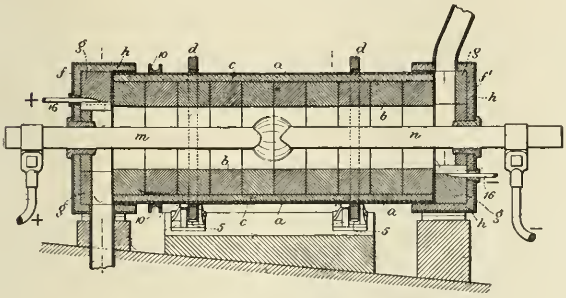
By Clinton Paul Townsend.

CALCIUM CARBIDE.

Mr. George E. Cox, of Niagara Falls, assignor to the Union Carbide Company, patents a method of converting such waste materials as the screenings and dust of calcium carbide and the partially converted material from previous furnace operations, into commercial ingots of carbide. Previous efforts along this line have not been lacking, but Mr. Cox now specifies the conditions which are essential to success. The refuse is of such high electrical conductivity that if it be attempted to fuse it under the conditions of the usual carbide furnace it is found that the heat of the circuit is not localized in the charge, but is, to a large extent, developed in the electrodes and their connectors. The proper conditions for the conversion comprise (1) the comparatively wide separation of the electrodes, in order to increase the resistance of the body of the charge, (2) the use of electrodes of high conductivity, as of graphite, and (3) a reduced voltage and increased amperage as compared with the values suited for the reduction of a mixed charge of coke and lime. Under these conditions this waste material may be formed into an ingot of carbide of commercial purity.

EDISON STORAGE BATTERY.

Recent patents issued to Mr. Edison cover a somewhat modified method of producing iron in an "electrolytically active" state, for use in his "reversible galvanic battery." The method consists in reducing finely divided oxide of iron, as ferric oxide, in a suitable retort by means of hydrogen at a temperature of about 900° Fahrenheit; some twenty hours are required for complete reduction at this temperature. The reduced iron is then permitted to cool to the normal temperature in an atmosphere of the gas, and is then flooded with water, after which it can be removed from the retort and handled without undue oxidation. The iron so prepared is mixed with flake graphite, or, preferably, with less than its own weight of copper or mercury. The form of battery which is the subject of the present patents, comprises this material, opposed in an alkaline electrolyte to nickel oxide.



LONGITUDINAL SECTION OF ELECTRIC FURNACE.

ELECTROLYTIC REDUCTION METHODS.

A series of electrolytic reductions, occurring in acid solution in the cathode compartment of a diaphragmed cell are described by Dr. Julius Tafel, of Würzburg, Germany. The first of these is the production of hydroxylamin by reduction of nitric acid in sulphuric acid solution. The cathode is preferably, but not necessarily, of mercury or amalgamated lead, and the anode is of lead. The conditions essential to success comprise the maintenance of the temperature at about 20° C.; the thorough agitation of the cathode solution, and the gradual addition of nitric acid in quantity proportionate to the current used, that is to say, at such rate that the evolution of hydrogen at the cathode is barely noticeable. The method is claimed to be a commercial one, but efficiency data are not given.

Two new compounds which the inventor names, "Camphidon" and "Camphidin," respectively, result from the cathode reduction of imido-camphoric acid, $C_{10}H_{15}NO_2$. The reduction proceeds in acid solution, a lead cathode being employed with sulphuric acid or a tin cathode with hydrochloric acid. Camphidon, having the empirical formula $C_{10}H_{17}NO$, is extracted by chloroform from the cathode solution after the precipitation therefrom of the greater part of the sulphuric acid. It is described as a soft crystalline mass, having a faint camphor-like odor and a melting point of 220° C.

Camphidin, $C_{10}H_{19}N$, is strongly basic, as its formula would indicate, and is obtained from the acid filtrate from which camphidon has been separated, by rendering the same alkaline and distilling with steam. Camphidin is crystalline, having an intense odor of camphor, and a melting point of 186° C. The formation of one or the other of these compounds depends upon the duration of the reduction, and under the conditions stated both compounds are produced. Their uses are pharmacal.

ELECTRIC FURNACE.

A departure from the usual type of electric tube furnace consists in providing within the tube an auxiliary heating means in the form of an arc between carbon terminals. The tube walls are composed of resistance material and are brought to incandescence by the passage of a current in the usual manner. A longitudinal section of the furnace is shown herewith. The tube is constructed of graphite sections, *b*, surrounded by an insulating sheath, *c*, and encased by sheet metal, *a*. This tube is mounted for rotation between stationary caps, *f*, *f'*, these caps being lined interiorly like the tube with insulating material and with graphite. The bearings consist of metal rings, *b*, mounted on the tube and turning on rollers, 5, power being applied to the tube through a pulley, 10. The furnace is preferably mounted at an inclination, and the feed and discharge occur through the cap plates. The terminals, 16, 16, of the heating circuit are on the cap plates, and contact is made through the annular graphite blocks, *g*, with the tube revolving in contact with them. The auxiliary heating circuit comprises carbon electrodes, *m*, *n*, introduced through the cap plates, and adjustable therein to form an arc at any desired portion of the furnace.

* * *

Electricity at the New York Military Tournament.

During the recent military tournament held in Madison Square Garden, the Electrical Corps of the Thirteenth Regiment, Heavy Artillery, N. G. N. Y., participated on two evenings, giving a torpedo defense drill. Company M of this regiment was designated by Col. Austen sometime ago to have charge of all electrical apparatus used in connection with the work of the regiment, such an organization being vitally necessary, as electricity enters so largely into the manipulation of heavy artillery in all coast defense operations. The corps have given several exhibitions in their armory in Brooklyn during the past winter, and their recent performance repeats their past successes. The drill at the Garden was devised to show torpedo harbor defense, and illustrated an attack on a supposed harbor by a hostile fleet at night. All was carried out in miniature, the tanbark arena representing the harbor.

As one of the spectacular features of the tournament, it was highly successful and from an instructive point of view very valuable, as it showed the public although on a small scale, how effectively a harbor can be defended by submarine mines. The system used is what is called "controlled automatic," and which can be operated manually from the shore as in judgment firing, or automatically by making proper switchboard arrangements. A vessel coming into contact with the mine closes the circuit through the charge, working as it were its own destruction. The wiring system used was much more extensive than in any of the previous efforts of the corps, and its complete success showed the thorough training of the young artillerymen. The open contacts in this instance were mounted on a short post placed directly over the mine, and which projected above the surface of the tanbark in the arena. The miniature ships were hauled across the tanbark surface and when over the buried mines closed the contacts, indicating on an annunciator located near the firing keyboard. The mines proper consisted of tightly wound bags of powder in which had been placed fuses, and were connected to the firing circuit through a resistance which, while letting sufficient current pass for testing purposes, was not strong enough to ignite the fuse. The firing was accomplished by cutting out this resistance, permitting the full force of the firing current to pass through the mine, causing the fuse to blow, exploding the mine and destroying the ship. The annunciator and firing keys were located in the cellar, and so far as the man operating them was concerned, might have been miles distant. Automatic firing was not tried, because, for reasons of safety, it was thought best to have the mines under control. This system is used in actual warfare, and is especially useful at night, the automatic man being unreliable at best.

Four searchlights traced the movements of the vessels across the darkened arena. A complete system of telephones was installed by which the commander was enabled to be at all times in instantaneous touch with all the points which effected the operations. Incandescent lamps were also used for signaling purposes.

The exhibitions in which this corps have engaged have been of the greatest value in giving the men who engaged in them experience in the handling of electricity, because they learn how necessary it is for them to be thoroughly trained in handling all the instrumental devices entering into their work. They learn that when anything goes wrong, "the other man" cannot be pleaded by the electrician—which teaches them that the utmost carefulness must be exercised in operation, or failure results. They learn that in addition to knowledge, courage is a great thing, as they must not know failure by any name whatever. As all the apparatus used in these drills is a miniature of what would be used in actual service, it is the best possible kind of instruction, as it is always preferable in technical training to give practical illustrations and experiments, rather than confine the course of instruction to reading and lecturing only. Sergeant M. C. Sullivan, who has been in charge of the instruction and drilling of the corps for the past year, was in command.

CURRENT NEWS AND NOTES.

VESTIBULE CARS.—Governor Odell has signed the bill which provides that street surface railroad cars operated throughout the State except in New York and Brooklyn, in the months of December, January, February and March, shall be equipped with vestibules. Companies operating in cities are given three years in which to complete the equipment of their cars.

RAPID TELEGRAPHY ABROAD.—A cable dispatch from Berlin of May 9 says: The government experiments between Berlin and Konigsberg with the Pollak & Virag system of quick telegraphy show favorable results. A speed of 40,000 words an hour has been reached. The government will now adopt the system for practical purposes between Berlin and Frankfort-on-the-Main.

DISCHARGE OF TELEGRAPH OPERATORS.—At St. Louis on May 8 Commercial Telegraphers' Union of America filed a petition in the United States District Court asking Judge Adams to issue an injunction to restrain the Western Union Telegraph Company from discharging men belonging to the union. The petitioners also ask that the company be restricted from blacklisting members of the union and from interfering with them in any manner.

MONT BLANC RAILWAY.—It is stated that plans have been drawn up for an electric railway from Le Fayet, about twelve miles from Chamounix, to the summit of Mont Blanc. The first section to be connected is to include in its stations the Motivon, the Col de Voza, Mount Lachat, Les Rognes and Tete Rousse, the provisional terminus being l'Aiguilie du Gouter, at 12,500 ft. above the mean level of the sea. Later the line is to be prolonged to the summit, 15,780 ft. above the sea level. The Municipal Council of St. Gervais has approved the scheme and granted the concession.

NEW ENGLAND LIGHTING.—Negotiations are said to be under way for a consolidation of a number of the electric light and gas companies in New England cities. The deal is being financed by a syndicate of New York and Boston capitalists, and it is reported that options on the majority of the plants which will be included in the combination have already been secured. The taking over of the individual companies has been carried out by giving the stockholders shares in the combine equal to the value of the stock held in the individual companies. The promoters say that the consolidated companies will curtail the working expenses and enable the combination to decrease the cost to customers.

HEAT OF RADIUM.—In the *New York World* of May 10, M. Pierre Curie, speaking of radium, says: "The heating powers of radium are very great, but so far its industrial uses appear to be very limited, as at the present price even the richest of your American millionaires could hardly hope to have his house heated with the aid of this new discovery. Some use of radium has already been made in the practice of medicine, and Dr. Daulas, of the Hospital St. Louis, has used it in skin diseases and found it efficacious in the treatment of cases of lupus. The substance has the remarkable property of continuously emitting heat without combustion. Half a pound of radium salt will evolve in one hour heat equal to that produced by the burning of one third of a cubic foot of hydrogen gas, and this evolution of heat continues for indefinite periods, leaving the salt at the end of months of activity just as potent as at the beginning. We have in radium a substance having the power to gather up and convert into heat some form of ambient energy with which we are not yet conversant.

ELECTRICIANS FOR THE ARMY.—The last Congress provided for 100 electrician sergeants at $408 per annum, and 25 master electricians at $75 a month and allowances. The War Department has issued a general order in regard to these appointments. Enlisted men desiring appointment as master electricians are to apply to the commandant of the school of submarine defense at Fort Totten, N. Y., through military channels. An applicant will not be recommended unless he has had a thorough course of study in electricity, mathematics, physics, etc., and three years of practical training in the use and care of steam and oil engines, of machines and machinists' tools and electrical appliances and apparatus. Applicants from civil life for appointment as master electricians will apply direct to the commandant of the school, and are required to give certificates from responsible persons of their qualifications, which must be of the same character as is required from the enlisted men. A practical examination of applicants who have passed a satisfactory theoretical examination will be held at the Fort Totten school for a period not to exceed two months, beginning August 1 next.

LETTERS TO THE EDITORS.

Parallel Operation of Direct-Connected Alternators.

To the Editors of Electrical World and Engineer:

SIRS:—The article of Mr. T. C. Oscanyan in your issue of April 18 points out the advantages in placing dampening devices upon the pole pieces of the fields of such alternators as give trouble in parallel running. I think that these advantages can more clearly be seen if we look at the case from another point of view.

The placing of damping devices upon the pole pieces of an alternator may be considered not a change in the alternator itself, but rather an addition of a powerful asynchronous motor to each unit, for the damping device is nothing else than the rotor winding of an asynchronous motor. The stators of these motors are the armatures of the alternators, and when the fictitious asynchronous motor runs at synchronous speed, it takes no wattless current from the mains as in the case of an ordinary asynchronous motor.

As soon, however, as there arises any difference in the angular velocities of both units, a current will flow from the faster running to the slower running unit, and the fictitious asynchronous motor will help the engine to bring the field of its generator up to synchronous speed. We can also consider the damping device as a magnetic clutch, working only through the effect of a flux upon short-circuited windings, in magnetically coupling both ends. But it is evident that such a clutch is the equivalent of an induction motor.

A good illustration of a properly devised damping device as applied to direct-connected alternators is found in experiments made some years ago in the electric lighting plant at St. Ouen, France. A report of these experiments was published in *Bulletin de la Société Internationale des Electriciens,* December, 1898, page 498, a short abstract of which was reprinted in the *Elektrotechnische Zeitschrift,* 1900, page 45. In this plant two alternating-current generators of 250 kw each, with damping devices upon their pole pieces, were direct-connected to cross-compound engines, running at 67 r.p.m. When the units were connected in parallel and giving current to the mains, the field circuit of one unit was opened and the steam shut off the engine of the other unit. This extraordinary proceeding had no effect on the motion of either unit, both continuing to run.

To understand the function of both units it is merely necessary to point to the fact that the damping devices are equivalent to the rotor windings of an asynchronous motor, and it is well known that an asynchronous motor worked above synchronous speed throws electrical energy back into the mains and requires mechanical energy for driving, thus becoming an asynchronous generator. This was furnished by the steam engine to the alternator, the field of which was not excited. The other alternator was running as a synchronous motor with an angular velocity a little less than the other or asynchronous generator, and in turn drove its engine from which steam had been shut off.

If properly devised damping devices will produce such results, they will also keep the alternators in step. Of course, this work decreases their efficiency, as any difference in the angular velocities generates a current in the damping devices, which is a loss to the generator. But if alternators running in parallel do not have damping devices, their engines must have heavy fly-wheels to obtain a minimum difference of angular velocities. And a heavy fly-wheel gives a greater loss of energy by friction than a lighter one, so that probably in both cases the losses of energy will be equivalent. As to the commercial features, it is only necessary to point out that a damping device may involve not only expense for its production, but also royalties on patents, while on the other hand a heavy fly-wheel requires a larger shaft and bearing than a lighter one.

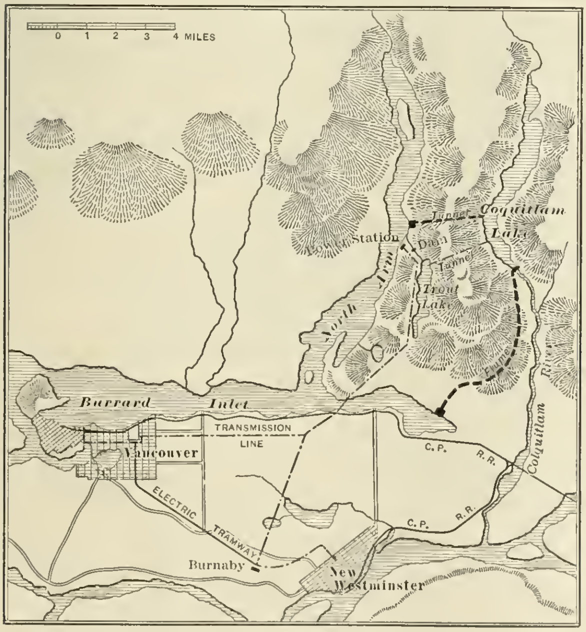
Mr. Oscanyan refers only to Corliss engines connected to alternators, but I do not think it necessary to confine the application to this type of engine, as other prime-movers give similar trouble when direct-connected to alternators if they have not sufficient weight of fly-wheel or damping devices on the pole pieces of the alternators.

Pittsfield, Mass. Frdr. W. Knopfe.

The Vancouver Power Plant.

To the Editors of Electrical World and Engineer:

Sirs:—Fearing that your editorial under the title, "The Vancouver Power Plant," in your issue of April 18, might be misinterpreted, I beg to make the following explanation of the peculiar conditions existing which made it advisable to adopt the extraordinary methods in the hydraulic development.



MAP SHOWING ROUTE OF VANCOUVER TUNNEL.

Trout Lake as a source of power is in itself of no value whatever, as the watershed is very limited and the outlet is practically dry, except during the rainy season. The original scheme was to develop the Coquitlam by fluming along the steep hillside a distance of about seven miles, and placing the power house at a point on Burrard Inlet, approximately as shown by the dotted line on the accompanying map. The soil along the proposed flume route is of a peculiar nature and exceptionally subject to landslides, which would make expensive construction, and the flume would also be subject to serious interruptions which would cripple the service for long periods, no matter what precautions were taken. This scheme was discarded on account of there being no storage at the end of the flume, the heavy cost of depreciation and maintenance and the unreliability of service.

It was then suggested that a tunnel connecting Coquitlam Lake with a point on the north arm, as shown by the dotted lines on accompanying map, be installed. The main objections to this scheme were that there was no feasible means of procuring storage to act as a balancing reservoir, and also that the tunnel would of necessity be large enough to carry the highest peak load. The writer, after looking over the ground, suggested that the tunnel connect Coquitlam and Trout Lakes. By this method Trout Lake acts as a balancing reservoir and the tunnel required is only large enough for the average, instead of the peak load. When the depreciation and maintenance on the proposed flume in the original scheme was taken into consideration, it is readily seen that this amount would pay the total cost of the tunnel in approximately fifteen years. The depreciation and maintenance on the hydraulic system being installed at present will be exceedingly low, and this fact in connection with the reliability of service to be obtained, and the freedom from high water and freshets, will make an ideal installation.

Seattle, Wash. K. G. Dunn.

Fuel Consumption in Central Stations.

To the Editors of Electrical World and Engineer:

Sirs:—Noting in your issue of the 18th inst. a letter relating to the above subject, in which it is claimed, "The pounds of water evaporated per kilowatt-hour, including only the energy transformations in pipe line, engines, generators and cables, gives no indication, unless the pounds of water evaporated per pound of coal is stated, of the boiler room operation where the largest losses always occur"; and the opinion further expressed that the economy of power station operation if expressed in pounds of water used per kilowatt-hour is of doubtful value, and that the "real need is of a simple expression for the economy of the station as a whole," I beg to differ from the writer of said letter for the following reasons:

First. The largest losses do not always occur in the boiler room, as the varying efficiencies of boilers under the usual range of conditions do not differ as widely as the varying efficiencies of engines, due to difference in character of loads, types of engines, etc. Boilers usually give their best efficiency when operating at or above their rated capacity, with an average efficiency when operating at one-quarter or one-half loads, ranging generally from 60 to 75 per cent. of their maximum efficiency; while engines operating on widely varying loads (as frequently required, particularly for railway service) show efficiencies varying much more than the boiler efficiencies mentioned.

Second. While primarily a simple expression for the economy of the station as a whole is desirable, yet when it shows results not up to usual standards, there can be no intelligent analysis of the conditions made or remedy prescribed, without sufficient data for separating the operation of the boiler room from that of the engine room, the relative efficiencies of the two not being fixed since each can be varied without affecting the other.

As illustrating the above, a railway power plant furnishing current (without storage battery auxiliaries) for operating the average electric railway of 20 to 40 miles in length, giving hourly service, will be required to take care of loads varying from friction load to 25 or 50 per cent. loads beyond the rated capacity of the machinery (if the units are suited in size to their average duty, as is usually aimed at where best economy is desired). Notwithstanding, however, even these great variations in load, the boiler efficiency of the plant varies but slightly from what it would be with a steady load equal to the average of the fluctuating one; the average engine efficiency, however, is very much lower with the fluctuating load than it would be with the steady one. If, however, under either of these conditions more boiler capacity is used than can be worked on the average up to its rated capacity, the boiler room efficiency will be reduced without changing in any way the engine room efficiency.

Per contra, if storage battery auxiliaries are used, the load on the power house kept constant, and the units are of the proper size to operate the average load economically, then the engine room efficiency will be greatly improved over the first condition mentioned, while the boiler room efficiency (if boilers are worked up to their rated capacity), remains practically the same, but less boiler capacity is, in the last mentioned case, required

There being, therefore, no fixed relation between boiler room and engine room efficiencies, the pounds of water evaporated (preferably expressed from and at 212°), must be known, to separate the records of operation of the boiler and engine rooms and analyze properly the station performance as a whole

My suggestion not having been to omit the pounds of coal (or pounds of combustible) from the station records, but to add to them and the kilowatt hour output "the pounds of water evaporated" (preferably from and at 212°), I again urge the securing of data as to the evaporation, that any general power station results not found up to the standard of best practice, may be intelligently analyzed and a proper remedy prescribed for the purpose of improving the economy of operation and likewise the net profits resulting therefrom.

Detroit, Mich. JOSEPH E. LOCKWOOD.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Shell and Core Type of Transformers.—NIETHAMMER AND EBORALL.—Some controversial communications on the subject of transformer design. Eborall had stated that it is impossible to build shell-type transformers of 100 kw with a maximum voltage drop (induction load) of less than 4 per cent., without getting a bad efficiency. Niethammer points out that this is an error, as nearly all American concerns and their affiliated European companies design all their large transformers as shell-type and with excellent results. The Union Electric Company, of Berlin, has built a great many shell-type transformers from 75 kw up to about 2,000 kw, with regulations of 1½ to 3 per cent. (maximum induction drop, short-circuit load) and has, at the same time, obtained efficiencies of 97.5 to 98.3 per cent.; the iron losses are usually slightly larger than the copper losses at full load. By using a good system of ducts and artificial cooling, the disadvantage of excessive heating of the shell-type is entirely overcome. Eborall replies that his views are supported by theory and by practice, and that it can only be a question of time before the shell-type of transformer will be abolished for everything but purely lighting work. Its only advantage is that it is cheap, while its disadvantages are that it is unmechanical, difficult to insulate, difficult to keep cool, and difficult to design for high efficiency over a wide range of load and good regulation at the same time. The two large American companies still adhere largely to the shell type. "This predeliction of the American for an out-of-date type is difficult to explain, but it may be due to the fact that American experience with transformers used on highly inductive loads is certainly much less than that in Continental Europe, by reason of the much larger extent to which rotaries are used over there. Whereas the Continental engineer makes a point of using three-phase current directly, when anyhow possible, the American prefers apparently to put a rotary in between, which, at any rate, has one advantage—it gives him a load of a high power factor. Thus the need of transformers which shall have full load drops of a few per cent. on a power factor as low as 0.5, does not arise, and thus the shell type is in this respect good enough. The American engineer simply employs three of his standard lighting transformers suitably connected." In recent years the General Electric Company have got out a complete series of standard core transformers which they specially recommend for power work.—Lond. *Elec.*, April 24.

REFERENCE.

End Play Device for Machines.—See the abstract "London" under Traction.

LIGHTS AND LIGHTING.

REFERENCE.

Electric Lighting of Railroad Cars.—GOETZE.—Continuation of his serial on this system.—*Centralblatt f. Accum.*, April 1, 15.

POWER.

Independent Crane Conveyors.—E. K. SCOTT.—An article on the use of independent crane conveyors for the coal supply in central stations. In small stations where it would not pay to lay down an elaborate conveyor plant, he thinks there is a future for the small independent crane conveyor which runs on overhead steel girders or rails and is actuated by an operator who rides with it. Consequently it may be taken in and out, round curves of comparatively small radius, and into out-of-the-way corners which cannot be served by the ordinary continuous conveyors, because the latter must always work in a straight line. The independent conveyor consists of a small locomotive and crane combined, the motor of which is supplied with current from the girder rails on which it runs, or else from a pair of trolley wires fixed between the upper and lower flanges of the rolled steel joist, on the lower flanges of which it is supported. It may be used to carry other things besides coal.—Lond. *Elec. Rev.*, April 24.

REFERENCE.

Swiss Plant.—RUNG.—A well-illustrated description of the hydroelectric power installation at Bezman, Switzerland, supplying current for lighting the nuemerous towns in the neighborhood and also for the supply of power for electrically driving several large workshops, silk-spinning mills, and a few small electrical railways.—*The Eng.*, May 1.

TRACTION.

Three-Wire System for Traction.—An illustrated description of the Grenoble-Chapareillan tramway, which is 43 km long, and on which the three-wire system is used with 1,200 volts between the outers. On the whole length of line overhead copper wires of 9 mm diameter distribute current to the cars; the wires are situated 70 cm from each other. The generating station is situated at Lancey, water power being utilized; the price of current is 100 francs (20 dollars) per horse-power-year. There are two 600-volt, 417-amp. dynamos in regular operation in series connected to the bus-bars, as shown in the adjoining diagram, the neutral wire being taken from the bus-bars connected to the common terminal of the two dynamos. The machines are compound-wound for 600 volts from no load to full load; they are shunt-excited and their field circuits include an automatic rheostat actuated by an automatic regulator on the Thury system. The neutral bus-bar feeds directly the neutral conductor of the tramway line, which is formed by the bonded track rails. The overhead wires are fed from the outside bus-bars of the station by means of boosters; these booster sets are each composed of two

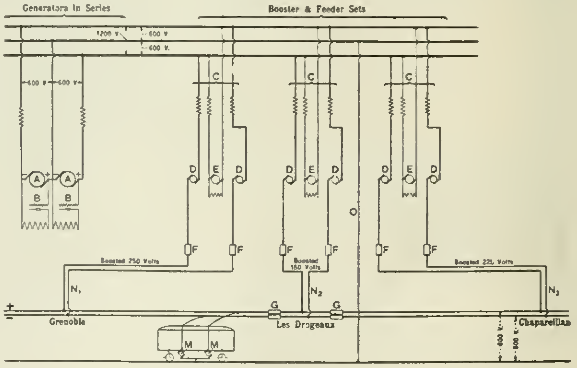
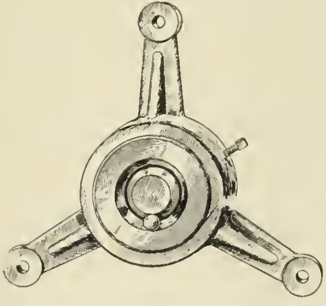


DIAGRAM OF GENERAL CONNECTIONS.

series generators run by one compound-wound motor, as shown on the diagram on the right-hand side. The motor, *E*, is fed from the bus-bars and the generators, D, are series-excited and connected in series with the positive and negative poles. The boosters are protected against possible short-circuit by overload circuit-breakers. As there is also danger of the whole set being reversed and the booster generators being run as motors, each set is provided with an automatic apparatus which simply short-circuits the armature of the motor in case the shaft revolves in the reverse direction. In the adjoining diagram *A* are the compound-wound generators, *B* automatic field rheostats, *C* booster sets, *D* series boosters, *E* compound-wound booster motors, *F* overload circuit-breakers, *G* section insulators, *M* railway motors, N_1 feeder No. 1, boosting voltage 250 volts, N_2 feeder No. 2 boosting voltage 150 volts, N_3 feeder No. 3, boosting voltage 225 volts; o is a neutral feeder to the rails.—Lond. *Elec.*, April 24.

Italian Third-Rail Road.—An illustrated description of the Milan, Varese, Porto Ceresio electric railway which has a length of 47 miles. It was installed by the French Thomson-Houston Company, the third-rail system being used. The power house contains three steam-driven 750-kw, 13,000-volt, three-phase generators. There are five sub-stations along the line, on the average about 10 miles apart; the three which are nearer Milan are equipped with two compound-wound, 500-kw synchronous converters each, the other two having one 250-kw converter each. In each of the larger sub-stations there are seven air-blast cooled transformers of 180 kw each, one being held in reserve; these reduce the pressure to 420 volts, from which the converters give direct current at 650 volts. The other two sub-stations are provided each with a buffer battery of 323 cells, of 320 amp-hours' capacity when discharged in one hour, and with a Thury motor booster. The Thury automatic regulator is used to maintain the output of the converter constant at all times, the battery and booster being connected in parallel with the converter. A battery of 505 amp-hours' capacity is also installed in the sub-station nearest to Milan.—Lond. *Elec. Rev.*, April 24.

London.—An illustrated description of the Hampton Court line of the London United Tramways Company. Three-phase current at 5,000 volts is used for transmission to a sub-station in which by means of transformers and synchronous converters the alternating current is changed to direct current of 500 volts. A special feature of the converters is the end play device shown in the adjoining figure; its object is to oscillate the armature so as to cause an even wearing of the bearings, commutator and collector. The ball race is kept pressed forward by means of a fairly stiff spiral spring and the device is screwed to the pillow-block by means of the three arms, so that the ball touches the end of the shaft when the shaft is about 1/32 of an inch from the end of its thrust. The armature is thus balanced laterally against a spring and is kept in a state of more or less constant axial oscillation.—Lond. *Elec.*, April 24.



END-PLAY DEVICE.

Surface Contact System.—Shawfield.—A reprint of his official report to the Wolverhampton corporation on the results obtained during one year, with the Lorain surface contact system on a trial line in that city. The report is in form of a comparison between this and the trolley system. Concerning safety to men and animals he concludes that although with the Lorain system there is probably a somewhat greater liability to harmless shocks, there is distinctly less risk of serious injury to users of the streets than with the overhead trolley system. On the score of reliability he thinks there is very little to choose between the Lorain system and the trolley system. The consumption of electrical energy per car mile is greater with the Lorain than with the trolley system; the total average current consumption per car mile with the Lorain system under normal conditions of traffic, is about 1.4 units per car mile, while it is 1.15 for the trolley system; in other words, 22 per cent. more energy is consumed, which represents about 0.82 cent extra cost per car mile. The cost of maintenance is also greater with the Lorain system than with the trolley, the difference being estimated is 1.626 cent per car mile. Some very brief notes are added on other surface contact systems, namely those of Dolter, Kingsland, Johnson, Lundell, Schuckert and Diatto.—Lond. *Elec.*, April 24.

Seattle-Tacoma.—A description of this interurban railway which is 36 miles long, the third rail being used in general and the trolley in the cities and where the road runs on the highway; the cars pass over crossings by their momentum. Power is distributed from three sub-stations to which it is transmitted from the main stations at each end of the line at 25,000 volts, generated at 2,200 volts and 60 cycles. The power station in Seattle is also used for lighting purposes. Induction motors directly connected to direct-current generators are used instead of rotary converters in the sub-stations and are in units of 300 kw each. The transmission wires are spaced on a 40-in. equilateral triangle and could be operated at 60,000 volts if desired. The cars are run in trains of 2 or 3 cars each; each car is equipped with 4 motors of 125 hp each and is fitted with multiple-unit control. The company also has an electric locomotive fitted with the same equipment, but with lower gear ratio.—*St. R'y Jour.*, May 2.

Electric Traction on Swedish State Railways.—A note stating that the exploitation of the many large waterfalls in Sweden has of late years gone ahead at a great pace, and that the Board of State Railways has recently presented a report to the government in favor of operating the railways by electricity.—Lond. *Eng'ing*, April 24.

Wattmeters on European Cars.—An article on the control of motormen by means of wattmeters. This is done in Magdeburg and the relative efficiency of the different men is reduced to a standard basis of comparison, viz., the ton-kilometer. Inefficient men are discharged and prizes are given to good men. The saving effected in energy after deducting the cost of operation and repair of the wattmeters and prizes to the motormen, varies between $1,800 and $2,000 per quarter of a year. The Rheims Tramway Company has also adopted a somewhat similar practice.—*St. R'y Jour.*, May 2.

REFERENCES.

Three-Phase Traction.—The first part of a well-illustrated description of the Valtellina Railway on which, as repeatedly noticed in the Digest, three-phase currents are transmitted at 20,000 volts, the voltage being reduced to 3,000 in transformers placed along the line, 3,000-volt, three-phase induction motors being used on the cars. —Lond. *Elec.*, April 24. The first part of an illustrated description of the same railway, by Cserhati, is in the *Elek. Zeit.*, April 27.

Multiple-Unit Systems in London.—The first part of an illustrated article on the electrically-equipped trains for the Metropolitan District Railway in London. This company has placed an order for the electric equipment of two seven-coach trains with the British Westinghouse and the Thomson-Houston companies respectively. The main object is to compare the Westinghouse and Thomson-Houston systems of train-control, and it will also afford an opportunity for teaching the drivers how the multiple-unit system, which is practically new in England, is manipulated. The equipment of the trains is described and illustrated.—Lond. *Elec.*, April 24.

Conduit Construction in Brussels.—A description of the original method of conduit construction planned for the Brussels tramways and of the method now actually used, which is much cheaper.—*St R'y Jour.*, May 2.

Roadbed.—Sattler.—The first part of an article on roadbed construction for tramways.—*Elek. Anz.*, April 26.

Friction Between Wood and Iron.—Klein.—An article on the friction coefficient between wood and iron and its influence on braking.—*Glueckauf*, April 25.

Automobile Exposition.—Two articles giving some notes on the recent automobile exhibition in Agricultural Hall in London and on the German Automobile Exhibition in Berlin.—*Centralblatt f. Accum.*, April 15.

Wires, Wiring and Conduits.

Fuses.—An article on the development of the construction of safety fuses in recent years. Aluminum is regarded by some engineers as a very good fuse for currents from about 20 to 100 amp.; in important installations aluminum and platinoid have been used very successfully for such current for several years past, and pure tin wire from 3 to 20 amp., but the opinion is expressed that the former metal could be used equally well for every case exceeding 3 amp. Of course the increased expense is a factor to be considered, still greater efficiency and less risk of arcing are worth something. It is thought that copper is not as safe a metal to use for heavy work as aluminum; and on no account should it be adopted for light work. Some notes are given on enclosed fuses.—Lond. *Review*, April 24.

REFERENCES.

Calculation of Networks.—An article on a simple method for calculating networks of conductors. Most of the methods, now in use, require the solution of as many linear equations as the network has branching points; this takes time and gives one no good idea of the system. His method avoids this practical disadvantage and is relatively easy to use, but cannot be described briefly. The article is illustrated by a long series of diagrams which explain the formulas.—*Elek. Zeit.*, April 23.

Elementary Treatment of Conducting Networks.—Wilberforce.—A brief note in which the author shows that the well-known reciprocal relations between the parts of a conducting network can be readily established without an appeal to the properties of determinants.—*Phil. Mag.*, April.

Electro-Physics and Magnetism.

Radioactivity of Uranium.—Rutherford and Soddy.—A paper in which they discuss the radioactivity of uranium, as compared with thorium. The case of uranium presents some interesting features and is in some respects simpler than that of thorium. They make an important distinction between the photographic and electric effects. The uranium radiation consists of two types: First, the easily absorbed rays, second the penetrating rays which are readily deviable in a magnetic field. The former constitute by far the greater part of the electric effect, the latter practically all the photographic effect. The case of uranium is especially interesting on account of two points: First, the existence of non-separable activity consisting entirely of easily absorbed rays, as in the case of thorium; second, the non-existence of easily absorbed rays in the radiation of "uranium X." This is probably an example of a general law that when gotten by itself free from the matter which produced it, on the one hand, and the products of its further change on the other, each type gives rise to homogeneous rays, and that in all cases the easily-absorbed rays are produced first and the magnetically deviable and penetrating rays only result in the final stages of the disintegration. Uranium gives more definite evidence on this point than thorium.—*Phil. Mag.*, April.

REFERENCE.

Iron Powder.—Maurian.—An article illustrated by diagrams, in which he gives the results of an experimental investigation of the magnetic properties of iron powders.—*L'Eclairage Elec.*, March 28.

Electro-Chemistry and Batteries.

Treating Nickeliferous Copper Matte.—Von Kuegelgen.—An article in which after some brief remarks on the process of Ulke (Transactions Am. Electrochem. Soc., Vol. I, p. 95), he describes a similar process, worked out by Guenther in Borcher's laboratory. The process is similar except that Ulke uses an ammoniacal nickel solution with insoluble (lead) anodes, while Guenther uses an acid solution and soluble anodes. He thinks that the last traces of copper can be most easily removed by means of precipitation by hydrogen sulphide; for the separation of the iron from nickel, he recommends separation of the nickel in form of nickel ammonium sulphate, which crystallizes out when the solution is cooled, while the iron remains in solution. If the iron and nickel are present in a proportion of 1 to 15, this separation is nearly quantitative; if this proportion is 1 to 2, about 90 per cent. of the nickel is separated. Concerning the electrolytic treatment of the nickel salt for the production of metallic nickel, he first tried insoluble (lead) anodes and various electrolytes, but found that there were disadvantages, one being the low solubility of nickel ammonium sulphate, the other the relatively high voltage required. Some of these are prevented by using soluble anodes. Moreover, it is desirable to use for the electrolyte a nickel salt like the sulphate, which is more soluble than nickel ammonium sulphate, and has a smaller tendency to crystallizing out with decreasing temperature. The principle of his process is to utilize the anodic energy of the current by using at the anode as electrolyte a mixture of two salts, the one electrochemically attacking the metallic anode, while the other decomposes the soluble metallic compound thus formed, the result being the regeneration of the solvent and the formation of an insoluble salt useful as a coloring material. This idea led to the necessity of a diaphragm, the cathodic part of the cell containing the nickel sulphate, and the anodic part the mixture above mentioned. In all cases he obtained good nickel at a moderate voltage and satisfactory ampere hour efficiency, but in every case the anodic by product was for some reason unsatisfactory, and he therefore concluded that his original idea was not practical, and had to be modified; he now uses in the anodic part of the cell only the salt which dissolves the anode, but the precipitation of the insoluble salt is made outside of the cell. In the electrolysis the voltage varied between 3.5 and 4 volts at a current density of 400 to 500 amp. per square meter and at a temperature of 60 to 65° C. The ampere-hour efficiency of the nickel production was above 90 per cent., when no higher current density than 400 amp. per square meter was used. The nickel produced was good.—*Zeit. f. Elektrochemie*, March 19.

Production of Metallic Potassium from Molten Potassium Hydroxide.—Lorenz and Clark.—An article in which they refer to the fact that the production of metallic potassium from its molten hydroxide meets with difficulties, while the electrolytic production of metallic sodium from molten sodium hydroxide is very simple. They refer to the theory of Lorenz on the electrolysis of molten salts which had been found to be correct by a great many experiments. According to it, the metals deposited at the cathode have a tendency to form what he calls metallic mist or fog, which is dependent upon the vaporization of the metals at the temperature of the bath; it acts like a depolarizer, reducing the ampere-hour efficiency. From this theory the tendency for the deposited metal to redissolve and form a metallic mist is much greater for potassium than for sodium; it is, therefore, necessary for the production of metallic potassium from its molten hydroxide that the cathode be enclosed by a porous diaphragm which serves to hold the potassium mist together. Experiments have fully confirmed this; as cathode he used an iron wire 3 mm thick passed through the top of a magnesite globe, the bottom of which is open; this globe is placed in the molten salt and acts as a porous cup; after the electrolysis it was found to be filled with solid potassium. They thus electrolyzed molten barium hydroxide in order to get barium; but barium oxide, and not barium, was found in the globe; the authors assume that the deposited barium reacts at once with the barium hydroxide. Magnesite was found to be an excellent material for such diaphragms, but it is not suitable for the electrolysis of molten chlorides.—*Zeit. f. Elektrochemie*, April 2.

Galvanic Cells.—Mugdan.—Continuation and conclusion of his article. The galvanic cell combined with a motor is theoretically the most perfect machine for converting chemical into mechanical energy, but this is not true in practice, and in spite of its bad efficiency, the steam engine is the cheapest method. The two disadvantages of galvanic cells are that the limited number of chemical reactions which can be utilized in them are all expensive, and that there are also losses, although they are smaller than in engines. He discusses briefly the galvanic cells used in practice and makes some remarks on the use of aluminum for electrodes, after which he takes up carbon cells; theoretical remarks are made on these among others that Nernst's calculations show that the combination of carbon and oxygen forming carbonic acid gas, gives as the e.m.f. of the ideal carbon cell about 1 volt. The experiments made to construct a practical carbon consuming cell are then noticed; and are thought to be very insignificant, as it has been proved that the energy given out was really due to the oxidation of carbon. He then refers to some roundabout ways of solving this problem and mentions as an instance the Daniell cell, the zinc sulphate of which may be regenerated by carbon, and the copper may be changed to copper sulphate, so that the cell may be used in a cyclic process, in which it gives out energy consuming only carbon and oxygen; but this very uneconomical and complicated device can scarcely be considered as a carbon cell. In summing up he states that a cell in which the oxidation of carbon renders work, is quite possible, but the technical difficulties are enormous, the cost of installing and maintaining being especially great.—*Chem. Zeit.*, April 1, 15.

Carbon Electrodes.—A summary of notes on the manufacture of carbon electrodes. Acheson's method is illustrated and described; the following notes on the method used in the German plant of Lessing are given. The special feature is the necessity of using very large machines, and pressures of 340 kg per sq. cm. The starting material is the retort carbon of gas works; pieces reduced to hand size and are heated to 1,200° C, not in contact with air. After reduction to an extremely fine powder it is mixed with absolutely dry tar, formed, pressed and then left in the air to harden. They are then heated in furnaces to 1,300°, which is the most difficult operation, and it is recommended to spend about two weeks for this heating and cooling. The French company, Le Carbone, uses the Girard & Street process of making graphitized electrodes; their furnace is designed for continuous operation; the carbon blocks pass through it from the top to the bottom and are heated up to white heat by several arcs; a furnace consumes 10,000 amp. at 130 volts; the principle of the process is that each carbon in the arc zone serves as electrode for one or several arcs.—*Zeit. f. Elektrochemie*, March 26.

Electrolytic Dissolution of Platinum by Means of Alternating Currents.—Ruer.—An account of experiments on the dissolving of platinum in various electrolytes under the separate or combined influence of alternating and direct currents. In one arm of a U-shaped tube there were the two platinum electrodes of the sinusoidal alternating current; the other arm contained the cathode of the direct-current circuit, one of the two other electrodes in the other arm being the anode of this direct current. In a sulphuric acid solution containing two parts of acid to one part of water, he found that platinum is not dissolved by the alternating current alone, as long as there is no oxydizing agent in the solution; but it is dissolved by the combined action of alternating and direct current; also by the alternating current alone when an oxydizing agent like chromic acid or even oxygen is used. Most of the other electrolytes which he tried behaved in the same way, but in some, like hydrochloric acid, sodium chloride, etc., in which one ion has a tendency to form a complex ion with platinum, alternating current alone dissolves platinum without oxydizing agents; but in these the platinum is dissolved under certain conditions by direct current alone. He assumes that the attack on the surface by alternating current is due to a formation of a very thin oxide layer when the platinum is anode, and to the reduction to a lower soluble oxide when the platinum is cathode. Passive iron behaves in a way similar to platinum, from which he concludes by analogy that the hypothesis that the passivity of iron is due to an oxide layer, is not impossible.—*Zeit. f. Elektrochemie*, March 19.

Bipolar Electrodes.—Brochet and Barillet.—An article on the use of a metallic plate placed without any electrical connections, between the anode and cathode in an electrolyte, but not filling out the total cross-section. Copper sulphate was used as electrolyte in all the experiments; at first they used platinum as the anode and as the intermediate plate; then they used a platinum plate coated with copper on the side toward the cathode for the intermediate plate; finally, they used a copper anode. The observations made in these different cases are described in detail, especially those under the conditions in which the intermediate plate acted as a bipolar electrode, or as an inert plate; and the results are what might be expected from theory.—*Zeit. f. Elektrochemie*, March 26.

Dannell.—An article on the same subject describing quite a number of experiments, and, commenting on the experiments of Brochet and Barillet. Among those of his experiments in which he used copper plates as electrodes and copper sulphate as electrolyte, he made a porous intermediate diaphragm 7 cm thick of 1-cm arc lamp carbons, running horizontally.—*Zeit. f. Elektrochemie*, March 26.

Decomposition Curves of Copper Salt Solutions.—Abel.—In a recent paper Miss Heiberg gave some decomposition curves of various copper solutions, which showed two sharp bends, one corresponding to the cupric ion discharge, the second, which was 0.1 volt lower, being assumed by her to correspond to the discharge of cuprous ions to metallic copper. The present author suggests that it is more probable that this second bend corresponds to the partial discharge of cupric ions to cuprous ions.—*Zeit. f. Elektrochemie*, April 2.

Cathodic Deposition of Lead.—Elbs and Rixon.—In the electrolysis of lead salts the lead is deposited on the cathode in two different forms, either as bright thin leaves or as a sponge of needles with a dull lustre. The authors in the present note state that they have found that an electrolyte which deposits lead in the first form invariably begins to deposit spongy lead at the moment when it contains four valent lead ions.—*Zeit. f. Elektrochemie*, April 2

REFERENCE.

Acetylene.—Keppeler.—The first part of an article on the impurities of technical acetylene and on its purification.—*Zeit. f. Calcium-carbid Fabr.*, April 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Stereoscope for Röntgen Ray Photographs.—An illustrated article in which attention is called to the fact that stereoscopic Röntgen ray photographs, produced by using two focus tubes, or by using a single tube in two successive positions, are always too large for use in the ordinary hand stereoscope. A direct-vision spectroscope devised by Walter is described which is capable of viewing photographs of any size, consisting of a combination of a wide-angle photographic camera and two simple eye pieces; for these latter lenses of the ordinary hand stereoscope may be used. In Walter's spectroscope there are neither reflectors nor prisms, but only lenses. The construction is described and illustrated in detail.—*Elec. Rev.*, April 24.

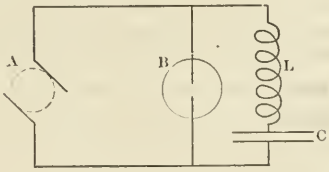
Units.—Dompieri.—An article in which he suggests a change of the absolute system of units. He purposes to divide the hour (which is as before the 24th part of a day) into 100 minutes, each of 100 seconds, and in the same way a circle into 24 degrees, each of 100 minutes, each of 100 seconds. The new second he suggests to adopt as the unit of time in electrical engineering. Instead of the centimeter-gramme-second system, he proposes to adopt the two-dimensional centimeter-second system, the mass having the dimensions, l^3t^{-2}. He urges that all electrical engineers should vote on the adoption of uniform practical units.—*Zeit. f. Elek.*, March 8.

REFERENCE.

Cable Testing.—Dalton.—The first part of an article, illustrated by diagrams, giving some notes on cable testing.—Lond. *Elec. Eng.*, April 24.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—Simon and Reich.—An article in which they first sketch the three epochs of the development of wireless telegraphy, the first characterized by the connection of the Righi oscillator with a vertical wire, as was done by Marconi; the second by Braun's transmitter of large energy capacity, small damping and large radiation; the third by Marconi's introduction into practice of Rutherford's magnetic detector. The author believes that much better results, both in respect to the distance of transmission and in the capability of tuning, could be obtained if the principle of resonance were fully utilized. All transmitters which are now used in practice are unsuitable for producing a sharp resonance phenomenon, because they all send out a series of rapidly damped waves interrupted by relatively very long intervals. What is wanted in order to accomplish an essential progress in wireless telegraphy, is the possibility of producing undamped waves, i. e., very high-frequency, alternating currents. The authors have not yet solved this problem, but believe they are approaching its solution; they make use of the Duddell phenomenon of the singing arc, in which a direct current is supplied to an arc lamp, which is in parallel with an inductance and a capacity; under proper conditions, alternating currents are produced. The authors use instead of the arc lamp a vacuum spark-gap, especially in the form of a Hewitt mercury lamp; this is shown in the adjoining diagram, in which *A* is a direct-current machine, *B* the mercury vapor lamp, *L* an inductance, and *C* a capacity; the frequency of the oscillations produced is then two times the square root of the product of *L* and *C*. The authors have repeated Hewitt's



WIRELESS TELEGRAPHY.

experiments in which he uses high tension, alternating current, instead of direct current, they found that during one alternation of the alternator the lamp is lighted quite a number of times, there being relatively long intervals during which the lamp is not lighted. They believe that the use of the Hewitt lamp has certain advantages; by properly adjusting the system and by increasing the voltage, the intervals in which the lamp is not lighted, can be so diminished that one series of waves practically follows another. High tension, direct current is preferable to alternating current.—*Phys. Zeit.*, April 1.

Wireless Telegraphy.—Righi and Dessau.—A communication referring to questions of priority in wireless telegraphy. They state that "nobody prior to Marconi had utilized the antenna at the same time both in the generating and the receiving apparatus." An anonymous writer states that Lodge as early as 1889 used the vertical wire, whether called "antenna" or "aerial" does not matter; he also used horizontal antenna. The instruments used by Marconi at the beginning of his experiments were not substantially new; "they were, as all the world knows, in reality the inventions of Prof. Righi."—*Lond. Elec.*, April 24.

REFERENCE.

Block Signals.—Kohlfuerst.—An illustrated article on automatic electric block signals on the industrial railways from Barnstein to Muttershausen in Lorraine.—*Zeit. f. Elek.*, April 26.

MISCELLANEOUS.

REFERENCE.

Physiological Effects of Alternating Current.—Andriessen.—An article, illustrated by diagrams, on charging phenomena, using alternating currents, and the influence of high frequency on the dangers from shocks. He concludes a human body cannot stand a stronger current when alternating, whether of low or high frequency, than when direct.—*Elek. Anz.*, April 2, 5.

Electric Photography.

The subjoined cablegram from London of May 12 may refer to something very old or very new: John H. Heaton, M. P., who has returned from Italy, whither he accompanied Signor Marconi, says he saw at an observatory near Rome specimens of a new system of electric photography, by which clear pictures can be obtained of persons and scenes twenty miles distant. He thinks it conceivable that the system can be developed so as to enable the making of photographs of friends in distant lands while conversing with them by wireless telegraphy.

New Books.

ALTERNATING-CURRENT CALCULATING DEVICE. For the use of Electrical Engineers. By F. G. Baum. Second Edition. Stanford University, Cal.: The Author. Price, $1.00.

Prof. Baum has issued a new edition of the pamphlet accompanying his device for calculating the regulation of a generator, transformer, transmission line or any combination of these for any load and any power factor. The device is also adapted to making synchronous motor calculations. In the latest form of the device some improvements have been added which extend its range. The text-book of instructions has been extended five pages, and the cuts on the back of the calculating device have been much improved by re-engraving. Prof. Baum's method of solving alternating-current problems is extremely convenient, it being possible to solve practical problems, not only in much less time than by the usual mathematical or the ordinary graphical processes, but with the liability of error very much reduced. Some of the more difficult problems usually considered beyond the capabilities of the average practical man, may, by its means, be solved as easily as the more simple ones.

SPECIELLE ELEKTROCHEMIE. Handbuch der Electrochemie. By Dr. H. Danneel. Halle: Wilhelm Knapp. 80 pages. Price, 3 marks.

Wilhelm Knapp, of Halle, Germany, the well known and enterprising publisher on the subject of Electrochemistry, begins with this volume the issue of a large and comprehensive handbook of electrochemistry. The following is a list of the subjects which will be included: Theoretical Electrochemistry, by Prof. Dr. W. Nernst, Gottingen; Measurements, by Dr. E. Bose, Gottingen; Special Electrochemistry, by Dr. H. Danneel, Aachen; Elements and Accumulators, by Prof. Dr. K. Elbs, Giessen; Electroanalysis, by Prof. Dr. F. W. Kuster, Klausthal; Electromagnetic Ore Dressing, by F. Langguth, Mechernich; Technical Inorganic Electrochemistry, by Prof. Dr. W. Borchers, Aachen; Technical Organic Electrochemistry, by Prof. Dr. K. Elbs, Giessen; Electroplating, by Dr. H. Stockmeyer, Nurnberg. The publication of the series is estimated to take about two years. These handbooks are intended to give as wide an information as possible about every electrochemical reaction, known up to the present time, its origin, its theory and application. The idea is certainly a very good one and will be welcomed by all, who are interested in electrochemistry. As the prospectus says, there is no need to justify the issue of such a handbook. Every one who has done original work in the field of electrochemistry, and has been forced to spend many weary hours in hunting up the widely scattered literature, will agree with the reviewer, that there is not only a want in the ordinary sense of the term, but a most crying need for such a book, in order to save much time and labor.

The present volume is the first section of the part dealing with "Special Electrochemistry," which will be complete in about 14 of these sections. The idea is to give in this part a compilation of the inorganic chemical reactions known up to now, with their literature, comprising data and literature on conductivity, polarization and changes of free energy in reactions (electromotive forces and single potentials). This first section deals among others with hydrogen, water, hydrochloric acid, sulphuric and persulphuric acid, etc., giving in detail their production and electrolysis in its historical development. The treatment is especially commendable for the large and valuable number of journals and patent references given.

BOOKS RECEIVED.

RÉFLEXIONS SUR LA PUISSANCE MOTRICE DU FEU ET SUR LES MACHINES PROPRES A DÉVELOPPER CETTE PUISSANCE. By Sadi Carnot. Paris: A. Hermann. 116 pages.

INDUKTIONSMOTOREN. Ein Kompendium fur Studirende und Ingenieure. By B. A. Behrend. Translated by Dr. Paul Berkitz, with notes by Prof. W. Kubler-Dresden. Berlin: M. Krayn. 182 pages, 107 illustrations and 10 plates. Price, 11.50 marks.

A TREATISE ON ELECTROMAGNETIC PHENOMENA. The Compass and Its Deviations Aboard Ship. Vol. II. By Commander T. A. Lyons, U. S. N. New York: John Wiley & Sons. 580 pages, 203 pages. Price, $6.00.

DIE BETRIEBSMITTEL DER ELEKTRISCHEN EISENBAUM. Von E. C. Zehme. Quarto, 312 pages, 315 illustrations and 66 lithographic plates. Price, 27 marks.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Annual meeting, May 19. Papers: "The Experimental Basis for the Theory of the Regulation of Alternators," by B. A. Behrend; "The Heyland Motor," by C. A. Adams, Jr.

AMERICAN ORDER OF STEAM ENGINEERS. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Wm. J. Davis, Ithaca, N. Y.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association. F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

Interstate Independent Telephone Association Secretary. E. M. Coleman, Louisville, Ky.

National Electric Light Association. Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

New York Electrical Society. Secretary G. H. Guy, 104 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

New Westinghouse Electric Train Control and Couplers.

The following statement has been issued concerning a new Westinghouse system of electric train control:

Important tests have been made of a new system of apparatus for the operation of motors upon the several cars in a train, usually called "multiple-unit control," which the Westinghouse interests have just brought forward. This new Westinghouse apparatus is of the electropneumatic type and is in principle like that supplied to the Brooklyn Rapid Transit Company, for its elevated trains. The improvement consists in arranging within one compact structure the electropneumatic devices to operate simple forms of electric switches, which include a safety circuit-breaking device and automatic means for preventing the application of too great an electric force to the motors, which saves electric current and insures smooth operation of trains.

NEW CAR CONTROL APPARATUS ON THE JOHN B. M'DONALD.

The simplification which has thus been affected in the most important feature of electric train operation is so great as to make the contrast in appearance between this new form, as attached to a car, and any other kind of control apparatus so striking as to command the immediate attention of railway people who have heretofore regarded unit control apparatus as crude and excessively complicated.

The new control apparatus has all of the usual safety appliances, including the arrangement whereby the current is automatically cut off and the brakes applied, in the event of an accident to the motorman, and, besides, it accomplishes other results not obtainable by any other form heretofore tried, and its weight, being from one-half to three-quarters of a ton per car less, it practically takes the heavier kind out of the running, because the cost of hauling the excess weight of the earlier forms is an interest charge on capital much greater than the first cost of the apparatus.

An automatic car coupling has also been perfected by which the electric connections and brake pipes are united by the same operation, and it is contended that this new coupling will add not only to the safety of employees, but greatly to the facility and convenience in the operation of electric trains.

The Westinghouse Company has placed upon the experimental car of John B. McDonald one of the new electropneumatic unit control systems developed by the Westinghouse Air Brake Company. This apparatus instead of employing a drum controller operated electropneumatically, as in the former type of electropneumatic control, makes use of a series of switches which are individually operated by electropneumatic apparatus of the same character as employed by the Union Switch & Signal Company in operating its electropneumatic signaling system and which have been subjected to years of test in connection with signals on numerous steam railways throughout the country.

The electropneumatic switches are operated progressively by the valves being so arranged as to admit air to their respective operating cylinders at the right time and rate to insure graduated acceleration of the train and also guard against sudden rushes of current. The organization is such that current in excess of a predetermined amount cannot be admitted to the motors, from which it results not only that the motors themselves are not subjected to undue strains, but the train is free from sudden and abnormal movements in acceleration. The valves may be adjusted so that any required degree of acceleration may be obtained. The details of the apparatus have all been thoroughly worked out and tested in connection with the apparatus of the various Westinghouse companies and have survived long periods of practical operation, so that while the organization of the apparatus in itself is new, it is made up of tried and proved apparatus, thus involving no features of uncertainty as to the practical operation of the new system. The Westinghouse interests are fortunate in being thus able to avail themselves of the results of the engineering skill and experience of their several different industries in order to select and apply the best features for effecting the various operations required in the new system. The accompanying figure gives a view of the underside of the car equipped with the new control apparatus. It will be noticed that it is very compact, occupying but a relatively small amount of space, and thus not in any way interfering with the braking and other apparatus required to be placed on the car.

A Long Trolley for Canada.

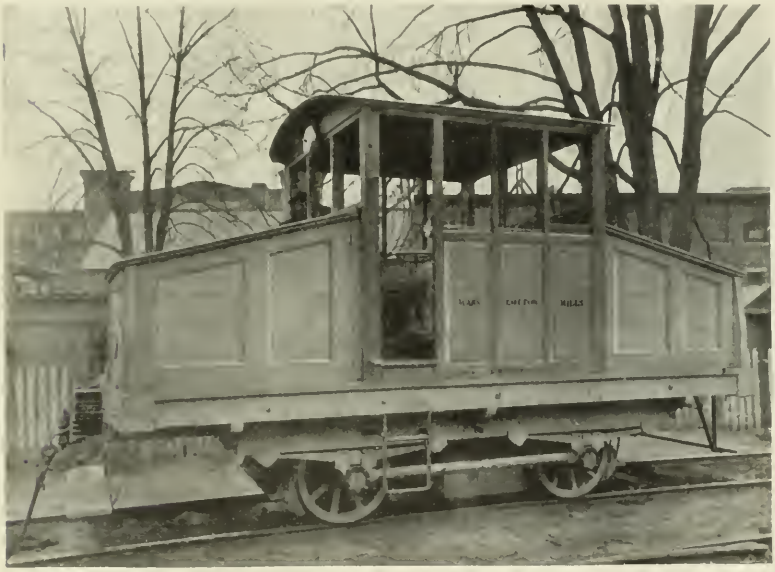
Mr. Felix S. S. Johnson, United States commercial agent at Stanbridge, Canada, reports as follows: A project for an extensive electric railway system through the south shore counties and eastern townships of Quebec is now in tangible form. It is understood that two main lines will be commenced this season, one to connect Montreal with St. John's by way of Longueuil and Chambly and the other between Montreal and Valleyfield, closely following the river bank and taking in St. Lambert, Laprairie, Chateauguay and Beauharnois. The roads are to be built with heavy tracks and in the most modern way, the cars being 50-odd feet in length, supplied with air brakes and motors capable of running at a speed of between 50 and 60 miles in straight stretches. There will also be parlor coaches for private parties.

It is claimed that this will be one of the largest electric railway systems in Canada, and it will form part of vast plans now being mapped out for an electric road to connect New York with Montreal. It is understood that connections will be made with the important trolley roads in Eastern New York—the Berkshires—and nearly a dozen systems in Vermont. Among the lines that are expected to serve as feeders for the projected main line, besides the Montreal and Southern Counties Railroad, are the Troy Traction Company, the Bennington Hoosick Railroad, the Hudson Valley line, the Troy and New England Company, and the Berkshire Street Railway Company, with about fifteen other corporations of less importance. The scheme is reported to be backed by capitalists from New York, Boston and Chicago. The proposed main line from New York to the Canadian border would pass through much attractive scenery, the shore of Lake Champlain, which it will follow, being particularly beautiful. The Montreal and Southern Counties Railway route will also have the scenic advantages of the Richelieu and St. Lawrence Rivers. It will further enable the farmers all along the south shore to reach the markets of Montreal with their products. The company's intention is to make special arrangements for the carrying of all kinds of farm products between midnight and 6 A. M., thereby allowing the farmers to get their stuff into Montreal in good condition for the morning market.

A Twenty-Ton Switching Electric Storage Battery Locomotive.

The electric storage battery locomotive described below has been designed with special reference to the economical handling of material in mills or other manufacturing establishments. It frequently happens that a single car load of raw material has to be distributed at various parts of the works, and, in such cases, much costly rehandling can be saved by shifting the entire car from point to point, and discharging each portion of the load exactly where it is required. A similar economy can be effected by collecting the finished product at the different buildings, and loading each consignment directly into its proper car. The locomotive in question is used for shifting cars while loading or unloading in this manner, and also for transferring material in course of construction, from one shop to another.

The simple and rugged construction of this locomotive reduces the expense for maintenance to a minimum, probably less than the cost of shoeing the horses which it replaces. The operating expenses consist of the cost of power required to charge the batteries, and the pay of one man. Even if charging current is supplied from an independent steam driven generator, it is cheaper than any other method of handling cars, as there is no waste of energy when the machine is not in operation.



20-TON ELECTRIC STORAGE BATTERY LOCOMOTIVE.

A locomotive of this type has recently been installed at the works of the Massachusetts Cotton Mills in Lowell, Mass. Previously the cars were shifted, one at a time, by three horses harnessed up tandem and under the most disadvantageous circumstances owing to the narrowness of passages, situation of tracks, etc. The locomotive is built for the standard 4-ft 8½-in. gauge, and fitted with standard couplings, making it suitable for use with any ordinary railroad car, and on any standard railroad track. The length over the bumpers is 21 ft. 4 in., and the height from the rail head to the top of the cab is 12 ft. 1 in. The wheelbase is 7 ft. 6 in., and permits the operation of the locomotive over a comparatively smaller turntable. It weighs about twenty tons, and runs at a speed of from two to four miles per hour on level track.

As will be seen from the illustration, the locomotive is perfectly "double-ended," the cab being located directly in the center. This makes a very desirable arrangement for switching work, which calls for operation in both directions with equal facility. The batteries are contained in the sloping compartments at either end. This disposition distributes the weight evenly on the four wheels, and, as each of these is a driver, the entire weight of the locomotive is usefully employed in traction. The wheels and axles are driven from the gear cases in the cab by means of Renold silent chains suitably enclosed. These chains are the only portion of the driving gear situated below the car body, the motors and gear cases being mounted in the cab where they are readily accessible, and always under the immediate notice of the operator.

The battery was furnished by the Electric Storage Battery Company, the elements being mounted in tanks of extra depth to prevent the electrolyte from splashing over the top. In mounting the battery special attention has been paid to protecting it against injury due to the shocks to which the locomotive is exposed in switching. There are two motors, specially wound, for the service. By connecting the two motors in series or parallel, and by varying the arrangement of the fields, an efficient speed control is obtained without wasting any of the energy of the battery by passing it through a resistance.

The controller is of the standard vehicle type, and has two levers which control every desired motion of the locomotive. The reversing lever is set to point in the direction in which the locomotive is to move, and the second lever controls the speed. These levers are mechanically interlocked, as in the case of a trolley car controller, so that the motors can only be reversed when the speed lever is in the off position. The locomotive may be run with the controller in any notch, there being no transition point on which a careless operator might leave his lever and burn out the apparatus.

As already mentioned, the speed-reducing gearing is located in the cab, instead of being beneath the car body. All the gears are machine cut, and run in a bath of oil, in fully enclosed gear cases of the C. W. Hunt Company's standard type. The same company's regular flexible and insulated coupling is used for connecting the motor to the gear case. There is a separate gear case for each of the two motors. It will be seen that the driving gear consists of two parts, which are exact duplicates of each other. In an emergency, one motor could be cut out entirely, and the locomotive operated by the remaining motor, but with a reduction of hauling capacity.

The speed reduction of the gear case is so proportioned to the safe discharge rate of the batteries, the safe capacity of the motor and the weight of the locomotive, that neither the batteries nor the motors can be dangerously overloaded. The driving axles are made to standard dimensions, and run in "Hunt" patent roller bearings, which reduce the friction at these points to an inappreciable amount. The wheels are shrunk in place, and have chilled treads and flanges of M. C. B. standard size and shape. A powerful brake is conveniently located in the cab. An alarm gong is also provided.

Experience has shown that in light switching service, the batteries can be recharged at various times during the day while the locomotive is waiting between hauls. For heavier service, it may be necessary to charge during the noon hour or after working hours in the evening. The battery is automatically protected during charging by well-known safety appliances, which open the circuit if the current is excessive, and also when it drops so low as to indicate that the battery is fully charged. The precise arrangement of the charging station depends very largely on the details of the electric plant available, and the builders of the locomotive are glad to advise their customers as to the methods to be employed in each particular case.

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Switchboard Speed Control of Water-Wheel Governors.

In the operation of multiple-unit plants it is often a great convenience, and sometimes almost a necessity for the switchboard attendant to be able to exercise control over the speed of any one unit. This applies equally to plants operated by water power and by steam. We illustrate a device for this purpose by means of which attachment when applied, for example, to a water wheel, the speed at which the governor holds the wheel can be gradually raised or lowered, or the wheel can be completely shut down if desired. The former is convenient when getting two or more generators into step or for varying the relative load carried by two generators when running in multiple, while the latter is useful in the event of accident or other emergency necessitating a quick shutdown.

The apparatus consists of a small reversible motor connected by double-reduction worm gearing to the bracket carrying the controlling lever of the governor. This bracket is given an endwise movement by the motor, which, by shifting the position of the controlling lever, varies the speed at which the governor holds the wheel. The illustration gives a view of the governor to which the motor is attached. The switch on the switchboard to the control motor has two buttons for raising and lowering the speed, and a small thumb switch for completely disconnecting the apparatus when not in use. The latter has three contacts, one of which is used for quickly shutting down the unit without the attendant being obliged to keep the push button depressed while this is taking place. The motor is furnished with automatic cut-outs, which prevent its overrunning after the limit of movement of the lever is reached.

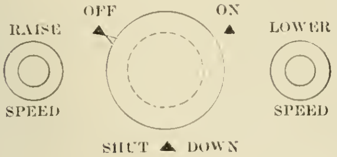


FIG. I.—CONTROL OF WATER WHEEL GOVERNOR.

In some instances the controlling switch is placed in a remote plant instead of in the plant where the governor is working, when two such plants run in multiple and it is desired to synchronize or otherwise control the speed from a single station. A detailed description and the method of operaiton of this governor was published in the issue of May 17th, 1902, and since that time a number of improvements have been made.

The governors are made in several sizes to suit different sizes of wheels. Where sufficient head of water is available, this pressure can be employed to operate the governor, but where this is not the case an oil-pumping system distinct from the governor is employed. The pump used for this purpose is of special construction adapted for governor purposes. The pump is fitted with two reciprocating plungers operated by a crank which works in an enclosed oil-tight chamber. The pump is driven by a pulley from the water wheel shaft and can be located in any position irrespective of the position of the governor. A receiver is provided to hold the oil under pressure for serving the governor.

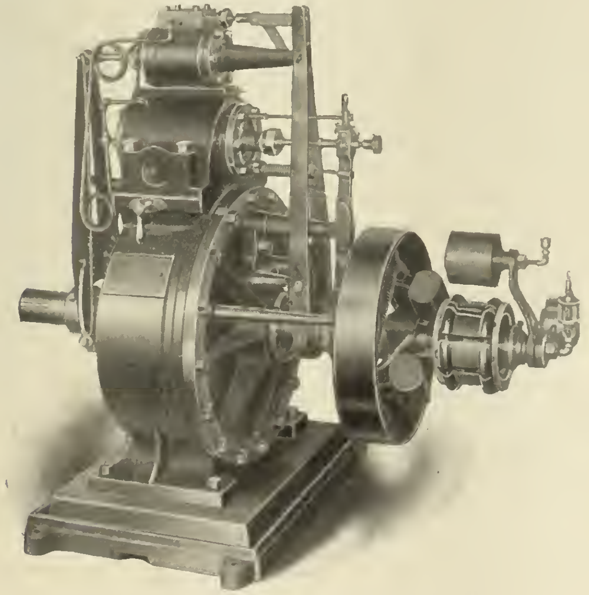


FIG. 2.—GENERAL VIEW OF WATER WHEEL GOVERNOR.

Among the plants which are now being equipped with these governors and electrical controlling attachments are the Rochester Gas & Electric Company, Rochester, N. Y., on their 6,000-hp installation; the Union Carbide Company's plant at Sault Ste Marie, Mich.; the St. Joseph River & Elkhart Power Company's plant at Mishawaka, Ind.; the York Haven Power Company, on the Susquehanna River, and many others. These governors are manufactured by the Sturgess Governor Engineering Company, Troy, N. Y., which has made a specialty of this business.

Pillsbury Alternating Current Ceiling Fan.

We illustrate herewith an alternating-current ceiling fan embodying a number of new features. Fig. 1 is a general view of a two-blade fan showing its external appearance, and Fig. 2 shows the construction in detail.

The revolving armature, *E*, is on the outside, which makes a very simple construction. The blades are attached directly in the sockets, *K*. The weight of the armature is supported on a ball bearing consisting of the two hardened steel washers, *F* and *G*, and the hardened steel balls, *H*. These balls are held in a cage so that they cannot be misplaced or lost if the ball bearing is removed. The bell-shaped oil cup, *D*, has a tube in the center extending up into the hollow shaft above the oil level and screwing into a thread inside the shaft. By this arrangement the oil cup can be unscrewed and removed without spilling the oil. All details are, in fact, arranged for the greatest convenience in installation and care.

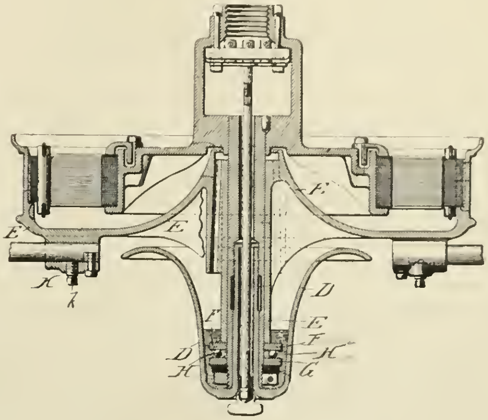


FIG. I.—DIAGRAMMATIC VIEW OF FAN.

These fans are claimed to be as efficient as direct-current fan motors, the four-bladed ones moving fully as much air as direct-current types of ceiling fans. The power factor is exceptionally high for a motor of this class, about 65 per cent. These results are secured by the use of the multiple-tooth filed pole, of graduated strength, for which, in conjunction with a phase or starting coil, a patent was granted to Mr. Pillsbury, dated January 30, 1900. His work on single-phase motors was highly commended last year by the Franklin Institute, which granted a medal to the Wagner Electrical Manufacturing Company, for the improvements in its Pillsbury-Schwedtmann single-phase power motors, which it has been building for the last five years.

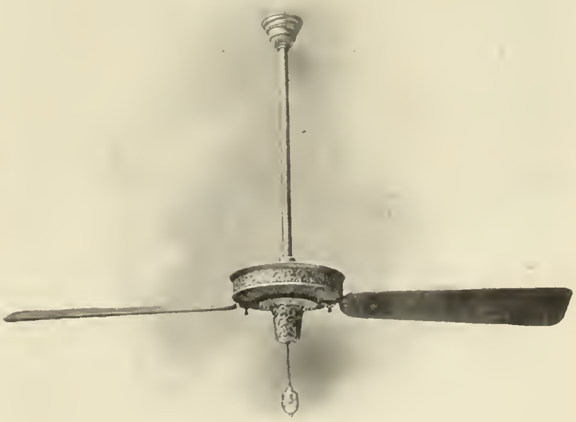


FIG. 2.—ALTERNATING-CURRENT CEILING FAN.

The ceiling fan described is manufactured by the H. E. Lindsey Electrical Supply Company, of St. Louis.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was freely offered by brokers and a fair-sized business was done. The closing rates were 4¼ per cent. for 60 to 90 days, 4½ per cent. for four, five and six months, and 5 per cent. for eight months. In the stock market there was a striking loss in volume of business as compared with the corresponding week in the two preceding years. The market opened with a better feeling and advancing prices, but it soon lapsed into dullness and inactivity, no interest being shown either by the speculative element or by outsiders. Electrics and tractions shared in the general dullness and no marked feature was exhibited in either line. In the outside market, trading in copper stocks was on a very small scale, but prices generally held firm. The sales of Brooklyn Rapid Transit aggregated 29,160 shares, the closing price being 65½, which was the lowest of the week, and represnting a net loss of ½ point. Metropolitan also closed at the lowest figure, which was 132, being a net loss of 1½. The sales aggregated 21,750 shares. General Electric fluctuated within narrow limits, the highest quotation being 194, and the lowest 193½, closing at 193¾, being a net gain of ¼ point. The transactions were limited, aggregating 3,720 shares. Westinghouse common made a net gain of 3 points, closing at 213, after reaching 220 at one time during the week. Western Union made a net gain of ½ point, closing at 85½. There was little activity in this stock, the number of shares sold being 1,630. American Telegraph & Cable closed at 81, being a net loss of ¾, and American Telegraph & Telephone 159¼, a net gain of 5¼ points. Following are the closing quotations of May 12:

NEW YORK.

	May 5	May 12		May 5.	May 12
American Tel. & Cable	80	80	General Electric	192	190¼
American Tel. & Tel	158	155	Hudson River Tel	..	..
American Dist. Tel	31	30	Metropolitan St. Ry	134¼	131
Brooklyn Rapid Transit	66¼	65⅝	N. E. Elec. Veh. Trns	¼	⅛
Commercial Cable	..	..	N. Y. & N. J. Tel	..	..
Electric Boat	22	20	N. Y. E. V. T. Co	..	7
Electric Boat pfd	37	41	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1¼	1¼	Western Union Tel	85¼	85¼
Electric Vehicle	11¼	11	Westinghouse com	210	210
Electric Vehicle pfd	15	15⅝	Westinghouse pfd	210	210

BOSTON.

	May 5	May 12		May 5	May 12
American Tel. & Tel	158¾	157	Western Tel. & Tel. pfd	98	96
Cumberland Telephone	..	..	Mexican Telephone	2⅛	2
Edison Elec. Illum	..	..	New England Telephone	138	137½
General Electric	..	192	Westinghouse		105
Western Tel. & Tel	19	19½	Westinghouse pfd	..	104

PHILADELPHIA.

	May 5.	May 12		May 5.	May 12
American Railways	49⅛	48½	Phila. Traction	97½	96¾
Elec. Storage Battery	74*	74½*	Phila. Electric	7⅛	7¾
Elec. Storage Battery pfd	74*	74½*	Pa. Electric Vehicle	..	..
Elec. Co. of America	8⅞	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	May 5.	May 12		May 5.	May 12
Central Union Tel	..	..	National Carbon pfd	97	96
Chicago Edison	..	..	Northwest Elev. com	..	..
Chicago City Ry	206½	205	Union Traction	5½	4
Chicago Tel. Co	..	..	Union Traction pfd	32	32
National Carbon	24	24⅛			

*Asked.

NEW ENGLAND TELEPHONE.—The New England Telephone Company has issued its annual report for the year ended December 31, 1902. The gross revenue was $6,024,609, an increase of $847,197, while the net earnings were $1,168,769, an increase of $131,286. The expenditures for new construction during the year amounted to $1,895,909, of which $371,810 was for aerial construction, $649,115 for underground conduit and cables, $387,771 for toll lines and $487,211 for equipment. The expenditure for plant and equipment was as follows: For new construction and proportion purchase, $1,895,909; for repairs and maintenance, $2,045,987; total, $3,941,896, as against an expenditure in 1901 of $3,801,383. The exchange stations December 31, 1902, numbered 100,864, an increase of 16,282; private line stations, 6,744, an increase of 45. The number of regular employees of all classes is 3,894, of whom 1,737 are males and 2,157 are females. It is estimated that the expenditures for maintenance and extensions of property during 1903 will be: For new construction, $1,800,000; for maintenance, $2,200,000; total, $4,000,000.

WESTINGHOUSE ELECTRIC STOCK.—The holders of record of the stock of the Westinghouse Electric & Manufacturing Company at the close of business on May 23, 1903, are offered the privilege of subscribing to $4,500,000 of new "assenting" stock at $80 per share of $50, at the rate of one share of such new stock for every four shares of existing stock. Subscriptions must be made before 3 o'clock P. M., on Monday, June 8, 1903, at the office of the company, No. 120 Broadway, accompanied by a check for $30 for each share subscribed for. The balance of the subscription will be payable as follows: July 23, 1903, $25 per share; September 14, 1903, $25 per share. The company did the enormous business last year of just $24,000,000, and the new capital is necessary to meet the even greater business ahead.

GENERAL ELECTRIC OFFICERS.—The annual meeting of the stockholders of the General Electric Company took place at Schenectady on May 12. The number of directors was increased from thirteen to fifteen, according to the plans already prepared, and other important business was transacted. The representation of shares was to the number of 308,000. These were re-elected directors: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., Frederick P. Fish, George P. Gardner, Eugene Griffin, Henry L. Higginson, J. Pierpont Morgan, J. P. Ord, Robert Treat Paine, second, George Foster Peabody and Charles Steele. Ex-Governor William M. Crane, of Massachusetts, and William C. Whitney, of New York, were elected to fill the two new directorships created at this meeting by an amendment of the by-laws.

THE NEW JERSEY ELECTRIC MERGER.—Articles of incorporation of the new trolley, gas and electric consolidation, which will be known as the Public Service Corporation of New Jersey, were filed for record in the County Clerk's office at Newark, N. J., last week. The concern is capitalized at $25,000,000 in shares of $100 each, while the paid-up capital will be $100,000. The incorporators are Thomas N. McCarter, ex-Attorney-General, who holds 334 shares; Thomas Dolan, presideint of the United Gas Improvement Company of Philadelphia, who holds 333 shares, and John L. Waterbury, of Morristown, who holds 333 shares. Mr. McCarter, who will be president of the new concern, is named as the local representative with offices in the Prudential Life Insurance Company's Building.

UNITED GAS IMPROVEMENT.—At the United Gas Improvements annual meeting last week the annual report showed net profits for the fiscal year ended December 31, 1902, of $3,473,643, an increase of $938,354 over the previous year. Comparison of the last two years shows net earnings $3,473,643, against $2,535,288. The sales of gas have increased over 1901 22½ per cent., and the business of the electric light and trolley companies 11 per cent. and 7½ per cent., respectively. Directors have been elected as follows: Clement A. Griscom, William L. Elkins, W. W. Gibbs, Randall Morgan, George Philler, Samuel T. Bodine, Thomas Dolan. The ticket was elected by a vote of 482,740 shares out of a total of 564,968. President Dolan was elected by the same vote.

UNITED RAILWAYS OF SAN FRANCISCO.—The stockholders of the United Railways Investment Company, of San Francisco, which controls the street railway systems of San Francisco, held their annual meeting last week in Jersey City. The balance sheet as of December 31, 1902, showed a cash balance of $13,431, after setting aside sufficient to meet the payment of the dividend which was paid January 3. There was also submitted a report of the operating company giving the balance as of December 31. The profit and loss account of the operating company covering the period of the corporation from March 20, 1902, to December 31, 1902, showed a surplus of $572,404.

CHICAGO UNION TRACTION.—The *Chicago Times* says that the terms under which the Union Traction Company of Chicago is to be organized after its receivership are gradually being outlined. Renewals of franchise for the north and west side systems will be asked for in the names of the North & West Chicago Street Railway Companies. The Union Traction will continue a leasing and operating company. As rent for the properties it will agree to pay fixed dividends on the North and West Chicago stock, probably 8 per cent. for the North side and 4 per cent. for the West and assume all existing bonds and other obligations.

CANADIAN WESTINGHOUSE.—It is stated that the Westinghouse Electric & Manufacturing Company contemplates forming a Canadian company to supply that market. The Westinghouse Air Brake Company will be interested. The capital of the company will be $2,500,000, of which the Air Brake Company will have $850,000, and the Electric Company $950,000, the remainder of the capital stock being taken at par by Canadians. Westinghouse electrical interests have for many years past been efficiently represented in Canada by Ahearn & Soper, of Ottawa.

DIVIDENDS.—The Lynn (Mass.) Gas & Electric Light Company has declared an extra dividend of 25 per cent. with its regular quarterly disbursement of 2½ per cent., which extra calls for the payment of $143,750. The directors of the Consolidated Gas Company of New York have declared the regular quarterly dividend of 2 per cent., payable June 15. The directors of the Niles-Bement-Pond Company have declared the regular quarterly dividend of 1½ per cetnt. on the preferred stock, payable May 15. The directors of the Pratt & Whitney Co. have declared the regular quarterly dividend of 1½ per cent. on the preferred stock, payable May 15.

CINCINNATI GAS & ELECTRIC COMPANY.—A director of the Cincinnati Gas & Electric Company is quoted to the effect that the demand for gas and electricity is the greatest in the history of the city. Some $300,000 have been spent in improving the facilities of the company and the benefit of this expenditure is just being felt. The proposed increase of $2,000,000 in the capital of the company will probably be voted on favorably at the annual meeting this week.

HAVANA TROLLEYS.—A special meeting of the stockholders of the Havana Electric Railway has been called for June 4 to consider the question of authorizing the use for purposes of construction, equipment or improvements of $250,000 out of $2,500,000 consolidated mortgage bonds reserved for future corporate improvements.

Commercial Intelligence.

THE WEEK IN TRADE.—Favorable reports were made to the mercantile agencies, although the labor situation is not encouraging. A large business continues generally, and industry is active, in most cases surpassing that of previous years at this time. Reports of the late cold wave are now coming in and show that crops of all sorts were arrested in nearly all sections. In labor matters, spring unrest seems to have culminated in strikes or lockouts of fully 100,000 men in the first week in May, double that number becoming idle the last week in April. Railway earnings in April were 13.4 per cent. larger than those of April last year, and 28.7 above 1901. The business failures during the past week aggregated 175, against 173 in the preceding week. Copper is still nominally 14¾ to 15c., but actual business would be done considerably lower, if any occurred. The metal was extremely dull, however, and no business was reported. In the iron and steel industry, cancellation of orders where deliveries failed to be made according to contract, and new business at lower quotations, indicate a tendency toward more normal conditions in pig iron. There has been a constant menace in the price situation, which restricted domestic trade and operated even more strongly against foreign commerce. Pending contracts for about 50,000 tons of structural material have been closed and other orders are only postponed by uncertainty regarding the labor situation. Railway requirements appear to have no limit; implement manufacturers are surpassing all records in their purchases of merchants' steel; machine shops are working at full capacity and all leading machinery markets report satisfactory conditions.

LARGE ELECTRIC CRANES FOR LOCOMOTIVE SHOPS.—Manning, Maxwell & Moore have recently secured, on behalf of the Shaw Electric Crane Company, of Muskegon, Mich., several important contracts for electric traveling cranes to be installed in various new railroad locomotive shops. A 120-ton crane has been ordered for the Pittsburg & Lake Erie shops at McKees Rocks, Pa. This crane will have two 60-ton trolleys. The span will be 65 ft. The equipment will be operated by a 215-hp motor, also of Shaw manufacture. For the new shops of the Pennsylvania Railroad at Wilmington, Del., five cranes have been ordered varying in capacity from 65 tons to 15 tons. Two 65-ton cranes, with double auxiliary hoists, will operate on a span of 76 ft. They will be driven by 130-hp motors. Two 15-ton cranes will travel over a 47-ft. span. They will be operated by 35-hp motors. A 20-ton crane for a 47-ft. span has also been ordered for the same shops. It will be worked by a 45-hp motor. Two 65-ton cranes, with double-auxiliary hoists of 7½ tons capacity each, fitted on trolleys, have been ordered by the Pennsylvania Railroad for the Renovo (Pa.) shops now under construction. These outfits will be operated by 130-hp motors. The span will be 76 ft. A 75-ton crane for a 77-ft. span, and to be operated by a 150-hp motor, has been contracted for by the same railroad for installation in its Columbus (Ohio) shops. Five 5-ton Shaw cranes to operate over an 84-ft span have been ordered by the new Wilmington Malleable Iron Works, which plant is to be electrically operated throughout.

AMERICAN DISTRICT STEAM COMPANY.—This active and prosperous concern, of Lockport, N. Y., has been doing a large business with its Holly system of utilizing direct and exhaust steam for heating. During the last year it installed 35 new steam heating plants, besides extensive additions to many other plants previously installed, and the outlook for its business so far this year is very much better than last. Owing to unprecedented demands for its goods, it was compelled to double its manufacturing plants at Lockport and also at North Tonawanda. It is just now engaged in installing plants at Birmingham, Ala.; Baltimore, Md.; Paducah, Ky.; Decatur, Ill.; Ebensburg, Pa., and Bangor, Pa., and in making extensive additions to large plants installed two years ago at Atlanta, Ga., for the Georgia Railway & Electric Company, also additions to the plant at Bristol, Conn. The general public is demanding a supply of heat from central stations, and the system of exhaust steam heating through underground mains is filling that want. It also enables electric companies who install the system to meet competition that may arise through other methods of lighting and enables them to sell their steam for more than enough to pay all fixed charges, practically securing their current at the station without exepense. It also enables them to increase their electric business by being in a position to furnish steam heat, electric light and power to large blocks that now have their own boilers, engines and dynamos.

THE PNEUMATIC SIGNAL COMPANY, Broad Exchange Building, New York, has purchased from Mr. S. Marsh Young, owner of the Young system of automatic electric track circuit block signals for electric railways, all his rights for the United States, Canada and Mexico, and will arrange to place the system at once on the market. The Young system furnishes the same measure of protection for electric lines as the standard track circuit system does on steam roads. The presence of any pair of wheels on the block section, a broken rail or wire, or an open switch results in a danger signal. The Signal Company will organize an electric railway department which will be in charge of Mr. Young. It will be remembered that Mr. Young was one of the incorporators and the first vice-president of the Hall Signal Company and was for some years the vice-president and general manager of the Manhattan General Construction Company, until he sold the company to the Westinghouse interests. The Pneumatic Signal Company's factory has been until recently at Troy, but they are now moving into their new works at Rochester, N. Y. This plant will cover about 240,000 sq. ft. of floor space. The system by which this company is best known is its low-pressure pneumatic system for interlocking and block signals on steam railway lines, used in Europe and America. Their entering the street railway field is a new departure.

BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, New York offices Taylor Building, has secured a contract for a 20-in. x 36-in. x 33-in. and a 15¼-in. x 26½-in. x 27-in. compound engine for the new Moline (Ill.) shops of the Chicago, Rock Island & Pacific Railroad. The engines are for light and power work. A 20-in. x 21-in. simple engine has been ordered for light and power use by the Passaic (N. J.) Steel Company. The Alms & Doepke Company, of Cincinnati, Ohio, has requisitioned for a 14¼-in. x 16-in. simple engine, also for light and power purposes. The National Steel Company, of New Castle, Pa., has ordered a 22-in. x 38-in. x 33-in. compound engine. A 16½-in. x 26½-in. x 24-in. compound is to be built for the Ashland Iron & Steel Company, of Duluth, Minn. Two 18¾-in. x 21-in. simple engines are to be shipped the National Mining Company, of Traveskyn, Pa., for light and power and the Fairmount Coal Company, of Monangah, W. Va., has ordered three engines of similar size for direct connection to generatnrs.

DE VEAU TELEPHONE APPARATUS.—The De Veau Telephone Manufacturing Company, of 27 Rose Street, New York City, has been extremely busy of late making installations of their apparatus. Among places furnished are the fine new New York Stock Exchange Building, as illustrated recently in these pages. Other places are Blair Building, Broad Street, New York; Potter Hôtel, Santa Barbara, Cal.; Carvel Hall Hotel, Baltimore, Md.; White House, Washington; Clarence G. Mackay residence, Roslyn, L. I.; Norfolk Navy Yard, Brooklyn Navy Yard, New York Post Office, New York Chamber of Commerce. Mr. A. S. De Veau reports also that they have furnished in the exchange line complete central energy plants to the Safety Electric Manufacturing Company, New Orleans, and E. Baker, Mount Olive, Va. They have also just extended the plant of the Baiting Hollow (N. Y.) Telephone Company. Mr. Gilpin, of the company, has just started out again on a long business trip.

TELPHERAGE FOR SWEDEN.—The United Telpherage Company, 20 Broad Street, New York, has just made an arrangement with Messrs. Aktiebolaget, Landens Hissar, and Messrs. Luth & Rosens, of Stockholm, Sweden, for the manufacturing and exploiting of telpherage business in Norway, Denmark and Sweden. The above firm will manufacture and install telpherage plants under the same system as that of the United Telpherage Company of United States. Arrangements have also been made for manufacturing and introducing telpherage apparatus in Great Britain and the Colonies, with Messrs. Siemens Brothers & Co., Limited, of London, England, and arrangements are also being completed with other large electrical manufacturing companies on the Continent.

The application of telpherage to the handling of material for manufacturers and for railway and steamship lines in connection with terminal freight bids fair soon to become an enormous industry.

ROCK ISLAND LOCOMOTIVE SHOPS.—The Chicago, Rock Island & Pacific Railroad's new shops at East Moline, Ill., are to be installed with considerable electrical equipment. The contract for the generators has been awarded to the General Electric Company. The Buckeye Engine Company will build the engines. The boilers are to be of B. & W. type. Light electric traveling cranes are to be put in by the Shaw Electric Crane Company. There will be two 50-ton cranes operating over a 95-ft. span, with auxiliary hoists of 6-tons capacity. Shaw motors of 135 hp will drive each of these outfits. A 10-ton crane for a 44-ft. span, to be driven by a 35-hp motor; a 20-ton crane for a 55-ft. span, to be operated by a 60-hp motor; a 5-ton crane also for a 55-ft. span, to be worked by a 20-hp motor; two 3½-ton cranes for a 44-ft. span, to be driven by 18-hp motors and a 5-ton crane for an 80-ft. span, to be operated by an 18-hp motor, have also been ordered.

USE OF NERNST LAMPS.—The streets of the City of Madison, Wis., are being illuminated with Nernst lamps. Some of the business men in one of the blocks on East Main Street put in five of these lamps independent of the city arc lights at each end of the block, making that section of the city a blaze of electric light. The absence of flicker in the Nernst lamp and the fact that it casts no shadow on the street make it especially adaptable for out-door lighting, and the occupants of the adjoining block to the west were not slow in also making arrangements for five of the lights. It is highly probable that the other blocks in this vicinity will adopt the same plan and that finally the capitol will be encircled with these effective little street lamps. The Public Library at Waterbury, Conn., is to be lighted with Nernst lamps, furnished by the Nernst Lamp Company of Pittsburg, Pa.

STEAM TURBINES AT HARTFORD, CONN.—The steam turbine plant of the Hartford Electric Light Co., Conn., which at present consists of a 2,000-hp set, is soon to be duplicated by machines built by the contractors for the original installation, the Westinghouse Machine Company. This was the first American plant where steam turbine units of large size were installed, and their complete success must be highly gratifying to the makers. In its application to the generation of electrical power the Westinghouse steam turbine is undoubtedly making marked progress. As an evidence of the energy with which the manufacture of these machines is being taken up, it may be interesting to state that the aggregate power of steam turbine sets completed, in hand and in order to the Westinghouse Machine Company does not fall far short of 200,000 kw.

HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson, Incorporated, 114 Liberty Street, has taken a contract for a 14-in. x 13-in. Harrisburg standard simple engine for installation in the plant of the Pennsylvania Salt Manufacturing Company at Philadelphia. The engine is to be direct-connected to a 75-kw Crocker-Wheeler generator for lighting purposes. Three 13-in. x 14-in. direct-current Harrisburg standard simple engines have been ordered for the Scioto Valley Pool, Columbus, Ohio, to drive three 100-kw exciter generators. A 13½-in. x 21-in. x 15-in. tandem compound Harrisburg standard engine has been ordered by the American Locomotive Company for its Alleghany (Pa.) plant. This engine is to be direct-connected to a 100-kw General Electric generator for light and power.

HUGE CEMENT PLANT.—The Quaker Portland Cement Company's plant, to be constructed at Sandt's Eddy, Pa., which is to be the largest in the United States, will be electrically operated. The initial capacity of the plant will be 5,000 barrels per day. Contracts have already been placed for the boilers, engines and conveying machinery. The boiler contract, which calls for a 4,000-hp equipment in eight units of 500-hp each, has been allotted to the Heine Safety Boiler Company. The engines will be built by the Allis-Chalmers Company. They will be of Reynolds Corliss type, the conveying machinery will be built by the Webster Manufacturing Company, of Chicago, Ill. R. Sherwood Dunn, of the Standard Oil Company, is the head of the Quaker Company. Professor Carpenter is the consulting electrical engineer.

EUROPEAN RAILS FOR MANILA ELECTRIC ROAD.—The rails to be utilized in the construction of the Manila electric traction system will be of European manufacture. J. G. White & Co. have awarded the contract to Wonham & Magor, 29 Broadway, New York, who secured the work on account of the British steel jobbing house of Suren, Hartmann & Co., of London. There will be about 30 miles of 70-pound T-rails and 10 miles of 7-in. girder rails, representing an aggregate weight of 4,000 tons approximately. Delivery is to be completed inside of five months. The bulk of the material will be turned out by Belgian and German mills.

THE UNION IRON WORKS, of San Francisco, are installing a power transmission plant near Reward in Inyo County, Cal., from which they will transmit power electrically over a distance of about two miles to the mill of the Reward Gold Mining Company, where induction motors will be used to drive a 20-stamp mill, an air compressor, and a rock breaker. The apparatus, which has been purchased from the Westinghouse Electric & Manufacturing Company, includes a 120-kw, three-phase alternator, a 2-hp exciter, a switchboard panel, including voltmeters, ammeters, rheostats, etc., two 50-hp induction motors, complete with auto-starters, slide rails, etc., a 15-hp induction motor, three 7½-kw transformers, two 1-kw transformers, and eight lightning arrester units. The transmission will be at 2,200 volts.

NERNST LAMP INSTALLATIONS.—The Atlas Tack Company has recently installed a large number of Nernst lamps, made by the Nernst Lamp Company of Pittsburg, in its factory at Fairhaven, Mass. Swift & Co., Union Stock Yards, Chicago, are lighting their temporary offices with the Nernst lamp. Two hundred and eighty-five 3-glower lamps are used, doing away with all desk lights and other local units. It is understood that this trial of Nernst lamps has proven so satisfactory that they will be used throughout the large permanent office building now under course of construction.

LIDGERWOOD ELECTRIC HOIST ORDERS.—The Lidgerwood Manufacturing Company, of 96 Liberty Street, New York, has secured a contract for three electric mining hoists from the Thomas Iron Company, of Hokendauque, Pa. There will be two single-drum equipments, each operated by a 75-hp General Electric motor, and one double-drum hoist, which will be driven by a 100-hp General Electric motor. The Metropolitan West Side Elevated Railroad, Chicago, has ordered a small Lidgerwood hoist to be operated by a 12-hp General Electric motor.

STROMBERG-CARLSON TELEPHONE PLANTS.—The Stromberg-Carlson Telephone Manufacturing Company, Chicago, has recently sold telephones and material to the Yantisville Telephone Company, Yantisville, Ill., and the O'Dell Farmers' Telephone Company, O'Dell, Ill. It has also just completed the installation of a 4,800 ultimate capacity lamp line multiple switchboard with 2,400 lines present capacity for the Interstate Telephone & Telegraph Company, at Springfield, Ill. That company has nearly completed its underground system, which extends over the major part of the city.

EQUIPMENT FOR AMERICAN TYPE FOUNDERS' COMPANY'S NEW PLANT.—The American Type Founders' Company, of 27 William Street, New York, has just let contracts through Edward R. Knowles, electrical engineer, for various equipment to be installed in its new plant at Communipaw, N. J., which is to be electrically operated. Two 125-hp Skinner engines have been ordered from the A. D. Granger Company, White Building, Liberty Street. The C. & C. Electric Company will build two direct-current generators of 75-kw capacity each.

BALL ENGINE ORDERS.—The Northern Electrical Manufacturing Company has recently placed in operation at its works at Madison, Wis., a 300-hp cross-compound self-oiling engine, arranged for direct connection to two 75-kw Northern generators. The Ball Engine Company, Erie, Pa., is supplying the engines. The Ball Engine Company has also recently sold to the Perry-Buskirk-Matthews Stone Company, of Bedford, Ind., a 200-hp engine, arranged for direct connection to 125-kw Western Electric generator.

THE AMERICAN PUSH BUTTON TELEPHONE COMPANY has taken new offices in the Electrical Exchange, 136 Liberty Street. This company reports considerable new business, including an order for $3,000 worth of telephones, from one of the prominent railway companies. Mr. W. V. Sweeten, manager of this concern, is planning to take a trip June 1 as far west as the Pacific coast, with its new type telephone, which is a decided improvement over the old style.

BRAZILIAN PLANT TO BE EXTENDED.—The electrical plant at Manaos, Brazil, which is operated by the Brazilian interests of Blytton Brothers, Coffee Exchange Building, New York, is to be enlarged. A 60-kw alternating-current generator of General Electric build, and a Harrisburg engine of 90-hp capacity will be installed. The boiler and induced-draft apparatus will be furnished by James Beggs & Co.

FIELD TELEPHONE AND TELEGRAPH SYSTEM FOR CUBA.—The Manhattan Electrical Supply Company, 32 Cortlandt Street, has secured a large contract for a telephone and telegraph system which is to be used in connection with the construction of an extensive railroad system in Cuba.

MEXICAN LIGHTING PLANT.—An electric lighting plant is to be installed at Lagos, located in the State of Jalisco, Mexico. Water power will be employed to generate the current. Madero & Co., of Parras, in the State of Coahuila, are primarily interested in the project.

General News.

THE TELEPHONE.

EUREKA, CAL.—Mr. W. E. Herron, representing the American Electric Telephone Company, of Chicago, has petitioned for a telephone franchise in this city.

SAN BERNARDINO, CAL. The San Bernardino Traction Company is installing a telephone system on its lines between San Bernardino and Redlands. Each car is provided with a telephone.

DOVER, DEL.—The Bourbon County Telephone Company, a Kentucky concern incorporated in this state, has certified to an increase in its capital stock from $75,000 to $130,000. The headquarters of the company are in Lexington, Ky.

JACKSONVILLE, FLA.—The Southern Bell Telephone Company is considering the erection of a long distance line from Jacksonville, Fla., to Lake City and other towns.

ATLANTA, GA. It is said that the reorganized Standard Telephone Company in Atlanta is planning long distance connections throughout the state and adjoining states. The new concern will be known as the Atlanta Telephone and Telegraph Company. A new switchboard with a capacity of 7,200 subscribers will soon be installed.

HONOLULU, H. I.—The Hawaii Telephone Company, of Wailuku, Maui, has been incorporated by S. Shmi, J. P. Sylva and Y. You. The place of business is Wailuku.

KEOKUK, IA.—The Iowa Telephone Company proposes to place its wires underground in this city.

ODGEN, IA.—The Odgen Telephone Company, with a capital stock of $25,000, has been incorporated.

RADCLIFFE, IA.—At the recent election a favorable vote was cast for granting a franchise to the Radcliffe Telephone Company.

CENTREVILLE, IA.—The Appanoose County Telephone Company has been formed with a capital stock of $60,000. It is a re-organization of the Centreville Telephone Co. Extensions and improvements to the system are to be made.

GIBSON, ILL.—The Gibson Telephone Company has changed its name to Granger Mutual Telephone Company.

HILLSBORO, ILL.—The People's Mutual Telephone Company has increased its capital stock from $5,000 to $10,000.

COTTAGE GROVE, ILL.—The Cottage Grove Independent Telephone Company will build a toll line between Equality and Eldorado.

EFFINGHAM, ILL. The E. Watson & Gilmore Telephone Company has been incorporated and the following-named offices have been elected: President, Geo. Kincaid; secretary, Mantz McCallen; treasurer, J. W. Phillips.

METROPOLIS, ILL.—The farmers of Massac and Pope counties have formed a mutual telephone company which will build lines throughout the two counties.

CHICAGO, ILL.—Another suit attacking the right of the Chicago Telephone Company to charge more than the franchise rate of $125 a year for the use of its telephones for business purposes has been filed in the Circuit Court. Thirty business firms and individuals are complainants in the new bill, and the allegation is made that the company has been exacting $175 a year. The complainants ask an injunction to restrain the company from charging more than $125 a year and from refusing to furnish them with its service. It is reported that more than 1,000 new subscribers were secured by the company during the month of April.

PAOLI, IND. The Hoosier Telephone Company's exchange in this place will be enlarged. A 200-drop switchboard will be installed and other improvements made.

VEDERSBURG, IND.—The Vedersburg Telephone Company, with a capital stock of $25,000, is a newly-organized company. Mr. D. T. Heffner is one of the directors.

UPLAND, KAN. The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $5,000.

OWENSBORO, KY.—The directors of the Kentucky & Indiana Independent Telephone Companies, of Owensboro, Rockport, Ind., and Louisville, held a conference recently for the purpose of arranging a circuit to connect the three cities. It is probable that a cable will be laid across the river at Rockport.

NORVELL, MICH.—The Brooklyn & South Norvell Telephone Company, of Norvell, has been incorporated with a capital of $500.

LITCHFIELD, MICH.—The Litchfield Farmers' Mutual Telephone Company has been incorporated with a capital stock of $2,000.

DETROIT, MICH.—The Huron Valley Telephone Company has been organized by farmers in the vicinity of Milford. The lines of the company will be connected with the Milford exchange. The organizers are C. E. Bourns, W. T. Bourns, C. B. Atkin, H. Peters, C. L. Pearson, Chas. Eno, Chas. Foote and W. K. Foote.

CAMDEN, MICH. The Camden Rural Telephone Company has been incorporated with a capital stock of $10,000 and will build a line from Camden to Reading.

AUSTIN, MINN. The Interstate Telegraph & Telephone Company, of Austin, has been incorporated with a capital stock of $60,000. The incorporators are James Keenan, John L. Gulden, Seymour Johnson, Thomas A. Revord, Charles A. Sterling.

BLACKDUCK, MINN. The Blackduck Electric & Telephone Company will erect a brick building for a power station and telephone exchange.

KASOTA, MINN.—James Bennett has been granted a franchise for a telephone exchange in this place.

HANNIBAL, MO. The Hannibal & Ralls County Telephone Company has been incorporated, with a capital stock of $1,000. S. B. Crook is one of the directors.

RED LODGE, MONT.—The Montana & Wyoming Telephone Company has increased its capital stock from $40,000 to $100,000, and will build a line from Billings to Bozeman.

ARLINGTON, NEB.—The Arlington Telephone Company has been incorporated with a capital stock of $10,000. The directors for the first year are C. Marshall, A. G. Ludwig, H. W. Marshall, Henry Hilgenkamp, H. L. W. Reckmeyer, A. G. Unland and C. Vail.

CHARLOTTE, N. C. The Southern Bell Telephone Company at Charlotte has decided to extend its service into the county.

RALEIGH, N. C.—The Interstate Telephone Company is connecting Raleigh with a number of outside points. Over $50,000 will be expended.

GREENSBORO, N. C.—It is reported that the American Telephone and Telegraph Company, of Greensboro, has purchased the property and franchise of the Greensboro Telephone Exchange.

NEW BRUNSWICK, N. J.—A franchise granting rights to the Central New Jersey Telephone Company has been approved by the Council over the Mayor's veto. In the debate preceding the ballot it was charged that opponents of the franchise had offered financial inducements to men to vote against the franchise.

TRENTON, N. J.—The National District Telephone Company has been incorporated, capital $100,000. Incorporators: S. W. Slayer, James H. Reid, B. A. Judd, R. W. Beard.

CAMDEN, N. J.—The Camden & Atlantic Telephone Company has been incorporated, with a capital stock of $200,000, by Wilfred B. Wolcott, C. E. Wilson and Norman Gray.

TRENTON, N. J.—The Interstate Telephone Company is making preparations to extend its system throughout the northern part of the state. The company has applied for several municipal franchises and the work of building the lines between the various towns will soon be commenced.

CANNONVILLE, N. Y.—The Cannonville-Deposit Telephone Company has been incorporated with a capital stock of $900. W. G. Pomeror is one of the incorporators.

MANCHESTER, N. Y.—The Red Jacket Telephone Company, of Manchester, has been incorporated, with a capital stock of $500, by Carlos P. Osgood, John H. Pratt and Oliver S. Titus.

PAVILION, N. Y.—The Oatka Valley Telephone Company has been organized by the election of the following-named officers: President, J. C. Doty; vice-president, Fred Chilson; secretary, George Bernd.

LANCASTER, N. Y.—The Farmers' Telephone Company has been organized in this village. Following are the officers: President, George Beck; vice-president, E. R. Ives; secretary and treasurer, H. Brunck.

CLAYTON, N. Y.—The Thousand Islands Telephone Company, of Clayton, has been incorporated, with a capital stock of $2,800, the incorporators being Wm. H. Consant, Chas. A. Ellis and Geo. H. McKinley.

PERU, N. Y.—The Champlin Valley Telephone Company, of Peru, has been incorporated with a capital stock of $3,000. The directors are J. E. Sherman, G. A. Mason and R. W. Hoff.

ITHACA, N. Y.—The Caroline Telephone Company has filed articles of incorporation. It has a capital stock of $3,000, and will build lines to connect the principle villages in and near the town of Caroline. The directors are Omar D. Mulks, W. C. Gallagher, A. J. Slater, George M. Bull, C. R. Lounsberry, John L. Mandeville, Henry D. Thomas, George Peck, Benjamin Rightmyer, Charles H. Blood and C. D. Phillips.

IRONTON, OHIO. The Ohio Valley Telephone Company has been organized, with a capital of $200,000, to consolidate the independent companies between Charlestown, W. Va., and Cincinnati. Extensions will be made.

ALTOONA, PA.—Johnstown and Pittsburg capitalists have organized a new telephone company, with a capital stock of $70,000, to build lines between Johnstown and Pittsburg. Construction work is already under way.

HUDSON, S. D.—The Hudson Telephone has been chartered and is about ready to start the construction of a system in this city. The company is capitalized at $10,000 and will build lines into the farming districts in all directions. At a recent meeting the following-named officers were elected: President, E. D. Cassill; vice-president, Oscar Oleson; secretary, Dr. E. R. Buck; treasurer, F. B. Cable.

GRANVILLE, TENN.—Dr. W. A. Hargis has organized a company to build a telephone line from Granville to Bagdad, Tenn., the line to be eventually extended in Kentucky.

NASHVILLE, TENN.—The Roaring Springs Telephone Company, of Greene County, Tenn., has been incorporated by H. A. Simpson and others, with $500 capital.

NORTH YAKIMA, WASH. The Pacific States Telephone Company will make extensions and improvements in the local system.

GLENWOOD, WIS.—The West Wisconsin Telephone Company will build a line from Downing to Boyceville, with party lines for farmers en route.

CASCO, WIS. The Casco & Brussels Telephone Company has increased its capital stock from $400 to $1,500.

FOND DU LAC, WIS.—The Wisconsin Telephone Company will build long distance lines to Plymouth.

STEVENS POINT, WIS. A. W. Bryant, of Oshkosh, is forming a local company to establish a telephone exchange.

GLIDDEN, WIS.—The Glidden Telephone Company has been granted a franchise to build and operate a system in this town. The company will build several exchanges in Ashland County and a toll line. It consists of J. W. [illegible], George L. McCurdy, W. L. Schuppert and Hodway.

CAPON BRIDGE, W. VA.—The Capon Bridge Telephone Company has secured a charter to construct a telephone line from Romney, W. Va., to Gore, Va., and between other towns in Virginia and West Virginia. The capital stock is $10,000, and the incorporators are D. A. Daugherty, J. H. Orndoff, T. K. Oats, Edward Oats, L. D. Anderson.

PORT ANGELES, WASH.—It is stated that the Council will install new machinery at the electric light plant.

NEW MARTINSVILLE, W. VA.—A charter has been granted to the Paden Valley Company, of Pittsburg, Pa., for the construction of water works and for carrying on operations to produce gas and electricity for supplying Paden Valley, in W. Va., with light, heat, power and water; capital $200,000. The plant is situated between New Martinsville and Sistersville. Incorporators: Thos. A. Watkins, Robt. Miller, and others, all of Pittsburg, Pa.

ELECTRIC LIGHT AND POWER.

LOS ANGELES, CAL.—It is announced that the Pacific Electric Lighting & Power Company has acquired by purchase the San Bernardino Gas & Electric Company.

GRIFFIN, GA.—An election will be held at Griffin on June 10 on the question of issuing $100,000 bonds for sewerage, water and electric light improvements.

ATLANTA, GA.—The City Council of Atlanta has accepted the bid of the Georgia Electric Light Company for lighting the city for five years. The price is $75 a year for each arc light.

LEWISTON, IDA.—It is stated that this city will be provided in the near future with an electric power plant and electric light.

GREENSBURG, IND.—A ten years' franchise has been granted the Greensburg Electric Company. The price is $60 per light on an all-night schedule. The present price is $75 per light on a moonlight schedule.

HUDSON, MASS.—The citizens have voted to appropriate $13,000 for an engine and generator for the municipal light plant.

AUGUSTA, ME.—The name of the Union River Light, Gas & Power Company has been changed to Bar Harbor & Union River Power Company.

OAKLAND, ME.—The Oakland Electric Company, of Oakland, has reorganized, increased its capital from $10,000 to $200,000, and purchased from the Messalonskee Electric Company its property in Oakland, including water power privileges. The purchasers will at once proceed with the development of the power. W. M. Ayer, of Oakland, and W. S. Wyman, of Waterville, are among the directors.

NORTH ADAM, MICH.—The citizens have voted for electric lights.

MT. CLEMENS, MICH.—Henry M. Wisler, of Chicago, Ill., and Chas. Flowers, of Detroit, have petitioned the Council for a heating and lighting plant.

STANDISH, MICH.—The citizens have voted to issue $20,000 bonds for water works and an electric light plant.

ST. CLOUD, MINN.—The Council has granted Mr. Carter a franchise for an electric light and power plant.

FARIBAULT, MINN.—It is reported that the Polar Star Electric Company will install a power plant at the Scott mill property and transmit power to this city. A new dam will be constructed.

BOZEMAN, MONT.—Alex. Freeman and other Bozeman parties have petitioned the county commissioners for an electric lighting franchise for the town of Belgrade.

ST. LOUIS, MO.—The Choctaw Gas, Light, Heat & Power Company has been incorporated; capital $150,000. Stockholders: Stanley D. Pearce, G. S. Hoss and Manton Davis.

LUMBERTON, N. C.—The citizens have vôted for electric lights.

REGINA, N. W. TER.—It is proposed to construct an electric light plant, to cost $30,000. John Galt, of Toronto, Ont., is engineer.

TRENTON, N. J.—The Trenton Water Power Company is having plans prepared for a power plant.

ALBANY, ORE.—It is reported that the Canal & Water Company will expend about $20,000 in improvements to its electric light plant and system.

GALION, OHIO.—The Ohio Central Traction Company has entered the lighting field and is offering to furnish lighting and power in both Galion and Bucyrus.

BELLAIRE, OHIO.—The Bellaire Gas & Electric Company and the Bellmont Electric Light & Power Company have filed articles of consolidation, the name of the consolidated company being the Bellaire Light & Power Company. The company's capital is $150,000 and it will have its headquarters in Bellaire.

SHENANDOAH, PA.—The People's Electric Light, Heat & Power Company, of Shenandoah, has been incorporated with a capital stock of $20,000.

HARRISBURG, PA.—The following-named electric light companies, each with a capital stock of $10,000, have recently been incorporated: Haverford Township Electric Light Company; Radnor Township Light Company; the Upper Merion Electric Light Company; Newton Township Electric Light Company; Easttown Township Light Company; Easttown Township Electric Light Company; Willistown Township Electric Light Company; Tredyffrin Township Electric Light Company and the Radnor Township Electric Light Company.

MEMPHIS, TENN.—The petition of the Memphis Consolidated Gas & Electric Company has been granted to place underground conduits, at a cost of about $93,000.

FLORESVILLE, TEX.—The citizens voted to issue $18,000 bonds for constructing water works and an electric light plant.

BELTON, TEX.—C. H. Denny, C. W. Meyers and Thomas Fairweather have purchased the plant of Belton Light & Power Company, and will install a day circuit.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—Surveys have been completed for the new electric railway to be built immediately from Hueneme, Ventura County, to Bakersfield, a distance of 115 miles. Gervaise Purcell, engineer of the road, is in charge of purchasing construction material and equipment.

WASHINGTON, D. C.—A certificate of the incorporation of the United States Lighting & Traction Company of the District of Columbia, has been filed. The capital stock is $2,000,000 and the incorporators are Edward White, W. A. White, W. L. Francis, of Washington, D. C., Herbert L. Stillman, of West Acton, Mass., Thomas W. Bickwell, of Providence, R. I. The officers are Mr. Bickwell, president; Mr. Stillman, treasurer; Mr. Francis, secretary.

WASHINGTON, D. C.—John R. McLean and his associate have closed the deal for the purchase of the Great Falls & Old Dominion Electric Railroad. The announcement is made on authority that the company will build a line from the Virginia end of the Aqueduct Bridge to Great Falls. The following board of directors has been chosen to represent the new interests in control; John R. McLean, R. D. Weaver, R. H. Goldsborough, George G. Boteler, Nathan B. Scott, Colin H. Livingston and William F. Hart.

SPRINGFIELD, ILL.—At a meeting of the Springfield & St. Louis Railroad Company, action was taken towards building an electric railway from Springfield to St. Louis. H. H. Littell, of Buffalo, N. Y., resigned the presidency, and the directors elected Horace Riordan.

PLAINFIELD, IND.—The owners of the Indianapolis-Plainfield Railway are planning to extend the line to Green Castle this summer.

RICHMOND, IND.—The Eastern Indiana Traction Company and A. H. Lamar & Company, New York bankers, have closed a deal for the construction of 86 miles of trolley line between this city and Marion. Peter Schwab and ex-Governor Campbell of Ohio are interested.

MUSKOGEE, I. T.—John J. Geghan, of Cincinnati, Ohio, representing Ohio capitalists, has asked the Council of Muskogee for a franchise to build an electric railway system.

GARDNERVILLE, NEV.—It is stated that a company to be known as the Gardnerville & Carson Electric Railroad is to be organized to build an electric railway to connect Gardnerville and Carson.

PEPPERELL, MASS.—The Pepperell & Ayer Street Railway Company is to be organized to build an electric railway through Ayer, Groton, Pepperell and Dunstable to a point on the New Hampshire line, near Hollis. The length of the road will be 12 miles. The capital stock will be $120,000. William S. Murray, of Bostôn; Loring N. Farnum, of North Andover, and Everett E. Tarbell, of Pepperell, are interested.

NASHUA, N. H.—The Hudson, Litchfield & Goffs Falls Electric Railway which is to connect this city and Manchester, has organized as follows: John W. Center, George M. Reid, M. C. Griffin, Isaac N. Center, J. P. Newell, Arthur S. Campbell, George W. Clyde, Kimball Webster and P. J. Connell, directors; Isaac N. Center, of Manchester, president; Arthur S. Campbell, of Manchester, vice-president; John J. Baker, of Hudson. The directors were instructed to proceed immediately with the construction of the road.

CINCINNATI, OHIO.—The Cincinnati, Milford & Eastern Traction Company has completed plans and specifications for all the material that will be required for building and equipping the road and all contracts will be closed in the near future.

SPRINGFIELD, OHIO.—The Bushnell syndicate is planning the erection near Springfield of a large power station with which to operate the Springfield, Troy & Piqua line and the Springfield & Xenia line, recently acquired by the syndicate. The latter road has no power house of its own.

BOWLING GREEN, OHIO.—The directors of the Lake Erie, Bowling Green & Napoleon Railway Company have voted to increase the capital stock from $300,000 to $1,000,000. The additional capital will be used for the extension of the road from Pemberville to Port Clinton.

BEAVER FALLS, PA.—Charters have been taken out at Harrisburg for the Beaver Falls Electric Street Railway Company and the Beaver & Bridgewater Electric Railway Company. The capital stock and directors of both companies are the same. It is proposed to construct an electric railway connecting the boroughs of Beaver, Bridgewater and Beaver Falls. The officers are John H. Park, president; John Warren, of Beaver Falls; William Fisher, of Rochester; William A. Park, of Beaver; James M. Beal and John E. Park, of Beaver, directors.

PROVIDENCE, R. I.—The legislature has granted to Waldo A. Hopkins, Samuel Mellor, Nicholas S. Winsor and Alonzo P. Mowry a charter for an electric railway to be known as The Pascoag & Providence Street Railway Company, with power to construct an electric railway in Burrillville, Gloucester, Smithfield, Johnson and North Providence. The capital stock of the company is fixed at $700,000.

GREENVILLE, S. C.—The city of Greenville has granted a 50-year franchise to the Greenville & Anderson Electric Railway. Dr. J. E. Coughlin, of Indianapolis, Ind., is interested.

WATERTOWN, S. D.—The Watertown & Lake Kampeska Railway & Transportation Company, recently organized under the laws of the State of

South Dakota, with a capital of $100,000, is to construct an electric railway from Watertown to a point on Lake Kampeska, a distance of nearly four miles. The officers of the company are: M. R. Baskerville, president; W. R. Thomas, vice-president; H. J. Mowrey, secretary; H. L. Sheldon, treasurer.

MEMPHIS, TENN.—The Memphis Street Railway Company will make extensions to its lines involving an expenditure of about $175,000.

SMITHVILLE, TENN.—It is said that Messrs. Fechcimer and Keifer, of Cincinnati, and the Rothchilds Banking Company, of Cincinnati, are interested in a plan to build an electric railway between Smithville and Watertown. Water power could be developed at Cul-Carmac Falls, a distance of two miles from Smithville.

NASHVILLE, TENN.—The local and Kentucky and Pittsburg capitalists who have incorporated the Gallatin & Nashville Interurban Railway and the Nashville & Columbia Interurban Companies have decided to consolidate both in one corporation to be known as the Tennessee Interurban Railway. The road will have a length of 75 miles and will run through the richest and most populous territory of Tennessee. At present each company has a nominal capitalization of $50,000, but this will be increased to $3,000,000 and perhaps more. Surveys have been made and rights of way secured, but it will be impossible to get rails for the track until next fall.

PETERSBURG, VA.—The Virginia Passenger & Power Company is now installing a new 600-hp temporary addition to its plant in Petersburg.

PALOUSE, WASH.—A company composed of C. E. Frederick, J. K. McConack and G. W. Peddycord has asked the City Council for a twenty-five-year franchise to operate an electric railway in this city.

SPOKANE, WASH.—It is stated that a company is being organized for the purpose of constructing an electric railway between Spokane and Medical Lake, a distance of 18 miles.

ST. MARYS, W. VA.—The Williamstown & Moundsville Railway Company has been granted a fifty-year franchise to build an electric railway through the county. Guy A. Wagner, of Wheeling, is president of the company.

NEW MARTINSVILLE, W. VA.—The New Martinsville & Proctor Street Railway Company is being organized to build an electric railway here. Jacob Koontz, I. D. Morgan and D. H. Cox, of New Martinsville, are interested.

KEYSTONE, W. VA.—The Keystone Traction Company has been incorporated to construct an electric railway from Sand Lick to Maybury, McDowell County. The capital stock of the company is $25,000 and the incorporators are O. J. Evans, Benjamin Evans, John Evans, Northfork, W. Va.; M. Goldstein, D. E. French, Keystone.

MILWAUKEE, WIS.—It is stated that the Milwaukee Electric Railway & Light Company plans to extend its lines from Hales Corners to Mukonago.

MADISON, WIS.—The Milwaukee & Southern Railway Company, which will construct a railway from Milwaukee to East St. Louis, has organized by filing articles with the Secretary of State. The motive power to be used is not stated, but it is understood it will be an electric railway. The company is organized with $50,000 capital stock. The incorporators are Earl Parcells, Roy B. Tabor, Robert A. Peet, of Chicago, and John B. Wallace and Harry A. Porter, of Mukwonago, Wis. The line will be about 500 miles in length.

NEW INDUSTRIAL COMPANIES.

THE CHIPPEWA ELECTRIC COMPANY has been incorporated at Sault Ste Marie, Mich., with a capital stock of $5,000.

THE AUTOMOBILE MOTOR COMPANY has been incorporated at Syracuse, N. Y., to manufacture automobiles, motor cycles and automobile sundries.

THE COMMERCIAL MOTOR COMPANY, of Jersey City, has been incorporated with a capital of $250,000.

THE WIRELESS NEWS PUBLISHING COMPANY, of New York, has been incorporated with a capital of $5,000. Directors: James Stewart, H. E. Wise, and M. G. Lathrop, New York.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., is enlarging its plant to about twice the size of the present establishment.

THE MOTOR ENGINE CO., of New York, has been incorporated; capital, $150,000. Directors: F. J. Carolan, Burlingame, Cal.; H. T. Shriver and J. H. Brewster, Jr., New York.

THE NATIONAL CHEMICAL POWER COMPANY, with a capital of $25,000,000, has been incorporated in Arizona, to engage in the generation of electricity for power and lighting purposes by means of a chemical process.

THE NEW YORK SCHOOL OF TECHNOLOGY has been incorporated, capital $100,000. Directors: William Seaton and Charles Macy, New York; C. H. Ingalls, New Brighton.

THE PITTSBURG AND ALLEGHENY SUBWAY AND TUNNEL COMPANY, of Allegheny, Pa., has been incorporated to construct a tunnel between Pittsburg and Allegheny; capital $250,000.

THE ROYAL AUTOMOBILE COMPANY has been incorporated at Trenton, N. J., with a capital stock of $250,000. The incorporators are Louis B. Dailey, Warren B. Akers and K. K. McLaren.

THE NEW YORK LONG DISTANCE AUTOMOBILE COMPANY, of New York City, has been incorporated with a capital stock of $10,000. The directors are Lewis Nixon, W. M. McDougall and F. D. Hutchins.

THE TOBIAS MOTOR COMPANY, of Chicago, hns been incorporated with a capital stock of $2,500, to manufacture engines, motors and machinery. The incorporators are John L. Tobias, Charles H. Ewing and Roy J. Zorn.

THE UNION SIGNAL COMPANY, of Sanford, Me., has been incorporated to manufacture and deal in electric car signals. The capital stock is $150,000. Mr. F. J. Allen, of Sanford, is president and treasurer.

THE OKLAHOMA ELECTRIC COMPANY, of Oklahoma City, Okla., has been incorporated with a capital of $1,000,000. The incorporators are F. B. Ziegler, William F. Young, B. R. Harrington, H. W. Boyd, J. S. Alexander, W. F. Harn and G. W. Spencer.

THE R. M. PATRICK ELECTRIC CONTRACTING COMPANY, of Syracuse, N. Y., has been incorporated with a capital stock of $50,000. Mr. R. M. Patrick is manager and Fred D. McIntosh, president. The company has already several large contracts on hand.

THE EASTERN CONSTRUCTION COMPANY, of Bangor, Me., has been incorporated, with a capital stock of $10,000, for the purpose of building and operating electric power and light plants. The officers are V. H. Foss, president; J. H. Green, treasurer, both of Bangor.

THE QUEEN CITY ELECTRICAL SUPPLY COMPANY is the title of a new concern just started business in Battle Creek, Mich. The new company will do all kinds of electrical work, motor repairing and carry a full line of electrical supplies. Captain George Perry is manager of the company.

THE GUARANTEE ELECTRIC COMPANY, of St. Louis, Mo., has filed articles of incorporation, with a capital stock of $6,000, full paid. The incorporators are C. J. Briner, F. E. Briner, L. T. Nolker, W. H. Nolker, J. P. Casy and Wm. Koeneman.

THE THOMAS REESE, JR., COMPANY, of New York, has been incorporated to carry on business as mechanical engineers. The capital is $150,000 and the directors are Thomas Reese, Jr., J. R. Reese and J. M. Weldon, of New York.

THE WHITLOW CORPORATION has been organized at New Bedford, Mass., to do a general electrical and mechanical business. The capital stock is $5,000. The officers are Samuel Whitlow, president; Obed N. Swift, treasurer, and Samuel Whitlow, 2d.

THE VEHICLE EQUIPMENT COMPANY, of Waverly, N. Y., has been incorporated to do a business of truckmen, hackmen, mechanical and electrical engineers and manufacturers and dealers in motive power; capital, $3,000,000. Directors: Martin Conboy, H. T. Mead, Leonard D. Baldwin, C. A. Greene and Henry Schoenherr, New York.

LEGAL.

SUIT ON TELEPHONE STOCK.—The Appellate Division of the New York Supreme Court has decided that John M. Mack has a cause of action against the Telephone, Telegraph & Cable Company of America in his suit to recover $100,000, which he paid in August, 1900, on an agreement by which Mr. Mack subscribed tc 10,000 shares of stock in the company, of a par value of $50 each, contracting to pay the balance of $400,000 as the company might make calls on its stockholders. The decision reverses Justice Davy of the Supreme Court, who upheld the company's demurrer. In overruling the demurrers the Appellate Division says that if Mack's representations are true, he is entitled to the recission of his subscription agreement and the return of his $100,000, no matter whether the stock is or is not worth the amount he agreed to pay for it. He cannot, however, recover against the directors individually, since there nowhere appears in his complaint any allegation that the stock is worthless or of less value now than it would be were all the representations made to him true, and therefore those who made the representations cannot be held liable for them. Besides, if he recovers against the company, he cannot expect to get additional damages against the directors.

PERSONAL.

MR. J. C. BARCLAY will, it is understood, represent the Western Union Telegraph interests at the approaching telegraph conference in London.

MR. THOMAS J. JOHNSTON, who is well-known in New York City as a counsellor at law and expert in patent causes, has moved from 66 Broadway to 11 Pine St.

MR. FRANK J. SPRAGUE, E. E., has been recommended by the Committee of Science and Arts of the Franklin Institute for the award of the Elliott Cresson medal for his multiple unit system of electric traction.

MR. GEORGE G. WARD, vice-president and general manager of the Commercial Cable Company, accompanied by Mr. Albert Beck, the secretary, will attend the telegraph conference in London this month.

MR. ALFRED H. HOLBROOK, patent law practitioner, has removed his law office to the Bank of Commerce Building, 31 Nassau Street, New York City.

MR. G. W. SCOTT, the well-known consulting engineer of Chicago, announces the removal of his offices to 1301-2 Security Bldg., to take care of an increasing business.

MR. F. A. CROSELMIRE, of the firm of Croselmire & Acker, platinum refiners, sailed last week on a three months' business trip to Europe on the Hamburg liner *Deutschland*.

MR. CHARLES KIRCHHOFF, editor of the *Iron Age*, lectures this week before the Franklin Institute, Philadelphia, on "The Utilization of Blast Furnace Gases for Power Purposes." The date is May 14.

GEN. E. S. GREELEY, formerly a leader in the electrical supply trade and now a prominent bank president at New Haven, Conn., has just been elected president general of the National Society of Sons of the American Revolution.

MR. ARTHUR WARREN, head of the publication department of the Westinghouse interests, with present quarters in England, is on a visit to this country, arriving on *Kronprinz Wilhelm* last week. After a few days in New York City Mr. Warren proceeded to Pittsburg.

MR. JOHN McGEORGE has recently been appointed consulting engineer of the Wellman-Seaver-Morgan Engineering Company. This position is one of importance and has been so since the combination of the Wellman-Seaver-Morgan Engineering Company and the Webster Camp & Lane Company.

MR. J. J. PUTNAM, general manager of the Clark Automatic Telephone Switchboard Company, Providence, R. I., has returned from a Western trip. He reports a most satisfactory condition of business out there. He closed a number of contracts for the company, and states that the outlook for its business is most promising.

PROF. R. S. MILLER, formerly associate professor of mechanical engineering at Purdue University, has been elected to a similar position in the school of engineering at Colorado College, Colorado Springs. Mr. Henry C. Lamb, who for some years has been in the employ of Mr. W. S. Stratton in the Independence Mine, has been appointed instructor in shop practice.

MR. HUGO REISINGER, of New York City, the well-known importer of "Electra" carbons and other electrical specialties, has been appointed honorary commissioner to Europe of the Louisiana Purchase Exposition Company. Mr. Reisinger has for some time been acting on the Exposition's New York committee for the reception of distinguished foreigners arriving in that city from Europe.

MR. SHIRO YAMAZAKI, who after graduation in Japan as an electrical engineer, entered the Schenectady works, where he has just completed a two-years' course in practical work, will return to Japan after visiting some of the more important electrical generating plants in this country. He will make the journey via Europe and also visit the most important electrical centers in Great Britain and the Continent.

MR. T. A. EDISON is also a great man in Germany. The Berlin *Tageblatt* asked its readers: "Who are the most distinguished ten men alive to-day?" It received 1,000 answers. Tolstoi's name heads the list, with 502 votes; Mommsen comes next, with 496; then Marconi, with 445; Ibsen, with 425; Edison, with 368; Nansen, 270; Röntgen, 264; Mensel, the artist, 248; Prof. Koch, 228 and Emperor William II, 203 votes.

MR. WILLIAM H. NISBET, of Sydney, New South Wales, formerly superintendent of locomotive power of the Queensland Government railways, who received his early training in the Westinghouse shops, and who now represents the Westinghouse Air Brake interests in Australia, sails from San Francisco this week, after a short visit to the United States. Some important contracts for electrical equipment, etc., are expected to be received on this side shortly after Mr. Nesbit's arrival in Australia.

MR. J. F. CALDERWOOD.—The directors of the Brooklyn Rapid Transit Company have decided to add a third vice-president to the list of officers and have elected J. F. Calderwood to the place. President Winter has also appointed Mr. Calderwood general manager, thus making him the virtual working head of the system. A year or so ago Mr. Calderwood came from St. Paul as assistant to President Greatsinger. He had eighteen years' experience in railroad management in the West.

MR. ALBERT VON HOFFMAN, Milwaukee, Wis., who will be remembered by street railway men as the inventor of the Falk cast welded joint, has announced through the daily press that he has invented a single-phase system of electric railway. No details as to the new system are given, however. The advantages claimed for the new system are those which would be common to any successful single phase electric railway system, namely, the elimination of rotary converter sub-stations, and the use of a high voltage on the trolley wire without the necessity of more than one trolley wire.

MR. EDWARD HUBER has withdrawn from the firm of McCrosky & Huber, of Cincinnati, manufacturers of adjustable reamers, with which he has been connected for the past three years. He has accepted a position as assistant superintendent in charge of the night force at the large electrical establishment of the Bullock Electric Mfg. Co., Cincinnati. Before entering the above firm Mr. Huber was for several years associated with the Bullock Company and the latter is to be congratulated on securing the services of so able a mechanic as Mr. Huber has long shown himself to be.

MR. RAY D. LILLIBRIDGE, the well-known publication and advertising manager, has outgrown his quarters recently taken at 170 Broadway, New York City, and to secure more room has taken the suite on the fourteenth floor occupied previously by the Standard Steel Car Company. He is already installed and very much at home.

MR. H. S. MEYER, chief designing engineer of the British Thomson-Houston Company, Rugby, England, is now on a visit to this country, and has been spending a few weeks at the General Electric Works, Schenectady. He is now in New York, and after attending the annual meeting of the American Institute of Electrical Engineers will sail for England on May 26.

SPENCER TRASK & CO., the well-known New York bankers, electrical financiers, etc., announce that they have admitted to the firm Mr. Eliphalet Nott Potter, of New York; that Mr. A. M. Fox, of Albany, will represent them in that city as resident partner; that a general power of attorney has been given to Mr. Carl G. Smedberg, and that the concern is moving this week to new quarters corner of William and Pine Streets.

MAJOR A. C. JOLY DE LOTBINIERE, R. E., the deputy chief engineer of the Mysore Government, is now in the United States with a view to placing contracts for additional equipment for the Cauvery Falls power transmission plant which furnishes power to operate the gold mines in the Kolar district, Mysore, India. The existing electrical equipment, which was furnished by the General Electric Company, has a capacity of 4,000 hp. It is to be extended to 6,000 hp. The turbines are of Pelton type built by the Swiss firm of Escher Wyss & Co., of Zurich. The transmission line is 92 miles in length. It is the longest in the British Empire.

LT. COL. CUBILLO, director of the Spanish Arsenal at Trubia, is now in New York for the purpose of purchasing further American electrical equipment, machine tools, etc., for installation in the extension of the plant, which turns out the big guns for the Spanish army and navy. The Westinghouse interests, as chronicled in these pages at the time, secured recently a contract for considerable electrical machinery, and the Niles-Bement-Pond Company furnished some large gun lathes and other machine tools. Col. Cubillo is a guest at the Hotel Manhattan. He is accompanied on his visit to this country by Mr. W. S. Accles, the European representative of the Niles-Bement-Pond interests.

MR. G. MARCONI.—A cable dispatch from Rome of May 7 says: Signor Marconi was made a Roman citizen at the Capitol at noon to-day by Prince Colonna, the Mayor of Rome. In the afternoon Marconi delivered a lecture in the great hall of the Capitol before King Victor Emmanuel and a large audience on what he had done and what he hopes to do in wireless telegraphy. At the conclusion of the lecture the King shook hands with Marconi and called him a glory to Italy. The enthusiasm manifested at Marconi's reception surpassed that exhibited during the recent visits of King Edward and Emperor William. Signor Marconi attended the State dinner given at the Quirinal the other day in honor of Emperor William, and the Kaiser, after cordially complimenting him, invited him to visit him at Berlin.

DR. M. I. PUPIN had a brief article in the twentieth anniversary number of the *New York World*, in which he said: Hitherto electricity has largely been employed as a motive power. It has been solving our problems of transportation and communication. It is just entering upon a new field, that of manufacture. It has moved things; now it will make them. The energy of our water reservoirs, our coal and oil fields will be transformed into electrical energy in great central electrical works, and from there distributed to various manufacturing points. Already Niagara is being to some degree utilized in this manner. I expect to live to see the time when most chemicals used for commercial purposes will be manufactured by electrical power. The United States will always lead in the development of electrical power, because it has enormous water power, coal and oil fields. This will enable it to attain and maintain an overwhelming commercial supremacy. This is all-important, for to-day commerce rules the world. Society rests upon an economical basis. Militarism, formerly triumphant, has lost its prestige. The influence of this country has brought about a revolution and instead of struggling for gold braid and hollow titles, men have learned here that position and influence are due to actual work done.

MR. CHARLES T. YERKES arrived on the *Kronprinz Wilhelm* last week, and was enthusiastic about the progress being made on the system of underground transit in London. He said: "When I was over here last I told you that the Londoners had not been able to grasp the full import of the improvements being made in their transit system. They are getting accustomed to it now, and are beginning to realize what we are doing, and just how big the undertaking is. The work has progressed faster than any other work of equal scope ever undertaken in the British Isles. Our immense new power house is the key to the whole situation. It covers four acres of ground, and has a water frontage of 1,100 feet. It will contain ten 7,500-horse-power engines, and there will be spare space to increase the power by 50 per cent. All the machinery will be installed by July, 1904. We have converted one old steam road five and one-half miles long into what is called a fourth-rail system. It is really what is called over here a third-rail system, but a fourth rail is used to take back the current without any loss. It is a surface surburban road from Ely to Harrow. The public has no access to the tracks, so that there is no danger of an accident from the charged rails. On this line we are testing controllers and motors and educating the men who are to make up the force of our entire system in London. It is a kind of preparatory or training school."

MR. A. RIEPPEL, Koeniglicher Baurat, of Nurnberg, Germany, the managing director of the Augsburg-Nurnberg Manufacturing Company., well known for many years as one of the largest and most successful builders of structural iron work, engines, cars, bridges, etc., in Europe, is now visiting this country for the first time. His works employ about 16,000 men and now have over 2,000 at work on the bridges, etc., of the new railroads being built by Germany in China. Their latest success has been with gas engines, both for gaseous and liquid fuel. They have long built these engines in smaller units up to 400-hp. and operated with petroleum, but for the use of waste gas as well as producer gases and in larger units, they have recently developed an entirely new design constituting the result of many years of extensive experience. The engine which is of the double acting cycle type, generally in tandem arrangement, is best adapted for the various purposes of modern power development up to the largest units required by municipal central stations and iron and steel works. Mr. Rieppel's visit to this country was made to interest the Allis-Chalmers Company in the manufacture of the products of his company, and by mutual agreement to enable each or either of them to get into closer touch with the requirements of the trade throughout the world. A contract has been entered into by the two companies giving the Allis-Chalmers Company the exclusive right to manufacture and sell the Nurnberg gas engine for this country and selling rights in many foreign countries, especially the Far East and South Africa. Details of this have already been given in these pages. The Augsburg Nurnberg Manufacturing Company under the direction of Mr. Rieppel, has made a phenomenal success with this new gas engine having within the past few months received orders for some 50,000-hp. throughout Germany and Spain chiefly for generating electric energy and for blast furnace and spinning mill work. One of these engines now being built is for an important spinning mill in Northern Germany where the engine will be operated by producer gas. Mr. Rieppel is now on a tour of inspection throughout this country after which he will visit the new and extensive works of the Allis-Chalmers Company at West Allis where these engines will be built.

Trade Notes.

THE MILWAUKEE COMMUTATOR COMPANY, Milwuakee, Wis., has filed notice of dissolution.

THE NORTH ELECTRIC COMPANY, of Cleveland, Ohio, has increased its capital stock from $200,000 to $250,000.

THE PITTSBURG STEAMSHIP CO., controlled by the U. S. Steel Corporation, has ordered a large Cross oil filter from the Burt Mfg. Co., Akron, Ohio, for use on one of its steamers.

THE VIVE MANUFACTURING COMPANY, of Chicago, has changed its name to Norstrom Lock-out Telephone & Manufacturing Company, and the capital stock has been increased from $2,500 to $6,000.

THE OHIO ELECTRICAL WORKS, Cleveland, Ohio, have placed on the market a line of efficient battery fan motors, with either wet or dry batteries. The sizes are from 5 to 12 inch fans. The motor with 9-inch fan takes only ¾ of an ampere at 7 volts and runs the fan at 1600-r.p.m. A new catalogue with discount sheet is now ready for mailing.

THE DU NOYER-CURRY ADVERTISING AGENCY, Utica, N. Y., announces that it is changing its offices in that city in order to provide for increased business which it has been able to secure through the strong and artistic advertising display it has been able to make for its customers. The agency has a number of well-known companies on its books, including one or two electrical concerns.

THE PRATT & WHITNEY COMPANY, Hartford and New York, has issued a calendar dated from May 1. It is in the form of a pad. Each day some extract from "The Letters of a Self-Made Merchant to His Son" is placed before the user of the calendar, and from the character of these quotations it is known as "The Wisdom Calendar." It affords excellent daily food for thought and guides for action.

MR. CHARLES J. BOGUE, 213 Centre Street, New York City, has recently issued a series of four bulletins relating to projectors and searchlights, photo engraving lamps, theatrical lamps for stage lighting effects and therapeutic apparatus. Each bulletin is completely illustrated with views of the various apparatus coming under the different heads, and the principal dimensions are given in connection with the illustrations.

TRAVELING ELECTRIC HOISTS.—Pawling & Harnischfeger, Milwaukee, Wis., manufacturers of traveling cranes, have just issued a handsomely illustrated bulletin showing a variety of traveling electric cranes. Large halftones show the utility of these hoists and in many instances the service to which these machines are applied is described. Mention is made of a few applications to which these hoists are already applied and a list of companies using these machines is given.

THE BOSSERT ELECTRICAL CONSTRUCTION COMPANY, Utica, N. Y., has been publishing a series of twelve bulletins during the past year. These bulletins are 7½x10½ and are neatly and attractively printed. A handsome green and gold cover with brass fasteners is provided for binding. The entire Bossert line is covered and illustrated, including switches, panel and distributing boards, outlet and switch boxes, Erickson insulators, conduit bushings and couplings, etc.

HUBBELL PULL SOCKET.—Mr. Harvey Hubbell, Bridgeport, Conn., manufacturer of the Hubbard pull socket, bas issued a neat circular in which are pointed out the advantages and features of this well-known device. By means of a pendant chain a single light, or a cluster of lights, may be turned on or off by a pull on the chain—every other pull turning the lights on; the alternate pulls cutting them out. These circulars are being sent out to electrical jobbers throughout the country.

THE GREGORY ELECTRIC COMPANY, Chicago, announces that it has just bought the large manufacturing property at the corner of Sixteenth and Lincoln Streets, Chicago, where it will overhaul and repair the larger size dynamos and motors exclusively. The new plant covers the entire block and is equipped with electric power transmission and electric traveling cranes, and railway tracks run into the building. At this new location the Gregory Company is ideally situated for quick handling and quick shipments, either in car lots or less, being within a quarter of a mile of the freight depots of all railroads in that section. The general offices and sales department will remain, as heretofore, at 54 South Clinton Street.

CHLORIDE ACCUMULATORS.—The use of storage batteries for lighting private yachts is rapidly increasing to such an extent that practically every steam yacht of modern construction now includes a battery of Chloride accumulators in its equipment. The great advantage of a storage battery lies in the fact that it enables the lights to be used throughout the night while the machinery is shut down, thus avoiding the vibration from the running of a generator which is especially noticeable in a yacht while lying at anchor. The Electric Storage Battery Company has recently contracted for the installation of five yacht lighting plants on boats now under construction at Morris Heights, N. Y.

THE OTIS ELEVATOR COMPANY will relinquish its extensive suite of offices in the Empire Building, New York, although its lease has still some time to run, and move to the Whitehall Building facing Battery Park, because of the impossibility of procuring additional accommodations in the former building and of the absolute necessity for increased office facilities. That a concern possessing about 12,000 square feet of floor space for its executive and sales offices in the popular Empire Building should be compelled to move, notwithstanding the possession of an unexpired lease, simply to get more room, is an couraging prospect, since the status of the elevator industry is indicative of the condition of affairs in the building and real estate trades, and in fact of the condition of business in general.

THE CHICAGO FUSE WIRE & MFG. CO. has just issued its catalogue No. 14, a copy of which is before us. It advertises fuse wire, fuse strip and fuse links for electric lighting and power circuits, also fuse blocks and fuses for telephone and telegraph work, together with wire joints and sundry items. all of the company's manufacture. This list is neatly printed on green tinted paper with a gilt cover, and is a convenient size for an ordinary pigeon hole. The Chicago Fuse Wire & Mfg. Co. believes that its customers will find this list most comprehensive and convenient from which to order. The catalogue also gives considerable condensed information. The company now carries stocks at its three offices in Chicago, Buffalo and New York. A copy of the catalogue will be sent on request.

ELECTRIC FANS AND ACCESSORIES.—The Manhattan Electrical Supply Company, New York and Chicago, confines its catalogue, No. 15, just issued, entirely to descriptions and illustrations of electric fans and accessories handled by it. The list includes bracket, ceiling and desk fans of a great variety, for both alternating and direct current, the machines being of all the standard makes and designs. Each style is briefly described. All the information necessary to aid the purchaser in selecting goods is given. This catalogue is peculiarly valuable because it brings together under one cover illustrations and descriptions of all the standard fans on the market, and the purchaser is thus enabled to compare the different machines without the inconvenience of handling separate catalogues.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 5, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

726,837. ELECTRICAL DISTRIBUTING SYSTEM; Leonard Andrews, Hastings, England. App. filed May 10, 1902. Comprises an alternating current generator, a conductor to be supplied thereby, a discriminating choking device and duplicate feeders including separate coils of said device.

726,846. INSULATOR FOR ELECTRIC WIRES; Joseph R. Bell, Peckville, Pa. App. filed June 28, 1902. The pin has a slot in the end in which the wire is deposited and a cap screws over the pin to confine the wire in the slot.

726,912. ELECTRIC LIGHT HANGER; John P. Hebendahl, Elizabeth, and Mass. App. filed April 18, 1902. Details.

726,860. ELECTRIC FURNACE; Joseph M. Carrere, New Brighton, N. Y. App. filed May 22, 1902. A rotary cylinder built of refractory bricks and having stationary heads between which it turns.

726,868. TROLLEY WHEEL; Fred B. Corey, Schenectady, N. Y. App. filed Aug. 21, 1902. A sheet metal wheel of steel, having a copper tread.

726,869. TROLLEY WHEEL; Fred B. Corey, Schenectady, N. Y. App. filed Aug. 21, 1902. A modification of the preceding patent.

726,912 ELECTRIC LIGHT HANGER; John P. Hebendahl, Elizabeth and John J. Gafney, Newark, N. J. App. filed Nov. 26, 1901. Details.

726,917. TROLLEY WIRE FINDER; Thomas S. Herrick, Muncie, and John H. Bissett and Franz M. Merrick, Anderson, Ind. App. filed Aug. 23, 1902. Elongated spiral grooves each side of the wheel conduct a displaced wire to the grove in the wheel.

726,929. INCANDESCENT LAMP; John W. Howell, Newark, N. J. App. filed April 29, 1901. A high-voltage lamp having a filament composed of a number of independent treated sections, jointed near the stem on the end of a supporting wire of smaller heat-radiating capacity than the terminal.

726,935. REGULATION OF ALTERNATING CIRCUITS; Thomas J. Johnston, Brooklyn, N. Y. App. filed November 20, 1901. (See Current News and Notes.)

726,936. TRANSFORMER; Thomas J. Johnson, Brooklyn, N. Y. App. filed Nov. 1, 1902. The inclosing casing of an oil-transformer contains passages for the circulation of a cooling liquid.

726,944. MULTIPLE SIGNAL TRANSMITTER; Geo. E. King, Newton Highlands, Mass. App. filed April 25, 1900. The signal wheel contains segments at different radial distances from the center, which are arranged to co-operate with respective circuit closers to send different signals.

726,945. ELECTRICAL OUTLET BOX; Hubert Krantz, Brooklyn, N. Y. App. filed Feb. 26, 1902. The box is in two parts connected by a ball joint, permitting them to be adjusted to fit the surface of the wall in which it is placed.

726,952. MEANS FOR AVOIDING HUNTING OF ALTERNATE CURRENT MACHINERY; Henry C. Leake, Newcastle-upon-Tyne, England. App. filed April 9, 1901. The invention relates to parallel systems of distribution in which single or multiphase machinery is so arranged and operated that the potential difference across their terminals is maintained constant in effective value and periodicity. The object is the provision of means whereby the periodic fluctuation of the angular velocity of the rotating part is decreased and in so far as it does occur, made of practical unimportance.

726,963. MEANS FOR PREVENTING THE DISTURBANCE OF TELEPHONE CIRCUITS; Carl Joseph August Mohalke, Charlottenburg, Germany. App. filed June 7, 1898. (See page 844.)

726,964. CENTRAL ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed November 26, 1900. (See page 844.)

726,984. TELEPHONY; William F. Pembleton, Wittenberg, Wis. App. filed June 19, 1901. (See page 844.)

726,987. MOTOR CONTROLLER; William B. Potter, Schenectady, N. Y. App. filed August 7, 1899. (See Current News and Notes.)

726,994. HAND SETTING MECHANISM FOR CLOCKS; Theodor Schaffer, Hellerup, Denmark. App. filed Feb. 5, 1900. Details.

727,021. TROLLEY; Wm. S. Stockton, Philadelphia, Pa. App. filed March 13, 1902. A yoke pivoted upon the trolley pole with its upper ends diverging from points near the rim of the wheel and serving to deflect the wire into the wheel.

727,024. MANUFACTURE OF CAMPHIDON; Julius Tafel, Wurzburg, Germany. App. filed April 3, 1901. A process consisting in submitting an acid bath of imido-camphoric acid to electrolytic reduction.

727,025. ART OF PRODUCING HYDROXYLAMIN; Julius Tafel, Wurzburg, Germany. App. filed Feb. 24, 1902. Nitric acid is reduced by electrolytic action.

727,026. CAMPHIDIN AND METHOD OF PREPARING SAME; Julius Tafel, Wurzburg, Germany. App. filed April 3, 1901. A process consisting in submitting a solution of imido-camphoric acid in sulphuric acid in the cathode compartment of a cell to the action of current and then removing the greater portion of the sulphuric acid and treating the remainder with chloroform to separate the resultant camphidon, then supersaturating the remainder with an alkali to isolate the camphidin.

727,031. ELECTRIC CONDUCTOR OR CABLE; Francis Tremain, Highgate, Eng. App. filed April 24, 1902. Induction coils are placed at short distances along a cable and suitably protected, to reduce the effects of "capacity."

727,041. INDEX NEEDLE OR POINTER FOR ELECTRICAL MEASURING INSTRUMENTS; Edward Weston, Newark, N. J. App. filed May 7, 1902. The counterweight of the needle is made in one piece therewith and bent upon itself as required to accurately adjust the balance.

727,060. TELEGRAPH APPARATUS; John C. Barclay, New York, N. Y. App. filed Jan. 10, 1903. Consists of novel means for converting direct current into alternating current and for maintaining ground connections for the line during the operation of the transmitters.

727,064. CIRCUIT CLOSER; Walter J. Bell, Los Angeles, Cal. App. filed Jan. 2, 1903. An attachment for trolley wires whereby current delivered therefrom to switch operating magnets in the track can be controlled from the car.

727,068. COLLECTOR FOR ELECTRIC TRAMROADS OR RAILROADS; Andre Balzano, Munich, Germany. App. filed Dec. 23, 1902. The slot containing the conductor is filled with a mixture of vaseline and glycerine.

727,077. APPARATUS FOR LOCATING METALS, MINERALS, BURIED TREASURES, ETC., WITHOUT DIGGING; Fred H. Brown, Los Angeles, Cal. App. filed Feb. 28, 1902. A testing apparatus for measuring the resistance between two points on the surface of the earth.

727,089. PRINTING TELEGRAPH; Henry Casevitz, Paris, France. App. filed Oct. 10, 1901. The invention relates more particularly to the operation of a register comprising a series of disks connected together similar to the disks of a mechanical counter.

727,095. METHOD OF UTILIZING CALCIUM CARBIDE REFUSE AND PRODUCT THEREOF; Geo. E. Cox, Niagara Falls, N. Y. App. filed Sept. 3, 1902. The refuse is converted into an ingot by passing a suitable current through it.

727,101. OZONE GENERATOR; George L. Curtis, New York, N. Y. App. filed Jan. 17, 1903. An apparatus adapted to generate ozone while held in the hand and to deliver the same to the nostrils of the user.

727,117. REVERSIBLE GALVANIC BATTERY; Thomas A. Edison, Llewellyn Park, N. J. App. filed Oct. 3, 1902. (See Current News and Notes.)

727,124. MOTOR; Harliegh Gillette, Chicago, Ill. App. filed July 17, 1902. The motive power is generated by a gravity-acting weight which operates intermittently against a swinging object. Between operations the weight is raised by an electro-magnet, the circuit of which is controlled by the weight.

727,147. AUTOMATIC OPERATING MECHANISM FOR ELECTRIC RAILWAY SWITCHES; Gray W. Johnston, New York, N. Y. App. filed July 16, 1902. A magnet energized by the car throws a peculiarly constructed circuit changer to energize one or the other of two magnets acting upon the switch point.

727,182. ARMATURE WINDING APPARATUS; Fred P. McBerty, Warren, Ohio. App. filed July 7, 1902. The armature shaft is clamped in a yoke which is rotated while a wire guide directs the wire into the grooves of the armature.

727,206. ELECTRIC SWITCH; Vernon Royle, Paterson, N. J. App. filed March 4, 1902. Details.

727,227. ELECTRIC RAILWAY; Clendinen A. Thompson, New York, N. Y. App. filed Feb. 4, 1903. A hood for the third rail is fastened to the web of the rail, thus making it possible to apply the invention to existing third rails.

727,249. RESISTANCE PILE; Edgar H. Wise, Westmont, Pa. App. filed May 12, 1902. Alternately arranged disks of conducting and non-conducting material having inter-engaging slit-portions which bring a portion of one into the plane of another.

727,276. MOTOR VEHICLE; Thomas L. Boyle, Ogden, Utah. App. filed Nov. 14, 1902. Details of a plan for throwing the motor onto a short circuit to act as a brake.

727,311. THERMAL ELECTRIC FIRE ALARM; Thomas R. Duncan and Francis A. Duncan, Newberg, Ore. App. filed March 6, 1902. An expansion chamber actuates a circuit closer, the amount of expansion permitted before such actuation being used to determine the location of the fire.

727,325. TRANSMISSION AND RECEIPT OF SIGNALS; Reginald A. Fessenden, Allegheny, Pa. App. filed June 2, 1900. (See Current News and Notes.)

727,326. SELECTIVE SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Manteo, N. C. App. filed Aug. 27, 1901. (See Current News and Notes.)

727,327. RECEIVER FOR ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed Sept. 27, 1902. (See Current News and Notes.)

727,328. RECEIVER FOR SIGNALING; Reginald A. Fessenden, Fort Monroe, Va. App. filed December 29, 1902. (See Current News and Notes.)

727,329. SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed March 14, 1903. (See Current News and Notes.)

727,330. SIGNALLING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Fort Monroe, Va. App. filed March 21, 1903. (See Current News and Notes.)

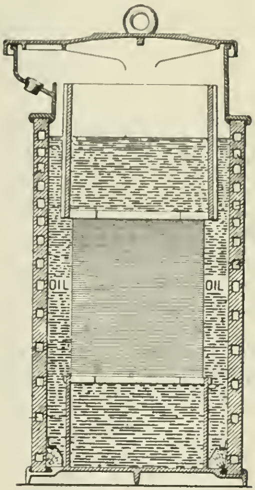
727,331. RECEIVER FOR ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed April 9, 1903. (See Current News and Notes.)

727,360. ELECTRICAL WATER HEATER; Harry M. Hill, St. Louis, Mo. App. filed March 31, 1902. Two concentric cylinders forming the terminals of a circuit, the water being directed through an annular space between them and being heated by the passage of current through it.

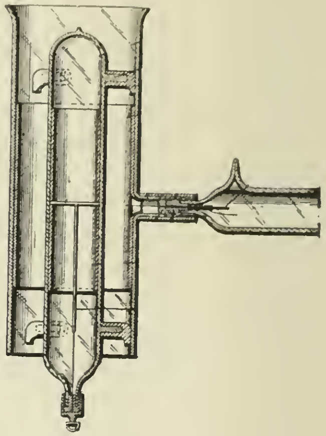
727,361. ELECTRICAL WATER HEATER; Harry M. Hill, St. Louis, Mo. App. filed May 10, 1902. A modification of the preceding patent.

727,411. ALTERNATING CURRENT MOTOR; Fred P. McBerty, Warren, Ohio. App. filed June 30, 1902. Small motors are started by twisting a crank shaft geared to the armature until such a speed is attained that the revolution is continued and accelerated by the current passing through.

727,457. APPARATUS FOR THE CONTINUOUS PRACTICE OF ELECTROLYTIC PROCESSES; Pedro G. Salom, Philadelphia, Pa. App. filed Sept. 17, 1902. The material to be acted upon is continuously supplied to an electrode and the product formed at another electrode is continuously removed without interruption of the process.



726,936. Transformer.



727,101.—Ozone Generator.

727,468. ELECTRIC CURLING IRON; Murray Shepherd, Salt Lake City, Utah. App. filed April 29, 1902. The handle of the iron fits into the side of a lamp socket to receive current therefrom.

727,471. COMBINED ELECTROLYTIC AND MECHANICAL INTERRUPTER; Horace R. Smith, Altoona, Pa. App. filed July 25, 1902. An interrupter suitable for the operation of Ruhmkorff coils comprising both an electrolytic or Wehnelt interrupter of modified form and a mechanical interrupter mutually qualifying the effect of each other.

727,478. ELECTRIC SWITCH; John L. Steeb, Butler, Pa. App. filed Aug. 30, 1902. Details of an electro-magnetic railway switch.

727,496. PLATE FOR ELECTRIC ACCUMULATORS; Donato Tommasi, Paris, France. App. filed Aug. 3, 1901. Short bars or plates extend across the cavities containing the active material.

727,525. ELECTRIC BATTERY FOR BODY WEAR; Richard Wingren, Burlington, Kan. App. filed Feb. 16, 1903. Details.

727,543. MULTIPLE SIGNAL TRANSMITTER; George E. King, Newton, Mass. App. filed Dec. 11, 1902. A modification of patent No. 726,944.

727,549. CATHODE HOLDER; Joseph Matthews, Birmingham and William Davies, County of Worcester, England. App. filed March 29, 1901. The holder has a trough-like receptacle to receive the metal falling from the cathode.

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NEW YORK, MAY 23, 1903.

CONTENTS.

A New Telephone Exchange for Yonkers, N. Y. 885
Successful Conference on the Union Engineering Building 858
Institute Annual Meeting 858
The Curtis Steam Turbine 859
Recent Development of the Chicago Edison and Commonwealth Electric Systems 863
The New Plant of the Oskaloosa Traction and Light Company 869
Development of Light and Power Business at Red Oak, Iowa 871
The Pontiac Light and Water Company, Pontiac, Ill. 874
Statistics of the Massachusetts Electric Supply Systems in 1902. By Alton D. Adams 877
Death of Edward Tremlett Carter 879
Centralized Management of Electrical Properties. By H. S. Knowlton 880
Enclosed Arc Lamp Statistics—Records of Thirty Central Stations. By L. B. Marks 881
Remarkable Development of Light and Power in Chicago 882
Rectification of Alternating Currents by Means of the Electric Arc 883
Electricity on Trunk Lines 883
The Use of the Differentially-Wound Telephone Receiver in Electrical Measurements. By Prof. H. Ho, Tokyo 884
Independent Telephone Traffic Company of Cleveland 885
A New Telephone Exchange for Yonkers, N. Y. 885
Annual Convention of Railway Telegraph Superintendents 886
Recent Electrochemical Developments. By Clinton Paul Townsend 886
New Telephone Patents 887
Niagara Meeting of the Electrical Engineers 889
Programme of the Chicago N. E. L. A. Convention 889
Current News and Notes 890
Letters to the Editors:
  A Correction. By Bion J. Arnold 891
  How to Produce Gravity Experimentally. By Townsend Wolcott 891
  Dimensions of Physical Quantities and Abbreviations of Units. By H. H. Wait 891
Digest of Current Electrical Literature 892
Self-Cooling Transformers 895
A Comprehensive Engine Test 897
Exhibits at the Railway Telegraph Superintendents' Convention 897
Eck Universal Fan Motor 898
Thermo-Call Button 898
Gain Cutting Saw 898
Motor Quick Stop Device 899
New Ignition Dynamo 899
Registering Brush-Holder 900
Smith Storage Battery Plant in Boston 900
Repairable Fuse Plug 900
News of the Week 901

NATIONAL ELECTRIC LIGHT CONVENTION.

The remarkable growth which has attended the membership of the National Electric Light Association during the past year, and which will doubtless result in a very large convention next week, brings out the essential fact that while in the large cities there must be extensive systems of electric light and power, these will be relatively few as compared with the number of central stations as a whole. There are now not far short of 3,750 central station systems in the United States, and the Association has already drawn into its ranks at least 25 per cent. of the most progressive and successful of these. But it is obvious that a great many of them are not large, and from the nature of their environment never can be large. They will grow and prosper, but limitations of local area, population, wealth, industry, etc., will also be determining and restricting factors as to their business.

It is obviously to the best interests of the Association that these many smaller companies should be members, while the companies should be studied in return as to the make-up of the programme, the work, etc., so that they may derive benefit from the existence of the body. We are glad to note the attention paid by the officers to these two points, and from such meetings as those of Cincinnati last year and Chicago this year, believe we shall be able to date a new era in the usefulness and influence of an Association whose opinions and decisions can be made of great and beneficial weight in every community and in every part of the country.

Emphasizing our views in this respect, we have taken occasion in this issue not only to note appropriately the progressive work of that great system, the Chicago Edison Company, but to describe and illustrate some of the more typical plants of lesser size, which have met problems of their own and have shown what can be done in limited spheres of opportunity. There is, indeed, a great future for the smaller systems, regarded collectively, and we believe that a great deal of benefit can be derived from the study of the plants that must always be in the majority and which in themselves provide a fine outlet for capital and talent. Some of the details given in the articles we present are of a most interesting and encouraging nature.

THE UNION ENGINEERING BUILDING.

As will be noted from the reports elsewhere in this issue, the work is actively going forward of carrying out plans to give effect to the Carnegie gift of one million dollars for a union engineering building. The conference last week of the delegates of the four national engineering societies and the Engineers' Club was of a most harmonious and satisfactory character, and the resolutions were framed and adopted in a spirit that augurs well for the future of this great and noble enterprise. A good deal of hard work yet remains to be done, and we congratulate the American Institute of Electrical Engineers on the zeal and enthusiasm with which it is buckling down to its part of the responsibility imposed upon it by the gift. In selecting Messrs. Scott, Arnold and Wheeler as its representatives for the joint work, the Institute has made a wise choice which we believe events will fully justify; and in the prompt manifestation of generosity upon the part of individual members and electrical companies, we see warrant and assurance of success all along the line. While members will give to the extent of their ability and public spirit, we are sure that the great electrical corporations drawing upon the Institute for their professional talent will recognize generally that this gift is also to them for their welfare, and, seeing this, they will be stimulated to meet Mr. Carnegie in his own wise and far-sighted endowment of the engineering professions and arts.

ELECTRICITY AND STEAM TRACTION.

Elsewhere in this issue we publish an abstract of Mr. De Muralt's article in the *North American Review* replying to that of Mr. Vanderbilt to which we directed attention some months ago. It seems to us that the reply is as good as the article that evoked it, and that electricity comes out very well from this latest analysis of its pretensions and performances in the field of traction. Meantime it is impossible to avoid noting the signs of the times that all make toward electricity and away from steam. It would be strange if they did not. The *New York Times* affords striking evidence last week. On Tuesday, discussing the Manhattan Elevated, it said: "The change from steam power to electricity is a success from every point of view. It has enormously increased the efficiency of the system, and in every way promoted in marked degree the public convenience." On the day following, it said, discussing the larger facilities given in Connecticut to the electrics, "The competition of the trolley is the most formidable the steam railroads have ever known, and it is only just beginning." It points out the inevitableness of electric transportation between New York and Boston, across the State. That is about enough for one week.

ELECTRICAL CONSOLIDATIONS.

The paper by Mr. Knowlton, which we publish in another column, excellently sets forth the gains which may sometimes be attained by consolidation and centralized management. Consolidation is the spirit of the times and has become so through its intrinsic advantages of one kind or another. Electric railway properties in particular often gain greatly in efficiency through wise consolidations of contiguous properties. In this case the gains are especially large and conspicuous, since connecting roads give new opportunities for mutual assistance and added public usefulness when placed under a single management. The facility which such combination lends to through routing of cars, the convenience of exchanging power and rolling stock and the more liberal system of transfers which becomes feasible; all these things tend to give new life to the united enterprise and to pave the way for even greater improvements. Common sense shows that two companies operating for the benefit of the same public in the same territory cannot carry on cut-throat competition without suffering thereby, and any sort of reasonable modus vivendi, from a rate agreement to actual union, will tend to improve the working conditions. And so we see a constant succession of coalitions of one sort or another and the results usually justify the wisdom of the union.

But there is another side of the question, which in the case of electric light and power companies must not be overlooked. The essential thing which makes ordinary combinations effective is physical union, the actual merging of two or more systems into one. Electric light stations are not like shoe factories, able to send a competing product to the other end of the country, and each is obliged to serve its own territory well or go out of business. And in such a condition we do not hesitate to say that the union of non-continuous properties into aggregations under a single management not absolutely and directly responsible to any one local public, is often of dubious advantage, save to the brokers who thereby inject a new flood into the united aqueous fluid of the component units. In cold blood the process practically means that the good properties lend a somewhat fictitious value to the poor ones at the expense of the public on whose patronage and good will prosperity ultimately depends, and often at the expense of honest investors who have looked upon the local plant as a sound conservative investment instead of a water bucket. We think that the alleged advantages from a centralized management are in such cases mostly moonshine, the fact being that the control is thereby removed from those who are in close touch with their customers and shuffled over into the hands of those whose only interest lies in squeezing out dividends to match imaginary assets. It is perfectly true that a big aggregation of plants may employ engineering talent of a high order, but it is notorious that it does not often do so, and frequently replaces competent local managers who are good business men and skilled engineers, by second rate men who can be had cheaply, and who are held up from failure by occasional aid of an order which the original superintendent would have scorned to ask.

We believe, and we think most central station managers will agree, that the key to success in their business is an intimate knowledge of the local situation and its requirements, a complete grasp of the powers, needs and limitations of the plant, and a direct personal knowledge of the needs of the customers. No two plants are exactly alike and it is the man who knows his station as a small boy his pockets, who is in daily touch with the community, and does not have to plead with a distant office for three months before he can do what is necessary now, who will make a success of the enterprise. We believe particularly for stations of moderate size in the all-around man clothed with plenary powers by his board of directors. If he needs expert assistance he can get it, and he will need it far less frequently than the man whose only initiative is a futile appeal to powers who have not the slightest local interest or responsibility. Moreover, the public has interests at stake in this matter and will be heard from sooner or later in the premises. A plant may gain a better credit rating by selling out to a combination, but it is often at the expense of shouldering its proportion of a fictitious valuation from which it receives small benefits, and the public still less.

DIFFERENTIALLY WOUND TELEPHONES AS MEASURING INSTRUMENTS.

The great sensitiveness of the telephone has made that instrument available for delicate electrical observations, almost from the date of its first construction, and the telephone has been employed in a great variety of measuring instruments, even prior to its use in the Hughes' sonometer. The real difficulty with the telephone in such cases has been owing to its extreme sensibility. When inserted in the balance wire of a Wheatstone bridge operated by pulsatory currents, the symmetry of the four arms of the bridge has to be well nigh perfect with respect not only to resistance, but also to inductance, leakage and capacity, before the balance can be adjusted to give silence in the telephone. If any one of the four quantities just mentioned is not balanced among the bridge arms, the telephone will sing its note of discord, and usually no readjustment with respect to the three remaining quantities will silence the note due to the particular missing symmetry.

On page 884 of this number, Prof. Ho draws attention to the uses which can be made of the differential telephone for the purposes of measurement. The plan is by no means novel, since differentially-wound telephones have been used in the past for similar measurements, but the article is none the less useful for the development it gives to the subject. Just as in the case of the singly-wound telephone in a Wheatstone bridge, the differential telephone will only keep silent when the conductors compared are similar in the several respects already mentioned, and any marked dissymmetry in the two branch circuits through the instrument will only produce a sound minimum and not a sound-zero. Although the human ear is marvellously sensitive to sound zero, or the contrast between silence and sound, it is very insensitive to the application of sound-minimum. Consequently, although, as Prof. Ho points out, the measurements are very sensitive, so that very small capacities or inductances may be measured and compared, there are marked limitations to the application of the method.

THE STEAM TURBINE.

Elsewhere we print an article describing the Curtis steam turbine so far as information has been available. What appeals particularly to the engineer in the steam turbine idea is the admirable mechanical simplicity possible in its practical realization, and in the Curtis machine this is exemplified in every mechanical feature. Indeed, one cannot but be impressed with the skill that has been shown in the mechanical design of the various parts, whereby the inherent simplicity of the turbine type has not been sacrificed while securing to the highest degree an efficient mechanical organization. This is particularly true in the adaptation of the turbine to the vertical shaft; the method of governing by multiple valves with electrical control; the manner of building the wheels, of controlling the pressure in the stages and in the design of the simple and efficient form of oil pressure bearing. The high order of ability exercised on the design of the mechanical details of the Curtis turbine can perhaps be no better illustrated than in the statement that the results obtained with the experimental machine finally fully embodying these details were so definite that orders with rigorous guarantees were without hesitation accepted for about a quarter of a million of horse-power before a single machine had entered into regular commercial use. Very much of the credit for this remarkable achievement is due to Mr. W. L. R. Emmet, to whom was assigned the responsibility of bringing the machine to the commercial stage, and who, together with his assistant, Mr. Oscar Junggren, is to be credited with many of the mechanical features of design that have so quickly assured the commercial future of the machine. A chapter giving in detail an account of this important phase of development of the machine would be of the greatest technical interest, and we hope that some day it may be written.

It is somewhat remarkable in view of the recent rapid development, that the commercial realization of the steam turbine idea was so long delayed. The first steam engine that history records was a turbine, and the kinetic principles involved were developed almost a half century ago by Thomson, Rankine and others, and later extended by Prof. Osborne Reynolds. It is true that the mechanical difficulties in the way have been very great, but that they were overestimated appears to be indicated by the manner in which they have in recent years been so largely surmounted by inventors. All forms and types of turbines, regardless of detail, depend for action upon principles that may be simply stated and easily understood. In the steam engine, the heat or molecular energy of the steam is manifested mechanically as pressure, and is transformed directly into the movement of the piston of the engine. In the steam turbine the molecular energy of the steam is transformed first into the energy of a stream of vapor moving in answer to a pronounced fall of pressure, and in which a high velocity of translation is thus developed. The energy of this moving stream is then transformed into mechanical motion through impact on moving vanes, as a consequence of which a part of the energy is transferred from the stream to the vanes. All forms and types of turbines, no matter what the detail, must be adapted to absorb in this general manner the energy of the stream. In the development of types, two broad lines have been followed. In one the purpose has been to transform as completely as possible, and in one operation, the heat energy of the steam into the mechanical energy of the escaping jet. This then impinges on the vanes of the turbine and gives up such a fraction of its kinetic energy as the conditions may determine. The De Laval turbine is a representative of this class. In the other general type, the two transformations are more or less continuous or distributed in stages throughout the machine. Thus the heat energy is partly transformed by expansion into the energy of the jet, and this into mechanical energy through action on the vanes. Then the same process is repeated until the largest possible fraction of energy has been thus transformed. In some cases the two transformations are in a measure carried on side by side, the heat energy being transformed by expansion into mechanical energy in the jet and then through action on the vanes into the motion of the turbine. The Curtis, Parsons and Rateau turbines are all of this general type, though differing in the general manner in which they fulfil the fundamental principles above referred to. There also seems to be no fundamental reason why under generally similar conditions there should be any essential difference in the steam economy of different types of turbines when working between the same initial and final conditions, and this appears to be borne out by economy tests of the two fundamental types.

In steam consumption several of the present commercial forms of steam turbines show economic performances somewhat less than those of the most efficient reciprocating steam engine, such as is designed for pumping service, though apparently fully equal to the best types of reciprocating engine used in electrical generation and superior to the ordinary engines employed in that service. A specific advantage claimed, however, is that there is very much less falling off in economy at fractional loads as compared with the best type of reciprocating engine, which, it is perhaps unnecessary to add, is a point of the highest importance in electrical generation. Moreover, there are the undisputed commercial advantages of considerable less cost of turbo-generator unit and less floor space occupied. Admitting that the steam turbine is commercially equal in economy to the best reciprocating steam engine at normal load, and superior in economy at fractional loads, yet the steam turbine cycle as at present utilized is less efficient than that of the reciprocating steam engine. In the working of steam, the turbine is free from loss by condensation and subsequent re-evaporation into the exhaust, there is less back pressure owing to freer exhaust, and there is more complete utilization of the expansive energy of the steam. These two latter points may be illustrated with reference to an ordinary indicator card by assuming that, working under the same initial and final conditions, the gains in the turbine cycle are represented by additional areas obtained by dropping the exhaust line of the indicator card and by adding a triangular area formed by a continuation of the expansion line beyond release. Moreover, the possibility of using a very high degree of superheat with the turbine still further extends its possible economic advantages over the reciprocating steam engine. Since, however, the two types are at present about on a par with respect to steam economy at normal load, it follows that the losses in working steam in the turbine are greater than in the reciprocating engine by an amount equivalent to the gain in the former through greater expansion, freer exhaust and using higher superheat. There is thus a large margin for the improvement of the steam turbine with respect to steam economy. At present little is known concerning the cause of losses in the steam turbine beyond the fact that a considerable proportion is probably due to friction from the presence of water of condensation, the amount of which condensation is necessarily so large that it can only partly be overcome by the greatest possible amount of initial superheating. The difficulties in the way of an analysis of the losses in the steam turbine are very great, but in view of the great commercial development the type is undergoing, we may expect many able minds to be brought to bear on the subject, with the probability of a progressive and final large increase in its steam economy.

Successful Conference on the Union Engineering Building. ·

In accordance with the call of Mr. C. F. Scott, a meeting of the nominated representatives of the five organizations named by Mr. Andrew Carnegie, in his gift of one million dollars to the four national engineering societies, and the Engineers' Club, for a building for their joint use and occupancy, was held pursuant to call, at the Engineers' Club in New York City on the evening of Friday, May 15, 1903. There were present on behalf of the American Society of Civil Engineers, Messrs. Noble (President), Wilgus and Pegram, on behalf of the American Institute of Electrical Engineers, Messrs. Scott (president) and Martin; on behalf of the American Society of Mechanical Engineers, Messrs. Dodge (president), Charles Wallace Hunt and Hutton; on behalf of the Institute of Mining Engineers, Messrs. Ledoux (president), Dwight and Kirchhoff. On behalf of the Engineers' Club, Messrs. Kafer (president), Redding and Fletcher.

The meeting was called to order by President Kafer, of the Engineers' Club, and on motion Mr. Charles F. Scott, president of the Institute of Electrical Engineers, was elected chairman of the meeting, and Prof. F. R. Hutton, secretary.

The chairman opened the meeting by reference to the questions which were to be considered, and called on Mr. Redding for a presentation of some of its legal aspects. After a very full and most harmonious discussion, the meeting passed the accompanying resolutions unanimously. The secretary was directed to transmit a copy of the resolutions, as passed by the meeting, to each chairman of the constituent committee present, with a request that the latter should transmit the action of the meeting to the governing body of each respective organization. The conference then adjourned, subject to call of the chair.

Resolved, That this Joint Conference Committee recommend to the respective governing bodies represented at this conference, that the following resolutions be brought before the several organizations to be acted on:

Resolved, That (insert name of organization) unite with (insert the names of the other four organizations) or any of them, for the purpose of accepting the sum of $1,000,000 as a gift from Mr. Andrew Carnegie, for the purpose of erecting suitable buildings for occupancy by various societies of engineers and The Engineers' Club, on the sites secured for that purpose on the north side of Thirty-ninth Street and south side of Fortieth Street, west of Fifth Avenue, in the City of New York, in the State of New York.

And Resolved, further, That (insert name of organization) has a very high appreciation of this generous gift of Mr. Andrew Carnegie, and this additional evidence of his recognition of the engineering profession and his deep interest in the welfare of the national societies of engineers and The Engineers' Club.

And Resolved, further, That a site on the north side of Thirty-ninth Street shall be purchased and held by trustees, or otherwise, as shall be determined by the joint committee hereinafter mentioned for The American Society of Civil Engineers, The American Society of Mechanical Engineers, The American Institute of Electrical Engineers, and the American Institute of Mining Engineers, or by such of them as shall vote in favor of coming into this enterprise.

And Resolved, further, That a joint committee shall be created to be composed of three members of each organization that shall unite in accepting said gift of $1,000,000 from Mr. Andrew Carnegie; and that the governing body of (insert name of organization) shall elect three members of this organization to represent it on and be members of such joint committee; and that the governing body of (insert name of organization) shall have the right and power to remove any member of such joint committee who shall be elected by it and to elect any member of this organization to fill any vacancy that shall occur in such joint committee by reason of the death, resignation, refusal to act or removal of any member who shall have been elected by the governing body of this organization as a member of such joint committee.

And Resolved, further, That the character and internal arrangement of the building to be erected on the site on Thirty-ninth Street, shall be determined upon by the affirmative vote of at least two-thirds of all of such of the members of said joint committee as shall represent all of the organizations, other than The Engineers' Club, on such joint committee; and that the character and internal arrangement of the club building to be erected on the site on Fortieth Street, shall be determined upon by the affirmative vote of all of the three members of such joint committee who shall represent The Engineers' Club on such joint committee.

And Resolved, further, That said joint committee shall, by the affirmative vote of at least two-thirds of all the members thereof, select and employ an architect to prepare the plans and specifications for the building to be erected on the site on Thirty-ninth Street, and for the club building to be erected on the site on Fortieth Street; and shall also obtain proposals for the erection of both of such buildings; and shall have power to make and enter into such contract or contracts as shall be approved and authorized by the affirmative vote of at least two-thirds of all of the members of said joint committee, for the erection of both of such buildings; and shall have charge of the erection of both of such buildings.

And Resolved, further, That said joint committee shall continue in existence until all of the purposes set forth in these resolutions shall have been fully accomplished.

Institute Annual Meeting.

The annual meeting of the American Institute of Electrical Engineers was held in New York City, at the house of the American Society of Mechanical Engineers, on May 19, when there was an enthusiastic and overflowing attendance. As the result of the annual election, Mr. Bion J. Arnold was declared president, with 705 votes. The new vice-presidents are Messrs. Calvin W. Rice, W. S. Barstow and Ralph D. Mershon. The new managers added to the council are Dr. S. Sheldon, A. H. Armstrong, W. C. L. Eglin and Prof. G. F. Sever. Mr. G. A. Hamilton was re-elected treasurer and Mr. R. W. Pope secretary.

The report distributed showed total cash receipts of $30,181 and disbursements of $29,559, leaving a balance of $621. The inventoried property on hand totaled up $13,400. The Institute also has $16,285 in United States bonds and $2,006 in cash. The Library fund has also some $2,000 not yet brought into account, including $1,100 from Mr. C. O. Mailloux. It was shown that the Institute during the year had gained 680 new members, an increase of 44 per cent. With the applications pending and associates elected and to qualify, numbering 391, there is an immediate prospective total of 2,620 members. At the council meeting in the afternoon 140 new associates were admitted.

Acting on the adoption of the resolutions given elsewhere in this issue, the Institute accepted its share of the Carnegie gift of $1,000,000 for a union engineering building and cabled its gratitude to the donor, with pledges of its best efforts to realize the results now rendered possible. President Scott made an able and interesting statement with regard to the whole matter and then read a number of letters commending the gift and endorsing the union plan. One came from Mr. T. A. Edison. Others were from Past Presidents Kennelly, Hering and Anthony. All the writers felt that a great opportunity had come to the Institute and believed that its members would rise to the occasion and justify all that was expected of them.

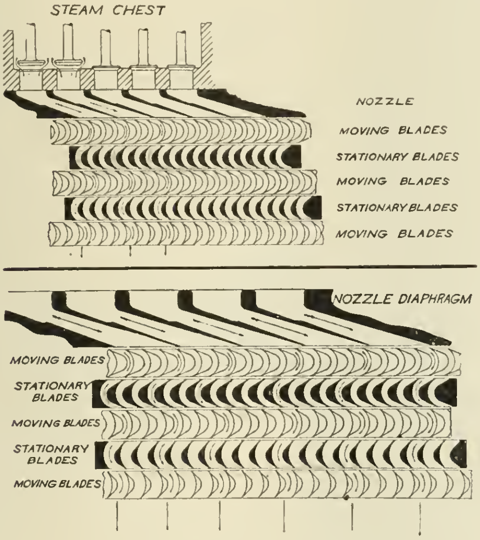
Mr. Scott stated that no beginning had yet been made of a proposed movement to raise a fund of $150,000 to $200,000 which should pay for the Institute's share of the land on which to erect the union building, but he read admirable letters from Prof. Elihu Thomson, who subscribed $5,000; Mr. Frank J. Sprague, who subscribed $2,000; Mr. J. G. White, who subscribed $1,000, with a contingent $1,500. He also stated that Vice-President Osborne, of the Westinghouse Electric & Manufacturing Company had authorized him to announce a contribution of $5,000 from that corporation. In the course of a brief, pithy speech, Mr. White expressed the hope and belief that while it would be the easiest thing in the world to get a mortgage on the property, the members of the Institute, aided by friends, by the great electrical capitalists and by the electrical companies, could raise outright the whole amount required in a short time. In the course of some remarks, Mr. Scott directed attention to the splendid work that had been done by Mr. Calvin W. Rive, the energetic chairman of the building committee, to whom a great deal of credit was due.

Papers were then read on "The Experimental Basis for the Theory of the Regulation of Alternators," by Mr. B. A. Behrend, and on "The Heyland Motor," by Mr. C. A. Adams, Jr. The discussion was brief on account of the lateness of the hour, and was participated in by Messrs. Behrend, Adams and W. L. Waters.

The Curtis Steam Turbine.

As early as 1895 Mr. Charles G. Curtis constructed an experimental steam turbine to demonstrate the correctness of conclusions at which he had arrived in a long, careful study of the subject, that a prime mover of this type is not necessarily limited to enormous speeds, which assumed limitation had served for a century or more to keep all but a few of the more daring inventive spirits from attempting to develop the steam turbine as a competitor of the reciprocating engine. Several years ago a 600-kw Curtis machine was installed in the Schenectady works of the General Electric Company, the performance of which in regular shop service so fully and quickly verified the soundness of the principles upon which its design rested, both with respect to mechanical operation and steam economy, that the General Electric Company without hesitation proceeded forthwith to its commercial development for purposes of electrical generation.

This first practical machine was horizontal in form and recalled the compound engine in that the steam was worked in two structurally separate steam casings, exhausting from the first into the second and thence into a condenser. Most of the machines now being built are of the vertical form shown in the accompanying illustrations, this construction enabling full advantage to be taken of the perfect balancing properties of this type of turbine and at the same time reducing to a minimum the floor space occupied. Doubtless in passing from one form to another, many changes in detail were found necessary or desirable, but concerning this there is at present no information. Indeed, few inventions have been so jealously guarded from the public, and it was not until several weeks ago that the mystery surrounding the machine was partially dispelled in a paper read by Mr. W. L. R. Emmet before the American Philosophical Society, of Philadelphia. This paper, which was printed in full in our issue of April 11, though meagre with respect to structural details, enters quite fully into the subject of the steam economy of the machine, compares the Curtis with the De Laval and Parsons turbines, and sets forth comparative theories of the operation of these several machines. In what follows, the mechanical details of the Curtis turbine will be more particularly considered in so far as the information available will permit, the reader being referred to the excellent paper by Mr. Emmet for a more general treatment.



FIGS. 1 AND 2.— SCHEME OF TWO-STAGE TURBINE.

With our present knowledge of the working of steam in the turbine and of the losses incident to the turbine cycle, any theories on the subject cannot be much more than conjectural. The difficulties in the way of analysis are apt to be accentuated by confusion of thought from the mind clinging to concepts formed with respect to the action of steam as it occurs in the reciprocating steam engine. Moreover, since pressure and velocity, and also change of pressure and expansion, are respectively correlative terms, and in the steam turbine we have to do with changes of velocity due both to impact and free expansion, and changes of volume due both to change of velocity and increase of containing volume, it is obvious how the mind in dealing with these and other terms under new and unfamiliar conditions may easily go astray. In what follows no theory of the action of the Curtis turbine will be stated, but in starting out the fundamental principles involved in the steam turbine in general will be reviewed.

A gaseous fluid, such as steam, in passing from a receiver at one pressure into a receiver at another pressure, acquires a definite velocity due to the difference in pressure. For example, steam at 150 pounds pressure passing into a vacuum of 28 inches, will attain a velocity of about 4,000 ft. per second. A jet striking a surface will exert a definite pressure against that surface, the value of which in the case of normal impact is expressed by half the square of the velocity per second into the mass of fluid delivered against the surface per second. Should a surface against which such a jet impinges, such as that of a vane attached radially to a shaft, remain fixed, there will,

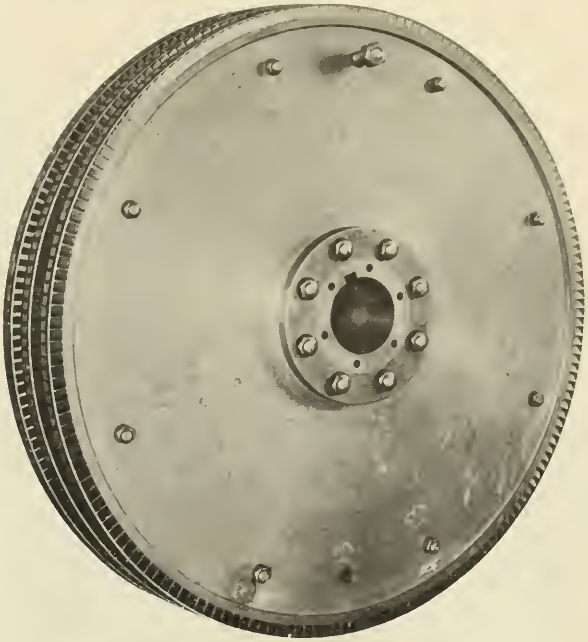


FIG. 3.—THREE-WHEEL STAGE, 500-KW TURBINE.

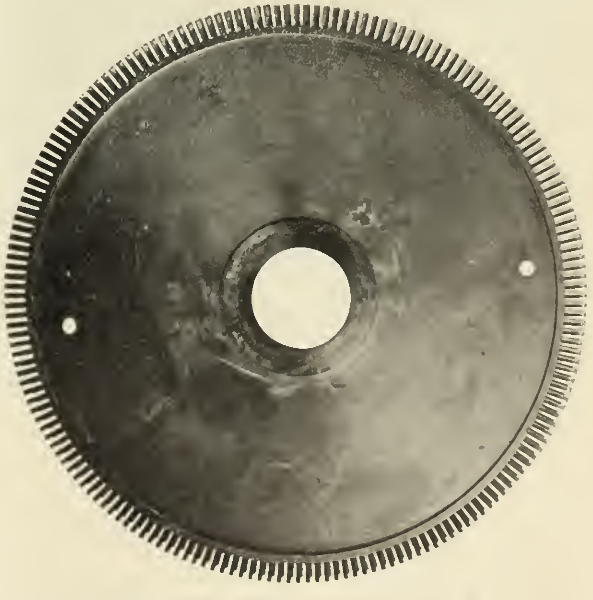
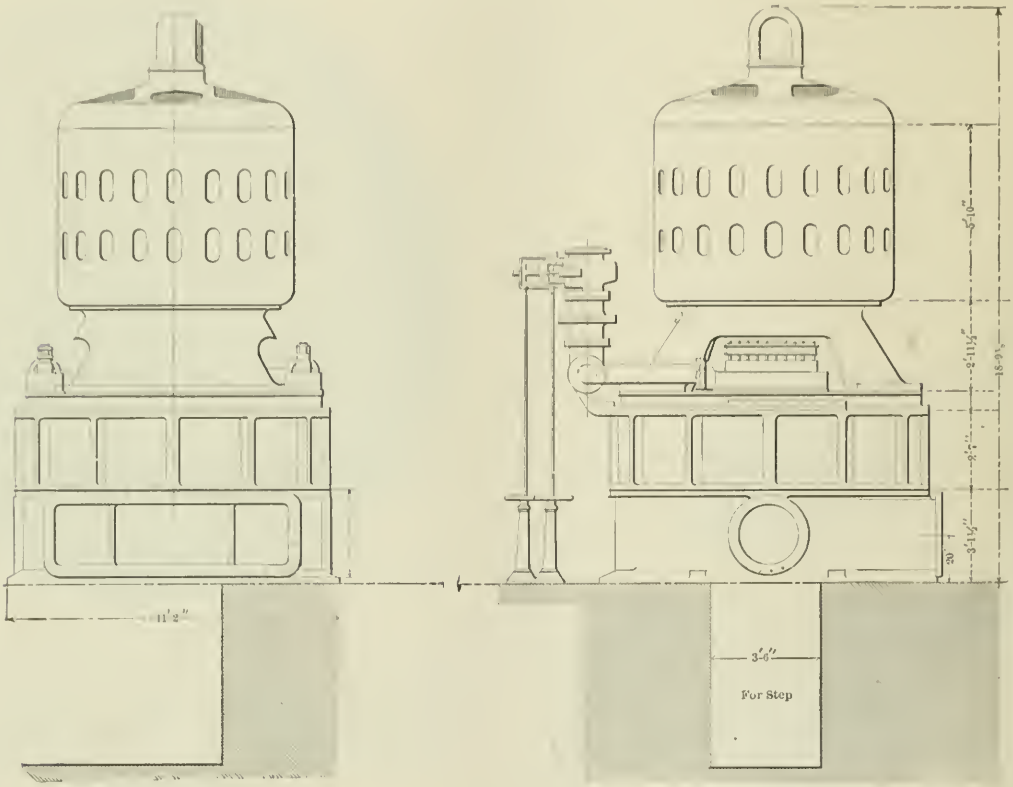


FIG. 4.—BUCKET WHEEL OF A 500-KW TURBINE.

of course, be no energy delivered to the shaft, it is also evident that should the vane have the same velocity as the impinging jet, no energy will be delivered, since there is no exchange of velocity between the jet and the vane. The maximum amount of energy delivered will be when the vane has one-half (or more accurately, a little more than one half) the velocity of the jet, for in that case, the



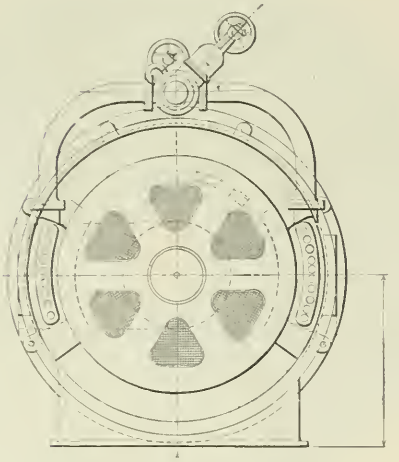


FIG. 5.—2,000-KW TURBINE.

remaining velocity in the jet after impact will equal the velocity of the vane and therefore be incapable of imparting further energy. Consequently, leaving aside any secondary actions, in order for a single-wheel steam turbine to act at maximum efficiency, its vanes should have a velocity of about 2,000 ft. per second working between the above limits of pressure—that is, not far from the velocity of a projectile from a modern piece of ordnance. It is thus readily seen that the problem encountered in the steam turbine is to extract from the steam the work due to its velocity without exceeding a moderate rate of revolution of the shaft carrying the vanes upon which the steam expends its velocity.

In the Curtis turbine the reduction of speed is obtained: 1°. By placing the vanes upon which the steam impinges at a relatively great radial distance from the axis of revolution, since for a given speed of peripheral velocity the revolutions will vary inversely as the radius. 2°. By the gradual absorption of the velocity of the steam at the periphery of a number of vane wheels; and instead of having all of these wheels in one chamber, they are divided into two or more groups of three or more wheels, contained in separate chambers, but secured to the same shaft. This provides for the development and parallel absorption of velocity in stages, the work being equally divided among the several stages.

Referring to the diagrammatic representations of Figs. 1 and 2, which apply to a two-stage turbine, and where the moving vanes or buckets are shown in outline and the stationary guides in black, the live steam enters through valves a multiplicity of nozzle-like passages, by which it is directed at a definite angle in jets against the blades of the first turbine wheel; from these blades the jets enter at a lesser velocity the guide passages below, where they are deflected at a proper angle to the blades of the second wheel, then pass into a second series of guides and finally to the third moving wheel—all three of the wheels, of course, being secured to one shaft. The steam then passes to a second chamber (Fig. 2), where, after undergoing the same action, it is finally exhausted into a condenser. In passing it may be remarked that the apparent obliquity of the horizontal lines in Figs. 1 and 2 is an optical illusion, the horizontal surfaces of the guides and wheels being, of course, parallel.

Since in the steam turbine the operation is the transformation of the energy of the steam jet due to its velocity, into useful energy at a shaft, steam pressure in its ordinary acceptance only enters in so far as it imparts velocity to the acting fluid. There is consequently an initial stage in which pressure is transformed into velocity, and here two factors are involved—the orifice and subsequent expansion previous to impact with the turbine vanes. In flowing through any orifice at maximum weight rate, an initial steam pressure is reduced to about six-tenths, and further reduction can obviously be obtained by permitting free expansion between the orifice and turbine vanes.

Referring to Figs. 1 and 2, the orifice proper is at the contraction shown in the throat of the nozzle, beyond which there is an increase in area for expansion. Thus, if we start with a pressure of 150 pounds (gauge), this will be reduced at the nozzle to about 80 pounds (gauge); and if the area of the discharging end of the nozzle is 80 per cent. greater than the orifice or throat area, the pressure at the discharging end will be not far from 10 pounds (gauge). The above figures are only approximate, as the effects of surface friction and eddy currents are not taken into account.

In the Curtis turbine, the dimensions of the nozzle are so calculated that the steam when it strikes the blades in any of the stages has a pressure but slightly above the exhaust pressure, and this pressure in the passage through the wheels and guides is reduced by further expansion and in various ways to about the exhaust pressure. At this point the velocity should for maximum efficiency be substantially all extracted, the curvature of the buckets throwing the steam backward with a velocity equal to the forward velocity of the buckets.

The steam then passes through another set of nozzles into the second stage chamber, connecting with the condenser, and emerges from these nozzles with its velocity regenerated to be substantially equal to that generated in the first stage nozzle with a pressure but slightly above the condenser vacuum. After impact with the three wheels in this chamber, the steam is finally conveyed to the condenser.

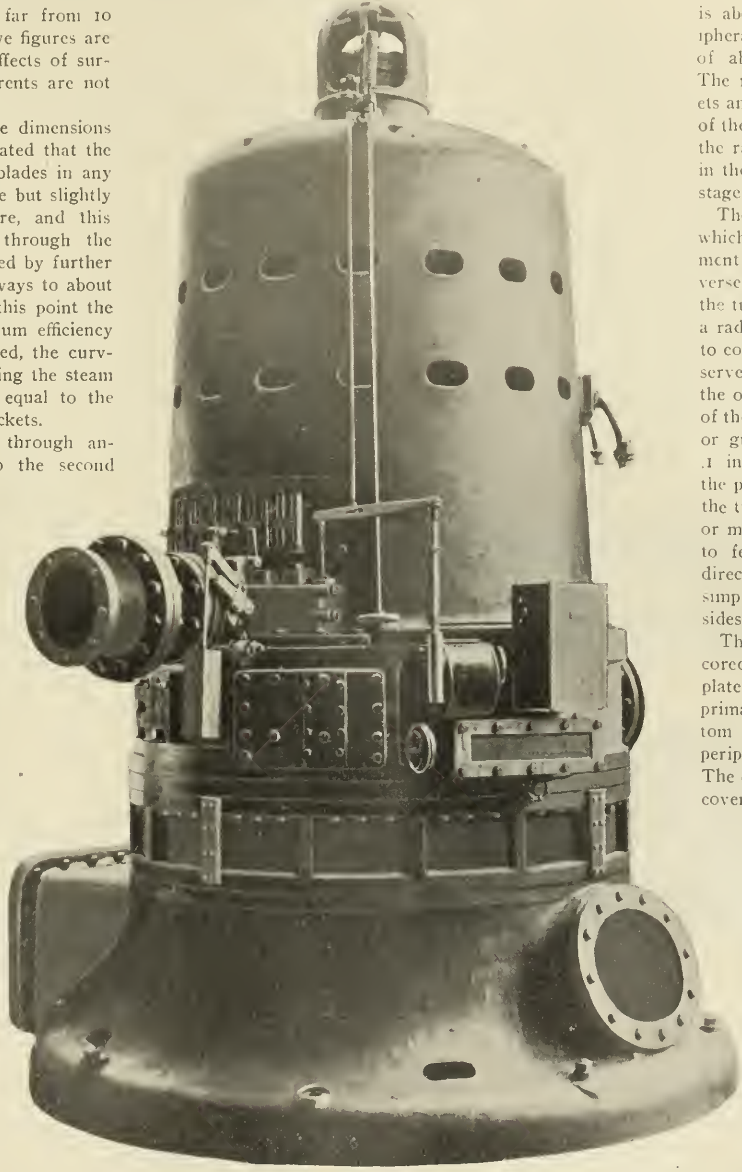


FIG. 6.—2,000-KW CURTIS STEAM TURBINE.

Fig. 6 gives an external view of a 2,000-kw turbine, showing the magnets controlling the first stage valves contained in the steam chest beneath, which valves will be referred to later. It will be noted that the valve structure only occupies part of the circumference of the frame—in the case of this machine only about one-twelfth for each of the two groups in which the entire number is divided. In all machines the first stage nozzles only extend over about one-sixth of the circumference of the turbine wheels. In the 500-kw size they are all grouped together; in intermediate sizes they are divided into two, and in the 5,000-kw size into three, groups equally spaced. In all machines, the intermediate guides have the same circuferential length as the corresponding nozzle group. In the second stage, however, the nozzles and intermediate guides more often occupy an entire circumference.

Figs. 3 and 4 show the wheels of a 500-kw turbine, and Fig. 7 segments of 1,500-kw wheels. In the case of a 500-kw machine, there are 280 vanes or buckets in each of the three wheels of the first stage, and 185 buckets in each of the three wheels in the second stage, the total number being thus 1,395. The passages of the intermediate guides have the same width and radial depth as the buckets which they serve. The curvature of the buckets and guides is different in the two stages. The buckets are cut by a special slotting machine in the ring of a solid steel disc or wheel about 1 in. thick, the tool being so guided that its cutting edge travels at each stroke over the exact curve to be reproduced. With this tool a complete wheel can be turned out daily. After the buckets are cut, a band is riveted about the periphery of the wheel, as shown in Fig. 8. The diameter of a 500-kw wheel to the outer edge of the buckets is about 4½ ft., giving a peripheral speed at this diameter of about 420 ft. per second. The radial depth of the buckets and guides in the first wheel of the first stage is about ¾ in., the radial depth of the buckets in the first wheel of the second stage being about 1 in.

The intermediate guides, which resemble the wheel segment of Fig. 8, but with reversed curvature, are bolted to the turbine outer case and have a radial depth merely sufficient to cover the buckets which they serve. The clearance between the opposing horizontal surface of the wheels, and of the nozzle or guide plates is from .04 to .1 in. The clearance between the periphery of the wheels and the turbine case may be an inch or more, since there is nothing to fear from leakage in that direction, the pressure being simply the shell pressure on all sides of the wheel.

The so-called nozzles are cored or cut passages in a cast plate which, in the case of the primary stage, forms the bottom of a steam chest over the periphery of the turbine wheel. The openings to the nozzles are covered by disc or poppet valves, there being one valve for each pair of nozzles. These valves are horizontally placed in the larger turbines. A valve is seated or opened by the action of steam on a piston on the valve stem, the steam being admitted or exhausted by a small needle or pilot valve actuated by a magnet. Current is supplied to the magnets from circuits connected with a controller, the current being taken from the exciter bus-bars of the generator operated, the amount of which is regulated by a rheostat, shown in Fig. 6. The number of magnet circuits closed at the controller—and consequently the number of valves held open—is regulated by a centrifugal governor at the head of the shaft, the connections of which with the controller is shown in the same figure. The above is the electrical type of governor.

The size and number of nozzles are fixed by the quantity of steam required to run a machine when working non condensing. When working condensing only about half of the nozzle valves are held open at full load, a machine thus having 100 per cent. overload capacity when exhausting into a vacuum. As implied above, the governing is effected by cutting in or out magnet circuits, thereby increasing or reducing the number of nozzles in service. The governor may also be independently controlled from a distance, as from a switchboard in starting up and in synchronizing, by means of a hand wheel for the 500-kw size and a small motor for the larger turbines. There is also an emergency shaft governor between the turbine and generator which trips and closes a butterfly valve in the main steam inlet. There is also connected with the governor mechanism a balanced throttle valve in the steam path of the first pair of nozzles, its connections being such that it must be fully open before the governor can move the controller to admit steam to another pair of nozzles, and vice versa, the effect of which is to obviate rapid alternate opening and closing of the magnetically operated valves, as would otherwise occur in keeping the speed constant. The governor is designed for 2 per cent. speed regulation between no load and full load, with a momentary variation not exceeding 4 per cent.

The nozzles of the second stage cover, as stated before, an entire circumference in some machines, and are secured to the diaphragm separating the first from the second stage. The nozzle openings are adjusted by a register ring which may be rotated through a small angle, covering or uncovering the nozzle openings sufficiently to maintain the necessary pressure relation between the two stages, or to shut off the second stage when the turbine runs non-condensing. This adjustment when once made remains permanent for an approximately fixed condition of load. The first stage casing is provided with a relief valve to guard against any undue pressure therein.

One of the important features of the Curtis turbine is the extreme simplicity of the shaft mounting. Owing to the manner in which the steam acts on the bucket wheels, the vertical pressure component can be very exactly balanced. As actually designed, the only pressure on the step of the vertical shaft is that due to the weights it carries. The step arrangement is simplicity itself, consisting of a cast-iron shoe secured on the foot of the vertical shaft over a similar stationary shoe. Oil at a pressure of 250 pounds per square inch or more as needed, is forced through a hole in the center of the lower shoe, then passes radially to the periphery of the shaft shoe, then upward to a babbitt guide bearing and finally back to the pump. In addition to the lower guide bearing there is another bearing between the turbine and generator and a third above the latter. In connection with the oiling system is an arrangement by which the turbine is automatically shut down in case of failure of oil supply.

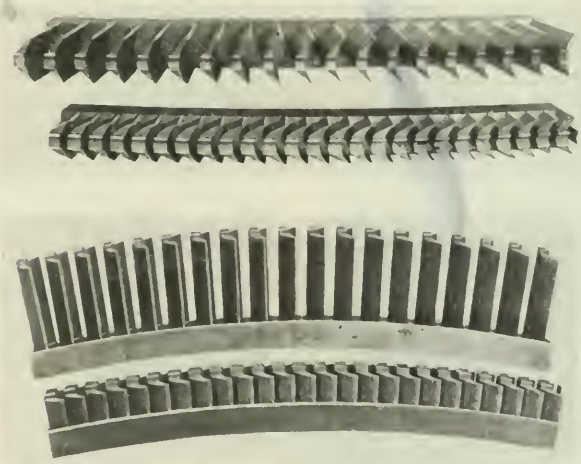


FIG. 7.—SEGMENTS OF 1,500-KW TURBINE WHEELS.

Following are speed and frequency data of the units thus far designed:

Kw.	Rev.	Frequency.	Kw.	Rev.	Frequency.
500	1800	60	2000	750	50
1500	800	40	3000	600	60
1500	900	60	5000	500	25
2000	750	25	5000	514	60

It is calculated that the steam consumption of a 5,000-kw. two-stage vertical unit will be 19.75 pounds per kw-hour. While this is a slightly greater consumption than has been reported for the most efficient types of reciprocating engines, such as those for pumping service, to be equitable, comparisons of steam consumption should be made between machines designed for the same service, and it is well known that in the design of reciprocating engines for electrical generating service, sacrifices in economy of steam consumption are entailed. But a remarkable intrinsic advantage of the steam turbine brought out in Mr. Emmet's paper is the comparatively slight dropping off of efficiency at partial loads—a point of the utmost importance in electrical generation. The guarantee for a 500-kw unit is 20.5 pounds of steam per kw hour at full load and 23 pounds at half load, under a boiler pressure of 150 pounds and a vacuum of 28 inches. For an extended discussion of the steam economy of the Curtis turbine, including a consideration of the superior effect of superheating and of the use of a vacuum, the reader is referred to Mr. Emmet's paper in our issue of April 11.

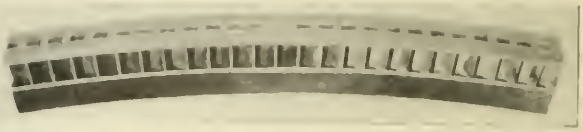


FIG. 8.—SEGMENT OF WHEEL RIM.

A. I. E. E. Membership.

The total membership of the American Institute of Electrical Engineers on May 1, 1902, was as follows:

Honorary Members		2
Members		405
Associates		1,142
Total May 1, 1902		1,549
Elected prior to May 1, 1902, and since qualified		16
Elected May 1, 1902, to April 30, 1903, and qualified		695
Restored to membership		1
		2,261
Total deaths	9	
Total resignations	12	
Dropped as delinquents	11	32
Grand total, April 30, 1903		2,229

The membership April 30, 1903, was classified as follows:

Honorary members	2
Members	417
Associates	1,810
Total	2,229

The gain in membership during the year is 680, an increase of 44 per cent. As there are now applications pending and associates elected but not yet qualified to the number of 391, there is an immediate prospective total of 2,620 members.

The associates elected during the year, May 1, 1902, to April 30, 1903, and their present status is as follows:

Qualified and now associates	695
Died before qualification	1
Elections cancelled	4
Not qualified on April 30	165
Total elections	865

Resignations have been received and accepted during the year from the following members and associates who were in good standing:

Members—Brown Ayres, W. E. Geyer, Henry Jackson. Associates—Frank Broili, Harry A. Gillis, F. A. Greenwood, A. F. McKissick, H. N. Sweet, Walter Rutherford, H. Schreiter, J. C. Finney, Paul Bonynge.

There have been the following deaths during the year: Member—Charles T. Child. Associates—Henry Norton, E. Rathenau, W. F. D. Crane, Max T. Steinle, F. J. Folk, E. A. Darling, I. D. Parsons, Sidney H. Short.

The Editing Committee finds that the increased quantity of material has made necessary the division of the bound *Transactions* into semi-annual instead of annual volumes. The discussions of the branch meetings add to the volume of material and to the labors of the Editing Committee. When discussions upon the same papers take place at the different branches, the same ideas are in many cases repeated, making a careful revision of the discussions necessary in order to prevent repetition while retaining all that is new and valuable.

Recent Development of the Chicago Edison and Commonwealth Electric Systems.

SINCE the last National Electric Light Convention in Chicago in 1900, the growth of the two great allied central station lighting companies of Chicago, the Chicago Edison Company and the Commonwealth Electric Company, has been almost beyond belief. At that time the distribution of direct current from rotary converter sub-stations had but fairly begun, and in the past three years the number and capacity of these sub-stations has been enormously increased, as will be seen from the figures given later. The chief interest to the central station man, however, centers in the Fisk Street Station, which is the great power house now under construction, designed for the use of 5,000-kw Curtis steam turbine units. When the order was placed little was known about this turbine, and it was a radical move on the part of the Commonwealth Electric Company, but the Chicago Edison Company has always been one of the leaders in central station practice. When it was decided to begin the construction of a second large generating station (since the limit of the capacity of the Harrison Street station, which was put in operation ten years ago, has been reached) it was realized that it would be desirable to design a power house for the production of electrical energy on a much larger scale and with much larger units than heretofore. It is unnecessary to recount the advantages in simplicity, economy on light load, saving of first cost and saving of floor space accomplished by the steam turbine.

The Curtis turbine, which is described elsewhere in this issue, is now comparatively well known in the engineering field. Such was far from being the case, however, when the order of the Chicago Edison Company was placed, and no little credit is due to the management of this company in taking the initiative and planning its great station for the use of this steam turbine. It should not be thought, however, that the company was unwise enough at the outset to commit itself irrevocably to the use of a device which had never had actual commercial trial in as large units as those for those for which the station was planned. The turbine room, by widening ten feet, could be easily turned into an engine room for reciprocating engine units. This was something that could easily be done with the amount of space at the company's disposal at this power house site, and was nothing more than a resonably conservative move at the time the turbine order was placed, for at that time of course much less was known as to the actual performance of the Curtis steam turbine than now. It was expected that the first 5,000-hp unit would be in operation by this time, but unforeseen delays have made this impossible.

The location of the new Fisk Street station, where the steam turbines are to be installed, is an ideal one for a large power house in many respects. As shown in Fig. 1, it is on the Chicago River, not far from the corner of Center Avenue and Twenty-second Street, or, to be more exact, at Fisk and Twenty-second Streets. It is surrounded on three sides by water, on the south by the Chicago River, and on the east and west by slips. These slips not only facilitate unloading of coal from barges, but also make it very convenient for condensing water. The Chicago River flows from east to west into the drainage canal with a good current. Condensing water will be taken in at the east slip and discharged into the west slip, so that there will always be a cool supply of condensing water at a minimum cost for piping. The level of the river being practically constant, no provisions have to be made for variation in the height of the stream, as is so frequently the case in the design of condensing plants. The company also owns, as is seen in Fig. 1, land on the south side of the river, opposite this station, the total area being 14 acres. A siding from the Chicago & Alton Railroad enters this land south of the river, and a siding of the C. B. & Q. Railroad fore, two rail sources of coal supply, as coal can be taken across the river in barges from the Chicago & Alton siding. The lot south of the river affords room for considerable coal storage, as it does also the lot on which the power station itself is located. The necessity for ample terminal and storage facilities for coal for a station of such size using two trainloads a day is very evident.

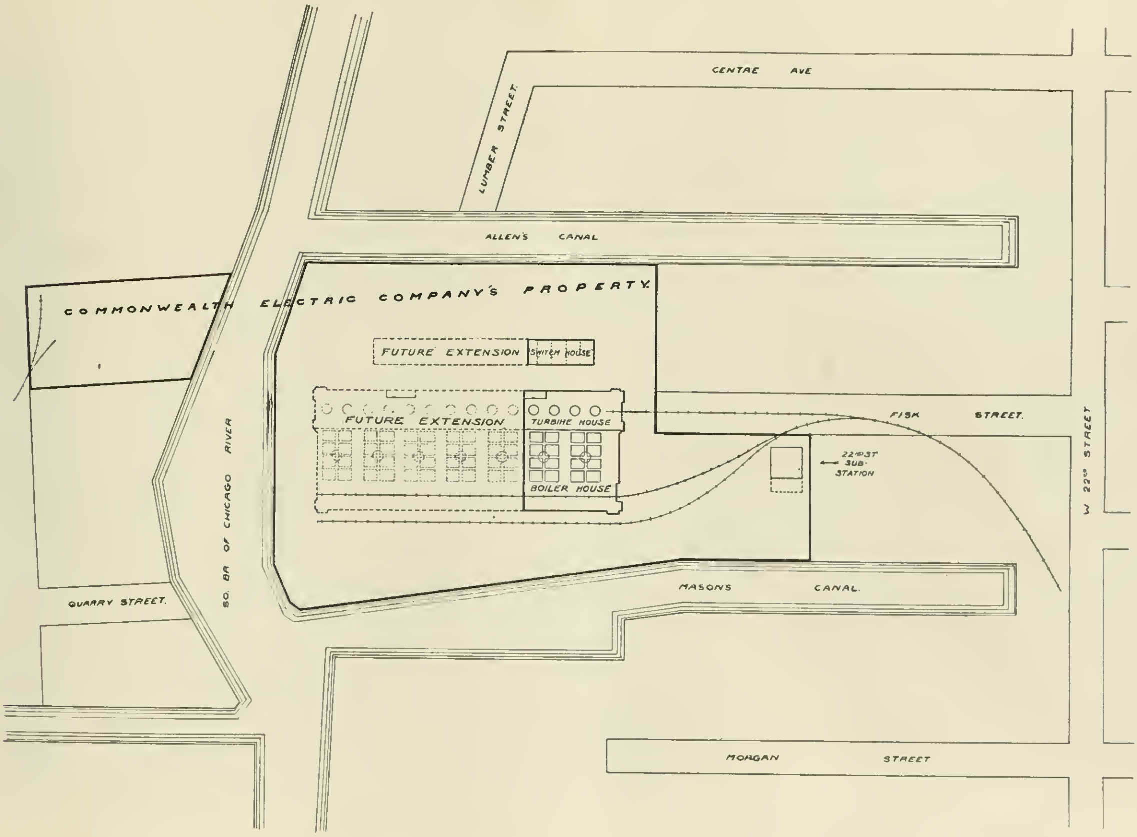


FIG. 1.—MAP OF COMMONWEALTH ELECTRIC CO.'S PROPERTY SHOWING PLAN OF FISK STREET STATION.

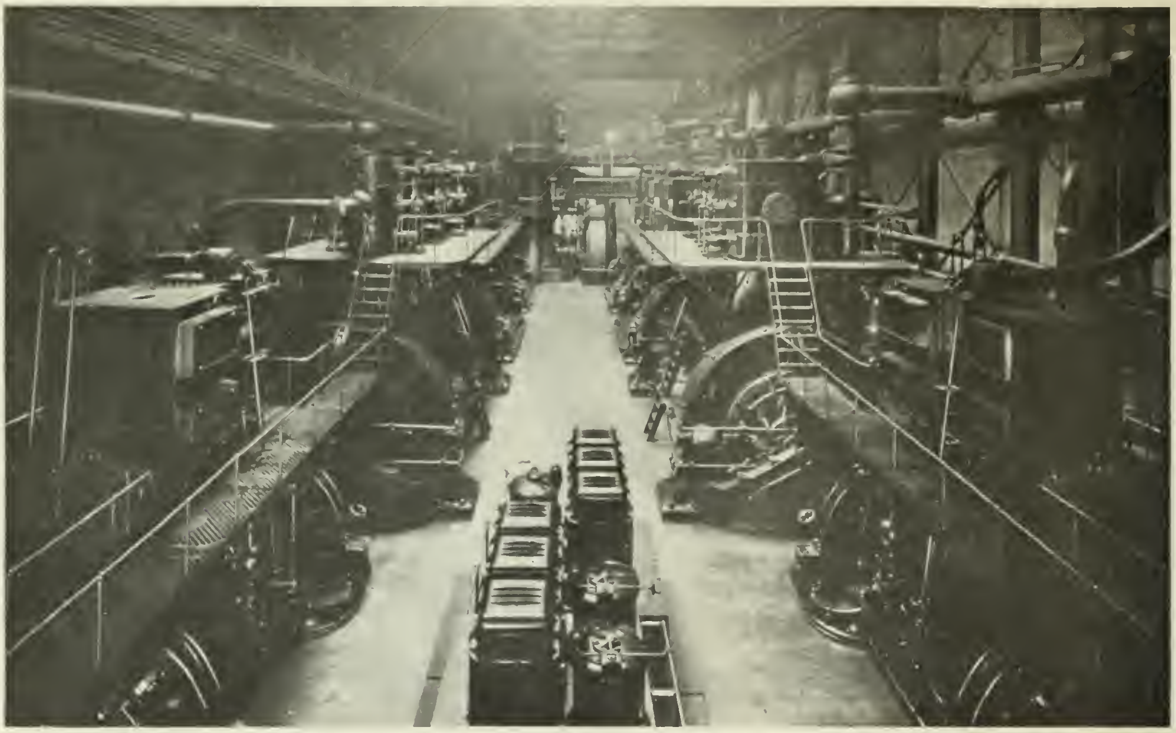


FIG. 2.—GENERAL VIEW OF HARRISON STREET STATION.

The Fisk Street station, as seen on the map (Fig. 1) is 3½ miles from the electrical load center of the city, which center is within three blocks of the corner of Clark and Monroe Streets. Real estate conditions in connection with this power station are radically different from those in New York, where the large power stations have been built. In other words, this company was able to obtain real estate considerably cheaper than it could be obtained for the large New York stations, and the saving of ground space was not in this Fisk Street station as great an object as in the large New York power houses. This is a point which should be remembered in considering the design of this station, which is briefly described later. The station occupies more ground space per kilowatt than the New York stations, but figured on the basis of cubic capacity, the Fisk Street station gives a very high output per cubic foot.

As seen by Fig. 1, the station is built in 5,000-kw sections. The present building is planned for four 5,000-kw steam turbines, one of which is about to be installed. The ultimate capacity is 14 units of 5,000 kw. Each steam turbine forms a section of the power house, together with a battery of eight Babcock & Wilcox boilers to supply it. Each battery of eight boilers is placed at right angles to the long way of the power house, which is a practice considerably at variance with previous power house design. The reason for this is the great amount of boiler capacity required to supply a single 5,000-kw steam turbine. In designing the power house, it was, of course, necessary to arrange it so it could be enlarged unit by unit, section by section, on a symmetrical plan. The boilers to supply one turbine should, therefore, occupy the same space measured the long way of the power house as the steam turbine unit. The only way, therefore, of getting boiler capacity sufficient to drive one of these turbines into the width of power house section required by the turbine itself, was to arrange the boilers as was done here. Of course by making additional floors to the boiler room, as has been done in the large New York stations, and putting the boilers in tiers one above the other, the old arrangement of placing the rows of boilers the long way of the power house might have been preserved, but it was not thought that considering safety, reliability and the cost of real estate, that a boiler room of several stories was here justified.

Each battery of eight boilers will be supplied by its own coal conveying apparatus. This coal-conveying apparatus will receive its coal from a crusher hopper, which crusher hopper will for the present be supplied from dump cars, although this latter is not the permanent arrangement contemplated. Each 5,000-kw section of the power house, with its 8 boilers, will have storage capacity of about 1,000 tons of coal. The boilers are equipped with Babcock & Wilcox chain grate stokers and with superheating coils, as it will be possible in this station, by the use of turbines, to take full advantage of chances for economy, by superheating the steam, as could not be done with reciprocating engines requiring the lubrication of pistons and valves. The stacks of this power house will be of steel, 205 ft. high and 18 ft. in diameter. The dimensions of the completed power house building are 600 x 230 ft. The turbine room spanned by the crane is 62½ ft. wide. The coal is unloaded under a part of the building having open arches.

The John A. Mead coal-conveying apparatus, with McCaslin buckets, has been selected. There will be an auxiliary fine coal hopper under the link grates to catch the fine coal which sifts through this type of grate. From this hopper the coal is taken back from the main hopper by conveyers. The boiler room floor is considerably above the level of the turbine room floor, as a basement 12 ft. high is under the boilers, and there is only two ft. difference in level between this boiler room basement and the main turbine room floor. Each battery of eight boilers will feed into a common header, and this header is below the boiler room floor, and from this header the steam piping will run on a level to the steam turbines. The boilers will be operated under 175 pounds pressure, with 150° superheating of steam. The steam piping for each unit is to be run in separate chambers in the basement, thus carrying out in the steam end the same idea of subdivision to prevent interruption that is being carried out in the electrical end. Electrically-operated steam valves will be used to enable valves to be closed from a distance in case breaks or leaks in the steam piping prevent men from entering the pipe tunnels to close the valves by hand. Alberger's surface condensers will be used in connection with the steam turbines.

About 8 per cent. of the space in the Fisk Street station is devoted to coal storage. A switch track enters one end of the turbine room, so that heavy machinery can be taken by the traveling crane directly from the car. Of course, these generating units will not have anything like the heavy parts of a slow-speed engine-driven generator of the same capacity, as these 5,000-kw units will run at a speed of 500 r.p.m.

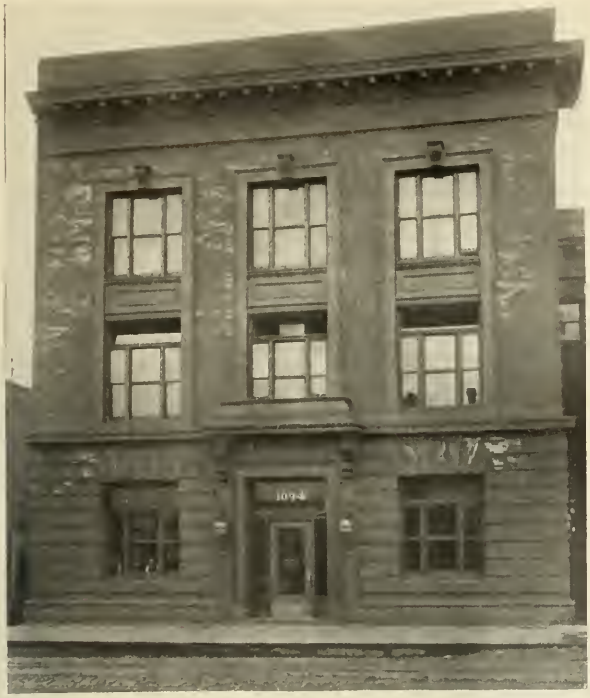


FIG. 3.—WEST MADISON STREET SUB-STATION.

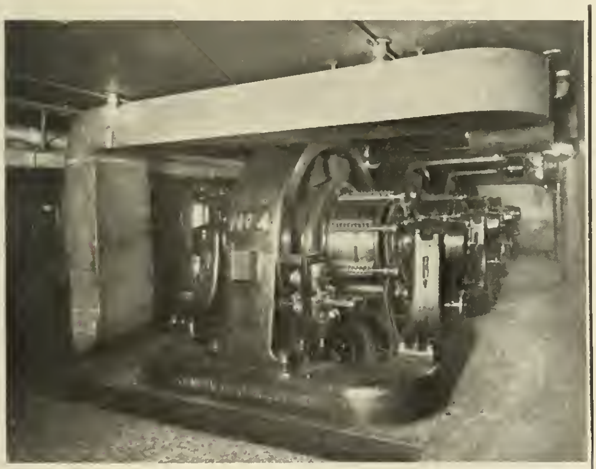


FIG. 4.—FOUR ROTARIES, DEARBORN STREET.

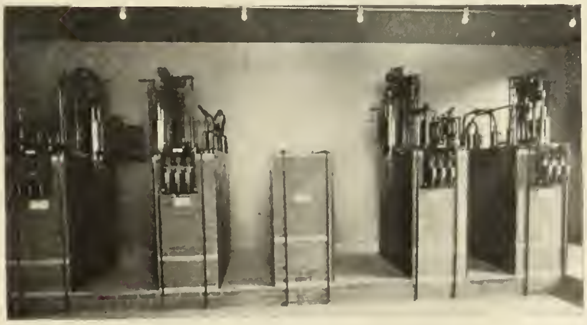


FIG. 5.—HIGH-TENSION SWITCHING APPARATUS.

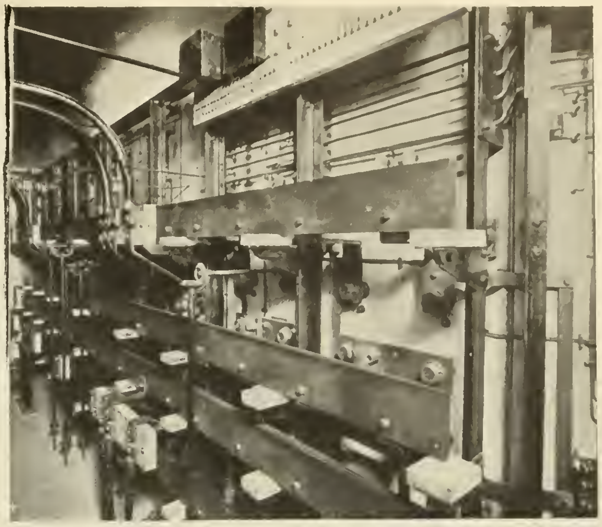


FIG. 6.—REAR OF SWITCHBOARD SEDGEWICK STREET SUB-STATION.

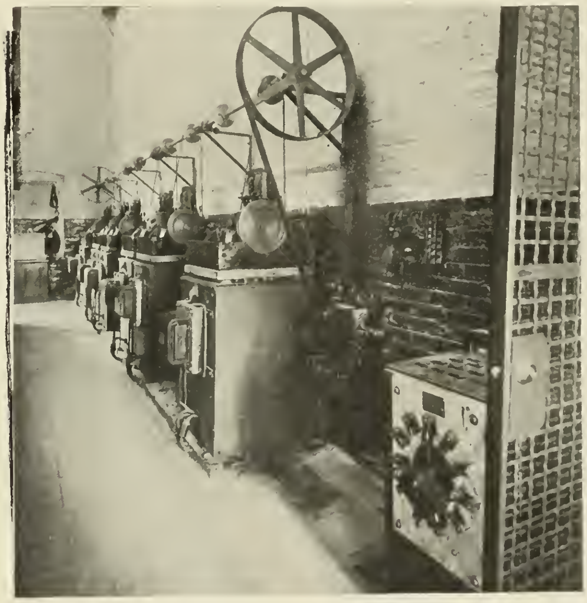


FIG. 7.—INDUCTION REGULATORS, MADISON STREET SUB-STATION.

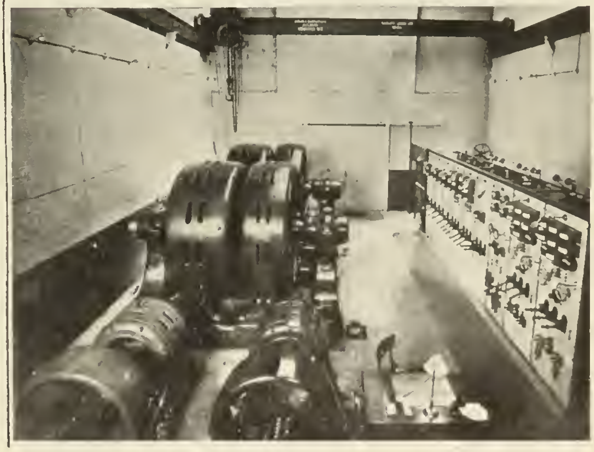


FIG. 8.—INTERIOR VIEW OF WEST MADISON STREET SUB-STATION.

CHICAGO EDISON AND COMMONWEALTH ELECTRIC SYSTEMS.

All the generators in this station will give 3-phase, 9,000-volt, 25-cycle currents, and will be star-connected, with neutral point grounded. The reason low-frequency generators were chosen for this station is that by far the greater part of the company's output is now and probably always will be converted into direct current at rotary converter sub-stations. The lower frequency is better adapted to the operation of rotary converters, as the 25-cycle rotary converter is a much more satisfactory piece of apparatus to construct and operate than the 60-cycle.

The controlling board is to be located in the turbine room, but the high-tension oil switches themselves will be in a separate building about 50 ft. away. This building will contain all the high-tension oil switches and high-tension bus bars, separated from each other by brick partitions. The principle of isolating one generating unit from another will be carried out as fully as is practical in the switching arrangements. Even the low-tension, direct-current controlling circuits between the controlling board and the high-tension oil switches in the switch house will be run in separate compartments. Each unit will feed directly a certain set of high-tension feeders. By means of a transfer bus, feeders can be transferred from one unit to another, or generators can be operated in parallel. The general scheme is to have each generator so it can be connected to a short section of feeder bus through an oil switch, or it can be connected to a main bus. The different short feeder bus sections can be tied together by oil switches, and the main bus is also sectioned by means of oil switches.

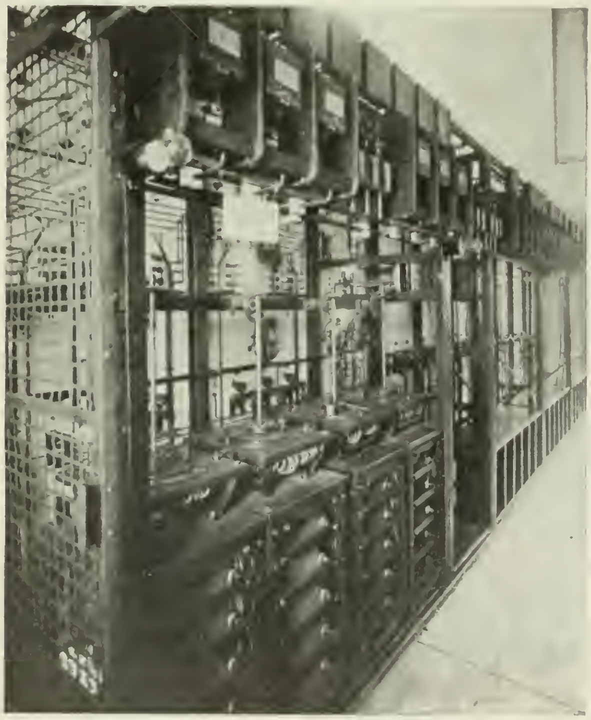


FIG. 9.—REAR OF SWITCHBOARD, WEST MADISON STREET SUB-STATION.

Only the instruments absolutely necessary for operation will be put on the controlling board in the station. Those not essential to operation, as the recording wattmeters and extra ammeters, will be put in the switch house, thus saving considerable low-tension control switchboard wiring, and simplifying matters for the switchboard attendant. Direct current for the operation of switches and other small apparatus requiring direct current will be supplied from a erty near Twenty-second Street, which is to be known as the Twenty-second Street sub-station. This sub-station being near the border line between alternating-current and direct-current territory, will supply both alternating and direct current for distribution.

The switch house is to be 50 ft. wide by 460 ft. long, ultimately, its length depending, of course, upon the length of the power house building. The basement will be devoted to the isolated compartments for the high-tension bus bars and connections. On the first floor will be the oil switches and instrument panels containing such instruments as are not needed on the operating board. On the second floor will be the quarters for the turbine room men.

In the new power house considerable attention will be given to the comfort of the employees. Reading rooms with current technical periodicals, lockers and baths, are among the comforts that are to be provided to increase the efficiency of the operating force.

The turbine room will be finished on the interior with glazed brick and terra cotta. There will be a gallery on both sides of the turbine room at about the level of the boiler room floor. The exterior of the building is finished in red pressed brick.

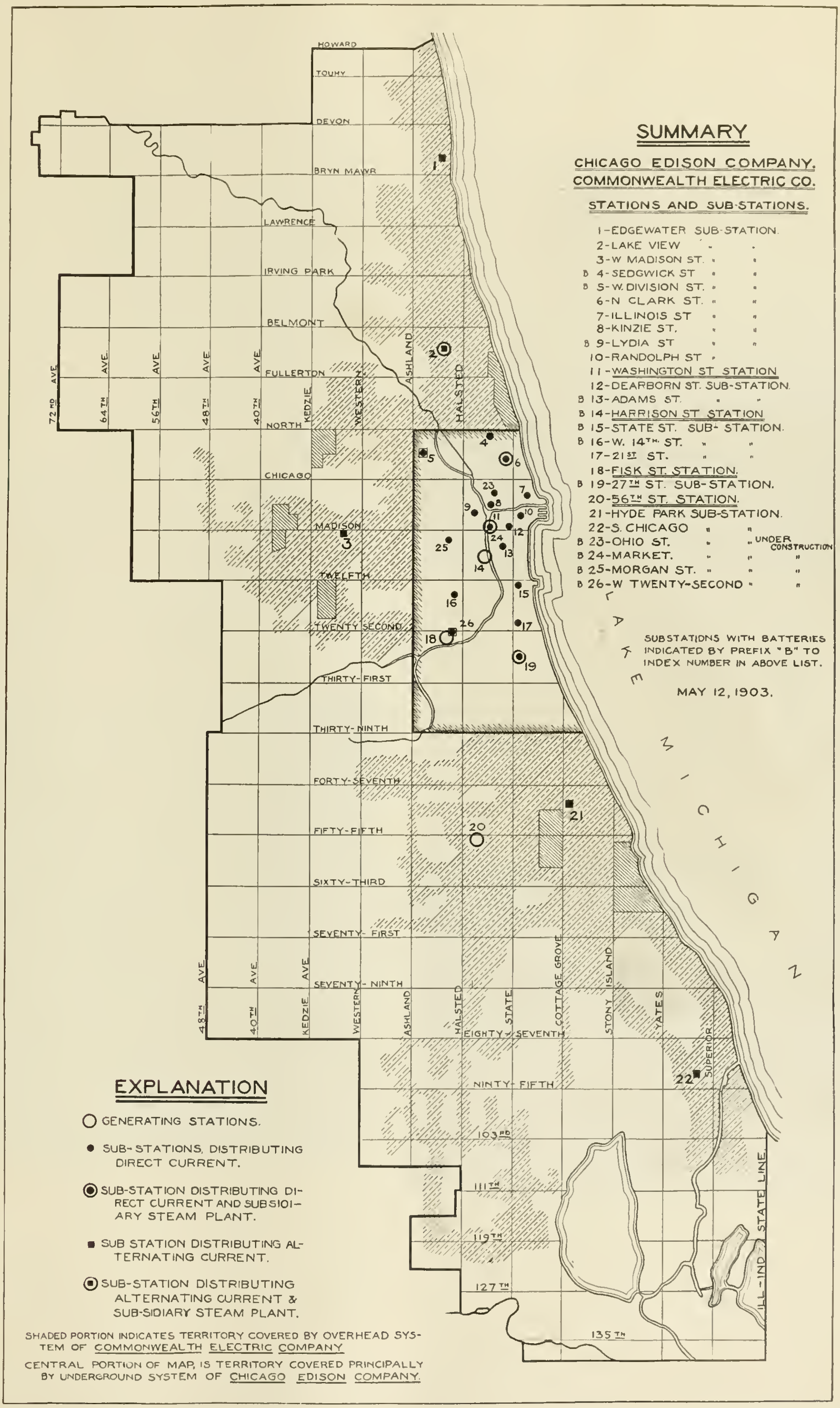
Although the Fisk Street station is attracting more general interest the country over at the present time than any other work recently done by the Chicago Edison Company, there are many other features in its recent development worthy of note. Most of these have been already described, either by special articles in these columns or by abstracts of papers presented by the officers of the company to various technical societies. As a matter of history, a few facts in regard to the growth of the Harrison Street station, which is the company's principal generating station at present, illustrate the remarkable expansion of the central station business in Chicago.

Ten years ago the Harrison Street station was just being started in operation, four 400-kw generators being the first equipment to supply current, although there were under installation in that station in 1893 four 400-kw generators and eight 200-kw generators, or a total of 4,800 kw. The generators were direct current, arranged in pairs on vertical engines. In 1900, at the time this station was described in the ELECTRICAL WORLD AND ENGINEER, May 19, 1900, just previous to the last electric light convention in Chicago, the equipment consisted of eight 200-kw and twelve 400-kw generators, or a total capacity of 5,200 kw. Some of these generators in 1900 were of the double-current type, giving either alternating or direct current. In 1903, at the present time, there are in this station eight 200-kw generators, twelve 400-kw, one 2,500-kw, one 3,100-kw, two 1,000-kw, and one 1,800-kw, or a total capacity of 15,600 kw. Fig. 2 shows the main engine room as it is at present.

Not only is the Harrison Street station fully loaded, but it is necessary at times of fall and winter peak loads to operate the steam plants in the three combination sub-station and subsidiary steam plants which the company was operating three years ago, as well as the Washington Street steam plant of 4,600 kw in direct current. These steam plants, to be sure, are put in service for only a few months each year, with one shift of men to carry the heavy load which comes in November and December. As they are already installed and of very little scrap value, it is not considered that it would pay to entirely abandon them and to invest enough money in modern generating plant and sub-station apparatus to carry the peak loads which the steam plants carry for a short time each year, even though the steam plant efficiency be low. By next fall these two companies will have 24,000 kw in rotary converters and 4,000 kw in frequency changers installed in its sub-stations. The maximum load in 1902 was 29,080 kw, of which 24,000 kw was direct current. The storage batteries carried during the maximum load mentioned 20 per cent. of the direct-current load. The connected load of the two companies is the equivalent of 1,652,000 16-cp incandescent lamps.

As was noted in the ELECTRICAL WORLD AND ENGINEER for November 29, 1902, in an article on "The Randolph Street Sub-station and the Development of the Chicago Edison System," there has been a great increase in the number of rotary converter sub-stations giving direct current to the Edison 110-220-volt network. Some of these sub-stations in the basements of modern fire-proof office buildings. Fig. 4 is the interior view of one of these at 114 Dearborn Street. The Harrison Street station was laid out as a direct-current plant, but as the direct-current district increased in size and the load density in all parts increased, it naturally was the most economical move to begin the establishment of rotary-converter sub-stations wherever the load seemed to demand it within the Edison district. At the time of the last convention in 1900 there were three of these direct-current sub-stations, and there are now, including those under construction, seventeen such sub-stations.

Outside of the Edison district, in the district served by the commonwealth Electric Company, a 3-phase, 4-wire system is used, with grounded neutral and 2,300 volts between any phase and ground. This alternating-current distribution is at 60 cycles. Part of this 60-cycle current is generated and distributed direct from steam plants, but there are a number of sub-stations at which 25-cycle,



SUMMARY

CHICAGO EDISON COMPANY.
COMMONWEALTH ELECTRIC CO.

STATIONS AND SUB-STATIONS.

1-EDGEWATER SUB-STATION.
2-LAKE VIEW " "
3-W MADISON ST. " "
B 4-SEDGWICK ST " "
B 5-W. DIVISION ST. " "
6-N CLARK ST. " "
7-ILLINOIS ST " "
8-KINZIE ST. " "
B 9-LYDIA ST " "
10-RANDOLPH ST "
11-WASHINGTON ST STATION
12-DEARBORN ST. SUB-STATION.
B 13-ADAMS ST. " "
B 14-HARRISON ST STATION
B 15-STATE ST. SUB- STATION.
B 16-W. 14TH. ST. " "
17-21ST ST. " "
18-FISK ST. STATION.
B 19-27TH ST. SUB-STATION.
20-56TH ST. STATION.
21-HYDE PARK SUB-STATION.
22-S. CHICAGO " "
B 23-OHIO ST. " " UNDER CONSTRUCTION
B 24-MARKET. " " "
B 25-MORGAN ST. " " "
B 26-W TWENTY-SECOND " "

SUBSTATIONS WITH BATTERIES INDICATED BY PREFIX "B" TO INDEX NUMBER IN ABOVE LIST.

MAY 12, 1903.

EXPLANATION

○ GENERATING STATIONS.
● SUB-STATIONS, DISTRIBUTING DIRECT CURRENT.
⊙ SUB-STATION DISTRIBUTING DIRECT CURRENT AND SUBSIDIARY STEAM PLANT.
■ SUB STATION DISTRIBUTING ALTERNATING CURRENT.
▣ SUB-STATION DISTRIBUTING ALTERNATING CURRENT & SUB-SIDIARY STEAM PLANT.

SHADED PORTION INDICATES TERRITORY COVERED BY OVERHEAD SYSTEM OF COMMONWEALTH ELECTRIC COMPANY

CENTRAL PORTION OF MAP, IS TERRITORY COVERED PRINCIPALLY BY UNDERGROUND SYSTEM OF CHICAGO EDISON COMPANY.

FIG. 10.—MAP SHOWING STATIONS OF CHICAGO EDISON COMPANY AND COMMONWEALTH ELECTRIC COMPANY.

9,000-volt current is put through motor generators to change its frequency to 60-cycle, 2,300-volt on the 4-wire 3-phase system. At first glance this would seem like a wasteful operation, but the amount of energy which has to be transformed by motor generators is so small a proportion of the total as to make it much more economical in carrying the load to have all the large generating units in the new Fisk Street station of the same voltage and frequency, namely, 25 cycles, 9,000 volts.

The Madison Street sub-station is one of those in which 9,000-volt, 25-cycle current is changed in voltage and frequency for alternating current distribution, and since it is one of those recently finished it has been selected as an example of this type of station for description here. It gives a good idea of the high standard of sub-station construction which this company requires in all its work, and also has some entirely new features installed here for the first time. The Madison Street sub-station has two 500-hp motor generator sets, consisting of a synchronous 25-cycle motor driving a 60-cycle generator, both motor and generator of the revolving field type, and on the same base. Exciting current for these motor-generators is supplied by two 50 kw exciters, each driven by a 75-hp induction motor. Fig. 8 is an interior view of this sub-station. One of the new features in this sub-station is the new switching device for the induction regulators. There are six 7½ kw induction regulators of the C. R. type, made by the General Electric Company. Each regulator has mounted upon it, as seen in Fig. 7, a switch for automatically controlling the voltage on the feeder that is supplied through the regulator. Instead of having an individual motor for each regulator switch, a line of shafting has been run the length of the row of regulators. This shafting is driven by a 1-hp motor. There are two magnetic clutches on each automatic switch, one of which when energized will move the regulator switch to raise the voltage, and the other one when energized will move the regulator switch to lower the voltage, by motion transmitted from the constantly-running line shaft. These clutches are energized from a relay contact, and the relay is operated from a shunt around the voltmeter on that feeder. The voltmeter has resistance in its circuit, calculated so that the indication of the voltmeter at any time will show the voltage at the center of distribution of that feeder. As long as the voltage is normal the relay is balanced so that it makes contact with neither of the magnetic clutches. Should the voltage get high or low the relay armature makes contact with one of the clutches, and this moves the regulator switch until the right voltage is attained.

This sub-station is supplied from a 9,000-volt feeder, which comes from the Harrison Street generatinng station. The plan of the 9,000-volt feeders of these companies appeared in the ELECTRICAL WORLD AND ENGINEER of May 9, 1903, illustrating a paper by Mr. Junkersfeld on "Multiple Versus Independent Operation of Central Stations." In addition to the regular feeder supplying this station, another feeder passes through the station and on to what is known as the Rockwell Street sub-station of the Lake Street Elevated Railroad, which is a rotary converter sub-station supplying direct current to that road. The feeder which supplies the Lake Street Elevated can be connected by means of knife switches to the incoming feeder bus-bar in this station. The regular feeder supplying the station can also be connected to this feeder bus-bar by knife switches. These switches are, of course, only for the purpose of making connections, and are never opened under load. The feeder bus-bar supplies the synchronous motors and other apparatus in the station through a main type C solenoid operated oil switch, made by the G. I. Company. All the oil switches in the station are of G. I. make. This main type C oil switch connects the incoming feeder bus, with the motor running bus, from which the motors are operated. There are two sets of motor buses, one known as the running bus, the other as the starting bus.

The starting bus-bar is supplied from the running bus through a compensator, which reduces the voltage from 9,000 to 4,000 volts for starting the synchronous motors as induction motors. The compensator is bus or starting bus energized at the time of starting the motor-generators by connection with the bus-bar through a type H oil switch. The starting of the motor generators is done through a type G switch, which is in reality two 3-pole oil switches with operating mechanism so connected mechanically that one switch will open when the other closes, giving in effect a double-throw oil switch. In starting, the motor-generator is thrown first on the starting bus and then onto the running bus.

In the main circuit of each generator is a type H oil switch for breaking current under load. For passing through this switch the circuit divides, one going through a type E oil switch to the A bus and the other going through a similar switch to the B bus, as there are two bus-bars. These latter switches are not for breaking the circuit under load but simply for connecting the generator to one bus-bar or the other. Oil switches were, of course, not absolutely necessary for this purpose but it was not thought desirable to introduce knife blade switches into the generator leads, since by the use of a cheap type of oil switch, all open switching devices could be avoided. The switches in the main generator leads are three single-pole switches. The neutral of the generator being grounded, no switching devices are necessary in it. The lighting feeders are operated as single-phase circuits connected between any one phase and the grounded neutral. It is, therefore, unnecessary to have only one single-pole switch for each feeder circuit. Furthermore, all instrument and potential circuits are run with one wire and the common return, all of which greatly simplifies switchboard wiring. All the 9,000-volt wiring in the station is run enclosed between slate partitions, and where going through one partition into another, insulated bushings are used, made of a new substance resembling hard rubber, known as the Stanton compound. The high-tension switch construction is well illustrated by Fig. 5, which shows the switches at another sub-station where they are more accessible for a photograph than at Madison Street.

Generator panels at this sub-station have for indicating instruments three ammeters, three wattmeters and one voltmeter. In addition to motor-generator panels and feeder panels, there are two panels given to feeders, which tie this sub-station to other sub-stations. These tie feeders also serve branches along the route between sub-stations. Feeders are fused with flat enclosed fuses. A good idea of some of the principal characteristic points of the switchboard wiring and construction of these companies is afforded by Fig. 9, which is the back of this Madison Street sub-station board, and Fig. 6, which is the back of the switchboard at the Sedgewick Street sub-station. It will be noted that the supporting frames are several inches back of the panels, so as not to interfere with the wiring. The direct-current feeders, as they leave the board, have taps taken off about 7 ft. apart for voltmeter leads, so that the feeder cable itself forms a voltmeter shunt. Changes in temperature in the feeder are compensated for by a series winding in the voltmeter circuit, surrounding the cable at the point it leaves the bus-bars. High-tension cables and all exposed places in the station are wrapped with brass tape.

The 9,000-volt cables for underground transmission are all three-conductor with conductors equivalent to 0000. They have paper insulation fixed 6/32 in. thick over each conductor, and the sheathing 9/32 in. thick over all three conductors inside the lead covering. Where the conductors leave the high-tension cables is a large bell filled with a compound called "minerallac," which is the invention of some of the companies' engineers. Manholes for high-tension cables are built so that there are no sharp bends of cables in going around square corners. That is, these manholes are built with diagonal corners. The 9,000-volt transmission lines will by next fall aggregate 60 miles and serve 19 sub-stations.

Four new sub-station buildings are under construction at the present time and the fifth building is being erected to house the present South Chicago sub-station.

The high-tension switching apparatus at Harrison Street station is undergoing a general overhauling, whereby feeder and generator oil switches, which are all solenoid operated, will be placed in separate fire-proof compartments, so isolated as to prevent the spread of trouble. The feeder switches will be equipped with overload and time limit devices, whereby they will open upon overload, but not until the overload devices at the far end of the feeders may have had time to act. Feeders are taken from a transfer bus, which is sectioned, and each section of this bus is fed by a generator. Each generator has three oil switches, all without overload devices. One of these switches controls the entire output of the generator. After leaving this switch, the circuit divides, one going through an oil switch to the transfer bus, from which the feeders are taken, and the other going through an oil switch, connecting it with the main bus.

Another notable change being made is one which will eventually result in the substitution of a sub-station having very large units, in place of the power house at Market and Washington Streets, which power house it is expected to shut down, except possibly for heavy load work, as soon as the Fisk Street station is in regular operation. This Washington Street station now occupies part of a large manufacturing block, known as the Electric Block. A new eight-story modern steel building is to be erected in place of this, in which the sub-station will occupy part of the main floor. This sub-station will have room for eight 1,000-kw rotary-converters, but the company's engineers have had the foresight so to lay out the floor space that one 2,000-kw rotary converter could be installed in the same place as three 1,000-kw machines. This station will be served by a traveling crane. The air blast chamber in the basement of this sub-station will be utilized for high-tension bus compartments. One notable feature here, will be the use of transformer regulators, which will give a large enough range of voltage so that no boosters will be necessary to raise the direct-current voltage, for charging storage batteries at this sub-station. There are many other interesting new sub-stations, as has been mentioned, but it would be impossible in the space available for this article to go into the details of all of them. With what has been published before in these columns, the foregoing will give a good idea of the recent developments in the systems of these two companies.

The New Plant of the Oskaloosa Traction and Light Company.

Oskaloosa, Iowa, has for many years been the home of one of the oldest and in some ways the most remarkable direct-current incandescent lighting plants to be found in the central states. Before electric lighting was thought of a company called the Oskaloosa Power & Land Company built a steam power house and some factory buildings on a large tract of vacant land something over a mile from the business center of the city. This land was well served by railroads, and it was the idea of the promoters of this company that if power, buildings and land were furnished manufacturers would flock in to avail themselves of the privileges offered. The manufacturers refused to flock, however, and matters looked blue for the power and land company.

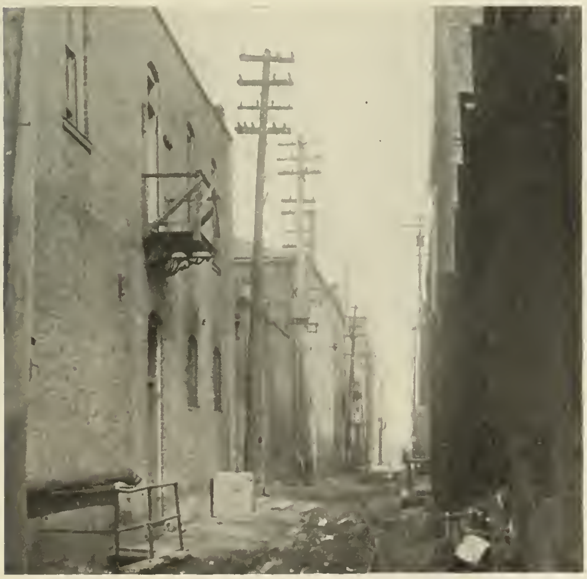


FIG. 1.—CHANGING FROM OLD TO NEW POLE LINE.

About that time incandescent lighting from central stations began to be talked of, and the outcome of the matter was that an Edison three-wire, 110-volt, direct-current system was installed in Oskaloosa, and the generators were located in this power house. The amount of copper required to give lighting service on a low-tension, direct-current system with the station so far from the center of distribution is easily imagined by those familiar with the subject. Nevertheless, the copper was put up, and the plant gave good service for many years in spite of the investment which it had on its pole lines. In all about 57 tons of bare copper wire were put up—a figure seldom equaled in a town of this size. Oskaloosa had a population of 9,212 in 1900.

Last year parties interested in the Ottumwa Traction & Light Company, operating in a neighboring Iowa city, obtained control of the lighting plant in Oskaloosa, and secured franchises for several miles of street railway. It was decided to abandon the direct-current system entirely, and put everything on a three-phase alternating-current system. This meant a very radical change, not only in the distribution system, but in the power house and motor service; for the old company had 45 direct-current motors owned by its customers to whom it was supplying current. The change, therefore, involved the practical rebuilding of the whole plant. The solution of the problem was heroic, but it has resulted in thoroughly up-to-date equipment. The old power station is being abandoned, and a new one, somewhat nearer the business part of the city has been started. Incidentally, about 35 tons of bare copper feed wire are being taken down, this feed wire constituting one of the chief marketable assets of the old property. The service is being transferred from the old to new pole lines in the business district, which change is in progress in Fig. 2. The pole line from the new station is seen in Fig. 2, which shows the substantial character of the work.

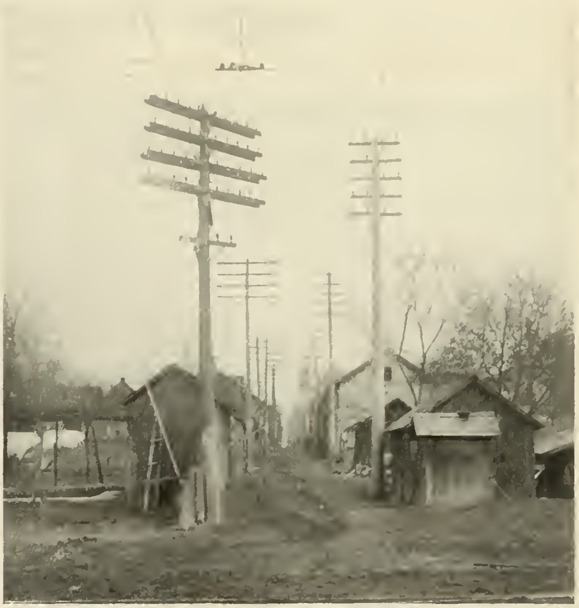


FIG. 2.—FIVE-ARM LINE LEAVING NEW STATION.

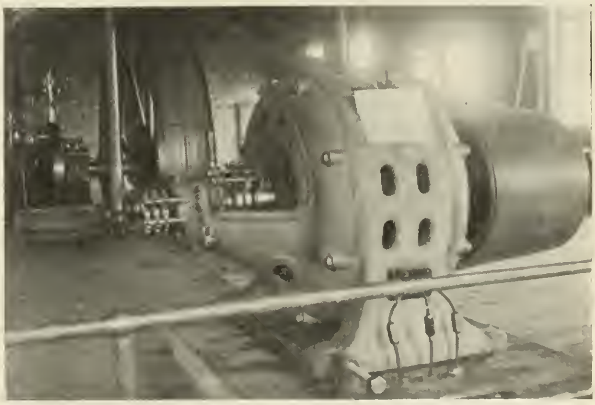


FIG. 3.—ONE OF THE GENERATORS.

The new plant is six blocks from the business square, which is sufficiently near so that some hot water heating can be done. The Yaryan system has been installed. The company has 3,300 ft. of mains. The new plant gives power and lighting service at 2,300 volts, 3-phase, 60 cycles. Single-phase lighting circuits are taken from the three phases of the power house bus-bars, independently of the 3-phase power feeders. Whatever fluctuation there is in the voltage of the lighting service from the starting and stopping of motors will, therefore, be confined to the fluctuation of voltage on the generator, as the feeders and transformers are independent of each other. In changing from direct-current to 3-phase motors, the company has accepted the customers' direct-current motors in trade, although many of these motors are of little market value.

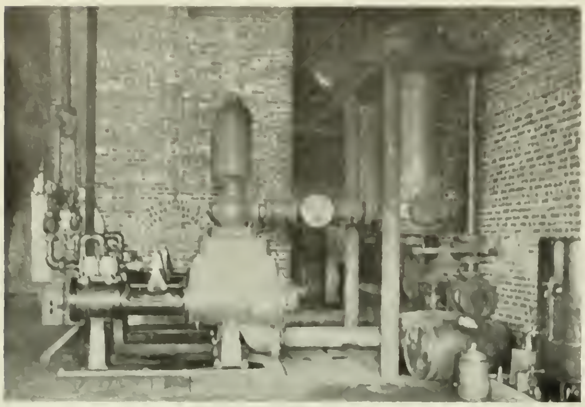


FIG. 4.—HOT WATER CIRCULATING PUMPS.

Formerly all the street lighting in Oskaloosa was done by incandescent lamps. A new contract has been made with the city, and the Oskaloosa Traction & Light Company is now supplying 101 enclosed General Electric street arc lamps, operated in series off of tub transformers. There are three tub transformers giving 2,200 volts, 6.6 amp. Two of these transformers supply street lights and other lights operated until midnight, and the other supplies all-night arc lights.

The power house equipment comprises two 200-kw, three-phase General Electric alternators of the compensating field type, with the exciter built into the machine. These machines run 600 r.p.m., and give 2,300 volts. One of these generators (Fig. 3) is belted to a Reynolds Corliss engine, built by the Allis-Chalmers Company. This engine is rated at 305 hp, and runs 96 r.p.m. The other three-phase generator is belted to a Westinghouse high-speed engine, rated at 330 hp. This engine is 18 and 30 in. x 16-in. stroke, running 250 r.p.m. This engine also drives a railway generator which at present is an old D 62 machine. This will be changed, however, for a new generator. The engine room contains, besides these two units, two Gardner pumps for maintaining the circulation of hot water in the heating system. These pumps are 14 and 12 in. x 12-in. stroke. There are three Stirling water tube boilers of 258 normal hp each.

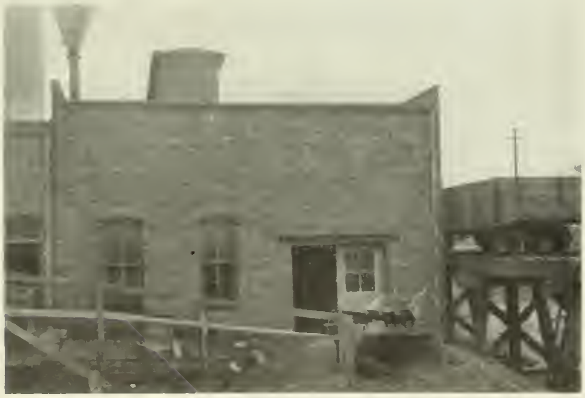


FIG. 5.—COAL AND ASH HANDLING.

The brick stack 125 ft. high was built by the Alphons Custodis Chimney Construction Company, according to that company's well-known form of chimney construction, using hollow radial molded brick. A "Star" vacuum class C feed water heater with a capacity of 30,000 lbs. of water per hour is located in the boiler room, where also are Gardner feed pumps. A siding of the Burlington railroad runs pas the boiler room at an elevation, as seen in Fig. 5, so that coal cars can be dumped into pockets, which pockets discharge directly in front of the boilers. If dump coal cars are not obtainable, the coal is shoveled directly in front of the boilers, Fig. 6. The ashes are taken out in wheelbarrows on to a platform and dumped into street railway cars for use in ballasting. Besides the light and power service three cars on four miles of street railway are operated, which is considered to be a remarkably good service for a town of this size.

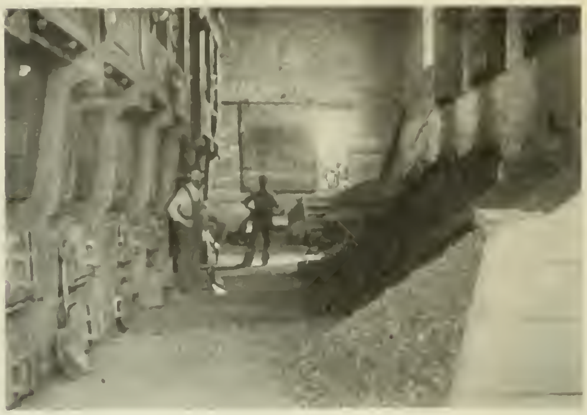


FIG. 6.—NO SECOND HANDLING OF COAL.

The rates for lighting are 15 cents per kw-hour, with discounts which give a rate as low as 5 cents per kw-hour to some of the largest users. The rates for power are 10 cents per kw-hour, with discounts as high as 50 per cent. to the largest users. For hot water heating, a rate of 17½ cents per square foot of radiating surface for the season has been established.

The officers of the Oskaloosa Traction & Light Company are: President, H. E. O'Neal; vice-president, Samuel Mahon; secretary, general manager and purchasing agent, J. F. Springfield; treasurer, Calvin Manning; auditor, H. W. Garner. The local management is under the supervision of Mr. Garner. The plant was laid out by and is under the general management of J. F. Springfield, of Ottumwa.

Interesting Southern Lighting Plant.

Gaffney, S. C., has its own lighting and pumping plant. The air lift is used, connected to a well 12 in. in diameter and 565 ft. deep and delivering to a cement motor-lined brick reservoir, through the center of which rises the well. The well and reservoir lie just outside the station, and the reservoir is about 20 ft. in inside diameter and 12 ft. deep. The air compressor is of the Laidlaw-Dunn-Gordon horizontal fly-wheel type, 14 in. x 14 in. x 18 in. in cylinder sizes and to start the water, compresses to 120 pounds. The normal operating air pressure is 80 pounds. From the reservoir the water is pumped to a 120-ft. standpipe, 15 ft. in diameter, by means of a Worthington 14 in. x 8½ in. x 10 in. duplex direct-acting steam pump. The plant is operated about 10 hours every night. A constant-current alternating system of arc lighting is in use, with a duplicate installation of machinery. There are two General Electric 60-cycle alternators, rated at 39 amp., and 2,300 volts at 900 r.p.m., each belted to a simple engine built by the Slater Engine Company, of Warren, Mass. Each generator has a 125-volt exciter driven by belt from the generator shaft, of 1.5-kw capacity. The lighting transformer is of 32-kw capacity and gives a current of 6.6 amp. The building is of brick with a concrete floor and mortar plastered walls inside.

Development of Light and Power Business at Red Oak, Iowa.

IN looking over the field of small central stations for description in this number of Electrical World and Engineer, that of the Red Oak Electric Company was selected as being one which has developed an unusually large amount of electric light and power business for a station located in so small a town. The plant is under the management of D. F. McGee, the recently elected president of the Iowa Electrical Association, who is also known over the country for the part he has taken in the proceedings of the National Electric Light conventions. Mr. McGee has demonstrated that the complaint so often heard from the managers of central stations in towns of the size of Red Oak, that there is nothing in the power business in such towns, and that "this town is too small for a paying electric light and power enterprise anyway," are usually groundless, and simply the result of inability or unwillingness to expend the effort and money necessary to get and take care of the business.

The population of Red Oak, according to the census of 1900 was 4,355. Up to three years ago, at which time Mr. McGee took charge, the company had no power business. A few weeks ago, when the representative of this journal visited this plant, there were connected for power service fifty-seven 220-volt motors of over ¼ hp. and eight 500-volt motors, ranging from 85 to 5 hp. This does not include the various fan and dental motors under ¼ hp. On the 500-volt circuit there is one 85-hp motor operating a flour mill 24 hours a day, one 45-hp motor running the water works pump about 8 hours a day, one 10-hp motor, two 7½-hp and three 5-hp motors. Of course, it would be impossible for every town of this size to develop such a large power business, because not every town has a sufficient number of enterprises using power. Nevertheless, the fact remains that in Red Oak, electric motors have displaced nearly every steam plant in the town, and in some notable cases, to be mentioned later, have supplanted steam engines where, to a casual observer, it would seem to be impossible to get the prospective customer to give up the steam plant. When the power business was started in Red Oak three years ago, it was run from a 220-volt direct-current circuit, and the business was mainly confined to the operation of motors in the stores and printing offices located around the business part of the town, which is but a short distance from the central station. Later, as it was found feasible to take on some larger power users, the 500-volt service was inaugurated. In fact, this service was first started to operate the 85-hp motor driving the flour mill, some distance from the station. This flour mill furnishes an excellent load, as it operates practically 24 hours every day, and forms a good basis upon which to build up further 500-volt service. Of course, the division of the power service into two classes, 500-volt and 220-volt, is in some respects not ideal; but like every lighting station, that at Red Oak has been a gradual evolution, and machinery has been installed from time to time as seemed best to fulfill the requirements. The use of a 220-volt, two-wire power service for the busiest part of the town makes it possible to give incandescent lighting service on the same circuits in the daytime, and to shut down the alternating-current residence lighting dynamos during the day.

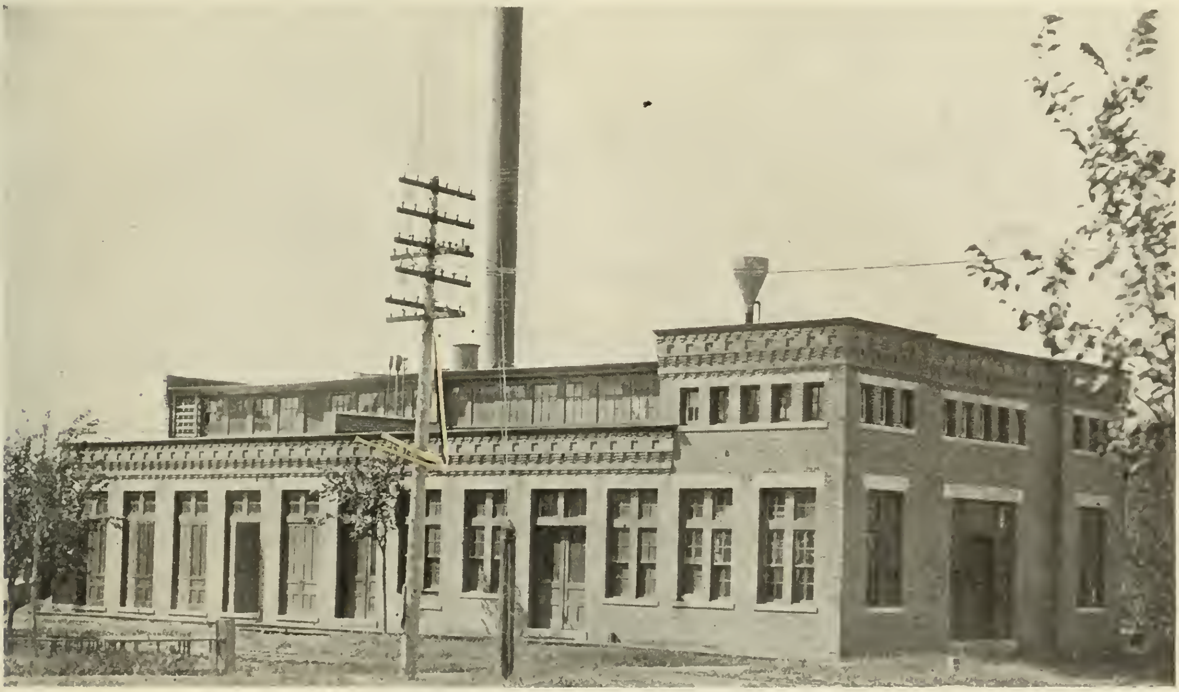


Fig. 1.—Red Oak Central Station.

The station (Figs. 1 and 2) though old, has been kept in good shape, and while not finished according to modern ideas of electrical engineering in large plants, is enough more efficient than any of the steam plants likely to be operated by small manufacturers in a town the size of Red Oak, so that the central station can successfully compete for power business. This power service is principally taken care of by a 225-hp 16 x 42-in. Filer & Stowell Corliss engine, which drives a line shaft, to which is belted one 60-kw, 220-volt Holtzer-Cabot generator, and one 110-kw, 500-volt General Electric generator. From this line shaft there is also driven a centrifugal pump (Fig. 3), which circulates the hot water in the hot-water Yaryan heating system operated from this plant. Another section of the line shaft is driven ordinarily by an 18 x 36-in. Sioux City Corliss engine. From this line shaft there is belted one 25-kw, 220-volt, direct-current generator, and two 35-kw, 1,100-volt alternating-current, 125-cycle dynamos. The line shaft is arranged so that the larger engine can drive the entire shaft when the load is light. This is done by getting together the two sections of the shaft by means of a friction clutch, and lifting the engine belt off the surface of the line shaft pulley by means of pieces of gas pipe placed under it, and resting on a frame (seen at the left in Fig. 2), which frame is built in the form of a semi-circle slightly larger in diameter than the pulley, from which the belt is to be lifted. The belt is kept tight by means of an idler, so that it is easily loosened enough that it can be lifted off the pulley to allow the pulley to revolve free. During the day, only the section of line shaft first mentioned as connected to the Filer & Stowell engine is driven. The maximum load on the 500-volt power circuit during the day is about 180 amp., and the minimum about 125 amp. The load on the 220-volt circuit during the day runs about 100 amp. In the winter, between 5 and 6 o'clock, when the downtown lighting is included also in this load, it runs as high as 100 amp. The maximum alternating current peak load is 70 amp. at 1,100 volts. These figures will give some idea of the amount of business the station is carrying.

All the 500-volt motors are supplied through recording meters, and it is found that there is only 15 per cent difference between the reading of the main recording wattmeter on the 500-volt circuit at the station and the totals of the consumers' meter readings. This is much less than the difference usually found on direct-current light and power circuits, and this is probably due to the fact that because the 500-volt meters are comparatively few in number and of large capacity, and run usually at a fairly good load, there is but little loss through motors running too slowly. It should be mentioned in this connection, however, that the 45-hp motor driving the waterworks pump has its wattmeter located in the central station rather than at the waterworks, which are a mile or more distant; hence the line loss on this circuit is not included in the wattmeter readings before mentioned.

Besides the electric service which has been enumerated, hot water heating service is applied to the business part of the town. The company has connected now about 50,000 sq. ft. of radiating surface. The pipes around the business quarter are run through the front o the cellars, which not only keeps down the cost of making service connections, but does away with digging trenches in the streets. It is found that building owners gladly permit this to be done even if they do not take the hot water service, because it puts them in a position where they can take it at any time, and increases the rental value of their property. A static head keeps a water pressure of 30 pounds to the square inch on the heating system. To force the circulation of water, a centrifugal pump adds 22 pounds to this static head, so the outgoing pressure is 52 pounds, and the incoming equal to the static head, or 30 pounds. The temperature of the outgoing water in the coldest weather is 165°, and that of the incoming water 155°. The mains are incased in Wycoff sectional covering. As said before, the centrifugal pump is driven by a belt from the line shaft. There is also in reserve a centrifugal pump driven by a small Westinghouse Junior high-speed engine, which was one of the first installed for lighting service in the station years ago.

By ordinarily driving the circulating pump for the hot water system from the line shaft, the benefit of the economy of the Corliss engine is obtained. From indicator cards taken on the Corliss engine, it is found that it requires 20 hp to run the centrifugal pump. The actual cost of operating the hot water system is, therefore, the cost of supplying this 20 hp continuously, except in the coldest weather, when a little live steam is used. Mr McGee does not believe in connecting up more radiating surface than can be operated with the engine exhaust in ordinary cold winter weather, as live steam heating is too expensive.

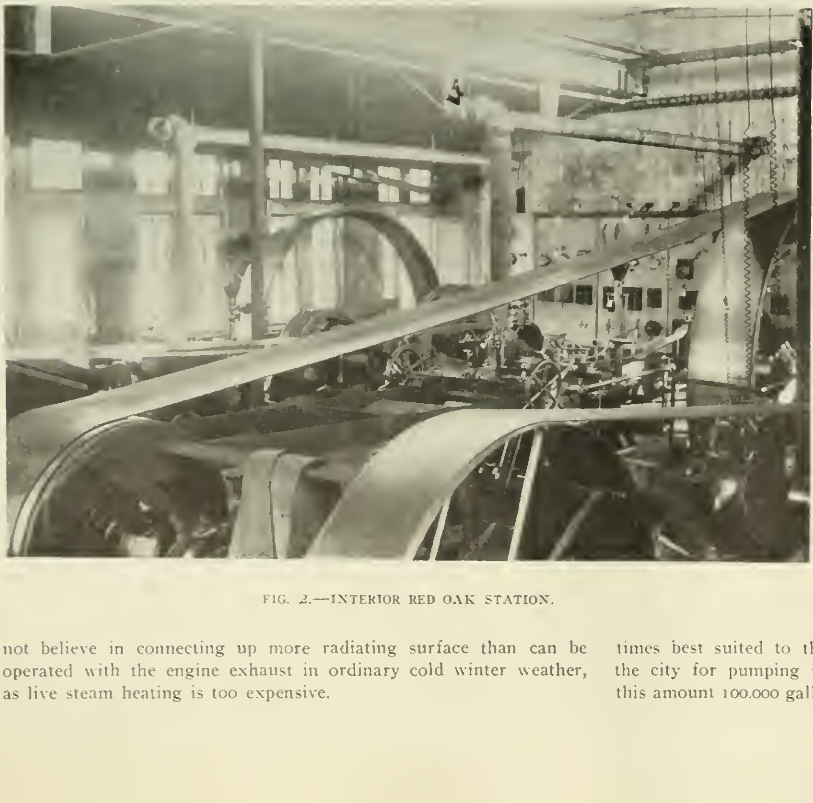


FIG. 2.—INTERIOR RED OAK STATION.

The boiler plant contains two boilers 60 in. in diameter by 16 ft. long, and two 72 in. in diameter by 16 ft. long, all of the usual horizontal return flue type. Three boilers are usually run to carry the load, but do not require very hard firing under such circumstances. For carrying peak load, a forced draft is available.

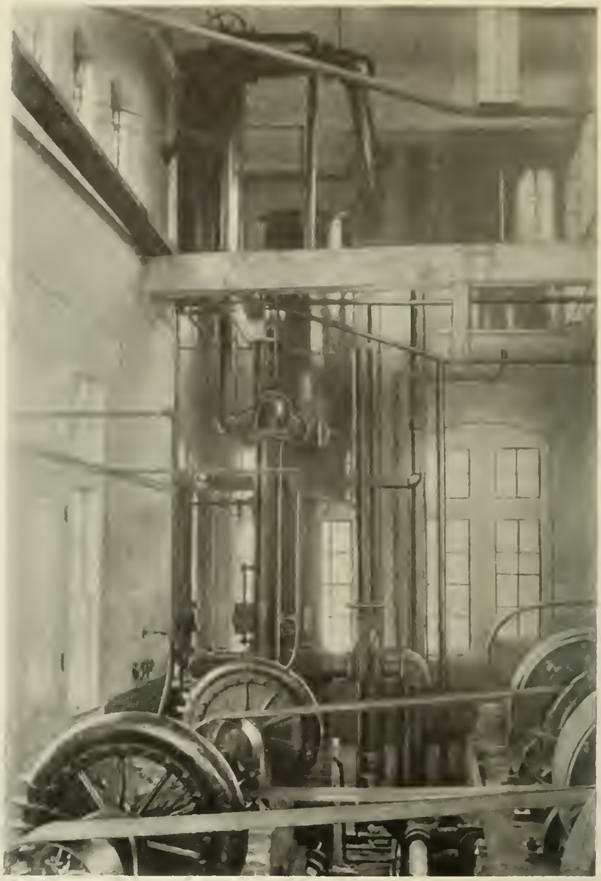


FIG. 3.—CENTRIFUGAL PUMP AND HOT WATER HEATERS.

In operating the stations, two day and two night men constitute the force. The outside force consists of two men and one boy; and these men do all the work on new wiring contracts, of which there is considerable at the present time.

This station was one of the first in Iowa to do waterworks pumping by electric motor from the central station. The waterworks is located about a mile from the station, and takes its supply of water from an open well near a river. It was formerly operated by steam, by direct-driven steam pumps. When the electric company secured the contract the company put in a 45-hp, direct-current motor, belted to a triplex pump, letting the steam plant stand ready for use as before. This pump operates against a head of 100 pounds to the square inch. The capacity of the standpipe is 238,000 gallons. The company is pumping about 112,000 gallons a day, so that there is plenty of capacity in the standpipe to enable the company to pump at times best suited to the economy of its plant. The rate paid by the city for pumping is $125 a month, the company to pump for this amount 100,000 gallons of water per day. For all water in excess of 100,000 gallons pumped each day, a rate of 4 cents is paid. The cost of the pumping apparatus put in by the company is given as $2,500. Mr. McGee figures that the company is receiving 4 cents per kw-hour for current used in city pumping, after deducting interest at 6 per cent. and depreciation at 6 per cent. on a $2,500 investment in pumping apparatus. It will be seen that as long as more than 100,000 gallons of water is pumped per day, the rate is practically 4 cents per 1,000 gallons. If 112,000 gallons are pumped per day, the interest and depreciation would be $0.007 per thousand gallons, making the rate received for pumping, after deducting interest and depreciation, $0.033 per thousand gallons. If the company is receiving 4 cents per kw-hour for current used in pumping, and $0.03 per thousand gallons, the energy consumed would be .82 kw-hours per thousand gallons. Mr. McGee does not consider the pumping rate a profitable one, except for the city which is saving from $1,800 to $2,000 per year on the contract over what it would have to pay to maintain a steam plant. The city could well afford to pay a higher rate.

The power rates are 7½ cents per kw-hour, with a discount which allows some of the very largest users 30 per cent. off. Most of the output, however, is paid for at the 7½-cent rate. The lighting rates for stores on the 220-volt circuit is 15 cents per kw-hour. The residents' lighting rate on the alternating-current circuits is 20 cents per kw-hour, with no discount and no minimum rates. Allowing 6 per cent. for interest and 6 per cent. for depreciation, it is figured that power costs at the switchboard of this plant 5 cents per kw-hour. This does not include any depreciation charges. The hot water feeding rate has heretofore been 15 cents per square foot of radiating surface for the season. This is to be increased to 20 cents the coming season. Coal costs normally $1.90 per ton.

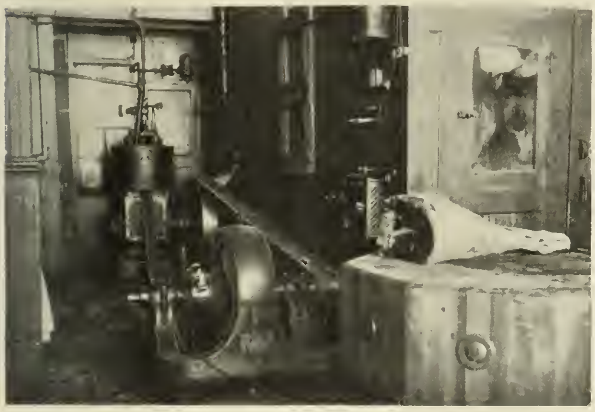


FIG. 4.—A PROGRESSIVE MEAT MARKET REFRIGERATION PLANT.

It is interesting to note the character of the motor load. Motors connected to this station are employed on 35 different kinds of work; and out of the 65 motors, only 15 are not arranged to be operated on variable speed. The necessity for variable-speed motors was largely instrumental in the selection of direct current for power service when this service was begun three years ago, rather than single-phase alternating-current motors.

It is especially notable that two laundries which have to maintain small boilers for use in the laundry have abandoned steam engines in favor of electric motors, and find it greatly to their advantage, because with no engine to run boiler depreciation and expense is so much less and the electric motor requires so little attention, being always ready for service whether steam is up or not.

The largest motor, as said before, is the 85-hp motor of the flour mill. This mill had an efficient Corliss engine and good boiler plant, but it was found, everything considered, that the electric power is more satisfactory in the long run, and probably no more expensive. It is unusual to find an ice machine in operation in so small a town as Red Oak, but one of the meat markets has installed an ice machine, driven by an electric motor (Fig. 4), and maintains a large storage room for its meats, and is thus enabled to serve its customers much better than customers are usually served from meat markets in small towns. This motor is installed under a contract that it shall be turned off during the period of heaviest load if the company so directs. As it is only necessary to operate the ice machine a part of the time, this helps give the station an all-day load, and one which does not increase its requirements at the time of the peak. Several motors are in use driving ice cream freezers, coffee mills and sewing machines. A large calendar company in Red Oak, the Thomas Murphy Company, has a thoroughly modern plant, equipped with individual motors for each machine. There are 22 motors in this plant. While the cost of individual motors is, of course, considerably more than that of single motors with line shafting, the fact that there are no shafts and belting to interfere with the work and throw dirt and oil makes the individual motor scheme much preferred by the management of this establishment. The other printing establishments of Red Oak also have electric motors.

The waterworks pump is started and stopped by simply throwing a double-pole switch at the central station. An automatic starter, made by the Elektron Manufacturing Company, is placed at the waterworks for starting the pump when the current is turned on. In order to keep the pump primed, a small jet of water discharges onto one of the plungers when the motor and pump are in operation.

The capital stock of this company is $30,000; but the present investment is in the neighborhood of $80,000, although no additional stock has ever been issued.

The foregoing are the principal points regarding one of the progressive central station companies of Iowa; and they give encouragement to further effort on the part of other companies similarly situated. The company has never gone through any revolutionizing changes in its station, involving heavy investment, and has worked along little by little, enlarging as necessity demanded it. While this policy may not have resulted in as thoroughly uniform and modern a plant as some engineers would wish, it is, nevertheless, as can be seen from the foregoing, a plant which is paying, and from the fact that it is getting so much business, must be giving reliable service. The experience of this company simply goes to demonstrate what can be done by good management with a station and equipment of the kind that prevails in the majority of small towns, and without any very revolutionary changes.

The Loss on British Telegraphs.

A special cable dispatch from London of May 16 says: A statement of the income and expenditures of the telegraph system since the Post Office Department took it over in 1870, shows that for the first two years the revenue paid the interest on the purchase money. In no single year since has it been sufficient to cover the interest charge. The deficiency in the year 1872 was £119,000. This has steadily increased, until last year it was £950,740.

The major portion of the deficiency was due to the heavy charge for salaries, which is yearly growing more rapidly than the increase in the revenue. A few years ago a committee was appointed to investigate the condition of the post office employees. They made liberal recommendations in regard to an increase in wages. These were carried out at an immediate cost of £500,000 annually.

Fresh demands are now being put forward and will be a matter of debate in the House of Commons. Mr. Austen Chamberlain, the Postmaster-General, wants to submit the demands to a committee of business men. The employees object, as they are anxious to have the matter go before the Committee of the House of Commons. They know that they can by their votes bring pressure to bear on members of Parliament in their favor. This is one of the very grounds on which John Burns, the Socialist leader in the House of Commons, recently advocated the disfranchisement of all government employees.

National Fire Protection Association.

The seventh annual meeting of the National Fire Protection Association will be held at Chicago, at the Chicago Underwriters' Association, 159 La Salle Street, beginning Monday, May 25, and lasting four days. A very full and interesting programme will come up for consideration and among special reports to be presented are those on thermoelectric fire alarms, F. E. Cabot, chairman; heavy current protectors on wires of signalling systems, R. Sweetland, chairman, and electric fire pumps, Mr. Sweetland. Exhibits of various kinds will be made specially at the Underwriters' Laboratories, 67 East Twenty-first Street, on Thursday, May 28, which will prove of great interest to the members. The president is Mr. C. A. Hexamer, and the secretary and treasurer is Mr. E. U. Crosby.

The Pontiac Light and Water Co., Pontiac, Ill.

THE much discussed question of securing a profitable day load has been successfully solved by the Pontiac (Ill.) Light & Power Company. Not only has this been accomplished, but very gratifying results have been obtained in other directions. Although possibly the engineering features of the plant are not as up to date in every particular as in some of the larger and more modern central station power houses, nevertheless, all improvements warranted by a sound business policy have been made, and others will be added from time to time, as the finances of the company permit. As power is to be furnished by the company to a proposed interurban line to run through Pontiac, it has been decided to delay temporarily several improvements contemplated until such time as definite plans have been decided upon for the latter.

Pontiac is a small town of about 6,500 inhabitants, situated on the main line of the Chicago & Alton Railroad, 92 miles from Chicago. Branch lines from two other railroads also enter the town. At the present time it is not reached by any interurban electric road, although, as already mentioned, such a one is being planned. The manufacturing as well as the business interests are such as are usually to be found in towns of such size, and as a consequence do not offer any special advantages for an electric light business or other public utilities.

Due to a desire to unite all of the public utilities except the telephone business under one management, as well as to prevent possible ruinous competition, the Pontiac Light & Water Company owns the electric light plant, the water works, an exhaust steam heating system, is installing a gas plant, and will furnish power to the proposed interurban railway. Although, of course, it is a popular conception that competition is the life of business, nevertheless the management appreciates the fact that, especially in a town of such a size, competition is ruinous, and, furthermore, the cost of management alone would be prohibitive, or at least burdensome in the case of several concerns. The modern tendency to unite under one management as many correlated interests as possible, certainly results in decreased operating and managerial expenses, and must benefit the public at large because of decreased cost of production. For an electric plant having a day load it is not only natural but also profitable to engage in the heating business. It is but a step further, especially when conditions are favorable, as they were at Pontiac, to engage in the water business. To prevent what might be ruinous competition, to exploit a field which not only serves to do pioneer work for the electric business, but also covers a field of its own which cannot in any way compete with the former, a gas plant has been installed.

The secret of the success of the electric light plant is due in no small measure to the securing of a large day load. As this is a matter of vital interest to all central station men, it may prove of interest to note the manner in which this was obtained. As Mr. Fred L. Lucas, the manager and secretary, very aptly expressed it, to secure such a load it is necessary first of all to operate day circuits and then to secure the business. The merchant, to do business, must have articles which he wishes to sell, upon his shelves. Samples will not suffice. A brief review of the methods so successfully pursued will no doubt be of value. That the mere operation of a day circuit alone will not suffice is self-evident. A progressive, energetic, pushing personal campaign is required to acquaint the public at large and the prospective user in particular, with the advantages to be secured in using the electric current. This campaign has been augmented by judicious and systematic advertising in the local papers, calling attention to the advantages of each particular piece of apparatus to be pushed, and more particularly to the disadvantages of competing articles. As will be noted from the accompanying advertisement, attention was called to and particular stress laid on the danger of using gasoline arcs, and incidentally the safety, cleanliness and good light to be obtained by using the electric current.

The following advertisement is here reproduced to afford those interested in small central stations an opportunity to study the methods pursued.

Another factor for securing business, especially power, is to have a few motors in stock which can be used for supplying an immediate demand. Mr. Lucas related an incident which brought out this point very clearly. He had been trying for over two years to place a motor in a printing establishment, but without avail. At last came the opportunity. The gasoline engine broke down—it could not be repaired in time—could Mr. Lucas help them out? A one hp motor temporarily did the work of one three times the size. The evening edition was but one hour late, and an entry had been secured where formerly the gates had been closed. Now two motors are required to take care of the work in this establishment. Another factor in the securing of the business has been the policy of making it easy for customers to secure their motors, or whatever other apparatus has been required. The customer pays the same price at which the company secures the apparatus, with enough added to pay freight and cost of installing. An original payment of 10 per cent. of the total amount is required, and the balance is distributed over several months in easy payments. These are but a few of the more important points in the aggressive campaign made by the Pontiac Light & Power Company, and these, of course, can be augmented and varied to suit local conditions.

Gasoline Not Sold for Illuminating Purposes in Houses

Have you noticed this heading on the bills and other forms of the Standard Oil Company?

Do you catch the significance of it?

They manufacture practically all the gasoline made and yet won't sell it to illuminate your house. Take this hint before you have cause to regret not doing so.

For a good light, one that is reasonable in cost and perfectly safe, use electricity.

FIG. 1.—PONTIAC LIGHT AND POWER COMPANY.

A very instructive and interesting study of the operating conditions of the plant can be made. In general it can be said that the demands made by the different loads on the power house go hand in hand. The heating system makes its greatest demands on the power house when the electric light load is greatest; and in summer when no heating is required all exhaust steam is utilized by an ice plant, which is run in conjunction with the power house, but is owned by other parties. In the plant of the Pontiac Light & Power Company electric current may be considered a by-product. As is well known, the greatest economies result from the complete utilization of raw materials and all by-products, and from a financial standpoint this certainly appeals most strongly to the stockholder. As already stated, the heating plant in general makes its greatest demand on the station when the load is heaviest, although in times

Perfect Work

can only be accomplished in a light, clean, well ventilated shop.

With an Electric Motor there is no

Smoke, Dirt and Oil

to cause trouble and annoyance. You can use them anywhere, on any floor, on the wall, or on the ceiling.

We sell the General Electric Co's., Motors cheaper than you can buy them elsewhere, and we fully guarantee them. Easy Terms.

Pontiac Electric Company.

FIG. 2.—PONTIAC LIGHT AND POWER COMPANY.

of very severe weather live steam has to be used in conjunction with the exhaust. Arrangements will be made to determine the exact cost of operating the heating system next winter, although to judge from the data available so far, the management has come to the conclusion that it has paid handsome returns on the investment. Another point which is a valuable feature, and concerning which nothing is to be found in text books, is the arrangement between the company and the ice people whereby the ice plant load is thrown off the power house at the time of the peak. As the brine is of such a volume as to afford sufficient storage capacity of cold, no bad results follow. It may be of interest to note that the power house furnishes not only the power required for the ice business, but also the distilled water employed in the system used, the steam for reboiling the condensed exhaust steam from the power house and the water for the ammonia condensers.

The earlier company passed through many vicissitudes, and changed hands frequently, until it was bought by the present owners November 1, 1899, and incorporated as the Pontiac Light & Water Company. Mr. J. A. Carothers is the president and treasurer, and also principal owner, and Mr. Fred. L. Lucas the manager and secretary. Although the capital stock of the company is $140,000 and 5 per cent., 25-year bonds to the amount of $125,000 are outstanding, the assets ($320,000) greatly exceed the liability, and the business, due to the conservative and at the same time progressive management, is in excellent condition.

The company has the contract for the city lighting, which includes forty-six 6.6-amp. constant-current General Electric alternating enclosed arc lamps and 60 3.5-amp. series incandescent lamps for the lighting of alleys and the outlying districts, for which the city pays at the rate of $72 for the former and $15 for the latter, per year. The commercial load consists of 100 arcs, the equivalent of about 6,000 16-cp incandescent lamps, and thirty-six 500-volt motors of ¼ hp and larger of an aggregate capacity of 170 hp, besides a large number of small dental and other motors, and 120 fan motors. There is also one three-phase, 60-cycle, 220-volt motor which drives an ice machine.

Because of low rates which were in force at the time the plant was bought, it has not been possible to differentiate between different classes of customers, a flat meter rate of 10 cents per kw-hour being charged, and in the case of customers not owning a meter, a minimum rental of 25 cents per month. This, combined with a minimum charge of 75 cents, makes an actual total minimum charge of $1.00 a month. Customers pay for all installations and renewals of lamps. A cash discount for prompt payment has not been inaugurated, as it was felt that such a course under the existing conditions, would mean a loss, although this system has been adopted with good results in the case of steam heating customers. A charge of 6⅔ cents per kw-hour is made for power, and in case a guaranteed minimum of $15.00 a month is made, the price of the current is reduced to 5 cents per kw-hour. All bills are payable between the 1st and the 10th of the month.

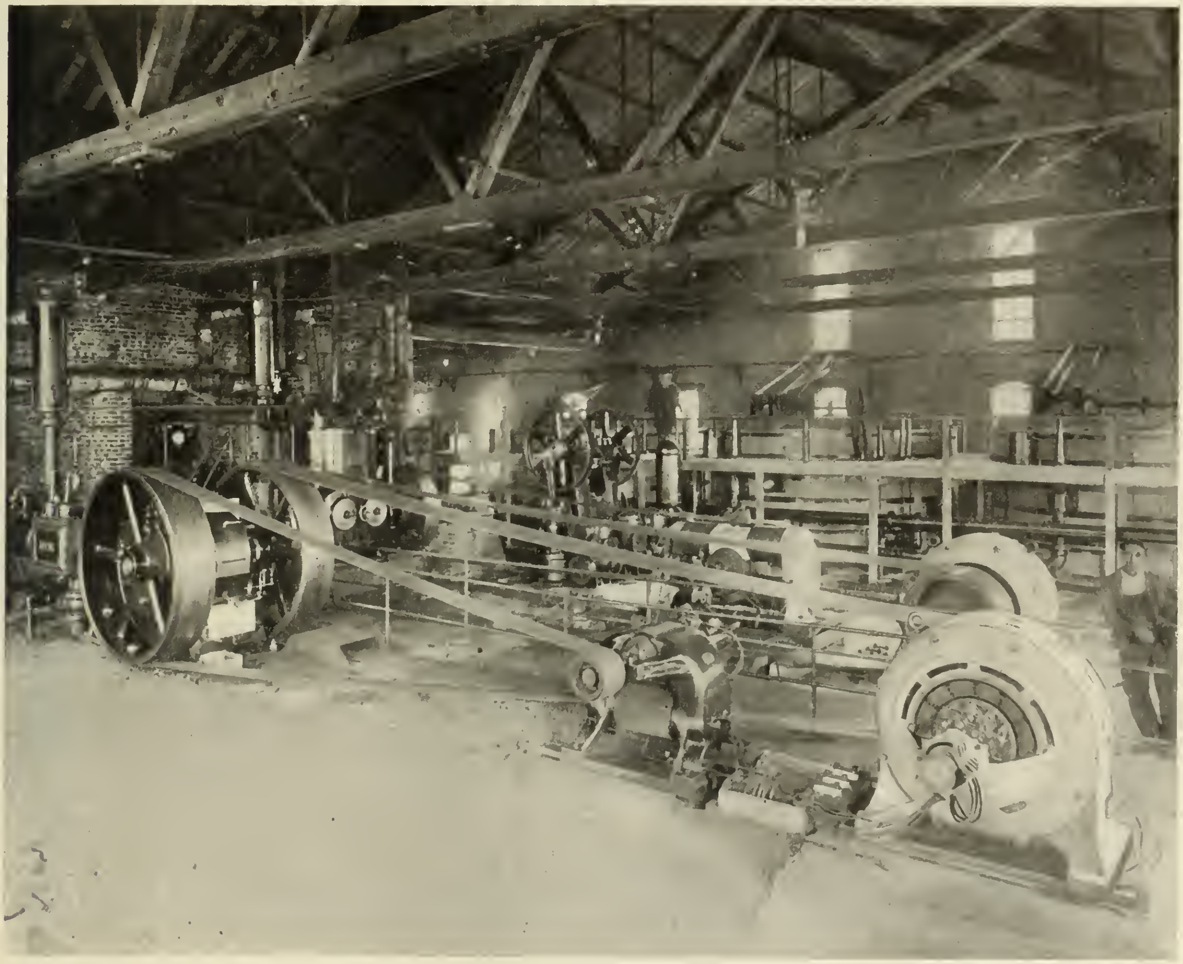


Fig. 3.—Interior View of the Pontiac Light and Power Company's Station.

The accounting system under Mr. W. H. Hessin has been developed to a proficient state, such as is warranted by the amount of business transacted. The card system is used wherever practicable, and a modified system of ledger accounts with individual customers is used. Because of peculiar local conditions, all bills are made out in duplicate, the latter serving merely as a memorandum for the customer, who receives the original receipted when payment is made at the office. A color scheme has been adopted whereby all bills or other records relating to any department can be readily separated from others. The number of customers served, some of whom, as for instance the County Farm, are located outside of the city limits, is about 525.

The power house is located on the Vermilion River, near the business center of the town. It is a brick structure, 98 x 110 ft., and was rebuilt when the present company secured control. The equipment at present includes two 250-hp Stirling boilers, provided with ordinary grates, and connected by a sheet iron breeching with a brick stack 125 ft. in height, 6 ft. in diameter, and having an inner core 70 ft. in height. The present layout is such that another boiler can be added without any difficulty. The coal has to be hauled to the boiler room, and as soon as the interurban road is completed will be obtained from the railroads by a spur run from the former. It is proposed to install a coal conveyer and coal bins reaching to the boiler room floors, with sloping cement floors, so that the coal will feed automatically and be convenient for the firemen. A small boiler pump is also located in the boiler room, and serves to pump the water for the boilers directly from the river in case of an emergency. Under ordinary conditions, the boiler feed is taken from the city supply, which has been purified in a Jewell filtering system and is heated in summer to about 130 or 140 by a 500-hp Cochrane feed water heater. In winter, as already mentioned, on account of the demands of the heating system on the exhaust, the temperature of the feed is not as great. The heater is so arranged that exhaust steam can be passed through it or be passed entirely.

Steam is generated at 145 pounds and supplied to the engines through a 10-in. main. A 16-in. and 22-in. by 16-in. tandem compound Ideal engine is belted to one 150-kw, 2,300-volt, 60-cycle General Electric compensated revolving-field alternator, and one 45-kw, 500-volt Wood generator. A 14 and 24 x 14 Westinghouse compound engine is belted to one 150-kw generator, identical with the one already described, and one 60-kw, 500-volt United States generator. A 12 x 12 single-acting triplex Gould pump of a capacity of 750 gallons per minute is driven by a Renold's chain directly from the shaft of the Westinghouse engine. A 500-volt variable-speed motor, however, will be used to drive this pump later on. Two steam pumps which are located in the old water works plant are to be transferred to the power house and used in cases of emergency, or when the Gould pump is overhauled. As will be inferred from the generators mentioned, a 500-volt power circuit is maintained. As street railway generators are shortly to be installed and because of the great expense that would be incurred in changing to any other system, it has not been considered advisable to discontinue this circuit. The 30-hp motor driving the ice machinery, however, is a three-phase alternating one.

A standard 2,300-volt alternating system is maintained for the commercial lighting. This is supplied by the two compensated revolving field generators. Two 25-lamp, 6.6-amp. General Electric constant-current transformers are installed for the city lighting. The switchboard which was also supplied by the General Electric Company contains one panel having instruments for measuring the total output of the alternating system, another does the same for the 500-volt power circuit, one contains the instruments for the series incandescent circuit, another is devoted to the series transformers, two to the generators, and one is a distributing panel. The switchboard is of standard construction, but it is interesting to note that as the alternators are three-phase and the circuits single-phase, it is necessary at times to change circuits over from one phase to another in order to balance the load on the phases. This is especially true on Sundays when the store lighting load is small. The commercial incandescent circuits are operated at 115 volts, and the residential circuits at 120. In the daytime the station pressure is 115 volts, and as a booster is inserted in the residential circuit, the proper pressure is maintained in the circuits. In the evening, however, the station pressure is 120 volts, and because of the drop, due to the inductive load of the arcs, the pressure remains 115 volts at the incandescent lamps on the commercial circuits, whereas the residential circuit because of the booster, has the same pressure as in the daytime. Although, of course, the potential at the lamps will not be as uniform as with potential regulators, the latter are out of the question because of the expense of installation and the cost of help for operating the same. The circuits, of course, are all overhead.

The overhead system, when taken over by the present company, was in a very bad condition. Eighty-two transformers of all sizes, from five lights up, not exceeding 150 lights in capacity, were connected to the system, in which, however, the two-wire was an unknown quantity. In a great many instances No. 12 B. & S. gauge wire had been used, and this from its own weight had been reduced in some places to No. 14 in size or less. The overhead system, however, in conjunction with the rest of the plant, is gradually being overhauled and rebuilt according to the most advanced practice. The transformers now are but 34 in number, varying from 20 to 1,000 lights in capacity. A three-wire secondary system has been installed in the business districts, at other points several transformers are in parallel, whereas the isolated transformer is used in the outlying districts only. Lightning arresters have been installed, and the secondaries will be fused and the neutral grounded as soon as possible. General Electric oil-insulated transformers are used exclusively. The feeders, of course, are single phase, although taken from a three-phase bus.

Another department which receives due attention—in fact, far more than is the case in some of the companies in the larger cities, is the meter department. Although, as is self evident to everyone, it is not wise to give particular attention to one department at the expense of another, nevertheless, when it is considered that the energy consumed on an electric light system at times of light load forms a no insignificant part of the total, and, furthermore, that the revenues received from both are nearly in the same proportion, it is self evident that too great care cannot be exercised in keeping the meters, as well as the meter department, at a maximum point of efficiency. Thomson recording wattmeters are used, and adjustable field shunt coils are fitted on all of them.

The heating system which was installed in the fall of 1901, in the opinion of the management, is a successful venture, although exact costs cannot be determined until the coming winter. It is the intention to increase this as soon as sufficient additional business can be obtained. At present there are 75 customers who are supplied by 6,000 ft. of mains which extend in a loop around the business section of the town. A total of 60,000 sq. ft. of radiating surface is connected to the system, which is mostly direct, only enough indirect radiation in the form of hot water heaters being installed in each building, that the condensed steam shall not have a greater temperature than 100 before being discharged into the sewers. The cost to the customers is 37½ cents per 1,000 pounds condensation, and a rebate of 10 per cent. is given for the prompt payment of bills within ten days of the first of the month. This discount has been found to be the best incentive for prompt collections, and was introduced, as the rates for heating were established, by the present company, and were so adjusted that the giving of the discount would not prove ruinous, as would be the case with the electric light business. The Holly system of exhaust steam heating of the American District Steam Company is used. As this system is well known, it is not necessary to go into the details of the same. A 10-in. exhaust pipe leaves the power house, and is successively reduced to 8 and 6 in., some 4-in. pipe being used for laterals. An oil separator removes all oil and water of condensation from the exhaust steam before it passes into the heating system. A 4-in. live steam pipe connects with the exhaust main through a pressure-reducing valve, which reduces the steam pressure to 5 pounds or less. In cold weather live steam is required to keep up the required pressure. The exhaust is turned into the heating system whenever the thermometer falls below 55 or 50° F., and the fact that the heat can be turned on in the houses at any and all times when there is any call for it, combined with the attendant cleanliness, etc., has proved an object for a great many to install the system, even though the cost may be somewhat greater than otherwise.

In the Pontiac system there are eight low points from which the water of condensation is removed by means of traps, which in turn are connected to the sewers. The customers' consumption is measured by a condensation meter, which also discharges into the sewer. From an economic as well as from an engineering standpoint, there is no doubt that the investment has proved profitable, and serves to show what can be accomplished in making existing investments still more profitable.

The waterworks were bought from the former bondholders at a receiver's sale in July, 1902. The physical property was in the worst possible condition, the city refusing to pay the rent for hydrants, as the service was entirely unsatisfactory. Unsuccessful attempts had been made to bore artesian wells. The river water, besides carrying a great deal of suspended matter, was unsanitary. When the Pontiac Light & Water Company assumed control, the attempt to bore artesian wells was abandoned, as it was found that the depth would be too great, and for that reason would involve pumping at too great an expense. It was further decided to do away with the old waterworks, doing all the pumping at the power house, although retaining a standpipe at that point. This is 12 ft. in diameter and 125 ft. high, having a capacity of over 100,000 gallons, and under ordinary working condition will be connected with the system. At times of fire, however, this will be cut off by means of an electric valve, located near the stand pipe, so that any desired pressure can be maintained on the mains.

As a result of careful investigation as to the best methods of treating the river water, the system of the New York Continental Jewell Filtration Company was installed. As the power house stands on a high bank, a 6-in. Lawrence Machine Works centrifugal pump driven by a 15-hp, 500-volt compound-wound General Electric motor is used in pumping the water from the river to two 30,000-gallon settling tanks, which are interconnected and so arranged as to allow the blowing off of all impurities which settle to the bottom of the tanks. A 4-in. centrifugal pump is to be installed as a reserve, which will pump 500 gallons per minute. The Jewell iron process of coagulation is made use of in these, the company guaranteeing the removal of 97 per cent. of the bacteria. From the top of these tanks the supply of water for three 500,000-gallon Jewell water filters is drawn, from which the water passes to a storage system, and thence to the pumps. A 7½-hp, 500-volt motor drives a countershaft operating the agitators in the filtering tanks, and a 3-hp motor drives the countershaft operating the centrifugal pump used for the coagulating process. There are eight miles of mains, supplying 310 customers. It is proposed to increase the number of customers by an aggressive and systematic campaign of advertising, calling attention to the wholly unsanitary condition of the well water which is used by a great many of the people. The supply is measured for all customers by meters owned by them, but the make is prescribed by the company. The rates are 25 cents per 1,000 gallons, and a discount depending upon the consumption is allowed on all bills paid before the 10th of the month following the quarter in which the water was used.

A gas plant with an annual capacity of 12,000,000 cu. ft. and provision for doubling that capacity with a holder of 50,000 cu. ft. are being installed at a point near the Chicago & Alton Railroad, as it was not thought advisable to install this near the power house, because of its proximity to the central part of the town. It is expected that all coke will be consumed by the home market, whereas the tar will be shipped to other points. Two solicitors are now at work and 300 customers at least are confidently expected before fall.

As already referred to, it was considered advisable to install the gas plant as well as acquire the waterworks, to prevent another concern from coming in and causing ruinous competition. The waterworks on the one hand would form a very good nucleus for starting an electric light plant and securing the city contract, whereas the gas plant in the hands of outsiders could be made a very formidable competitor. As it is, the gas business can be pushed to advantage in the field peculiarly its own; that is, for fuel, and used with discretion in connection with the electric light business for illuminating purposes. The ownership of the waterworks by those interested in the electric light business certainly has the effect of preventing others from gaining a foothold, which would be far easier in case the public utilities mentioned were not owned by one concern. There is no doubt but that ownership of public utilities by one concern and under one management is not only of benefit to those directly interested in the financial affairs of the company, but under wise management must also result to the good of the public in general.

It is almost impossible in an article of this scope to analyze as thoroughly the elements of success which enter into the successful operation of such a plant as might be desired. We do not look to such plants for the latest and most improved engineering apparatus and methods, but rather to the successful solution of the problem in hand, which consists in getting satisfactory returns on the existing investment, and the securing of a healthy increase in the business under those conditions.

Where Fanning Island Is.

Civil Engineer Werry, who was sent to determine the position of Fanning Island, in connection with the establishment there of a station of the British-Australian cable, has found that the latitude as given on the Admiralty charts is 26 seconds too far north. The longitude, as shown by the charts, is correct.

Statistics of the Massachusetts Electrical Supply Systems in 1902.

By Alton D. Adams.

Dynamos at electric lighting stations in Massachusetts had a combined capacity of 84,375 kw on June 30, 1902. These figures represent an increase of 21 per cent. over the like capacity of the previous year. In spite of this increase, the number of dynamos employed stood at 868, representing a loss of 60 machines in the previous twelve months. These movements were due to the general tendency to replace small belted dynamos with much larger direct-connected units, which carried the average capacity of all generators from 74 to 97 kw each.

Changes in the capacities of the several classes of dynamos were very unequal during the year. Arc machines sustained a loss of 18 per cent. and stood at 10,110 kw. Generators used for power purposes only, represented 15,926 kw, a gain of 12 per cent. Dynamos suitable for incandescent lighting gained 35 per cent. in capacity and reached 58,339 kw. From these figures it appears that arc dynamos had 12, power generators 19, and dynamos suitable for incandescent lighting 69 per cent. of the total capacity at lighting stations. Compared with the previous year the arc dynamos had lost 5 per cent. and the power generators 1 per cent., while incandescent dynamos gained 7 per cent. of the total station capacity. The capacity lost by arc dynamos was greater than the gain in power generators, so that the increase of capacity in generators suitable for incandescent lighting was greater than the total increase of the systems. At the rate of shrinkage here indicated for arc dynamos, a few years will see their entire disappearance from electric systems. The obvious cause of this movement is the substitution of enclosed arcs, at constant pressure for interior lighting, and at constant, alternating-current for street service, in the place of series direct-current lamps. Generators of the direct-current type for the supply of power only are employed in some instances to operate railway rather than stationary motors, so that it is impossible to state just how much of the increase in their capacity was applied to either purpose. Dynamos suitable for incandescent lighting, of both the direct and alternating-current types, are now largely applied to the operation of stationary motors, and this fact accounts in part for the marked rise of capacity in this class of machines.

DYNAMOS AT ELECTRIC LIGHTING STATIONS IN 1902.

	Number.	Total kw.	Average kw.
Total	868	84,375	97
Increase	60*	14,941	23

	Arc.	Incandescent.	Power.
Kilowatts	10,110	58,339	15,926
Increase	2,124*	15,242	1,823

	Arc.	Incandes't.	Power.
Percentage of total capacity	12	69	19
Loss of percentage	5	7†	1

ENGINES, BOILERS AND WATER WHEELS.

	Number.	Total H.P.	Average H.P.
Engines	327	102,390	313
Increase	17*	13,042	53
Boilers	345	60,593	176
Increase	14*	270	8
Water wheels	43	9,623	224
Increase	1	191	0

* Decrease.

† Gain.

Steam engines, like dynamos, show a rise of total capacity coupled with a decline in numbers during the year. Thus the total number of engines at electric lighting stations was 327, representing a loss of 17, and their combined capacity was 102,390 hp, a gain of 14 per cent. Along with this increase of total capacity came a rise of the average horse-power to 313, or 20 per cent. above that of the previous year. Boilers fell back to 345, a loss of 14 in numbers, but stood at 60,593 hp, showing a small gain of 270 hp in total capacity. This movement raised the average horse-power by 8, or to 176 per boiler. The fact that engine rating exceeded that of boilers by 68 per cent. is accounted for in large part by the practice of allowing an evaporation of 30 pounds of water per hp-hour for boilers, while economical engines operate at a much lower rate of consumption.

A single water wheel was added in the electric light stations of the State during the year, and the total wheel capacity was thus raised to 9,623 hp. Of the combined rating of engines and water wheels amounting to 112,014 hp, the wheels represented only 86 per cent. The total rating of dynamos reduced to horse-power amounts to 112,500, or 9.8 per cent. more than the rated power of engines, but almost exactly equal to that of engines and water wheels combined.

On June 30, 1902, 8,042 stationary motors were connected to electrical supply circuits within the State, and the combined rating of these motors amounted to 34,570 hp. The average horse power of these motors was 4.2, representing a rise of 0.3 hp each during the year. Motors on circuits operated by power generators fell to 22 per cent. of the total number, a loss of 12 per cent. in twelve months, while motors on circuits operated by dynamos used also for incandescent lighting gained 13 per cent. in relation to the number of all motors and closed the year at 78 per cent. of the total. A single arc motor remains in the field. Boston contained 4.435, or more than one-half of all the motors supplied by electric light stations in the State, and the average capacity of these motors was 4.4 hp each. The total capacity of motors at Boston was 44 per cent. of that for the entire State. The loss in the total number of motors at Boston, as well as the loss of 989 motors from the circuits of power generators throughout the State was due to changes at Boston by which 1,086 motors were dropped from the circuits of power generators in that city. All of the motors at Boston were thus brought into circuits fed by generators that also supply incandescent lamps. As the number of motors operated by power generators decreased 1,086 at Boston, but only 989 for the entire State, it follows that there was a gain of 97 motors of this class outside of that city.

STATIONARY MOTORS CONNECTED TO ELECTRICAL SUPPLY SYSTEMS.

Circuit.	Number.	Gain or loss.	Horse-power.
Arc	1	4*	
Power	1.747	989*	
Incandescent	6,294	1,064†	
Total	8,042	75†	34.570
Motors at Boston	4.435	358*	19,670

* Loss.
† Gain.

TOTAL ARC LAMPS.

	Single open.	Double open.	Enclosed.
Number in state	1.690	6,066	19,292
Increase or decrease	590*	1,721*	3.580†
Number in Boston	137*	....	8,828
Increase or decrease	166*	308*	1,005

* Decrease.
† Increase.

STREET AND COMMERCIAL ARCS.

	Street.	Commercial.	Total.
Number	13.991	12,384	26,375
Loss or gain	89*	1,165†	1,076
Percentage of total	53	47	....

* Loss.
† Gain.

Conquest of the arc lighting field by enclosed arcs has gone rapidly forward during the year, as may be seen by the gain of 3.580 in the number of this type of lamp; while single open arcs lost 590 and double arc lamps, 1,721 of their number. At the close of the fiscal year, the electric lighting systems included 1,690 single open lamps, 6,066 double lamps and 19,292 enclosed arcs. Owing to the fact that not all of the lamps included in the electric systems are in use at any one time, the total number of these arc lamps, 27,048, was greater by 673 than the sum of public and commercial arcs. The street or public arcs stood at 13,991, having decreased in number by 89 during the year, but commercial arcs made a gain of 1,165 and closed with 12,384, showing a net gain of 1,076 for all arc lamps in use. Of these lamps 53 per cent. were devoted to public and 47 per cent. to commercial service.

Arc lamps continue to be rated at nominal candle-powers that range from 500 to 4,000, besides ampere ratings of 1 to 20 in the case of enclosed arcs. For public lamps the rating by nominal candle-power is still the favorite method, all save 459 of these lamps being so rated. Commercial lamps are more commonly rated according to the amperes taken, 64 per cent. of their number being on this basis. Among commercial arcs, 5 amp. was the most frequent rating, 31 per cent. of their total number having been of that capacity, while 2,000-cp lamps followed with 19 and 1,200-cp lamps with 15 per cent. Of the public arcs 45 per cent. were rated at 1,200, and 51 per cent. at 2,000 cp.

Commercial incandescent lamps were rated at 2 to 150 cp each, and their total number was 1,305,473 on all the lighting systems of the State. Of this number, 98 per cent. was made up with nominal 16 cp lamps, and there were only 3,576 lamps of all higher candle powers. The tendency to use lamps of less than 16 cp rating was very slight, the largest number in any one size being 5,430 lamps of 10 cp. The total number of commercial incandescent lamps rose 16 per cent. during the year.

Incandescent street lamps like those in commercial service were mainly rated at a single candle power, but this rating for the street lamps was 25 instead of 16 candles. Of the 20,101 incandescent street lamps, 74 per cent. were of the nominal 25-cp size, and 32-cp lamps followed with 10 per cent. of the total number. Unlike arc street lamps, the incandescents increased in numbers during the year, the rise amounting to 9 per cent. of their number at the beginning. These incandescent street lamps have been shifted in the main from constant-pressure alternating and constant direct-currents circuits to lines operated by constant current transformers.

PUBLIC ARCS RATED IN CANDLE POWER.

Candle power.	Number.	Candle power.	Number.
1,200	6,312	1,600	26
1,500	2	2,000	7,170

PUBLIC ARCS RATED IN AMPERES.

Amperes.	Number.	Amperes.	Number.
5.5	320	6.6	139

INCANDESCENT STREET LAMPS.

Candle power	15	16	20	24
Number	216	158	854	414
Candle power	25	30	32	40
Number	14,950	869	2,036	546
Candle power	50	64	65	75
Number	23	17	17	1

COMMERCIAL ARC LAMPS.

Candle power	500	600	800	1,200
Number	1	5	16	2,085
Candle power	1,500	1,600	2,000	4,000
Number	2	60	2,306	6

COMMERCIAL ARC LAMPS.

Amperes	1	3	4	5	6	6.8
Number	1	540	1,103	3,842	1,656	108
Amperes	6.6	7	10	15	20	..
Number	17	456	43	2	1	..

COMMERCIAL INCANDESCENT LAMPS.

Number	152	751	984	3,851	5,430
Candle power	2	4	6	8	10
Number	2,293	1,288,284	2,338	486	25
Candle power	12	16	20	24	25
Number	6	648	43	1	29
Candle power	30	32	50	65	150

CAPACITIES OF CONNECTED LOADS.

Load.	Kilowatts.	Percentage of total.
Arc street lamps	6,234	5.1
Incandescent street lamps	1,830	1.6
Commercial arc lamps	5,599	4.6
Commercial incandescent lamps	72,871	60.0
Electric motors	34.570	28.5
Total	121,101	99.8

To determine the total capacity of loads connected to the circuits of electrical supply systems, each kind of apparatus has its rating reduced to a kilowatt basis. For this purpose, it is assumed that the full load efficiency of all motors is 74.6 per cent., so that one kilowatt must enter the motors as electric power for each mechanical horse-power delivered. With arc lamps rated at nominal candle-powers, 0.25 watt has been taken as the rate of consumption per candle-power. Arc lamps rated in amperes are assumed to operate with 80 volts each. All incandescent lamps of both the street and commercial sorts have been computed on the basis of 3.5 watts per nominal candle-power.

ENERGY INCOME PER KILOWATT CAPACITY OF CONNECTED LOAD.

Loads.	Kilowatts.	Dollars income.	Dollars per kw.
Arc street lamps	6,231	1,410,812	233.
Incandescent street lamps	1,830	353.364	195.
Motors	34.570	921,786	30.
All commercial lamps	78,470	3.721.284	47.42
Total	121,101	6,578.598	54.

From these computations it appears that the total capacity of lamps and motors connected to electrical supply systems amounted to 121.101 kw. or 14 more than the corresponding load of the previous year. Of the total capacity of dynamos at electric lighting stations, in 1902, the connected load was 143 per cent. Commercial incandescent lamps made up 60 per cent. of this load, having gained 1 per cent. in their relation to total capacity during the year. Electric motors represented 28.5 per cent. of the connected load and had lost 1.2 per cent. of its total in the preceding twelve months. Other items in the load each varied less than one per cent. as to its total when compared with those of 1901.

The year under review shows an increase of 5 per cent. in the number of poles included in electrical supply systems, and closed with this number at 116,004, of which 110,942 were set in public streets and 5.062 elsewhere. Meantime the length of underground conduit went up 11 per cent. to 1,257,855 ft., or 239 miles. At 50 poles per mile, the number just named corresponds to 2,320 miles of line, or ten times the length of underground conduits. The underground conduits contained 8,968,798 ft. of wire, or an average of 7.1 wires per conduit. The length of conduit added during the year was 25 miles, and of pole line, at 50 poles per mile, 120 miles.

Electrical supply systems within the State were operated by 66 companies that did only electric business, and by 24 gas companies during the year. The sum of stocks, bonds and notes outstanding against the companies may be taken as an approximate measure of their investments. This sum was greater by $6,267,190 for all the gas companies of the State than for the purely electric companies, but the electric assets of the gas companies stood at the sum of $4,064,594, so that the total investment in electrical supply was probably greater than that in all the gas systems. Extensions of the purely electric companies have been provided for by an increase of 8.4 per cent. on the face value of their stocks, 7.2 per cent. on their bonds, and 8.4 per cent. on notes payable. Comparing the electric assets of the gas companies with the assets of the purely electric companies, it appears that the latter have made 86.1 per cent. of the total investment in systems of electrical supply.

The surplus of all the companies doing a purely electric business amounted to 14.1 per cent. of their capital stocks at the close of the year, but the actual amount of this surplus was 28.1 per cent. less than that of 1901. Gross income of all electric lighting systems by whomsoever operated amounted to $6,642,309 for the year, representing a gain of 9.1 per cent. over the like income for 1901. Of the income named, 99.0 per cent. was derived from sales of electrical energy, and 1.0 per cent. from the rent of motors, meters and fixtures, and from steam heating. Operating expenses of all electrical supply systems amounted to 62 per cent. of their earnings, leaving a gross profit of $2,532,493. Of this profit the gas companies earned 18 per cent., leaving $2,142,920 for the purely electric companies. Incomes of the last-named companies from jobbing and rents of buildings brought their gross profit up to $2,563,758, or 12 per cent. on their investments, measured by the sum of stocks, bonds and notes. Of the gross profits just named, interest absorbed 13.5, dividends 47, depreciation charges 10.2 and sundry items 39.6 per cent., resulting in a deficit. The sum of dividends was $1,207,458, or 8.7 per cent. on capital stocks. Depreciation charges amounted to only $262,086, or 1.2 per cent. of the face value of stocks, bonds and notes, or 1.3 per cent. on the value of the assets of electric companies. These charges left a deficit of $269,714 in operations for the year.

The income of electrical supply systems was 87.3 per cent. of that derived from the sale of gas throughout the State, but gas street lamps earned only 9.8 as much as the electric.

Of all sales of electrical energy, that for commercial, arc and incandescent lamps by meter was the most important, and yielded 46 per cent. of the total energy income. Next in importance came the service to arc street lamps, which furnished 22 per cent. of the energy income. Sales of current for power purposes yielded 15.9 per cent. of the income, a gain of 1 per cent. over the previous year. Commercial incandescent lamps at contract rates earned only 3.5 per cent. of the total income, and commercial arc lamps on contract rates were credited with 6.8 per cent. of this total. Incandescent street lamps earned 5.4 per cent. of the energy income, or one-fourth as much as the arc street lamps. Arc and incandescent street lamps combined earned 27.4 per cent. of the entire energy income, or 1.2 per cent. less of this total than in the previous year.

Of the $4,109,816 expended in the operation of all the electrical supply systems during the fiscal year of 1902, 53.4 per cent. was represented by the outlay at the electric stations, 18.7 per cent. by the cost of distribution, 13.1 per cent. went for offices and management, and 14.6 per cent. for miscellaneous expenses. The total of these expenses was 4 per cent. greater than that of the previous year. Fuel represented 48.4 per cent. of the entire expense at electric stations, and 22.8 per cent. of all operating expenses for electrical supply systems. The other items of expense at electric stations were made up of wages, 27.4 per cent.; rent of real estate, 4.4; steam plant repairs, 6.5; electric plant repairs, 4.9; station repairs, 2.4; water, 2.8; oil and waste, 2.1, and apparatus and machinery, 0.7 per cent. of the total there.

Taxes paid on all the electrical supply systems by whomsoever owned amounted to $341,822.87, and this sum is only 1.1 per cent. of the value of all assets of electric companies, plus the value of electric assets of the gas companies, according to their own statements. Current bought by electrical supply systems amounted to $33,672, a sum greater by 56 per cent. than that of the previous year, showing the tendency to trade between the various companies and with electric water power plants.

Percentages of energy income from each load:

Commercial arc and incandescent lamps by meter	46.
Arc street lamps	22.
Motors	15.9
Commercial incandescent lamps by contract	3.5
Commercial arc lamps by contract	6.8
Incandescent street lamps	5.4
All street lamps	27.4

Arc street lamps yielded an income during the year of $1,410,812, or $233 per kw of capacity in those connected to the systems. Incandescent street lamps come next in relative income with a total of $353,364, or $195 per kw of their capacity. The income per kilowatt from arc street lamps shows a decline of $13 and the like income from incandescent street lamps $18, compared with corresponding figures of the previous year. From all commercial lamps, both arc and incandescent, the income was $3,721,284, or $47.42 per kw capacity, in 1902, this income per kilowatt being more than $4 below that of 1901. In the case of motors the entire income amounted to $921,786, or $30 per kw of capacity, this latter sum being $1 greater than that of the previous year. These incomes per units of connected capacity seem to indicate a general reduction in prices for electrical energy as represented by $54 per kw capacity, in 1902, instead of $58 as in 1901.

Five of the electric supply companies did not earn enough to pay operating expenses during the year, and twenty-five more of the companies paid no dividend. The largest dividend paid was 50 per cent. on capital stock in the case of a company that sold its plant and went out of business. Two companies paid dividends of 10, and nine companies 8 per cent. on stocks.

Death of Edward Tremlett Carter.

We regret to report the death of Mr. Edward Tremlett Carter, editor of London *Electrician*, which occurred at Cleveden, Somerset, April 17. Mr. Carter, who was born at Calcutta, April 26, 1866, was educated at Bristol, privately, and at Merchant Venturers' College, and afterwards at University College. On completing his engineering studies under Profs. S. P. Thompson and H. S. Hele-Shaw, at University College, Bristol, Mr. Carter, in 1885, was appointed lecturer at the School of Electrical Engineering, Hanover Square, London, at that time the only school in the world having a fully organized electrical engineering course. While on the staff of this institution, he organized courses of lectures and practical training in mechanical engineering, machine design and other branches of engineering. One of these courses subsequently appeared as a series of articles in the *Electrician*, and afterwards in book form, entitled, "Motive Power and Gearing for Electrical Machinery." During the eight years he remained at the school he engaged in practice as a consulting engineer, and also contributed numerous articles to the *Electrician*. In 1893 he joined the editorial staff of that journal under Mr. A. P. Trotter and in 1897 was appointed editor of that journal, a post which he has retained until the present time. Mr. Carter was a member of the Institution of Electrical Engineers and of the Société des Ingenieurs Civils de France; also a Fellow of the Royal Astronomical Society and of the Physical Society of London. About 1897 Mr. Carter paid a visit to the United States, and the many acquaintances he made here at that time, as well as other Americans who have experienced his hospitality in London, will regret his untimely decease.

Centralized Management of Electrical Properties.

By H. S. Knowlton

AMONG the powerful economic changes which differentiate the present from the past in industrial life, few are of greater importance than the development of the trust and syndicate principles of property ownership. The tendency of the times is a combination of interests whose objective point in the last analysis is always a greater financial return per unit of investment. This is derived by either limiting or annihilating competition, reducing operating expenses and possibly fixed charges, or by a concentration of property management in a few responsible hands, the identity of the different systems remaining intact. The absence of competition defines the trust principle; and its existence, or non-suppression, the syndicate. It is impossible in the scope of this article to discuss the trust problem, and impracticable to treat the syndicate question with that thoroughness which it deserves, but as far as space permits, I shall attempt to note down some of the essential features of centralized management as they apply to the control of electric railway and lighting properties existing in the United States to-day.

The industrial progress of the last century has converted many former luxuries into necessities so vital in their relations to our daily life that the advance of civilization itself would be stayed if they were taken away. Substitute the horse in place of electric motive power in city transportation, and the imagination demands no further illustration. Upon this fact rests the foundation of success—the output of the electric property being an imperative necessity of civilization in urban communities. If the system is managed on scientific principles, with honesty and fair dealing practiced by both consumer and operator, a long step has been taken toward financial prosperity.

It would be difficult to name any city in this country which is to-day a stranger to the incandescent lamp and the electric car. It is far easier to discover electric systems which are burdened with antiquated apparatus, and so inefficiently operated that dividends are meagre or conspicuously absent. The tremendous electrical developments of the last quarter century are in the main responsible for this. Operating economy and the progressive applications of a newly developing science seldom travel together, and in the first enthusiasm of electrical progress it is not surprising that little attention should have been given to the expert analysis of financial and operating efficiency. In the last decade, however, the elimination of losses has gradually been given increased attention, and the centralized management of properties has naturally followed.

In order properly to estimate the advantages of centralized control, it is desirable to understand something of the controlling organization itself. It is essential that the combination which operates the property include in its make-up highly specialized ability of at least four kinds—financial, executive, technical and tactical. It must, further, be in close touch with a syndicate of banking houses or capitalists of recognized standing, and may or may not occupy the same offices with them. Its headquarters are preferably located in one of the great money centers of the country, as its work demands every facility for the swift transaction of business which modern labor-saving methods can produce. In the office organization the subdivision of labor will depend largely upon the number and character of properties managed, and the employees will vary from less than a score to several hundred.

Broadly speaking, a large managing concern may be divided into at least three departments in its controlling offices: executive, operating and engineering. Although the functions of these separate divisions will at times overlap, the work of the concern is usually parcelled out to that particular branch of the office which can dispose of it most efficiently. Sub-departments for the handling of mail, telegrams and express matter, the purchase of all kinds of apparatus and supplies, the preparation of drawings, filing of records, statistics and data, the auditing and keeping of accounts, management of securities, etc., will all play an important part in the conduct of the concern's affairs. In each one of these departments the work will be divided further among specialists most qualified to perform it, so that in the last analysis each piece of work receives the attention of an expert in some particular field, and is seldom carried through in detail by the "all-around" type of man which a single property requires when managed from within itself. Thus, in the engineering department all questions arising in any of the properties in regard to the capacity of railway motors and distributing systems for given schedules and services will be referred to an engineer who is a qualified expert in that class of problems, and the organization's decisions in those matters will be largely based upon his figures. In like manner, the legal department will refer questions of power contracts to a particular man whose knowledge of that subject is special.

It is thus apparent that a rightly managed centralized body can offer to the smallest and most scattered properties advantages in operating control which are impossible to any but the largest city companies. The expense of concentrating and maintaining a staff of experts at headquarters is far less burdensome to the coalesced organization than even a much smaller corps of specialists would be to the individual company. The various common operating supplies can frequently be purchased in bulk with great economy, and the operation of each property can be watched with microscopic eye. Data of the utmost significance is constantly flowing into headquarters from the outside plants, and an exhaustive analysis of the operating results in toto and per unit of output often yields comparisons which can be the means of saving hundreds or thousands of dollars in yearly operating cost. By plotting the financial and operating figures of the different properties from week to month in graphic diagrams, the presence of any unusual variation in conditions can be immediately detected, and at once attacked by the solvent of expert analysis.

When the various properties are located in widely differing sections of the country, the field of investigation and possible reduction of wasteful expense is almost limitless. It is safe to say that no growing property remains in, if indeed it ever reaches, the happy state in which no further improvement in expenses or methods is possible. Few managers of individually controlled systems have either the time or facilities to make anything like the detailed comparative analysis of depreciation, power losses, idle capital invested, etc., which are possible to the trained dissectors employed by the progressive controlling organization.

The card catalogue, correspondence, data and record-filing systems of the headquarters office should be as nearly perfect in their adaptation to the accurate and prompt transaction of business as human skill can make them. A well-equipped and maintained technical and commercial library is inseparable from the highest efficiency in the active management of the properties. Nor should the collection and classification of reliable data from other properties than those controlled by the concern be lost to view. It should frequently send its experts to examine new and instructive installations and systems, and thus prepare itself to take prompt advantage of any improvement in apparatus and methods which can be applied at home. The expense of such examinations will be justified in the long run by the progressive work which will be accomplished, and there will be little room for methods to become fossilized. From time to time special investigations of the financial economy of the property investments in proportion to the business done should be made, apart from the data furnished by the operating reports.

An important phase of such an organization's work is the reception of business propositions from the four quarters of the globe in regard to new electrical or other industrial developments to be financed and operated. The data which the management obtains from its own properties is thus of great use in judging the prospects of others, and the larger the field of control, the broader is the range of possible prediction. Consequently, as new properties are taken on, the efficiency of the financial analysis should be much increased.

It is doubtless true that the centralized control of a property hundreds or even thousands of miles from the headquarters office would be unsuccessful without the services of a resident manager. Countless situations arise each week which demand the presence of a strong personality acting in the home organization's interests. Such a representative must be a picked man, diplomatic, resourceful, with sound business ability, common sense and a good general knowledge of the technical phases of the work. Standing between the controlling power and the public, alive to every possibility of obtaining new business, extending the company's influence, and, above all, keeping the system in motion, he will find little time to devote to the detailed analysis practiced by the centralized body's financial experts. The importance of the latter in higher economies of operation is thus the more apparent.

It is certain that securities of any property operated by a centralized management possess a stability in value which is not found in the case of a system controlled by a single individual, whose death or mental disability may bring untold disaster upon the property through the incompetence or heedlessness of heirs and assigns. Again, the controlling management should have a vital financial interest in so developing and operating the property that its value is constantly being increased, and it should confine itself to operation and development apart from the business of buying and selling securities used merely as objects of speculation and barter.

In estimating construction and operation cost, the liberally conducted property management has an immense advantage over the singly operated company. Knowing as it should the detailed cost of every system which it controls, it is in a position to estimate the cost of new work with unusual accuracy. A further advantage arises in the comparison of previous quotations by contractors and manufacturers with present figures submitted.

Finally, efficient centralized management requires a considerable amount of traveling per year by certain experts of the headquarters office. In every case where complete data cannot be obtained by correspondence, or wherever a personal trip from the executive office to the property will positively throw additional light upon the local conditions, such a trip should be made. The data used in making financial estimates and analyses should always be the best obtainable at any cost consistent with the permanent economy of the work, or serious losses will follow.

Considered broadly, centralized control with a resident manager, therefore, appears the condition of greatest success in the operation of many existing electric properties, and the further development of this method will undoubtedly continue to attract the increasing interest of the industrial economist of the twentieth century.

Enclosed Arc Lamp Statistics—Records of Thirty Central Stations.

By L. B. Marks.

In an article on "Enclosed Arc Lamp Statistics," contributed to these columns in the issue of November 4, 1899, data were given by me showing the number of open and of enclosed arc lamps in use in 1895, 1896, 1897, 1898 and 1899 respectively on the circuits of thirty-six of the lighting companies holding membership in the Association of Edison Illuminating Companies.

The records in the following table are supplemental to those given in the article above referred to and contain the data submitted to me in March, 1903, by thirty companies, as follows:

Georgia Railways & Electric Company, Atlanta, Ga.; Edison Electric Illuminating Company, Boston, Mass.; Edison Electric Illuminating Company, Brockton, Mass.; Edison Electric Illuminating Company, Brooklyn, N. Y.; Buffalo General Electric Company, Buffalo, N. Y.; Canton Light, Heat & Power Company, Canton, Ohio; Chicago Edison Company, Chicago, Ill.; Columbus Edison Company, Columbus, Ohio; Edison Electric Illuminating Company, Cumberland, Md.; Edison Illuminating Company, Detroit, Mich.; Elgin City, Chicago & Alton Railway Company, Elgin, Ill.; Edison Electric Light & Power Company, Erie, Pa.; Jackson Light & Power Company, Jackson, Mich.; Minneapolis General Electric Company, Minneapolis, Minn.; New Orleans Railways Company, New Orleans, La.; New York Edison Company, New York, N. Y.; Paterson & Passaic Gas & Electric Company, Paterson, N. J.; Piqua Electric Company, Piqua, Ohio; Metropolitan Electric Company, Reading, Pa.; Rochester Gas & Electric Company, Rochester, N. Y.; Missouri Edison Electric Company, St. Louis, Mo.; St. Paul Gas Light Company, St. Paul, Minn.; San Francisco Gas & Electric Company, San Francisco, Cal.; Edison Sault Electric Company, Sault Ste. Marie, Mich.; Washington Water Power Company, Spokane, Wash.; Syracuse Lighting Company, Syracuse, N. Y.; Toledo Railways & Light Company, Toledo, Ohio; Potomac Electric Power Company, Washington, D. C.; Connecticut Railway & Lighting Company, Waterbury, Conn., and Wilmington City Electric Company, Wilmington, Del.

City.	Open arcs.	Enclosed Arcs.	Remarks.
Atlanta, Ga.	....	1,850	Street lamps d. c. series enclosed—displaced d. c. series open; commercial a. c. multiple service.
Boston, Mass. ...	100	8,000	Street lamps d. c. series enclosed; 4,050 series lamps—displaced d. c. series open. Includes Boston Elec. Lt. Co. and Suburban Lt. & Pr. Co.
Brockton, Mass. ..	....	790	
Brooklyn, N. Y..	4,140	4,970	Street lamps d. c. series open and d. c. multiple enclosed; 3,380 series open arcs.
Buffalo, N. Y. ...	....	6,700	Street lamps d. c. series enclosed—displaced d. c. series open.
Canton, O.	....	555	Data Dec. 31, 1902. Street lamps (349) d. c. 6.6 ampere series enclosed; store lamps d. c. multiple and d. c. series enclosed.
Chicago, Ill.	2,292	10,182	Street lamps d. c. series open.
Columbus, O.	803	836	Open arc service d. c. series.
Cumberland, Md...	100	150	
Detroit, Mich. ...	....	1,469	
Elgin, Ill.	....	320	
Erie, Pa.	....	1,110	Street lamps all d. c. series enclosed (700)—displaced d. c. series open.
Jackson, Mich.	250	190	Open arcs are all street lamps d. c. series; enclosed arcs are store lamps multiple a. c.
Minneapolis, Minn.	1,215	2,275	Open arcs all d. c. series; 922 of these for street lighting.
New Orleans, La.	1,874	1,860	Open arcs all d. c. series. New Orleans Railways Co. and Edison Electric Co. Consolidated.
New York, N. Y.	1,138	12,422	Statistics for Borough of Manhattan only.
Paterson, N. J....	1,023	1,145	All but 56 of the open arcs are d. c. series.
Piqua, O.	135	125	
Reading, Pa. ...	700	750	Open arcs d. c. series.
Rochester, N. Y. .	2,262	2,468	Open arc d. c. series street service. Company writes April 3, 1903, "The past year we have taken another Company into our fold and they had a great many open arcs."
St. Louis, Mo. ..	65	2,915	Enclosed arcs a. c. multiple.
St. Paul, Minn. .	....	1,949	396 street lamps a. c. series enclosed; 140 a. c. multiple enclosed and 1,413 d. c. multiple enclosed arcs on commercial circuits.
San Franc., Cal...	1,500	2,800	Street lamps d. c. series open.
Sault Ste. Marie, Mich.	....	247	Street lamps a. c. series enclosed. Store lamps a. c. multiple.
Spokane, Wash. .	399	699	Open arcs are d. c. series. Company writes March 31, 1903, "We are now displacing 275 T-H open arc lamps by 7½ ampere series alternating enclosed arc lamps."
Syracuse, N. Y.....	1,325	925	All open arcs $9^{6}/_{10}$ ampere d. c. series street lamps; 125 a. c. series enclosed on commercial circuits.
Toledo, O.	869	315	Street lamps only, reported; of these 315 arc a. c. series enclosed.
Washington, D. C.	....	2,394	1,066 street arcs of which 569 are series d. c. enclosed, which displaced d. c. series open; balance multiple d. c. enclosed.
Waterbury, Conn.	512	414	Open arc lamps d. c. series.
Wilmington, Del..	476	559	All but 53 of the open arcs are d. c. series.
Total	21,178	71,384	

In the table, series (constant-current) high-tension arc lamps are referred to simply as "series," direct-current lamps as "d. c.", and alternating current as "a. c."

Of the 21,178 open arcs connected to the circuits of these companies in 1903 about 4,250 are multiple lamps, the balance being series. Of the 71,384 enclosed arcs, about 11,000 are series lamps, the balance being multiple. The vast majority of the multiple lamps, enclosed and open, are operated on 110 to 120-volt direct-current constant potential circuits.

The comparative use of open and of enclosed arc lamps by these companies since 1895 is graphically represented in the accompanying chart.

Referring to the open arcs, the unbroken lines represent multiple lamps and the dotted lines direct-current series lamps. Attention is called to the fact that the statistics for the years 1895-6-7-8 do not include series arc lamps, and hence for these years the chart shows the comparative use of multiple lamps only. This limitation, however, does not apply to the years 1899 and 1903, for which the records include all of the lamps connected to the circuits of the companies.

It will be noted from the chart that the number of arc lamps connected to the circuits of the companies in 1903 is almost double that of 1899. Part of this increase is due directly to the absorption of or amalgamation with, other lighting companies, during the past four years. Thus, for example, since my report of November 4, 1899, the Edison Electric Illuminating Company, of Boston, has absorbed the Boston Electric Light Company and the Suburban Light & Power Company, of Boston. Just how many lamps were taken over by the companies as a result of these consolidations, I am unable to say, but the statistics account for at least 3,000 series open arcs thus acquired. Hence, although from the chart it would appear that there has been no substantial decrease in use of series open arcs since 1899, as a matter of fact the records show that over 4,000 of the series open arcs reported by the companies in that year have since been displaced by series enclosed arc lamps.

Most of the street lighting is done by series lamps and the bulk of the indoor lighting by multiple lamps. In thirteen of the cities the street arcs are direct current series open; in five, direct current series enclosed; in three, alternating current series enclosed; and in three, direct-current multiple enclosed. In ten of the cities the companies have no open arcs whatever on their circuits.

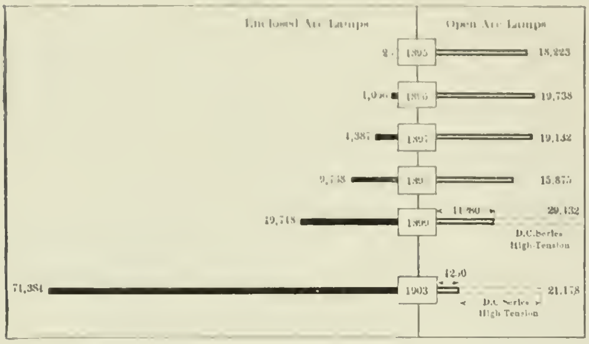


CHART SHOWING COMPARATIVE USE OF OPEN AND ENCLOSED ARCS.

Although the above figures include only a small proportion of the total number of lamps used in this country, the records may be said to fairly point out the trend of arc lamp practice in the United States. In general the following conclusions may be drawn from the statistics:

1. The enclosed arc lamp has not only largely displaced the open arc, but has greatly extended the field of arc lighting.

2. The multiple open arc lamp is rapidly going out of use. The series open arc is still used a considerable extent for street lighting, but is being gradually displaced by the series enclosed arc lamp.

◆

Remarkable Development in Light and Power in Chicago.

In view of the visit of the National Electric Light Association to Chicago next week, the annual reports of the Chicago Edison and Commonwealth Electric Companies just issued are more than usually interesting. They show what can be done in a great city under able and progressive management, especially where a unification of plan has been made effective over a large area. From time to time these pages have illustrated and described very fully and exhaustively the successive developments of the Chicago Edison system, including various articles during the present year, and we now give the financial results of the past year, indicative of the brilliant success of the engineering and economic policies adopted.

Net earnings of the Chicago Edison Company in the fiscal year ended March 31 were $1,213,929. The amount left after the deduction of bond interest was $912,939, which figures 10.6 per cent. on the total amount of stock outstanding and the advance payments for new stock to be issued in November and about 12 per cent. on the average amount of stock outstanding for the year.

The surplus account was increased nearly $180,000 after $90,000 had been written off for depreciation and $8,000 for insurance reserve.

The company's totals increased during the year nearly $2,000,000. Two increases in the stock were authorized, the second installment not having been delivered as yet, although nearly all of the subscription money has been paid in. The money has gone into extensions and improvements of the company's plants.

INCOME ACCOUNT.

	1903.	1902.
Gross income from electric current and mdse. sales	$3,409,576	$2,806,609
Operating, repairs, renewals and general expense	2,195,646	1,720,820
Net income all sources	$1,213,929	$1,085,789

CHARGES AGAINST INCOME.

	1903.	1902.
Interest on bonds and debentures	$300,990	$300,983
Dividends paid	593,346	515,982
Balance	$319,593	$268,821

The balance sheet as of March 31:

ASSETS.

	1903.	1902.
Plants, real estate and franchises	$14,230,840	$12,766,540
Material and unfinished work	388,025	405,494
Accounts and notes receivable	784,465	358,997
Cash	136,035	121,033
Total	$15,539,365	$13,652,064

LIABILITIES.

	1903.	1902.
Capital stock:		
Stock issued	$7,589,500	$6,899,900
Advance payments for new stock authorized	997,187	....
Fractional scrip	170	....
Total stock	$8,586,857	....
Bonds and debentures	5,508,000	$5,508,000
Accounts payable	123,859	140,336
Depreciation reserve	590,000	500,000
Insurance fund	68,000	60,000
Surplus account	610,084	431,077
Open account	52,565	112,751
Total	$15,539,365	$13,652,064

The Commonwealth Electric Company, which is the associated organization and is owned outright by the Chicago Edison Company, made a remarkable increase in earnings in the fiscal year ended March 31. Its net income from all sources increased nearly 40 per cent. to $378,821, and after the payment of largely increased bond interest there remained for the surplus account $158,000, or 3.16 per cent. on the stock.

This is by far the best showing the company ever made. The company's balance after bond interest in its first year ended March 31, 1899, was $25,155. It has increased steadily every year since then till the total amount of undivided profits carried in the balance

The financial statement for the year ended March 31 compares as follows with that of the preceding year:

	1903.	1902.
Gross income from electric current and merchandise sales	$1,002,085	$769,666
Operating repairs and renewals and general exp.	623,264	497,903
Net income from all sources	$378,821	$271,763
Interest on bonds and debentures	220,705	167,261
Balance	$158,116	$104,502

The comparative balance sheets follow:

ASSETS.

	1903.	1902.
Plants, real estate and franchises	$10,292,883	$8,914,599
Material in storeroom and unfinished work	159,417	107,577
Accounts and notes receivable	126,216	108,637
Cash	164,372	157,759
Open accounts	11,079	15,393
Total	$10,753,968	$9,303,965

LIABILITIES.

	1903.	1902.
Capital stock	$5,000,000	$5,000,000
Bonds and debentures	4,950,000	4,000,000
Accounts payable	382,124	40,237
Undivided profits	421,844	263,728
Total	$10,753,968	$9,303,965

sheet equals $421,000, or 8.4 per cent. on the capital stock. The company had never paid any dividends. The stock was given as a bonus with the bonds.

During the year the Commonwealth Company increased its bond issue $450,000. Some of these bonds were placed in Chicago and some in London. The balance sheet shows a large increase in the amount of bills payable owing probably to the active new construction work.

Rectification of the Alternating Current by Means of the Electric Arc.

It is interesting to note that some of the phenomena involved in the Cooper-Hewitt static converter were studied by MM. Jamin and Maneuvrier as early as 1882. The *Lumiere Electrique,* of July 18, 1882, contains an abstract of a paper on the subject which appeared in the *Comptes Rendus,* of June 12, 1882, the abstract being prefaced by a note signed with the initials of the editor, Count du Moncel.

The note states that the writer had witnessed some interesting experiments made by MM. Jamin and Maneuvrier in which it was shown that when an alternating current is passed through an aerform medium between electrodes of unequal mass and surface, current of one sign predominates, the result being a differential current very energetic in its action and having the property of a unidirectional current. It is stated that this effect does not seem to be connected with a similar one that has been noted with respect to a Ruhmkorff coil, but appears to have its cause the dissymmetry of the electrodes, the value of the current being dependent upon the nature of the larger electrode. A maximum effect is obtained with mercury and copper and a minimum with iron. The differential current always passes from the larger to the smaller electrode. The electrolytic effects produced by this current are very energetic, but it is necessary in every case that an arc be formed between the two electrodes.

The paper by MM. Jamin and Maneuvrier in the *Comptes Rendus* opens by stating that the machine employed in the experiments normally produces a symmetrical alternating current, and consequently would not decompose water nor affect a tangent galvanometer in circuit. This condition does not change if the current passes through a circuit containing several arc lights, provided that the two carbons of the lights are equal, identically arranged and have the same temperature. If, however, there is placed in circuit with the alternating current a lamp having carbons unequal in cross-section, the two components of the current from the machine cease to be equal; that which passes from the large to the small carbon, from the electrode of greater to that of lesser temperature, predominates. It attains a maximum between a large electrode of gas retort carbon which is heated but slightly, and a carbon pencil terminating in a fine point and which attains a high temperature. The same phenomenon is produced in the same sense when an arc is made to pass between any metal and a carbon point. In general, the predominating current is feeble or lacking when the arc is short, and increases with the distance between the electrodes. With zinc it is at first as intense as with copper, but drops suddenly, probably owing to the formation of oxide, with which the zinc soon becomes covered. The paper gives a mathematical discussion with relation to the two factors of mean e.m.f. of the differential current, and the resistance introduced into the circuit by the arc formed. The conclusion is that carbon, iron and lead offer the greatest resistance and copper and mercury the least.

An account of some experiments is then given, in which a direct current was passed, first between electrodes of carbon and mercury, next between mercury and carbon; in the latter case the arc had a pronounced green color and the metal was volatilized energetically; in the other case the arc was reddish in color and there was a less abundant production of vapor. This renders evident the dissymmetry which occurs when an alternating current is passed, the arc then being green, which proves that the current which passes from the mercury to the carbon predominates over the current which passes in the opposite sense; and since there is no difference in the resistance of the arc, it is necessary to seek a particular property of alternating currents to arrive at a reason for the action.

Each of the currents contain at the moment when they commence to flow, a certain sum of energy which becomes free when they cease and gives rise to a current in the opposite sense; or, according to Edlund, to a counter e.m.f. Thus one component at first very feeble, increases little by little and when it ceases gives rise to an inverse action which assists the other component developed by the machine at the same moment. If, then, the first component offers a smaller reaction than the second component, it will be less enfeebled and more reinforced and will determine the direction of flow. Whatever may be the explanation, it is clear that an arc once produced at a mercury surface, the differential current engendered entirely changes the action of the generators; and that one of the systems of currents, if not entirely extinguished, is at least considerably weakened, and the other system consists of successive currents of a greater strength and duration. The introduction of such arcs thus rendered the machine experimented with, which otherwise is incapable of decomposing water, to have the effect of a primary battery equivalent to 100 Bunsen cells; and like a primary battery, the effect can be employed in electrochemical processes, to magnetize soft iron, reduce metals, transmit power—in short, replace a direct-current machine in all of its applications.

The paper concludes by a statement that alternating-current machines of the day are only applicable to the production of light, all attempts having failed to render such machines by means of a rectifier applicable to electrochemical purposes. From the above it is seen, however, that a rectifier can be replaced by one or several arcs formed between a bath of mercury and a carbon point. In conclusion it is stated that the economic conditions of this transformation remain to be determined.

Electricity on Trunk Lines.

In the current issue of the *North American Review,* Mr. C. L. De Muralt contests the opinion of Mr. Cornelius Vanderbilt that while it is possible, from an engineering standpoint, to adopt electricity as the motive power for trunk railway service, yet from the financial point of view the change is not possible. Mr. De Muralt discusses all of the various factors involved and then considers specifically the cases of the Pennsylvania and New York Central railroads.

The former operated last year a total of 3,670 miles of road, the latter a total of 3,320 miles. With an alternating-current, high-potential system, the electric equipment of the line would not cost more than $6,000 to $7,000 per mile, including second, third and fourth tracks and sidings, or a total of $25,690,000 for the Pennsylvania, and $23,240,000 for the New York Central. If we count ten per cent. for interest, sinking fund, etc., this would represent an annual charge of $2,569,000 in the one case and $2,324,000 in the other.

The operating expenses for these two roads during the last year were made up as follows:

	Pennsylvania.	N. Y. Central.
Fuel for locomotives (motive power)	$6,000,133.94	$4,635,877.09
Water for locomotives	335.286.00	295,582.77
Other supplies for locomotives	382,548.12	334,672.56
Wages of engin'rs, firemen and roundhouse-men	5,716,847.83	4,829,442.54
Wages of other trainmen	4,442,127.34	2,991,334.66
Wages of switchmen, flagmen and watchmen..	3,900,427.49	2,511,552.06
Other expenses for conducting transportation	14,540,541.88	11,607,537.54
Repairs to locomotives	4,412,983.29	3,608,971.89
Repairs to other equipment	10,674,725.61	5,661,991.79
Repairs to roadbed	8,541,035.48	6,145,341.10
Repairs to structures	4,122,017.98	2,454,690.96
General expenses	1,858,319.09	1,786,494.17
Grand total	$64,927,894.05	$46,863,489.13

Mr. De Muralt then applies the figures found during the course of his investigation, which lead to the following reductions if electricity were adopted as motive power:

Fuel, 10 per cent., or	$600,013.39	$463,587.71
Water, saved entirely	335.286.00	295,582.77
Other supplies, 50 per cent....	191,274.06	167,336.28
Wages to engineers, etc., 25 per cent.......	1,429,211.96	1,207,360.63
Repairs to locomotives, 50 per cent........	2,206,491.65	1,804,485.95
Total amount saved	$4,762,277.06	$3,938,353.34

In the case of either road, the amount saved would be almost double the amount necessary to pay a handsome return on the additional investment, and Mr. De Muralt considers that he has been extremely conservative in every part of the estimate.

A conclusion is that it is not in the cost of fuel alone that we may expect to find the economy of the electric system. Some of the other items taken together add up to a very important amount, and will cause the operating expenses of most roads to be smaller by using electricity than by using steam, without mentioning at all the advantages of increased comfort to passengers, and the possibility of greater speed should this be desired

If water power can be used for producing electricity, that will simply mean an additional advantage In that case, the cost of motive power will be greatly reduced, and the saving thus effected will amount to at least one third of the total amount now spent for fuel, and often to a great deal more For a railroad like the New York Central, capable of supplying practically its entire system from the water power of Niagara Falls, the upper Hudson and the St. Lawrence, this would represent an additional saving of more than one and a half million dollars yearly.

Of course, even with these convincing figures it would not do to imagine that a complete trunk line system of several thousand miles of road could be converted from steam to electric traction all at once. Yet there is no reason whatever why electricity should not be adopted immediately on those sections of the road where the saving is most apparent. Instead of spending each year large amounts for additional steam engines, as has to be done at present, these amounts could be used for gradually acquiring all the necessary electric locomotives; and, in the mean time, the steam locomotive thus rendered superfluous on the sections operated electrically could be used to complete the rolling stock of the sections still employing steam. The traffic could be carried on in exactly the same way whether steam or electricity was used as motive power, and thus the change could be made without interfering at all with the regular operation of the road.

The Use of Differentially Wound Telephone Receiver in Electrical Measurements.

By Prof. H. Ho, Tokyo.

It is known that a telephone receiver may rival in its sensitiveness the most sensitive mirror galvanometer, but its use in electrical measurements is limited by the fact that it is not adapted to replace a galvanometer in so-called deflector methods, though it has proved very useful in some of the nul methods, an example of which is the well-known Kohlrausch method of measuring electrolytic resistance. To remedy this inconvenience to some extent and to extend the use of the telephone receiver in electrical measurements, the writer has devised several methods involving the use of a differentially-wound telephone receiver, and believes he has found a new system of electrical measurements very useful in some cases, which will be briefly described below.

The receiver used was an ordinary double-pole pattern, the coils of which were replaced by differentially-wound bobbins, made by winding two similar wires side by side so that the two coils should be exactly equal in their magnetizing effect as well as in their resistance and inductance. The coils were each of 140 ohms resistance and proved perfect in their differential action.

I.—THE COMPARISON OF CAPACITIES.

The method of connection is shown in Fig. 1, in which C_1 and C_2 are the capacities to be compared, C_2 being supposed larger than C_1; T is the differential receiver, r r two equal non-inductive resistances, R a variable non-inductive resistance which shunts a coil of the receiver and an r in series with the larger capacity; and finally, ~ is the source of alternating current. The process of measurement is as simple as the connections. We merely adjust R until no sound is heard in the receiver, then if r is the resistance of each of the coils of the receiver, the required ratio of the capacities is given by

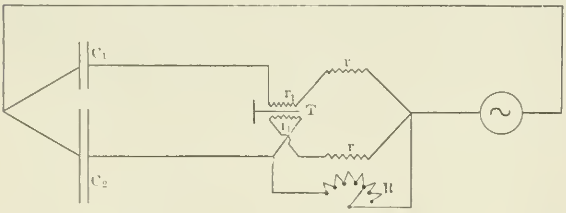


FIG. 1.—DIAGRAM OF CONNECTIONS.

$$\frac{C_2}{C_1}=\frac{\dfrac{r_1+r+R}{R\,(r_1+r)}}{\dfrac{1}{r_1+r}}=\frac{r_1+r+R}{R}$$

The inductance of a telephone receiver is usually very small compared with its resistance, but for security we have added in series, r having a value of 1,000 ohms, and in consequence the division of current in the two parallel paths, r_1+r and R, can be computed without taking account of the inductance; the derivation of the preceding formula is evident without further explanation. It is convenient to use a resistance box with sliding contact for R, and we may choose such a value of r as suits the case, and the value of R at hand.

This method is particularly valuable for the measurement of small capacities, it being necessary only to raise the alternating e.m.f. sufficiently to make the charging current audible in the receiver; moreover, it enables one to measure a capacity in an alternating-current circuit under its working pressure and frequency; for example, in the testing of cables. The method is thus quite simple and practical, and it may also prove useful in the study of the behavior of dielectrics under various pressures and frequencies.

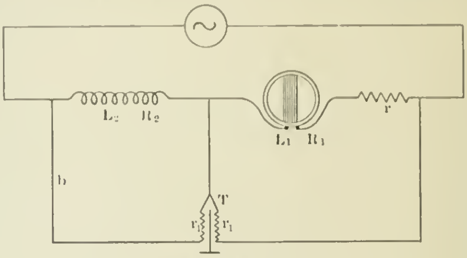


FIG. 2.—COMPARISON OF INDUCTANCES.

To give an idea how accurate are the results which can be obtained by this method, even for very small capacities, we give here the results of the measurement of the capacities of three Leyden jars, designated *A*, *B* and *C*. The standard of comparison was a parallel plate air condenser, the capacity of which could be easily calculated from its dimensions and was found to be .00054 m.f.

C_1	C_2	r_1	r	R	The value of C_2 calculated.
Air condenser	A	140	1000	1145	.0010800 m. f.
Air condenser	B	140	1000	945	.0011934 m. f.
Air condenser	C	140	1000	1320	.0010044 m. f.

To test the accuracy, various groupings of the jars in multiple were tried, and the results were as follows:

C_1	C_2	r_1	r	R	The value of C_2 calculated.
Air condenser	A+B	140	1000	353	.0022788 m. f.
Air condenser	B+C	140	1000	365	.0022248 m. f.
Air condenser	A+B+C	140	1000	225	.0032778 m. f.

If calculated from the results in the first table, the numbers in the last column would be .0022734, .0021978 and .0032778 respectively.

Finally, comparisons between the Leyden jars themselves were tried and the following ratios were obtained:

C_1	C_2	r_1	r	R	The ratio $\frac{C_2}{C_1}$ calculated.
A	B	140	1000	10000	1.11
C	B	140	1000	5800	1.20
C	A	140	1000	15400	1.07

If calculated from the results in the first table, the ratios in the last column would be 1.11, 1.19 and 1.08, respectively.

From these measurements we may infer that even for such small capacities it is easy to get values correct within 1 per cent. The e.m.f employed was frnm 300 to 500 volts effective.

II.—THE COMPARISON OF INDUCTANCES.

In Fig. 2. L_2 is an unknown inductance, R_2 ohms in resistance, L_1 variable inductance, R_1 ohms in resistance: for example, Ayrton and Perry's standard of inductance, and T the differential telephone receiver.

A non-inductive resistance, r, is added either to L_1 or to L_2 to make them equal in resistance, and then L_1 is varied till no sound is heard in the receiver. In this condition, we have evidently $L_2 = L_1$.

If L_2 lies beyond the range of L_1, we may proceed as follows: Put in such a value of r that the resistance of the L_2 side is n times that of the L_1 side, and at the same time insert a non-inductive resistance, R, somewhere at b so that $R + r_1$ is n times larger than r_1. Now adjust L_1 till no sound is heard. In this condition we have evidently $L_2 = nL_1$. Choosing n properly we can bring L_2 into the range of an adjustable inductance at hand.

The method gives in ordinary cases the value of inductance correct within one per cent., and as may be seen, it is quite simple and direct. We are sure that any one who tries it for the first time will be surprised to find the quickness and the accuracy of the method.

III.—THE COMPARISON OF RESISTANCES.

In case the resistances to be compared are large, we adopt the same connection as Fig. 1, putting the resistances in place of the capacities. The method of the measurement is evident without description. If the resistances, R_1 and R_2, be very high, we may simply write

$$\frac{R_1}{R_2} = \frac{r_1 + r + R}{R}$$

If the resistances are low, they are to be joined in series and the receiver connected as shown in Fig. 3, the balance is then obtained either by moving the knife-edges or by varying the resistances of one of the receiver circuits, or applying both at the same time. The required ratio is given by

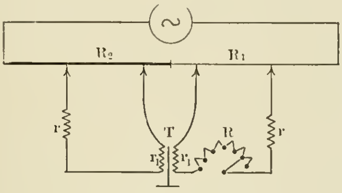


FIG. 3.—DIAGRAM OF CONNECTIONS.

$$\frac{R_1}{R_2} = \frac{r_1 + r + R}{r_1 + r}$$

Independent Telephone Traffic Company of Cleveland.

The Independent Telephone Traffic Company, of Cleveland, which has succeeded the Ohio Independent Telephone Association, held its annual meeting at Hotel Chittenden, Columbus, May 12, 13 and 14. This company was chartered as an organization for mutual benefit for the independent telephone companies of Ohio. About fifty companies were represented at the meeting, the majority of them having previously become stockholders in the new traffic company.

The first day's session was devoted to regular order of business, including the report of President W. Gilbert Thompson, A. V. Hageman, treasurer, and H. H. Robinson, chairman of executive committee. After the session the members were given an opportunity to inspect displays of equupment furnished to the traffic company for that purpose by manufacturers. These exhibits were entirely in charge of officers of the traffic company, and there were no manufacturers' representatives present.

The papers presented were brief and to the point and they were freely discussed. They were as follows: "Reduction of Expense in Exchange Operation," F. L. V. Turner, general manager Cuyahoga Telephone Company, Cleveland, Ohio; "The Farmer Line Problem," O. F. French, assistant general manager Federal Telephone Company, Cleveland. Ohio; "Development of the Small Exchange," Howard Schwartz, general manager Star Telephone Company, Ashland, Ohio; "How to Make County Toll Line System Profitable," M. M. Herron, general manager Millersburg, Wooster & Orville Telephone Company, Millersburg, Ohio; "Economy in Long-Distance Operation," H. H. Robinson, general manager United States Telephone Company, Cleveland, Ohio; "The Value of Standardizing," H. C. Devin, general manager Mt. Vernon Telephone Company, Mt. Vernon, Ohio.

One of the chief aims of the traffic company is the standardization of telephone equipment of all kinds and members were asked to give freely their experiences with the products of various manufacturers. The sales department of the Independent Telephone Traffic Company is in the hands of Walter Green, general manager, Cleveland, and already large purchases of standardized equipment are being made through the department, the stockholders of the company reaping the advantages of buying goods in quantity.

The following directors were elected for the ensuing year: W. G. Thompson, Lebanon; Jerome Penn, Washington C. H.; W. J. Crawfley, Salem; Eugene E. Knox, Portsmouth; H. H. Robinson, Cleveland; C. E. Yoder, Bellefontaine; J. G. Palmer, Conneaut; A. V. Hageman, Lorain, and A. H. Doudna, Bridgeport.

A New Telephone Exchange for Yonkers, N. Y.

A new telephone exchange was occupied at Yonkers last month by the New York Telephone Company. The new four-story building erected by the company is situated on a lot 50 ft. x 100 ft. on the west side of Riverdale Avenue, about 150 ft. south of Main Street, and one block from Getty Square, the business center of Yonkers. The building is of fire-proof construction throughout, and is specially designed for telephone purposes. The four floors of this building are arranged and used as follows: The top, or fourth, floor will be used exclusively by the operating force of the central office. It is divided into two parts, one reserved for the operating room, and the other for the operators' quarters, and in order to allow the greatest possible amount of light and air is designed with a high ceiling and with windows in the front, rear and one side, and a skylight in the central portion of the ceiling. The operating room is 20 ft. wide and runs the entire depth of the building.

Next to the operating room is the operators' sitting room, to which the operators may retire when not on duty at the switchboard. This is a room 17 ft. x 16 ft., with two large windows in the front of the building. It will be furnished with easy chairs, etc., and newspapers and current magazines will be kept on file for the use of the operators. Next to the sitting room is located the dining room. This room is 11 ft. x 22 ft., and will be furnished with dining tables and chairs. An electric stove will be provided in this room, and coffee, tea and milk will be served to the operators free of charge during the lunch periods. Opening into the dining room and sitting room with a door leading directly to the stairs is a locker room. In this room lockers will be provided in which the operators will leave their hats, coats and lunches while on duty at the switchboard, and where they will leave their individual transmitter and receiver sets when they go home. A large toilet room for operators opens from the locker room.

The floors of all the rooms on this floor except the toilet room will be covered with linoleum. The toilet room floor will be finished with white tiling.

On the third floor of the building and directly under the operating room is situated the terminal room equipment. There are two other rooms on this floor 22 ft. x 30 ft. and 18 ft. x 22 ft. respectively, which are suitable for use as offices.

In the rooms on the second floor will be located a representative of the treasurer's office and the headquarters of the contract department for the Westchester division. There are, besides the rooms occupied by these offices, two other rooms suitable for offices, and a large toilet room for the use of the tenants. The ground floor will be divided into two stores.

Ultimate capacity of switchboard	4200 lines
Ultimate No. of "A" positions	20
Ultimate No. of "B" positions	3
Ultimate No. of common trunk positions	3
Ultimate No. of operators to be employed	50
Present equipment	3100 lines
Present No. of "A" positions	13
Present No. of "B" positions	1
Present No. of common trunk positions	1
Number of working lines at time of opening office	1200
Number of working stations at time of opening office	2100
Number of operators employed at time of opening office	30

The above statistics may be given as to the central energy switchboard and subscriber line equipment at the time of the opening of this office.

Annual Convention of Railway Telegraph Superintendents.

The twenty-second annual convention of the Association of Railway Telegraph Superintendents was held at the St. Charles Hotel, New Orleans, on May 13, 14 and 15. The convention was called to order on the morning of May 13 by President J. H. Jacoby, who made a few felicitous remarks. The welcome of the city was extended to the members by Assistant City Attorney McGuirk on behalf of Mayor Capdevielle. Mr McGuirk extended the hospitality of the City Hall and all its electrical departments to any of the visitors who might wish to look it over. The address was appropriately responded to by President Jacoby.

It was voted to hold the next annual meeting at Indianapolis, Ind., on the third Wednesday in June, 1904, on account of the proximity of Indianapolis to St. Louis, thus affording the members an opportunity to visit the big exposition.

The election of officers for the ensuing year resulted as follows: President, C. S. Rhoads, of Indianapolis; vice-president, C. P. Adams, of Chicago; secretary-treasurer, P. W. Drew, of Milwaukee. After the election of officers, Mr. C. E. Yetman, of New York, explained the operation of his new typewriter transmitter, which is now being used on the telegraph circuits of the Associated Press and other news-distributing concerns. The instrument attracted much attention and was critically examined by the members.

An amendment to the constitution was unanimously agreed to relative to qualification for membership. Under the new limitations, membership can be greatly extended and associate members may now be admitted. The latter can engage in the proceedings of the meetings but are not entitled to vote.

Secretary Drew gave a little history of the work of the association up to the present time, and closed with a touching tribute to those who had fallen in the line of duty. His review was followed by the election of several new members and of associate members. Letters of regret at their inability to be present were read from Assistant General Manager J. C. Barclay and General Superintendent B. Brooks, of the Western Union Telegraph Company; T. D. Lockwood, of Boston, and several others.

In the afternoon the American Telephone & Telegraph Company tendered an excursion to West End, where the party was given a delightful luncheon. This affair was managed by the company's special agent, Mr. Percival W. Miller. At the conclusion of the luncheon, remarks were made by several gentlemen. Col. William H. Adkins, traffic agent of the Southern Bell Telephone & Telegraph Company at Atlanta, acted as toastmaster, and various toasts were appropriately responded to.

The second day's session was called to order at 9.30 A. M. by the new president, C. S. Rhoads. The first order of business was a paper written by Mr William Maver, Jr., and read by Mr. Jacoby, entitled, "Railway Safety Block Signals," which presented some new ideas on the general subject. The paper was discussed at considerable length by many of the members.

This was followed by the reading by the secretary of some notes, also by Mr. William Maver, Jr., on the subject of Multiplex Telegraphy.

The author stated that it was long ago shown to be feasible to operate a polar duplex on circuits on which there was the equivalent of a number of 150-ohm relays. These experiments were described in the ELECTRICAL WORLD October 6, 1888. He congratulated Mr. Fry, of Milwaukee, on his practical success in work in this line and if he (Fry) succeeded in operating the Edison quadruplex on a similar wire he was deserving of especial congratulation. Mr. Maver had never succeeded in making the No. 2 side work in the manner required in commercial practice on account of the inductance of the relays. Of course if one should by a fortuitous combination of circumstances, or by design, obtain capacity and induction in the right proportion on the line, as pointed out by Dr. Pupin, he would doubtless get successful results on the quadruplex even with a number of relays in the line.

Mr. C. F. Annett, of Chicago, read several letters written by men in charge of wrecking trains on the Illinois Central Railroad, speaking in the highest terms of the utility of the telephone as part of the wrecking train equipment and the superiority of the long-distance telephone over the telegraph in such work.

Mr. W. W. Ryder, of Chicago, next read a paper in which he described his new switchboard, which he had found so simple to understand and operate that the average railroad telegraph operator could manipulate it without previous instruction. This paper led to the suggestion of action on the part of the association looking to the instruction of operators in the practical use of switchboards, and the subject was very freely discussed.

After adjournement at 1 P M., the members of the association spent a couple of hours in riding around the Illinois Central belt, taking in the various points of interest along the road, and in the evening the entire delegation attended the opera at the Athletic Club Park, where *"Fra Diavolo"* was played.

At the third day's session, May 15, the committee on courtesies submitted its report, thanking all who had contributed to the pleasure of the members during their stay in the city and to the success of the meeting. Other business transacted at this meeting was the description by Mr. G. L. Lang, of the automatic telegraph circuit and signaling machine of Mr C. K. Jones, and the reading of a paper by Mr. F. A. C. Ferguson on "The Composite Telegraph and Telephone Circuit." The latter subject was discussed and a committee was appointed to investigate the working of circuits now in operation, in order to pass upon the efficiency of the use of a single wire for telephone and telegraph communications at one and the same time. A representative of the Bell Telephone Company referred to an instance where he had received a telephone message with almost perfect precision while the wire was being operated for telegraph purposes between Pittsburg and New York. On the other hand, instances were pointed out where the transmission of telephone messages over underground circuits was interfered with by simultaneous transmission of Morse telegraph messages on the same wire. In the discussion, however, it appeared to be evident to those present that simultaneous transmission could be satisfactorily accomplished, and the members were favorably impressed by what they had learned as a result of the discussion of the paper. Other business transacted included a paper by Mr. F. F. Fowle on the "Transposition of Telephone Circuits," which he illustrated by blackboard diagrams, and a paper by Mr. W. W. Ryder on the "Telegraph Camp Train."

The convention then, at 1 P. M., adjourned to meet next year in Indianapolis.

During the business meeting of the last day, the ladies of the party were conducted through the old French quarters of the city and in the afternoon taken on a steamboat excursion around the harbor. On Saturday, May 16, the Louisville & Nashville Railroad Company gave an excursion to the delegates to several points on the Mexican Gulf.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

PRODUCTION OF ALKALI EARTH METAL PERMANGANATES.

Wilhelm Hickmann, of Frankfort-on-the-Main, Germany, assignor to the Chemische Fabrik Griesheim Electron, patents an interesting method for the production of the permanganates of the alkali earth metals, salts whose formation does not readily take place by simple double reaction with the easily-prepared alkali permanganates. In its simplest embodiment the process is carried out in an electrolytic cell provided with a diaphragm, the cathode compartment being filled with dilute potassium hydrate and the anode compartment with a solution of potassium permanganate, maintained saturated, and carrying calcium hydrate in suspension. On passage of the current permanganic acid is formed in the anode compartment, and combines directly with the calcium hydrate therein contained to produce the desired salt. According to a second method the cathode compartment contains a saturated solution of potassium chloride, and the anode compartment a solution of potassium permanganate in which a limited amount of calcium chloride is dissolved. The reaction proceeds in this case with liberation of chlorine and production of calcium permanganate in the anode compartment.

ELECTROLYTIC REDUCTION OF METALS.

The cathodic reduction of metallic compounds has developed along two quite independent lines, both of which have led to substantially similar results in the apparatus employed and in the method of procedure. On the one hand the metallic compound, as the oxide or sulphide of such readily reducible metals as copper or lead, may be considered as a depolarizer when the object in view is to avoid the presence of hydrogen or to reduce the e.m.f. required for a given reaction; and on the other hand, when the object is to produce a metallic sponge, the metallic compound is regarded as an ore to be reduced, hydrogen as a convenient reducing agent, and the electric current as a means suitable for the production of hydrogen. In either case, of course, the process and result are identical.

Richardson, in 1893, made this cathodic reduction of metal compounds continuous by the expedient of evenly spreading over the surface of a moving cathode belt a layer of the compound (copper oxide) to be reduced and carrying the same slowly under stationary anodes, the metal being removed from one end of the cell and fresh oxide supplied to the other. Richardson's purpose was to reduce the e.m.f. in the electrolysis of brine.

Mr. Pedro G. Salom now patents an apparatus similar in its mode of operation to that of Richardson but differing in form in that for a moving belt serving to carry the compound to be reduced he substitutes a rotary annular trough (cathode); or, since the essential point is a relative movement, the trough may be stationary and the anode may slowly revolve above it. As applied to the reduction of galena the apparatus consists of an annular lead-lined cathode trough containing the ore to be reduced in the form of a thin layer and the sulphuric acid electrolyte. The anode is also of lead, and conforms in a general way to the shape of the trough into which it depends, a segment being cut away, however, to provide for the introduction of the sulphide and the removal of the lead. The anode is arranged to swing slowly around in the trough, whereby portions of the latter are uncovered in succession, the fresh ore being introduced at the advancing side of the anode and the reduced lead removed as it is uncovered by the retreating side. A hopper and distributing plate serve for the automatic introduction of the charge, the withdrawal of the sponge being conveniently accomplished by hand.

As a curious instance of the development of very similar devices for widely differing purposes it is interesting to note in this connection the carbide furnace patented in Germany to Hermann Nicolai. This furnace consists of a horizontal rotary annular trough constituting an electrode, the charge being introduced into the same at one point by a hopper and the finished product removed by a scraper at another point. Intermediate to these two points are devices for distributing and compacting the charge, and the hooded electrodes by which the conversion is effected. Except for the concentration of current incident to the carbide process, the apparatus of Nicolai corresponds closely with that of Salom.

New Telephone Patents.

A new insulator patented to J. B. Bell, of Peakville, Pa., is of that type in which tie wires are ordinarily dispensed with. The main insulator is of the usual petticoated type with the ordinary tie wire groove, but the top instead of being rounded, is drawn out into a threaded boss. This boss is divided through its center by a longitudinal tapered slot from the sides of which project staggered frets in a manner such that a wire forced into the slot will be given a horizontal kink. This insulator body is surmounted by an insulating cap arranged to screw down over the boss and so provided with a downwardly extending lip that when screwed home, a vertical kink is given to the wire. By these means a wire may be secured against slipping through the insulator.

An inductance coil cable is the invention of Francis Tremain, of Highgate, England. It is his object to provide a construction for submarine cables whereby there may be included within it at intervals inductances of such magnitude that the advantages of the Pupin method of transmission may be obtained for submarine work. The problem involves a coil of considerable length, yet semi-flexible, so that it will not be damaged in the handling of the cable. Fig. 1 shows a coil section of the cable core, two varieties being exhibited. At the center is a core of fine metallic wires, magnetic or not, according to the magnitude of the inductance desired. Surrounding this is an insulating tube upon which the coil is mounted in one or more parts. Each part of a coil consists of a series of short sections wound indefinitely. These are about three-sixteenths inch long, and being impregnated with an insulating binding material form practically independent annular rings. It is this construction which gives the flexibility to the structure. Between each two coils an insulating spacer is placed which serves as a guide for such conductors of the cable as do not tap the particular coil in question.

Lead-covered aerial cable, the present day standard, at times fails due to imperfections or cracks in the sheath, which are not discovered or do not occur until the cable is in place. Such openings admit moisture to the cable, which, being absorbed by the paper effectively short-circuits the whole in a remarkably short space of time. To repair the defect it is customary to "boil out" the cable by treating the exposed core with hot paraffine wax. Such a procedure is at times very awkward, especially if the break is between poles. To facilitate such repairs, Mr. John Daggett, of Elyria, Ohio, has devised his repair apparatus. This consists of a trough-shaped receptacle mounted on trolleys so that it may be suspended from and moved along a messenger wire. Beneath the middle of the trough a torch is carried and within it the paraffine is melted and allowed to act upon the cable, let down into it from the messenger for that purpose.

A patent for a subscriber's station annunciator has been granted to George K. Jackson, of Reece, Kan. The device consists of a short strip of sheet metal swiveled near its center upon a nut or a bushing adapted to be placed upon one of the gong supporting studs of a magneto bell. This metal strip is so mounted that it is nearly balanced about its axis and one end is so shaped that it may engage the bell hammer. To set the annunciator the strip is placed horizontally and the hammer is so made to engage it that it will remain in this position. When a call is received the vibration of the hammer releases the strip, which, by its unbalanced weight, will swing into a vertical position, thereby indicating a call. Such a device is most useful where a large number of telephones are so placed that the rings do not readily indicate at which instrument a call is to be answered. Two receiver patents refer primarily to methods of holding the diaphragm. Both inventors, Messrs. M. R. Hutchison and W. L. Denio, respectively desire to provide a mounting by which not only is an elastic contact between the casing and diaphragm maintained, but by which an initial buckling stress is put upon the diaphragm. Such a stress renders a diaphragm more sensitive than normal. Mr. Hutchison accomplishes his result by encircling the diaphragm with an elastic rubber band, which clamps it tightly. This reduces the resistance to the slight motion of the periphery of the diaphragm accompanying its vibration, and at the same time it causes the desirable initial buckling stress. Mr. Hutchison also surrounds the rubber clamping band at intervals with a metallic strip which will serve to connect the diaphragm electrically with its case where this is desirable, as say where the diaphragm is used in a transmitter; and also serves to hold the rubber band in place. These metal strips are mounted by inserting one end beneath the edge of the band and then bending it about the outside of the band to a position parallel to but upon the other side of the diaphragm from the starting point.

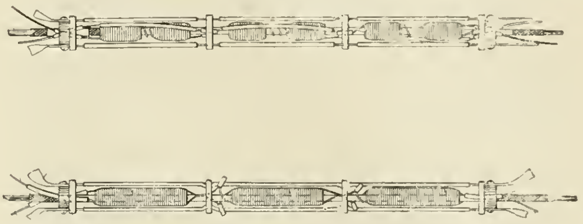


FIG. 1.—TREMAIN CABLE.

Mr. Denio holds his diaphragm in place by means of metallic spring washers. Several shapes are suggested, either one or two washers being provided for a single diaphragm. These washers may be plain concave, fluted concave, or may be scalloped on the inside, the points being turned up to bear upon the diaphragm to give the initial bias.

Two selective ringing patents, describe step by step selective apparatus, one relying on an electrical lock for the non-wanted stations, while the other provides a mechanical lock. Both have the very material disadvantage of a considerable complication of moving parts at the subscriber's station, just where it is a considerable trouble to get at and adjust it. Both devices are shown sufficiently well for explanation in Fig. 2. The electrically-locked device is that shown in the upper part of the figure. This is the invention of F. E. Green, of Newburyport, Mass. There are two sets of signalling contacts; the first, normally open and included directly in the bell circuit, is shown just above the left-hand magnet spools. This contact tends to close, but is held open by the extremity of the toothed slider. Attached to this contact, in addition, is the equivalent of a dash pot. The result of this is that even when the contact is released by the slider an appreciable time is required for the circuit to be closed. The second contact is normally closed and is shown to the right of the left hand magnets, the movable member projecting up in the path of the swinging ratchet dog extending downward from the main slider. This contact forms a short circuiting shunt on the bell, and it is the distance relation of the contact and dog which determines the selection of the station for signalling.

When any station is desired, the operator sends out to the line a series of impulses, all being of brief duration save the last, which is maintained for the length of time it is desired that the bell at the wanted station shall ring. At the first short impulse, the operating or left-hand magnets at all stations, which are across the line circuit, actuate their armatures and advance all sliders one tooth. At all stations the main contacts are released and begin the retarded process of closing. At station A another action has taken place. The shunt contact has been opened by the ratchet dog. The bell does not ring, however, unless A is desired, for otherwise the first impulse will be short and the second quickly following it will step the dog over the shunt contact and allow it to close before the slow-acting main contact has closed. The long duration last impulse of a signal does, however, allow the main contacts to be made while the short-circuit contact at the desired station remains in engagement with the dog.

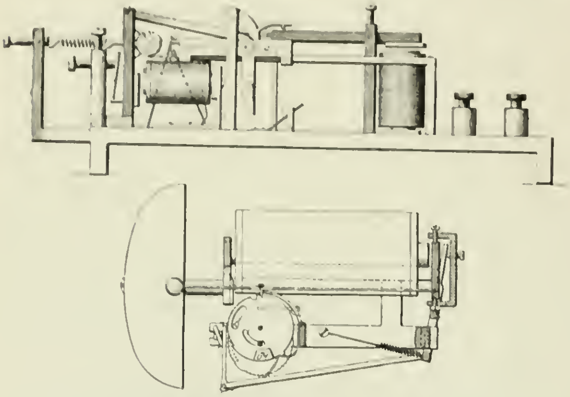


FIG. 2.—GREEN AND WATKINS SIGNALLING APPARATUS.

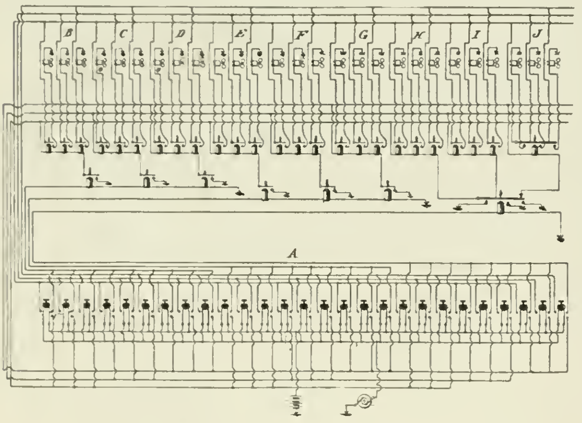


FIG. 3.—SMITH TELEPHONE CALLING SYSTEM.

The bell at this station, therefore, sounds receiving current from a local battery. Of course, the signal circuit at all other stations is at this time closed, but this is without effect on the bells at these stations, as they are all shunted by the second contacts. Now there is a second magnet shown at the right. This is a tripping magnet and is in the bell circuit, so that when the main circuit is closed this magnet is energized and thereby raises both actuating and retaining falls and thus the slider is returned to zero position by a retractile spring attached to it.

Referring now to the second selector shown in Fig. 2, it is seen that besides the regular vibrating armature of the ringer, a second armature with pivots at right angles to this is provided. This last armature is so mounted as to be unaffected by the polarizing magnet, and it is, therefore, similarly responsive to currents in either or both directions. This armature, through an arm and pawl, affects the rotation of two eccentrically mounted ratchet discs. Both discs tend to return to the unactuated position by gravity, each being provided with a counter weight. One, the upper, is allowed at all times to respond to this tendency. On the other hand, the second is held by a retaining pawl, except just at such times as the first disc has reached its normal position. In the figure a locking bolt is seen projecting across the bell hammer rod. This bolt is held in the interfering position by the two ratchet discs, which virtually serve as tumblers for the lock. Each disc has a notch in it and when these come into coincidence the bolt drops and releases the bell. On the upper or free disc the notch registers with the bolt when in the normal or returned position. On the lower disc the notch registers just when the number of teeth corresponding to the station number have passed the ratchet fall.

As with the preceding apparatus, the operator sends out a code signal, the first impulses being of short and the last of long duration. Each impulse serves to turn both discs, the upper getting an unrestrained throw of a considerable angle and the lower moving one tooth and being then stopped and held by the retaining fall. If the second impulse follows quickly no lock is released, as at no station does the upper disc get back to normal position before re-actuated by the following impulse. If one is the code number of the station desired, then the first impulse will also be the last, and being maintained for some considerable period, the free disc will have time to return to zero. By construction the notch of the first station will be beneath the bolt. Therefore, the bolt at this station will be released and the bell will ring. At the same time at all other stations the free disc will have returned to rest and thereby deflect the retaining falls of the respective lower discs. These latter are then free to return to zero as soon as the cessation of the ringing current, following the release of the operator's key at central, allows the actuating pawls to pass back upon the free discs in the upward motion. Mr. W. D. Watkins is the inventor of this system of selection.

Three other selective system patents all cover modifications of the same general scheme, namely that of employing a sufficient number of wires to effect a considerable number of different combinations. For example, with the circuits shown in Fig. 3, using nine wires from central, 27 stations may be selectively signalled. And if polarized relays be used it is possible to greatly increase the number of combinations and one hundred and eight stations may be selectively signalled over these same nine wires. This use of polarized relays is the subject of a second of the patents, while the third omits the tertiary relay circuits, bringing the number of circuits to six and the number of stations to nine. These patents have been granted to Charles B. Smith, of New York City.

Mr. Smith has also obtained a patent for an automatic telephone system. In this system there is no central office, but the automatic devices are scattered at the various sub-station premises. As with his selective systems, Mr. Smith requires a considerable number of wires all reaching every station. This, of course, prohibits an economical line construction. In fact, it would seem a prohibitive feature. It is impossible to describe the apparatus in detail here, but some idea of its complication may be obtained from Fig. 4. Three selective and signalling wires and one battery wire loop into each station, and several pairs of talking wires tap into each station. The talking wires are the equivalent of the connecting cords of manual systems and an equivalent number are required. The scheme of operation is as follows: Of the signalling wires, one is continuous from station to station, while the other two are in short sections, extending from one station to the next only. One of these sectional wires normally broken up, is adapted to be made up into a continuous line, the making-up process proceeding about the circuit of stations in definite, say left-handed, direction, in response to the automatic apparatus. The second sectional line, normally continuous, is simultaneously broken up. The general process of making a connection involves the automatic sending of impulses through the respective stations to the left, to the desired station, the apparatus at each intermediate assisting in forwarding the connection to that next to the left. When the desired station is reached a signal is sent out to it over the normally closed sectional wire. After the signal is received automatically, upon the cessation of the current all selective wires are broken up or reformed to normal condition, as the case may be. The removal of the receiver from the hook serves to pick out automatically the lowest numbered idle talking wires and simultaneously to cause the called station to select the same pair. Of the apparatus shown in the figure, the lowest is the signal forwarding apparatus and next above is the selective and signal transmitting apparatus, while at the top is the talking circuit selective apparatus.

The final patent granted last week is one for a "Combined Telephone and Fire Alarm System." This system is for use with central energy lamp-signal switchboards, and is the work of W. L. Denio.

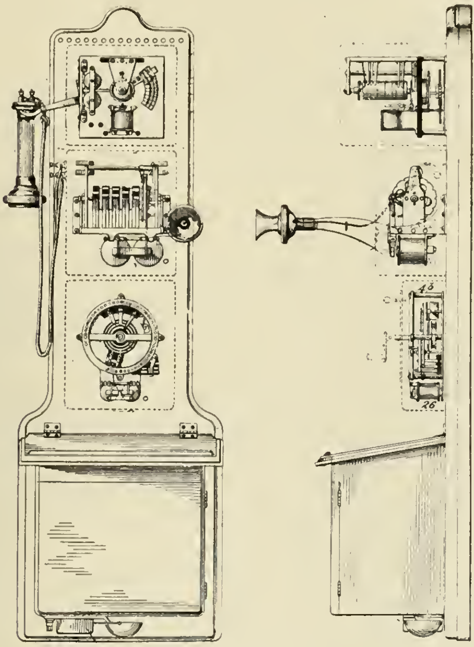


FIG. 4.—SMITH TELEPHONE.

The fire alarm apparatus is controlled by thermostats distributed about the subscriber's premises. It sends a code flash signal to the central office, which signal appears at the line lamp, giving the station number. That this may be distinguished at once as a fire signal, the circuit is carried through a vibrator, which causes a fluttering lamp flash and at the same time rings the subscriber's bell. A burglar alarm attachment sends the code signal, but omits the fluttering feature and the subscriber's bell signal. The apparent utility of this device is much greater than the real, as in a busy exchange in the day the operator would very probably miss the signal, at least in part, while at night it is more than probable that no operator would see the whole signal in large systems, while in small ones the operator would probably not be present at the switchboard at all when the signal began.

Niagara Meeting of the Electrical Engineers.

Prof. G. F. Sever, chairman of the general committee for the meeting of the American Institute of Electrical Engineers at Niagara Falls, on Monday, July 3, sends us the following programme:

Monday—Institute and President's Day (Morning) 9.30 to 1.—President's Address. Lunch, 1.00 to 2.00. Afternoon—Visits to local points of interest. No pre-arranged programme. Evening—No pre-arranged programme.

Tuesday—Electrical Day (Morning) 9.30 to 1.—Railroad Papers. Lunch, 1.00 to 2.00. Afternoon (2.15).—Tour of inspection of electrochemical and other electrical installations operated by the Niagara Falls power and power houses of the Niagara Falls Power Company. Evening—Dance under the auspices of local committee at Cataract House.

Wednesday—Niagara Day (Morning) 9.30 to 1.00.—Power Transmission Papers. Lunch, 1.00 to 2.00. Afternoon—Trolley trips to Niagara Gorge, Fort Niagara, Brock's Monument, Chippewa. Visits to following plants: Niagara Falls Hydraulic Power & Manufacturing Company, Canadian Niagara Power Company, Natural Food Company. Evening—Entertainment Cataract House, under auspices local committee and general committee.

Thursday—Excursion Day (Morning) 9.30 to 1.00.—Miscellaneous Papers. Lunch, 1.00 to 2.00. Afternoon—Excursions to Olcott Beach, St. Catharines, Lockport, Tonawanda Sub-Station. Evening—Illumination of Gorge route.

Friday—Buffalo Day (Morning) 9.30 to 1.00.—Joint meeting with Society for Promotion of Engineering Education. Adjournment of technical meetings. Lunch, 1.00 to 2.00. Afternoon—Trips to Buffalo, Buffalo General Electric Company, Buffalo Terminal House. Adjournment of Institute convention.

Following is a partial list of papers promised: "The Energy Transformations in the Synchronous Converter," by W. S. Franklin; "The Storage Battery in Sub-Stations," by W. E. Goldsborough and P. E. Fansler; "Commercial Alternator Design," by W. L. Waters; "The International Electrical Congress of 1904," by Elihu Thomson; "Symbols and Nomenclature," by Carl Hering; "The Magnetic Units," by Dr. A. E. Kennelly; "The Legalized Standard of Electromotive Force," by Prof. H. S. Carhart; "Institute Branch Meetings, their Organization, Development and Influence," by Calvin W. Rice.

Programme of the Chicago N. E. L. A. Convention.

Below will be found the programme of papers and reports for the Chicago twenty-sixth annual convention of the National Electric Light Association, day by day. The meetings will be held at the Auditorium Hotel, which will be headquarters:

Tuesday Morning, May 26.—Address of President Ferguson. Report of editor of *Progress,* Mr. T. Commerford Martin. Report on office methods and accounting, W. M. Anthony. Tuesday Afternoon.—Paper on advantages derived from use of one system of generation and transmission of electrical energy from all power stations in one locality, Mr. Charles L. Edgar. Paper on standard ratios for transformers, Mr. John S. Peck. Paper on boiler and furnace efficiencies, Mr. A. Bement. Report of Committee on Flue Gases, Henry L. Doherty, chairman.

Wednesday Morning, May 27.—Paper by Charles F. Scott on the young engineer and the electric lighting plant. Paper on tactful relations with customers, Mr. John W. Ferguson. Paper on attitude of employer toward benevolent, insurance and educational associations among employees, Mr. Arthur Williams. Paper on first aid appliances, Dr. J. D. McGowan. Wednesday Afternoon.—Paper by Prof. Elihu Thomson. Paper on steam turbines, Prof. Wm. Lispenard Robb. Paper on district heating, Mr. John W. Glidden. Paper on the application of four-ampere series alternating arc lamps for street lighting, Mr. Henry Hallberg.

Thursday Morning.—Paper on salt as a by-product, Mr. Alex Dow. Paper on some fundamentals of photometry, Prof. H. E. Clifford. Report of Committee on Photometric Values of Arc Lamps, Mr. Henry L. Doherty, chairman. Exhibition and description of the Matthews integrating photometer, Prof. Charles P. Matthews. Report on decorative and sign lighting, Mr. Arthur Williams. Thursday Afternoon.—Paper on relative advantages of electrical and mechanical methods of variable speed control for general power service, Mr. William Cooper. Report of theft of current, Mr. Robert L. Elliott. Report, unaccounted, for current, Mr. L. G. Van Ness. Report of Committee on Standard Electrical Rules, Captain William Brophy, chairman. Question box. Executive session. Reports of secretary and treasurer and Executive Committee. Election of officers.

As already noted, Mr. James Wolff has been appointed by President Ferguson as chairman of the local reception and entertainment committee for the convention of the National Electric Light Association. This committee has arranged to have a general reception in the Auditorium parlors on Monday evening, May 25, from 8.30 to 10.30. Arrangements are also being made for a tally-ho party on Tuesday morning for the ladies attending the convention, to drive to the Washington Club, where they will have luncheon. After luncheon they will drive through the South Parks, returning to the hotel in the afternoon. A matinée party at one of the theatres is contemplated for the ladies on Wednesday afternoon. Engrossed invitations were issued last week for the Monday reception.

CURRENT NEWS AND NOTES.

TELEPHONE CONVENTION.—The annual convention of the National Independent Telephone Association will be held in Chicago June 24 and 25. The secretary is Mr. J. B. Ware, Ellicott Square Building, Buffalo.

WIRELESS TELEGRAPHY IN ALASKA.—Secretary Root has, according to a Washington dispatch, approved plans for the erection of a wireless telegraph system between Cape Nome and St. Michael, in Alaska. Masts 200 ft. high will be erected at both places.

COMMERCIAL AUTOMOBILES are to be given a test this week by the Automobile Club of America in New York City, under rules and regulations already announced. Six classes are made, divided along the line of dead load capacity. The electrical entries at present are inconsiderable."

MUNICIPAL ELECTRICIANS.—The Executive Committee of the International Association of Municipal Electricians has fixed September 2, 3 and 4 for the annual convention, and selected the Hotel Rudolf, Atlantic City, N. J., as the headquarters. An exhibition of wireless telegraphy will be one of the special features of the convention.

ROWLAND SYSTEM IN ITALY.—A special cable message from Rome of May 16 says: "The American engineers, Wiegand and Penniman, have arrived here for the purpose of making certain telegraphic tests. They will apply Rowland's apparatus for the simultaneous transmission of eight dispatches over one wire on the Italian telegraph lines."

TELEGRAMS IN MANCHURIA.—A British official at Shanghai has received from the Imperial Chinese Telegraphs a memorandum which, verbatim, is as follows: "In regarding to charges to New-Chwang at old time is 38 cents per word, but since Russian has occupied at Manchu, charges being increased to dollar ten cents, as they treat Manchuria same as Russia in Asia." This official intimation is considered significant.

THE LIEBIG CENTENNIAL.—The Verein Deutscher Chemiker celebrated the hundredth birthday of Justus von Liebig with a dinner at the Chemists' Club, 108 West Fifty-fifth Street, New York, on the evening of May 12. The speakers told of incidents in the career of the German master chemist. Among those who spoke were Prof. Ira Remsen, president of Johns Hopkins University, and Prof. William H. Brewer, of Yale. About 300 were present.

LIGHTING NOTRE DAME, PARIS.—The Paris correspondent of the *New York Herald* writes: "An American sightseeing in Paris told me he had been in Notre Dame and seen the Cathedral in the evening, lighted by electricity. He was much disappointed. The hard, brilliant searching light banishes the dim religious shadow which gives a charm and mystery to the venerable church. Modern improvements do not harmonize with mediæval mellowness."

MARCONI RESTING.—Mr. Marconi has, according to a recent dispatch from Rome, suffered a relapse from an attack of influenza, owing to overexertion, and has gone to Bologna for a fortnight's rest. Before leaving he is said to have completed negotiations for the establishment on the coast of Tuscany of an extra powerful wireless telegraph station to connect with the Argentine Republic. The government, the dispatch adds, will contribute $140,000 toward the project.

DRAWBAUGH WIRELESS TELEPHONE.—A dispatch from Harrisburg, Pa., states that Daniel Drawbaugh, the well-known inventor, who resides near that city, is completing a wireless telephone system. He is now able to converse over a distance of one mile, so the dispatch states, and when he completes a new apparatus, upon which he is now at work, he expects to be able to talk five miles. It is stated that Dr. Ward, of the University of Pennsylvania, who represents the United States Signal Corps, is closely watching Mr. Drawbaugh's experiments.

AERONAUT MONUMENT IN PARIS.—A novel and ingenious monument by Bartholdi to the aeronauts of the Siege of Paris is to be erected in the vicinity of Montmartre. It will stand about 60 ft. high, and be capped by a balloon of bronze, glass and transparent mica. Its diameter will be about 10 ft., and inside will be an electric lamp with a reflector, so that by night the monument and the surrounding place will be illuminated. The balloon will be guided by a symbolical figure of the Genius of Paris, and under it a mother with her dying children will represent the City of Paris.

A WIRELESS TELEGRAPH POOL.—A cable dispatch from Berlin of May 10 says: "It is understood that the agreement between the Allegemeine Elektrizats Gesellschaft and the Siemens-Halske Company regarding wireless telegraphy will take the form of a trust, of which the component parts will be the Slaby-Arco system of the former company and the Braun system of the Siemens-Halske combination. This combine will then make a working arrangement with Marconi's company. The capital of the new trust will probably be a million marks. It is believed that Count Arco will be the director."

TRIAL OF SUBMARINES.—The electric submarine torpedo boat *Porpoise*, in a government trial on May 18 on Peconic Bay, off New Suffolk, fired a torpedo at the end of a successful submerged run of a mile and a half. The missile went straight between two flags set 150 ft. apart, representing a war vessel. The Navy Trial Board, represented by Capt. C. J. Train, Capt. Charles R. Roelker, Commander W. C. Cowles and Lieut. J. J. Woodward, were satisfied with the result. The submarine *Shark*, in three surface trials of a mile each made an average speed of 7.25 miles an hour, which exceeds the government requirements by a quarter of a mile.

OMNIBUSES IN PARIS.—A cable dispatch from Paris of May 9 says: "When is an omnibus not an omnibus?" This is a question on which millions of American money depend. Fifty years ago the omnibus company was intrusted with transportation from one point to another in Paris. Of late years lines of tramways from the suburbs, heavily financed from America, have been allowed to penetrate to the center of the city. The omnibus company declares this is a breach of its monopoly and sues for an interdict. The municipality denies that a tramway is an omnibus line and says there is no breach of contract. All the big counsel in Paris are engaged on the case.

LIGHTING FORT RILEY.—According to the *New York Sun*, the authority recently granted by the War Department for the lighting of the reservation at Fort Riley by electricity is of more than local importance. The geographical center of the United States lies within the limits of the post, and at present the conical roof of a large cistern situated on the highest ground of the reservation covers it. When the electrical plant is installed, it is proposed to place a lamp on the top of this roof, the light of which will be visible for miles in every direction. This will be a shining mark by night, while the hill and its lofty tank indicate clearly by day the middle point of our continental system.

LONG RANGE FOR CAMERAS.—With reference to an item of news in our last issue, the following special cable dispatch of May 16 from London will be of interest: "Henniker Heaton, M. P., England's leading postal reformer, has just returned from Rome, whither he accompanied his intimate friend, Marconi. He told the *World* correspondent to-day of the latest scientific wonder which he saw there—the taking of photographs at a distance of from twenty to twenty-five miles. 'I visited one of Marconi's radiograph stations, three miles outside of Rome, in the Campagna,' he said, 'and was shown there perfect photographs of a large size taken by electricians and scientists from that station of views in the mountains twenty-five miles away. How this marvel was accomplished is their secret. Whether it was done by some new ways of utilizing the Hertzian waves or an entirely new discovery, I am unable to say. The photographs were clear, bringing out in sharp definition the outline of houses and the figures of men and women as though taken only ten or twenty yards off. They appear able to extend or narrow the field at will. One of the operators told me that in a short time they hope to be able to take photographs of objects and places two hundred miles distant and enable you to see the person you are telegraphing to at that range. No one is permitted to enter the radiograph station, and, so far, the secret has been admirably kept.'"

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION.—The adjourned annual meeting of the New York State Independent Telephone Association will be held at the Butterfield House, Utica, N. Y., on June 10, 1903. Officers will be elected and other business transacted. Mr. Charles O. Harris, 59 Stone Street, Rochester, N. Y., is secretary of the association.

DISABLING TELEPHONE SERVICE.—A recent telegram from Chicago says: "Out of an apparently insignificant strike has grown a great deal of trouble for the telephone patrons of Chicago. The cable splicers are fighting the Chicago Telephone Company, and to-day their sympathizers cut the cables in one of the big trunk conduits of the West Exchange. As a result 700 telephones in the Northwest Side are useless. Non-union men were sent to splice the break, but their work was interfered with by strike sympathizers, who attacked them and threw stones at them."

MOST POWERFUL SEARCHLIGHT IN THE WORLD.—The *Woman's Magazine,* of St. Louis, has given the General Electric Company an order to build an electric searchlight, which shall excel in size and illuminating power any heretofore constructed. This searchlight will be placed on the dome of the new building, which the publishers of this magazine are erecting on University Heights, just out of the city limits, and in full view of the Exposition Grounds. This searchlight promises to be one of the most striking advertisements yet employed.

ELECTRIC AUTOCAR IN BELGIUM.—A report from the United States State Department says: "Consul-General Richard Guenther writes from Frankfort, April 7, 1903, that, according to the *Journal de Bruxelles,* the International Sleeping Car Company has given orders for building an electric autocar, which by August next will be running upon the Belgian State Railroad between Brussels and Ostend. The distance of 125 km (78⅛ miles) will be covered, it is stated, in less than an hour. The car will carry 40 passengers." What this items of news means is not quite clear.

ENGLISH ELECTRICAL JOURNAL IN GERMANY.—Sometime ago we printed a note from a foreign contemporary reporting that an electrical journal was about to be published in Berlin in the English language. In reply to an inquiry we are informed from Berlin that the only foundation for the story appears to be that "a prominent electrical journalist was in Berlin for several days some weeks ago and appeared to be very busy and interested in something which people generally did not understand. Nothing can be learned from those who would be most likely to know if such a plan were on foot."

IMPROMPTU SURGERY.—At Vallejo, Cal., recently, an ingenious application of electricity to surgical operations was demonstrated. An apprentice at the navy yard was severely injured by a piece of steel, which flew from a tool, embedding itself in his face. It was thought that the metal had been entirely removed from the wound, but there were indications of the presence of a foreign substance. Master Electrician Petrie arranged an electromagnet of his own design capable of lifting 500 pounds. The magnet was held directly over the orifice of the wound and the current was turned on. In an instant the piece of metal was drawn from the wound and attached itself to the magnet.

THE NERNST LAMP PATENT IN GERMANY.—The Imperial Court (First Civil Senate) of Germany has reversed on appeal a decision of the German Patent Office against the validity of the Nernst patent. The complainant in the proceedings before the Patent Office was William Boehm, a chemist, who contended that the invention of Nernst was anticipated by Jablochkoff. In 1877 a German patent was issued to the latter, the specifications of which disclosed that if an insulating substance such as kaolin is introduced into a high-voltage circuit and becomes heated "under the influence of sparks" the passage of current is permitted and the material becomes incandescent. This patent and subsequent publications on the work of Jablochkoff formed the principal issue. In rebuttal it was claimed that the main principle of the Nernst lamp was a preliminary heating by external means, and this was upheld by the court, which, as stated above, reversed the decision of the Patent Office.

LETTERS TO THE EDITORS.

A Correction.

To the Editors of Electrical World and Engineer:

SIRS:—On page 832 of your issue of May 16 a statement is made purporting to give my views as recently stated before a meeting of the American Institute of Electrical Engineers, at Chicago, in favor of direct-current power houses for railways, and which would lead one to believe that I have recently changed my opinions regarding the advisability of the use of alternating current for heavy railway work.

What I meant to convey by my remarks, and what I believe should have been understood from what I actually said, was that I believed in a number of alternating-current power houses, distributed along the line, feeding alternating-current directly into the working conductor at a sufficiently high pressure to allow these power houses to be located a reasonable distance apart; for by so doing, the use of step-up and step-down transformers, rotary-converters, and the entire sub-station equipment would be eliminated. This, of course, assumes the use of alternating-current motors on the cars, the practicability of which I think will soon be demonstrated. Since I have so strongly advocated the use of alternating-current motors for railway work, for some years, and am still in favor of them, I dislike to find myself quoted as being apparently against them.

I shall be obliged if you will kindly rectify the error in some suitable manner.

CHICAGO, ILL. BION J. ARNOLD.

How to Produce Gravity Experimentally.

To the Editors of Electrical World and Engineer:

SIRS:—The article on "How to Produce Gravity Experimentally," by Mr. Robert Stevenson, C. E., published in your issue of the 16th inst. certainly contains some remarkable statements; and if the facts are as the author says they are, they are certainly contrary to the accepted laws of motion. As, however, Mr. Stevenson admits that he is at variance with all the authorities, he will perhaps pardon my temerity in saying that I think he is entirely mistaken in his observation of the motion of the water after it has left the nozzle.

I have not tried the experiment in the precise form described, but I have tried an approximation to it with an ordinary hose. If the nozzle of an ordinary hose be held in the hand and moved as nearly as possible in a circular orbit, while the flow of water is at the same time properly regulated with the stop-cock, it is an easy matter to throw the ejected water into a helical or helicoidal form; but this is a very different thing from causing the individual particles of the water to move in helicoidal paths. Each elementary portion of water travels in a trajectory identical, or at least sensibly so, with the one it would have traveled had the nozzle been held stationary at the point where the given portion of water was ejected.

The appearance of a helix rotating upon its axis without motion as a whole in the direction of the axis, and of a similar helix moving bodily in the direction of its axis without rotation, are sometimes so similar that it is difficult to distinguish between them. A particular case in point, in the writer's experience, is that of a sub-marine cable passing through the armoring machine. At a point just beyond that where the armor wire was "closed" upon the core the eye was unconsciously arrested by a stationary portion of the machine, so that the observation was continually directed to successive portions of the armor. This, owing to the helical lay of the armor wire, produced the appearance of axial rotation. So persistent was this illusion, that it was only dispelled by grasping the cable in the hand, when the eye unconsciously followed the hand, and the attention was directed to a single point of the armor. The dis-illusionment was instantaneous.

NEW YORK. TOWNSEND WOLCOTT.

Dimensions of Physical Quantities and Abbreviations of Units.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of January 5, 1901, there appeared a sheet of the "Symbols of Physical Quantities and Abbreviations for Units, recommended at the International Electrical Congress, 1893." I have noticed some more or less evident mistakes in this table and thought perhaps it might be well to call your attention to them, although it is probable you have already noticed them. They are as follows:

A. The defining equation for acceleration should be $a = \frac{v}{T}$, and its dimension should be $L \times T^{-2}$.

B. The coulomb is an ampere-second, the abbreviation being *a-s*.

C. The joule is a watt second, abbreviation, *w-s*. Yours truly,

Chicago, Ill. H. H. Wait.

[*A* is a valid statement and criticism, the error noted being due to a misprint. Another error which crept in the table is the definition of frequency, which should be $\frac{n}{T}$, and its dimension, T^{-1}. As to *B* and *C*, the table does not undertake to establish the relation of the coulomb and ampere hour, which are correctly treated as independent units. It implies that both the coulomb and the ampere-hour are units of quantity, which is true. Similarly, no intention existed to demonstrate the relation of the joule and watt hour. It appears probably that some action will be taken at the coming St. Louis International Electrical Congress with respect to electrical nomenclature and symbols, in which case a revised version of the table will be printed in these columns.—Eds.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motors with Commutator. Blondel. The first parts of what appears to become a very long serial on the theory of induction motors, provided with a direct-current commutator. Rotten was the first who, in 1891, patented such a machine; Goerges described such a machine later in the same year. The recent development is due to Heyland and Latour, as was stated frequently in the Digest. The present author gives first a description of the Goerges motor, together with a very full analytical theory, illustrated by a series of diagrams. He then takes up the Latour arrangement. As the first two parts of this serial fill 34 pages, it is impossible to give a brief summary. The author criticizes various previous remarks of both Heyland and Latour.—*L'Eclairage Elec.*, April 25, May 2.

REFERENCES.

Theory of the Single-Phase Induction Motor.—Cahen.—A reply to a remark of Goerges, who had stated that the conception of a single-phase alternating-current field being the resultant of two equal imaginary revolving fields, which rotate in opposite directions, is not very easy to grasp, and leads to inexact results. The present author denies emphatically the exactness of the latter criticism and shows that if the method is correctly applied, it leads to correct results.—*Elek. Zeit.*, April 30.

Three-Phase Alternator.—Doane.—A didactic article, illustrated by diagrams.—*Elec. Age*, May.

LIGHTS AND LIGHTING.

Osmiun Lamp.—Kubes.—An article on the osmium lamp, in which, after some brief remarks on its manufacture, the following data are given of its behavior. On account of the small current consumption of the osmium lamp, compared with the carbon filament lamp, a saving of 50 to 56 per cent. is effected. Concerning the constancy of the light, it is stated that the ordinary incandescent lamp loses about 15 to 20 per cent. of its initial candle-power after 500 to 600 hours of burning, while the osmium lamp gains a few per cent. during the same time, and only after 1,000 hours it begins to lose a comparatively small proportion of its candle-power. The average life of the lamp has been given by the manufacturers as 500 hours, but in recent tests a large percentage of lamps is said to have had a life of 2,000 hours. The end of the life of the lamp is due to the burning through of the filament. In one test the original candle-power was 33, with a consumption of 1.54 watts per candle; after 500 hours, 32.4 candles and 1.49 watts per candle; after 1,000 hours, 31.7 candles and 1.5 watts per candle. In another test the candle-power was at the start 34.7 candles, with 1.5 watts per candle, after 600 hours, 31.8 candles and 1.54 watts per candle; after 900 hours, 31.6 candles and 1.58 watts per candle. The decrease of candle-power was, therefore, at the maximum still below 9 per cent. after 1,000 hours, while the watt consumption increased only by 3 per cent. Two tests made in Nüremburg with 32 and 25-candle lamps are described, in which the 32-candle lamps behaved in a peculiar way, as their candle-power first decreased, then increased again above the normal value and finally remained nearly constant; the candle-power of the 25-candle lamps first increased considerably and later decreased gradually. In both types of lamps the watt consumption per candle became smaller, with a greater candle-power. It follows that when overloaded the lamps show a lower watt consumption. Osmium lamps stand overloading better than ordinary incandescent lamps, although the life is diminished. The disadvantages of the osmium lamp are its low voltage and the fact that it must be used in a downward position, as the filament is strongly bent when the lamp is lighted. The commercial lamps are sold for 16 volts at 10 and 16 candles, 25 to 3 volts at 25 candles, 27½ volts at 16 and 25 candles, 32 to 44 volts at 25 to 32 candles. The inventor hopes that at some future time he will be able to place commercial lamps for 110 to 120 volts on the market. The supply of osmium is small, and the price of the lamp is, therefore, high, namely, $1.25; 19 cents are given back, if the burned out but unopened lamp is returned within 18 months. The filament of such a lamp can be treated and used again.—*Zeit. f. Elek.*, April 19.

Osmium Lamps for Train Lighting.—Breidensprecher.—A note on the lighting system which has been in successful use on passenger and freight trains of the Marienburg-Mlawka Railway in Germany, since 1894. The current is derived from storage batteries carried on the train. As the incandescent lamps formerly used were not very durable and showed a diminution of their lighting power towards the end of their life, osmium lamps were substituted since the beginning of August, 1902; they gave 10 cp at 16 volts, and the calculated energy consumption was 1.5 watts per candle-power. The storage batteries then required recharging after 72 hours, whereas with the old lamps they had to be recharged after 32 hours, the final voltage being in both cases the same. After burning 750 hours, no diminution in the light could be observed in the osmium lamps, the bulbs of which kept perfectly clear while those of the carbon lamps had blackened. The vibrations of the trains did not affect the lamps. For the ordinary incandescent lamps, with an average life of from 300 to 400 hours, 22.5 cents was paid; for the osmium lamp, with an average life of 1,000 hours, the cost was $1.19; the cost for depreciation was, therefore, 0.056 cent for the old lamp and 0.119 for the osmium lamp.—Lond. *Elec*, May 1.

Life of Nernst Lamps.—With reference to some recent discussion of this subject, the experience of the electrical engineer in Gravesend is quoted; he installed 48 Nernst lamps of 0.5 amp. in place of incandescent gas burners, and the average life at the end of three months was 960 hours, individual burners lasting over 165 hours; the 960 hours do not represent the true life, as at the expiration of the three months there were of course 48 burners alive. From a report of another engineer who installed three sets of six lamps each, it appears that the average life of one set was 836 hours, of another 575 hours, and of the third 652 hours.—Lond. *Elec.*, May 1.

REFERENCE.

New Incandescent Lamps.—Hammer.—A section of his recent Franklin Institute Lecture on "recent electrical and scientific developments abroad" deals with the three-phase lamps of Ganz & Co., and the Coruto Co., such as are used on the Valtellina Railway and with the osmium and Nernst lamps.—*Jour. Frank. Inst.*, May.

POWER.

Electricity in Mining.—An account of the proceedings at a recent meeting of the English Department Committee inquiring into the application of electricity in mines. Of special interest is the examination of Bigge concerning the respective merits of direct-current and three-phase working. He was most emphatic in his advocacy of the latter system and said that one might even work with considerably higher pressure, yet there is less danger of break-down, one reason being that there is a smaller difference of potential between adjacent windings of the rotor. The simpler and stronger construction of the three-phase motor and the ease with which it may be repaired, are great advantages. Combined with the question of economy is that of whether high pressures should be brought down the shaft of a mine; he claims that the workmen are more careful when they know that contact means certain death and that there are, therefore, actually less fatalities in connection with high-tension than with low-tension systems.—Lond. *Elec.*, May 1.

Water Power in Electrical Supply.—Adams.—An article giving some statistical notes. Electrical supply from transmitted water power is now distributed in more than 50 cities in North America; some instances are mentioned. For comparison of the expansion of electric waterpower systems with those operated by steam, when located in different cities, statistical data are given on the electric supply development in Hartford and Springfield on the one hand, and in Fall River and New Bedford on the other hand; the conclusion is drawn that water power has been the most potent factor in the comparatively very large rise of electric loads in the two former cities. He also mentions that the application of transmitted water power in electrical supply, has displaced steam as a motive power in many large industrial plants that never would have been operated from steam-driven electric stations; he quotes some instances. He believes the development of water powers will continue to increase and that in another ten years the greater part of electrical supply on the American continent will be drawn from water.—*Elec. Rev.*, May 9.

REFERENCES.

Canadian Water Power Plant.—A detailed, well-illustrated article on the water power development at Chaudiere Falls, P. Q. At present two revolving-field, 750-kw alternators have been installed, the voltage being 10,500 and the frequency 66⅔. The power transmission by subaqueous cable to the transformer sub-stations at Levis, is also described.—*Eng. News*, May 7.

Electrically-Operated Milling Plant.—Perkins.—An illustrated description of a power plant recently installed in Scotland for transmitting electric power to various mills and factories in different sections of the city. The total capacity is 2,000 hp, each of the half dozen concerns requiring about 300 hp. Direct current of 500 to 530 volts is used.—*Elec. Rev.*, May 2.

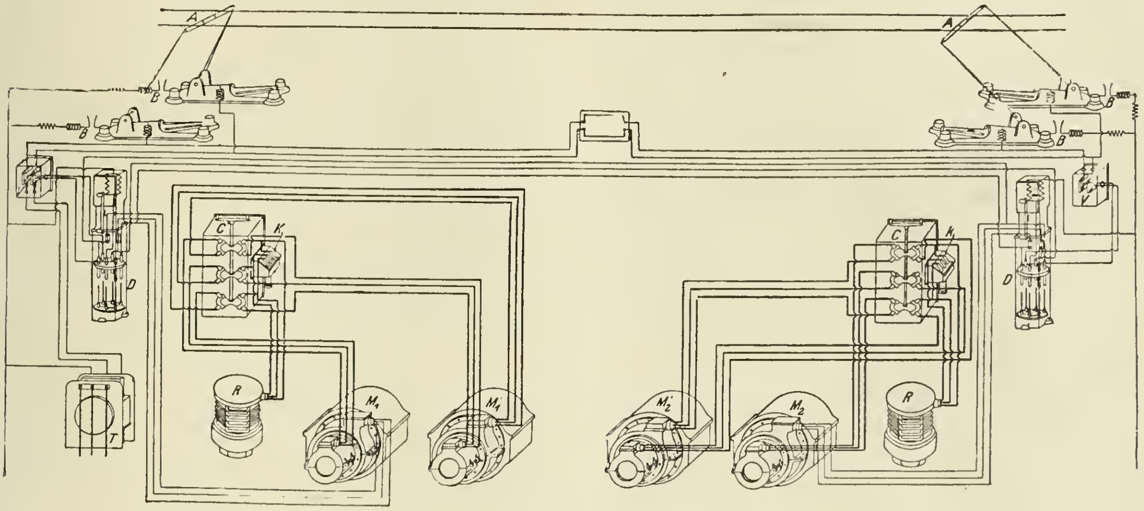
Steam Turbine.—An illustrated description of the Rateau turbine, for which, in spite of considerable friction on the surfaces of the disks in the chambers, an efficiency is claimed considerably higher than that of the best compound engine using superheated steam.—*St. R'y Jour.*, April 18.

Electric Equipment of Bridges.—An illustrated description of the electrical equipment of two new rolling-lift bridges in Chicago, direct-current tramway motors being used in both cases.—*West. Elec.*, May 9.

Steel Plant.—Perkins.—An illustrated article on central power stations at iron and steel plants.—*Elec. Age.*, May.

TRACTION.

Valtellina Three-Phase Railway.—Cserhati.—The conclusion of his detailed profusely-illustrated description of the Valtellina high-tension, three-phase railway system. The construction of the motor cars and locomotives is described and illustrated. At present motor cars are used for the passenger service and locomotives for the freight service; but it is intended to use electric locomotives for the large passenger express trains, also for a speed of 60 to 70 km on a grade of 1 per cent. for trains up to 250 tons, and with a speed of 35 km for trains up to 400 tons. These locomotives will have to develop a tractive effort of 9,000 kg in starting. The motor cars now in use weigh 53 tons each, and are able to draw a train of five to seven passenger cars having a total weight of 150 tons, on a grade of 1 per cent., with a speed of 65 km per hour. There are 10 such motor cars in use, each having two bogie trucks; each truck is provided with two axles, on each of which one three-phase motor is mounted. One motor of each bogie truck is the high-tension motor, the other a 300-volt auxiliary motor for use in starting, braking and for mounting steep grades. At these times the two motors are connected in cascade (in tandem), the high-tension, three-phase currents being supplied to the stator winding of the primary motor, while its rotor winding is connected with the stator winding of the second motor. The primary motor is so designed that its rotor gives 300 volts for running in tandem. The rotor circuit of the second (auxiliary) motor is closed by a resistance, which is gradually disconnected, and which is short-circuited when the motors have reached tandem synchronism, namely one-half full speed. The starting of the motors, the raising of the liquid in the rheostats, the raising and lowering of the trolley poles and the operation of the Westinghouse brakes, are all done by compressed air. When a motor car starts, the tandem connection is used; at the short-circulating of the rheostat one-half full speed is reached. The auxiliary motor is then disconnected from the circuit and the same rheostat is connected to the slip-rings of the high-tension motor and is gradually short-circuited. The controller handle has three positions: in the first the motors are disconnected, in the second the motors are connected in tandem and the terminals of the rheostat are connected with the slip-rings of the second (auxiliary) motor; in the third the auxiliary motors are disconnected and the slip-rings of the high-tension motors are connected with the rheostat. The operation of the gradual disconnection of the rheostat takes place automatically. The wiring diagram of the motor car is given in the adjoining diagram. From the trolley poles, *A*, the current passes



Valtellina Three-Phase Railway.

to a distributing box, *I*, which contains the contacts, by the removal of which the electrical connection of the trolley poles with the circuit of the car is interrupted. *B B* are lightning arresters. *D* is the main switch, *C* the controller, *K* a short circuiting switch, M_1, M_2 the high tension motors, M'_1, M'_2 the auxiliary 300-volt motors, *R R* liquid rheostats, *T* a transformer for the air pump, lighting and heating. The arrangement in the locomotives is similar to that of the motor cars.—*Elek. Zeit.*, April 30.

Double Unit System.—An illustrated article on the Paris Metropolitan Railway. Eight car trains are used, with one motor car at the front and another at the end, and what is called the "double-unit system" of control is used. Each motor car, if used with three trailers, can be controlled by the usual series parallel control of its two motors; in an eight-car train the two pairs of motors are connected in series or parallel from the controller of whichever car happens to be in front for the time being, the resistances of this car only being utilized. Current is supplied to the line at 500 volts, partly generated directly at the company's own power house and partly supplied in form of three phase currents transformed in converter substances.—Lond. *Elec.*, April 24.

Steam Turbines in Traction Plants.—An editorial on steam turbines for interurban railways. The weak point in the present steam turbine is said to be its high speed, as for instance 1,800 revolutions for a 500-kw turbine or 500 revolutions for a 5,000-kw turbine, for which speeds it is difficult to build a direct-current generator. The result is that turbines so far have been constructed entirely for alternating current work; but even if no reduction in speed is possible, the turbine will still be used largely in railway service.—*St. R'y Jour.*, April 25.

Paris.—An article on extensions which are being made to the Metropolitan Underground Railway in Paris. All of the surface tramways demand the introduction of the trolley and estimate that the saving with the trolley over the accumulator cars would amount to 222,000 francs per annum. Another aspect of the Metropolitan competition with the tramway and omnibus companies is shown by the decrease in the number of horses, which is 6,000 less than two years ago. An underground double-track road between Antwerp and Brussels is proposed; the line would be 42 km in length and the distance would be run in 22 minutes.—*St. R'y Jour.*, May 2.

REFERENCES.

Electric Traction.—A long article giving trade notes on tramway and railway cars, car equipments, lines and feeders, engines and generating plant, batteries, switchboard instruments and telephones.—Lond. *Elec.*, April 24.

Electric Railway Power Distributions.—Gump.—An article illustrated by diagrams, in which he discusses the various factors which enter into the design of an electric railway power distribution system. The subject is discussed under the following heads: Grading and drop of voltage; load curve; feeders; return circuit; bonding; power plant; electrolysis.—*West. Elec.*, May 9.

Wooden Blocks as Insulators for Third Rail.—Leavitt.—An account of tests of the wooden insulators used on the third rail of the Albany & Hudson Railway, showing in a table the ampere losses and the conditions as to moisture. He believes wooden insulators to be perfectly satisfactory.—*St. R'y Jour.*, April 18.

Vatellina Three-Phase Railway.—Hammer.—A part of his Franklin Institute lecture on "recent electrical and scientific developments abroad" deals with this railway—*Jour. Frank. Inst.*, May.

Washington, Baltimore & Annapolis Road.—A summary of the plans for the roadbed and overhead construction in the transformation of this installation, which is to be equipped with the Lamme single-phase system.—*St. R'y Jour.*, April 25.

Conduit System in London.—The first part of a detailed and well-illustrated description of the conduit system used by the London County Council tramways.—Lond. *Elec.*, April 24.

Rockford, Beloit & Janesville R'y.—An article on the main power plant and distribution system of this interurban system in Wisconsin, with data upon the performance of the power plant and general operating statistics.—*St. R'y Jour.*, April 25.

Ohio Central Traction System.—A description of the interurban line extending from Bucyrus through Galion and Crestline to Mansfield, Ohio; it is to form an important part of the Cleveland & Southwestern system, which will ultimately furnish a complete electric trunk line between Cleveland and Columbus. The maximum grade is only 2 per cent. The most important feature of the equipment is the steam turbine, which has just been installed.—*St. R'y Jour.*, April 25.

Car Shops.—A description of the car shops of the Rochester Railway, which are equipped for all classes of construction and repair work. Power is furnished by electric motors, but compressed air is also extensively used.—*St. R'y Jour.*, April 11.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Kansas City.—A well illustrated description of the Central Avenue Station in Kansas City. There are two 1,500-kw, 6,600-volt, three-phase, 25 cycle generators, this low frequency being chosen on account of its adaptability to motor and railway synchronous converter sub-station service. As this frequency is too low for satisfactory lighting, 2,300-volt, 60 cycle, two-phase generators, direct-connected to 6,600 volt, three phase, 25 cycle synchronous motors, are used to supply the lighting service.—*Power*, May.

REFERENCES.

Voltage Regulation in Networks.—Hiecke.—An illustrated paper, read before the Vienna Electrical Society, in which he describes the methods used in the central stations and in the three and five-wire networks of the General Austrian Electric Company, for keeping the voltage constant. In order to measure, in the stations, the voltage at the distant feeding points, each feeding point is connected with the measuring instruments in the stations by means of pilot wires which are placed in the feeder cables. Descriptions are given of the instruments and of the various methods of regulating the voltage by means of change of speed and by varying the exciting current of the steam dynamos, by varying the number of cells of the storage batteries, and by means of balances. The method used for starting up operation after an accidental closing down is also described.—*Zeit. f. Elek.*, April 19.

Distribution Losses and Resonance Phenomenon.—An account of the discussion of the two papers by Constable and Fawsett on distribution losses in electric supply systems, and by Field on a study of the phenomenon of resonance in electric circuits with the aid of oscillograms; both of which were recently noticed in the Digest.—Lond. *Elec.*, April 17, May 1.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Determining the Distribution of Currents in Electric Networks.—Teichmueller.—A long communication, in reply to Herzog and Feldmann, concerning the further development, by the latter authors, of an older method of Kennelly, another method of Frick and another method of Coltri.—*Elek. Zeit.*, April 30.

Capacity of Cables.—Andriessen.—A mathematical article on the determination of the capacity of cables by decomposing it into partial condensances. The case of a two-core cable is fully treated and a few remarks are added on polyphase cables.—*Elek. Zeit.*, April 30.

ELECTRO-PHYSICS AND MAGNETISM.

Pulsating Direct Currents in the Alternating-Current Arc.—Monasch.—An illustrated paper read before the Darmstadt Electrical Society. In view of the applicability of the Cooper Hewitt mercury arc lamp for converting three-phase currents into pulsating direct current, the author gives a review of the former work of other investigators on pulsating direct currents in the alternating-current arc. Jamin and Maneuvrier were the first who found that from the alternating-current arc direct current can be taken, which produced electrolytic action. A summary is then given of the investigations of Sahulka, Gold, Lang, Eichberg and Kaller, Blondel, Duddell and Marchant, Arons, Mrs. Ayrton and others. The Cooper Hewitt invention is an interesting generalization of our knowledge of pulsating direct current in the alternating-current arc, because his arcs are very long compared with those of Blondel, and also because Cooper Hewitt gets a pulsating direct current in an alternating-current arc between two different metallic electrodes, while this phenomenon has, up to the present, been observed only between metal and carbon or between carbons of different natures and diameters.—*Elek. Zeit.*, April 20.

Electric Conduction.—Strutt.—A note on a Royal Institution lecture on some recent investigations of electrical conduction. He made an experiment in which a Röntgen ray tube placed in the gallery of the lecture hall, discharged a gold-leaf electroscope near the lecture table. He then showed how ionized air would discharge the electroscope, even when the instrument was shielded from the direct action of the Röntgen rays. The Crookes tube was placed in a leaden box with a window, and another leaden box, having an aluminum window, was held in front of it; air was passed through this box by means of a pair of bellows and a rubber tube, and when allowed to play on the knob of a gold-leaf electroscope, effectually discharged it. Curves, representing the relations between current and e.m.f. in cases of such discharge, are straight lines for metals, while charged gases appear to become, as it were, saturated at a certain potential, the curves bending over and becoming almost horizontal from a particular value onwards. Taking air as unity, the relative saturation currents for Röntgen rays are for hydrogen 0.1, sulphur dioxide 8.73, and methyl iodide 70.3; and for Becqueral rays hydrogen 0.16, sulphur dioxide 2.32, methyl iodide 5.18. He then described Wilson's apparatus and experiments demonstrating that a discharge takes place in a closed vessel; he thinks the discharge may be of Becquerel rays from the walls of the vessel itself.—Lond. *Elec.*, May 1.

Coherer.—Hanchett.—A short article on a simple microscopic experiment of coherer actions. From his observations he draws the following conclusions as to the requirements for a good coherer. The particles used should be "impervious to oxidation"; they ought to be as light as possible; aluminum would be very good if it had not the well-known oxide film on its surface. The number of filings in the coherer should be the smallest possible.—*Elec. Rev.*, May 2.

Electro-Chemistry and Batteries.

Ions in Solution.—Kohlrausch.—A paper in which he advances a new hypothesis concerning the nature of mobility, based on the latest values of ionic mobilities. He suggests that the ion carries with it a mass of adhering solvent or "atmosphere" which for multivalent or compound ions differs from that of monatomic ions. He thus attempts to reduce the properties of ions in electrolytes to one fundamental element, namely their hydration or power of forming such an atmosphere. This water atmosphere varies with the nature of the ion, but enough is not known about the molecular forces to describe this more definitely. If the electrolytic resistance is in reality a mechanical friction, it follows that the mobilities of all the ions tend toward zero at about minus 40°.—*Proc. Roy. Soc.*, April 7; abstracted in Lond. *Elec.*, April 24.

Decay of Metals.—Milton and Larke.—An abstract of a paper read before the British Institution of Civil Engineers on some experiments made to determine the galvanic action between copper, iron, brass, Muntz metal, etc., when in contact with sea water. Weak but long-continued applied currents had a decided corrosive action upon copper and its alloys, which was greater in those containing the most of copper. With a current of 0.001 amp. acting on an immersed area of 40 sq. cm in the case of Muntz metal, the wasting was confined to the de-zincification of that poorest in copper; but the same current, acting upon 60 sq. cm of ordinary brass condenser tubes, caused a fairly uniform corrosion of both the copper and the zinc. It seemed that decay was more frequent in metals which had a duplex or more complex structure than in the more homogeneous, and was due to a slower or less energetic action than that causing corrosion; moreover, it involved an action which removed only a part of the constituents, whereas corrosion might result from chemical action alone, or both combined. Pitting was probably often due to local segregation of impurities of the metal, but it might also be due to local irregulariaies of the surface or structure which produces local irregularities in the distribution of galvanic currents. In the case of brass exposed to sea water, tin was distinctly preservative, while lead and iron were both injurious, rendering the brass more readily corrodible. Electrolytic action alone, produced with applied currents, even when they are exceedingly minute, might produce very severe corrosion or decay; every effort, therefore, should be made to prevent such action by careful insulation of all electric cables. Whenever galvanic action is inevitable through the proximity of different metals exposed to the same electrolyte, zinc plates should be arranged so that they would be negative to both of the other metals.—Lond. *Elec.*, April 24.

Electrogalvanizing.—Cowper-Coles.—Some notes on electrozincing as used extensively in shipbuilding yards for coating steel plates and boiler tubes. When properly done, the results are claimed to be excellent, but sometimes work may look well, although when tested it is found to be only thinly coated with zinc. An electrogalvanizing plant should be practically automatic, so that it can be put in charge of any intelligent workman, and this, he says, is accomplished by substituting insoluble lead anodes for those of zinc and replenishing the bath by passing it over filter beds containing zinc powder or dust. A recently installed plant in London, in which this is done is described.—Lond. *Elec. Rev.*, April 24.

REFERENCE.

Electric Steel Process.—Beecker.—An illustrated article on the Kjellin electric steel process in use at Gysinge, Sweden.—*L'Ind. Electrochimie*, March.

Units, Measurements and Instruments.

Maximum Demand Indicator.—An illustrated description of a maximum demand indicator, consisting chiefly of a differential thermometer, which acts on a novel principle whereby a drop of mercury contained in a glass tube, having a bulb blown at each end, is caused to act both as a gas valve and also as a registering index of the maximum dhifference of temperature to which the bulbs have been subjected. The lower cylindrical bulb is closely embraced by a helical heating resistance wire, which is connected to the terminals of the current by two spring blades, which tend to close the helix and so cause it to grip the cylindrical bulb closely and insure good and uniform contact between the heating surface of the resistance wire and the glass bulb. The expansion of gas in the lower heated bulb causes a definite transference of gas into the upper bulb, corresponding to any given current, and on removing the thermometer from the heating helix, or switching off the current, the contraction of the gas in the lower bulb, or cooling, causes the mercury to sink downwards in the stem to a point determined by the total volume of gas originally transferred during the heating process; the drop of mercury acts as a valve. The tube carries a fixed scale marked in amperes or otherwise, and the mercury thus forms an index of the maximum current passed through the heating wire. Should the heating wire be broken or get burnt through by a short circuit or excessive current, the spring terminal blades to which its ends are attached instantly close together and short-circuit the instrument, thereby preventing a failure in the service. The instrument is said to be compact and low in price.—Lond. *Elec.*, May 1.

New Books.

Elementare Vorlesungen uber Telegraphie und Telephonie. By Dr. Richard Heilbrun. 3 lieferung. Berlin: Georg Siemens. Complete work, 11 marks.

The author of this brochure has compiled a description of the various kinds of batteries that are used in telegraphy and telephony. At the beginning of the pamphlet the chemical theory of the various cells is taken up and discussed at length, while subsequently all of the modern forms are illustrated in detail. Finally, a description of storage batteries and discussion upon the methods of making plates, completes the book.

Self Cooling Transformers.

The accompanying illustrations show the latest type of Westinghouse oil-insulated and self-cooling transformer. In this type of transformer both high-tension and low-tension windings are divided into many flat coils. The high-tension conductor, in all transformers except the very small sizes, is a flat copper ribbon wound concentrically with only one turn per layer. The layers are separated from each other by a specially prepared insulating material in addition to the cotton covering of the conductor, while the coils are insulated individually and are separated by heavy insulating washers. This form of construction is such as to practically eliminate any danger of break-downs between layers or from turn to turn—one of the most common troubles in transformer operation.

The low-tension side is wound in the same way with conductors of rectangular cross-section. In the larger transformers many wires are paralleled and are arranged in such a manner as to eliminate eddy currents in the conductors.

The advantages of this improved method of winding employed in the oil-insulated self-cooling transformer may be summed up as follows:

(1) The total e.m.f. of the transformer is divided among many coils, reducing proportionately the strain within an individual coil. (2) The e.m.f. between layers is reduced to that of a single turn (ranging from 10 to 25 volts). (3) The coils may be spread apart

at the ends so that a very large surface is exposed to the oil, thus providing ample radiating facilities. (4) The regulation of the transformer is greatly improved by the interlacing coils which is permitted by this method of construction. (5) In case of damage to a coil another one may be substituted with little trouble and without returning the transformer to the works.

Oil passages or ventilating ducts between the coils and in the iron provide an even heat distribution and a consequent uniformity of temperature throughout the transformer. The arrangement of these ducts between the coils is such that when the transformer is operated, a vigorous circulation of oil is set up directly through the interior of this winding, and the ducts placed at frequent intervals between the laminations bring rapidly moving oil within less than one inch of every particle of iron in the transformer.

The amount of heat developed in a transformer depends upon its capacity and efficiency. In a 500-kw transformer of 98.5 per cent. efficiency there is a loss at full load of 7½ kw or 10 hp. Since this loss appears as heat, it must be disposed of, to prevent a dangerously high temperature.

This heat may be dissipated by simple radiation from the surface of the containing case; by the circulation of water through pipes immersed in oil, or by the constant removal of heated oil and its return after having been cooled. The advantages of the first simple method are obvious.

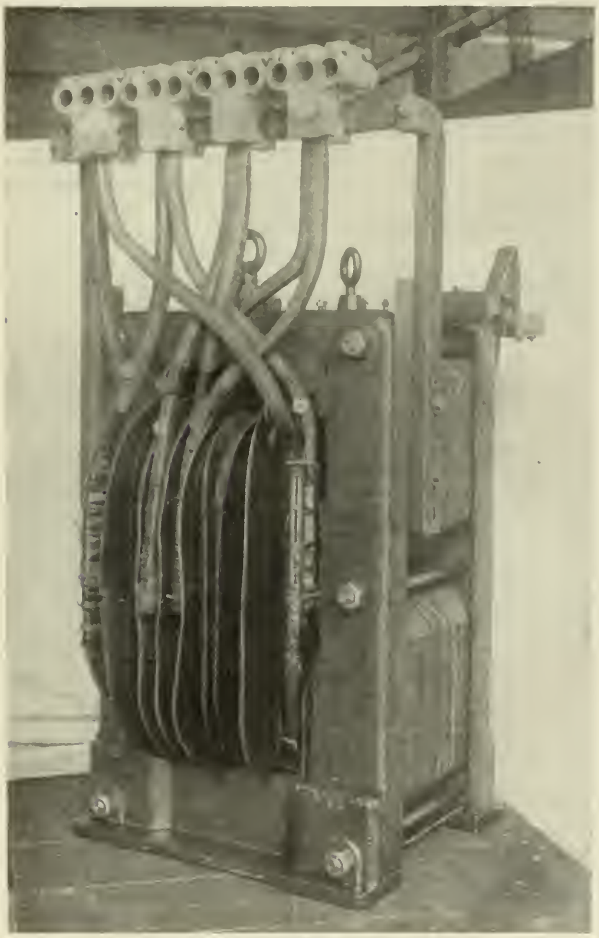


FIG. 1.—OIL-INSULATED TRANSFORMER.

To dispel the heat generated in a transformer of the self-cooling type a case with a large surface area exposed to the air is required. The greater the radiating surface, the lower the temperature. The Westinghouse transformers are mounted in heavy sheet-iron cases protected by an outer framework of angle iron. The surface area of the case is increased by corrugations, and is capable of radiating an immense amount of heat.

The high-tension terminals are mounted on a marble slab at one end of the transformer, the leads being brought out through bushings. The low-tension terminals are mounted at the opposite end of the transformer on a steel bar heavily insulated with mica, making an entirely safe construction.

In large transformers for long distance transmission, close regulation is of even greater importance than in the ordinary small transformer for lighting circuits, as the drop in the line is often of considerable magnitude, and with raising and lowering transformers the transformer drop occurs twice between the generator and the load. This drop is greatly increased when the power factor of the load falls below unity, as it does where current is supplied to induction motors. It is, therefore, particularly necessary that close regulation be obtained in transformers designed for transmission work, especially if used for supplying motors. This point has received careful attention in the design of the transformers described, and the highest practicable standard of regulation has been attained.

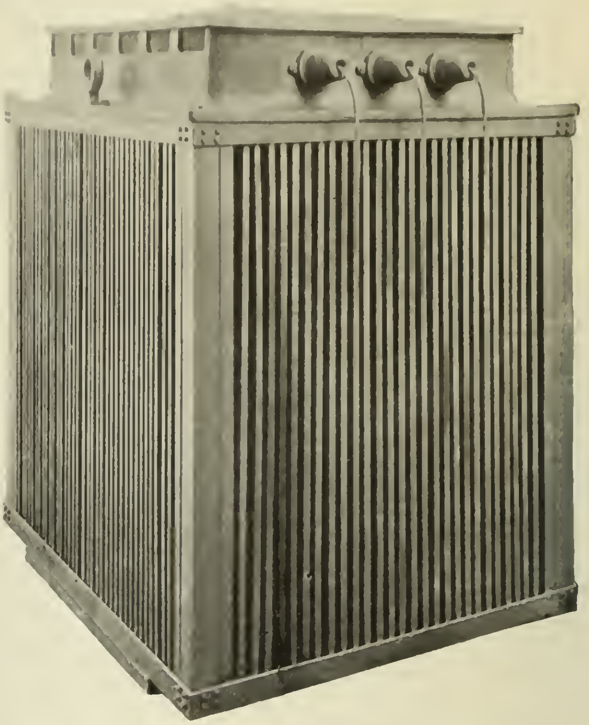


FIG. 2.—OIL-INSULATED TRANSFORMER.

Oil-insulated self-cooling transformers may be wound for practically any voltage desired. The following high-tension voltages, however, have been adopted as standard: 2,200, 6,600, 11,000, 16,500, 22,000, 33,000 and 44,000. Taps are brought out from the high-tension winding for three lower voltages. This provision makes it possible to use duplicate transformers at both ends of the transmission line, the taps on the lowering transformers accommodating them to the reduced line voltage. The following table shows the exact voltages for which Westinghouse standard transformers are wound, the capacities being from 10 to 500 kw:

STANDARD VOLTAGES FOR OIL-INSULATED SELF-COOLING TRANSFORMERS.

2200	6600	11000	16500	22000	33000	44000
2100	6300	10500	15750	21000	31500	42000
2000	6000	10000	15000	20000	30000	40000
1900	5700	9500	14250	19000	28500	38000

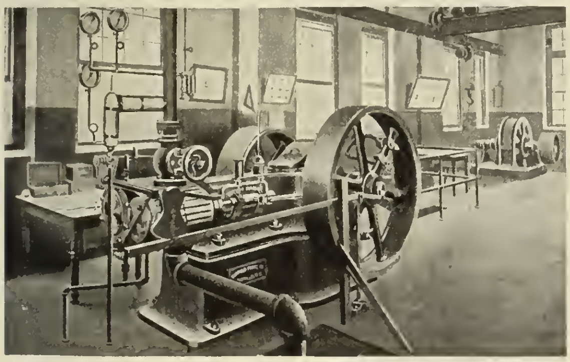
Transformers of a capacity not exceeding 150 kw may be wound for voltages as low as 50, and the larger transformers for voltages as low as 100. Either or both windings may be divided into two equal parts so arranged as to permit either series or multiple operation, the change being effected by a simple rearrangement of connectors on the terminal block. Taps may be brought out from the low-tension winding for ample variation in both voltage and ratio, and are provided for a total of five voltages—full voltage, 5 per cent. and 10 per cent. less than full voltage; half voltage, and 5 per cent. less than half voltage.

A Comprehensive Engine Test.

Profs. Reeve and Allen, of the Worcester Polytechnic Institute, have made in the power house of that institution a comprehensive series of tests for the Buffalo Forge Company on a 12-in. x 12-in. single-cylinder engine, which are models of what engine tests should be. Below we give an abstract of the report on the tests:

The engine tested is a single-cylinder, horizontal, center-crank, shaft-governor engine, having a cylinder measuring 12 x 12 in. and scheduled to run at 300 r.p.m. It was erected upon temporary foundations on the power house floor and belted to a quill upon the main line shaft. Steam was drawn from the vertical boilers through 36 ft. of permanent covered pipe and 17 ft. of temporary naked piping. The exhaust was led through three elbows and 14 ft. of pipe into a surface condenser with which all other connections were broken. During the tests the quality of the steam at the throttle was observed many times by means of a throttling calorimeter. The condition of the steam supplied to the engine was frequently investigated. It was at all times practically dry saturated steam.

In order to insure absolute steadiness of power developed, the engine's governor was blocked into such positions as would give the various cut-offs desired. The speed was maintained constant by insuring that the load was at all times greater than that which the engine would drive, the balance being made up by a second engine belted to the same line shaft. The governor of this second engine performed the regulation for the entire system. The speeds recorded are, therefore, no record of the action of the governor of the engine. The variations between the several tests are due to variety of adjustment of the governor of the second engine and of the load between the two engines. During any one test the speed was sensibly constant.



ENGINE TEST.

During all of the tests all of the exhaust from the engine was condensed in the surface condenser and the steam consumption was taken as its weight. During all of the non-condensing tests, care was taken that the pressure within the condenser was just atmospheric, while at the same time no vapor was allowed to escape. During the condensing tests the vacuum maintained in the condenser, about 22 in., was the best that could be, in view of the limited size of the condenser. This arrangement left the steam pressure as the only variable in any one test, and this was kept as nearly constant as possible by skilled control. The duration of each test was twenty minutes, but the engine was always kept in continuous operation for at least one hour, and often for several hours, before entrance upon a test.

The indicator readings were taken from a pair of Thompson instruments fresh from the hands of the makers. The indicator rig was built specially for the tests. It contained no geometric error; the error from lost motion was imperceptible; the length of cord involved was 8 in. for one indicator and 24 in. for the other. The indicator cocks were screwed directly into the cylinder ports. All gauges and thermometers used were calibrated especially for this work.

The friction of the engine when run empty was carefully determined. Because of the difficulty of making this determination with reliability two different indicators and six sets of springs were employed. The result of the whole is that the engine's friction is estimated at very close to 3.0 hp, or 4.3 per cent. of the engine's rating. The unusual lightness of this friction led to the repeated checking of its observation, as just noted, before accepting the result.

The results of the tests are shown in the accompanying table of data. The only explanation needed is perhaps in regard to the column of cylinder efficiency. These figures show the proportion of the heat available for work, under the conditions actually prevailing at the time of the test, which the engine succeeded in converting into work. That is, it is the percentage of the theoretically possible which the engine actually attained. In this column 100 per cent. would be the record, not of an engine which converted all of its heat supply into work, for no engine could imaginably do that, but of an ideally perfect steam engine operating under the conditions under which the engine operated. The results from the engine tested, figured in this way, are good standard ones.

In addition to the efficiency tests, a 36-hour endurance test was run under 80 lbs. of steam pressure and a load of 69.67 hp. During its imposition, two observations of efficiency were made. Their results are scheduled with the others as tests Nos. 100 and 101. As to the showing made by the engine under this endurance test, it can only be said that no fault or suggestion of fault developed itself. The engine ran smoothly and quietly, with cool bearings, throughout the test. When shut down it was apparently ready to start upon a second similar run with equal success.

RESULTS OF ENGINE TESTS.

Test No.	Conditions of engine.	Actual pressure gauge.	Speed revolutions per minute.	Power. Observed h. p.	Power. Average h. p.	Water rate.	Cylinder Efficiency.	Thermodynamic Efficiency.
*14	Normal cut-off	125.50	321.6	125.90	123.5	27.6	55.6%	9.16%
*15	125 lbs.	124.00	302.6	121.10		27.5	56.1%	9.17%
3	Normal cut-off	79.30	304.1	74.10		30.6	60.9%	8.30%
4	80 lbs.	81.30	308.4	69.35		31.0	59.4%	8.20%
5	80 lbs.	76.10	296.1	75.82	71.55	31.6	60.4%	8.07%
100	80 lbs.	81.60	301.1	69.50		31.7	57.7%	8.04%
101	80 lbs.	81.50	299.3	69.00		31.9	57.8%	7.98%
8	25% under load	79.40	297.8	56.00	56.18	33.3	55.9%	7.65%
9	80 lbs.	80.30	297.7	56.35		33.0	56.1%	7.71%
6	50% under load	82.00	305.0	37.20	37.09	35.3	52.0%	7.21%
7	80 lbs.	81.80	304.3	36.97		35.5	51.8%	7.17%
10	75% under load	81.50	306.1	16.39	16.65	52.3	35.3%	4.87%
11	80 lbs.	81.50	306.5	16.90		49.9	36.9%	5.10%
16	25% over load	81.60	304.0	89.30		33.1	55.3%	7.69%
17	80 lbs.	81.10	300.9	87.30	87.00	34.4	53.7%	7.41%
18	80 lbs.	79.00	298.9	84.40		34.6	54.1%	7.36%
12	Normal cut-off	81.90	312.2	88.85	87.64	27.8	66.2%	9.15%
13	Condensing	80.00	310.3	86.42		27.5	67.4%	9.27%

In the 36-hour test: Pressure, 82.78 lbs. gauge. Horse power, 69.67 (average). Friction of the engine when run empty: 3.0-hp, equal to 4.3% of rating.

*Tests Nos 14 and 15 run at 125 lbs. pressure (gauge).

As to the general design and construction of the engine, Profs. Reeves and Allen add that with all which could be seen, upon dismembering the engine both before and after the series of tests was run, they were favorably impressed, and that for simplicity, compactness, good distribution of metal and convenience of arrangement, the engine provoked favorable comment from all who saw it.

Exhibits at the Railway Telegraph Superintendents' Convention.

At the New Orleans convention last week of the Association of Railway Telegraph Superintendents, several exhibits were made.

Mr. W. S. Logue, manager of sales of the Edison Manufacturing Company, New York, explained the merits of the various Edison products used in railway telegraph service.

Mr. Avery P. Eckert, assistant treasurer of the Safety Insulated Wire & Cable Company, of New York, had a display of samples of this concern's wires and cables.

Mr. E. W. Vogel had a neat exhibit representing block signals, crossing signals, relays and various other pieces of apparatus used in railroad signal work. The Yetman telegraph transmitter was represented by the inventors, Mr. Charles E. Yetman and G. G. Conkling, manager of the New York office. These gentlemen had on exhibition several of their typewriter transmitters.

Mr. C. K. Jones, of Tuscumbia, Ala., inventor of the automatic telegraph circuit protector and signal machine, exhibited one of these instruments. The object of the device is to eliminate delays to trains resulting from failure of operators to promptly answer calls on the wire.

The American Telephone & Telegraph Company was represented by Mr. Percival W. Miller, special agent, F. E. Fowle, of the engineering department, and J. J. Gordon, of New York, besides several other gentlemen from different parts of the country. Mr. Miller had a composite telephone and telegraph circuit connected up in his parlor. In the operation of this circuit not the slightest interference could be detected while both telegraph and telephone messages were being transmitted at the same time.

The Western Electric Company, of Chicago, was represented by M. E. Lambranch.

Mr. C. E. Brown represented the Central Electric Company, of Chicago.

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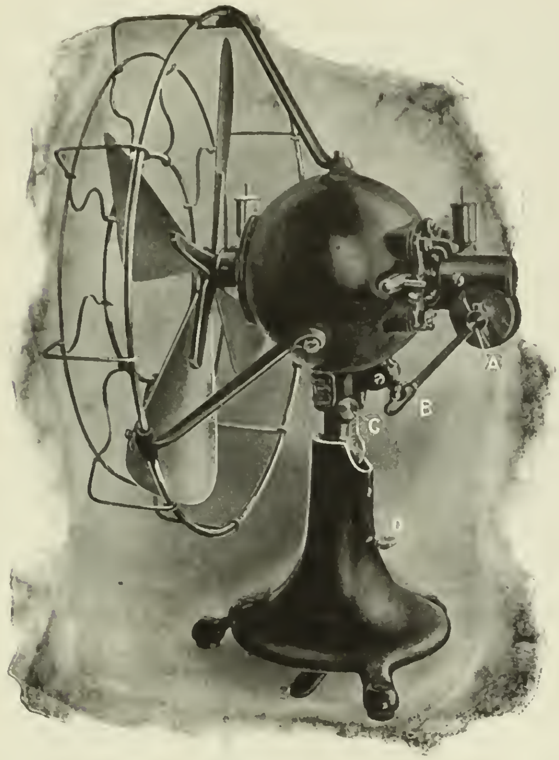
The Eck Universal Fan Motor.

The popularity of the idea involved in a fan motor which shall distribute its breeze instead of blowing constantly in one set direction is shown in the ingenuity which is being brought to bear upon the solution of this not altogether easy problem. Our readers may all be assumed to be fairly familiar with the subject and will, therefore, recognize in the development of the device of the Eck Dynamo & Motor Works, of Belleville, N. J., a distinctly original method of periodical revolution, so that instead of being always pointed to the north, the fan distributes its breeze with equality and benefit to every other point of the compass. For this reason the Eck Hurricane fan in its new evolution is called the "Universal," and as will be seen from the cuts, the oscillatory motion is secured by a simple positive and direct drive. The trunnion arrangement for the desk type of fan allows a quick adjustment to be made in the motor stand, so that the general direction of the breeze can be regulated to suit any varying height of desk or shelf. By reference to the cut, it will be seen that in order to adjust the fan from a desk to an oscillating type, the screw, *A*, is loosened, the connecting rod at *B* is lifted and the screw, *A*, is moved from the center of the wheel and tightened a greater distance from the center, giving a corresponding wider arc of oscillation and vice versa. This involves loosening screw *C*, whereas to adjust from an oscillating to a desk fan, screw *C* is tightened and screw *A* is loosened, moving toward the center of the wheel until it stops and is tightened. In order to adjust for a trunnion or bracket fan, screw *D* is loosened, setting the head of the motor at the desired angle and is then tightened. The connecting rod at *B* is lifted and the motor head is turned to either side, as wanted, and screw *C* is tightened. All these arrangements can be made very simply and easily without screwdriver or wrench.



UNIVERSAL FAN MOTOR.

The fan blades are full formed with a high propelling force, and are run at high speed with a minimum of noise. They are cut from heavy sheet brass and securely riveted to a strong cast spider or hub. The guards are rigid and durable, with the attaching braces cast with ribs, so that the fan can be picked up by the guard, the top brace being used as a handle. The motor is fitted for oiling purposes with an automatic grease cup, which gives adequate lubrication for easy and cool running the entire season. The insulation is excellent throughout, and the bearings are of phosphor bronze and self-aligning.

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Thermo-Call Button.

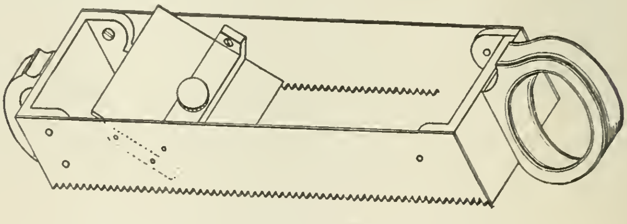
The American Thermo-Call Company, of Boston, Mass., is placing on the market a device which discovers and reports fire automatically. It is very useful for hotels, factories, steamboats, public buildings and private dwellings. The American thermo-call button may be substituted for the push button now in general use, utilizing the same wires, etc., without requiring any alteration, thus making the call bell service doubly useful, i. e., combining regular call bell service and automatic fire protection. It is small and ornamental in design and is easily attached to the wall and connected as the ordinary push button. When once installed it needs no further attention either before or after an alarm has been given.

The button is set to give an alarm at 125° F. when not otherwise desired, but can be set at different degrees between zero and 400°, as may be desired, by the simple turn of an adjusting screw. It thus combines the ordinary push button now in general use and an automatic fire alarm, which, when the surrounding temperature reaches the degree at which it is set, indicates instantly the location of trouble, giving the occupants immediate notice of an incipient fire and making it possible for the fire to be extinguished without loss. The mechanism of the button is so simple and perfectly adjusted that it acts immediately. It should last a lifetime, requiring no special care and attention.

THERMO-CALL BUTTON.

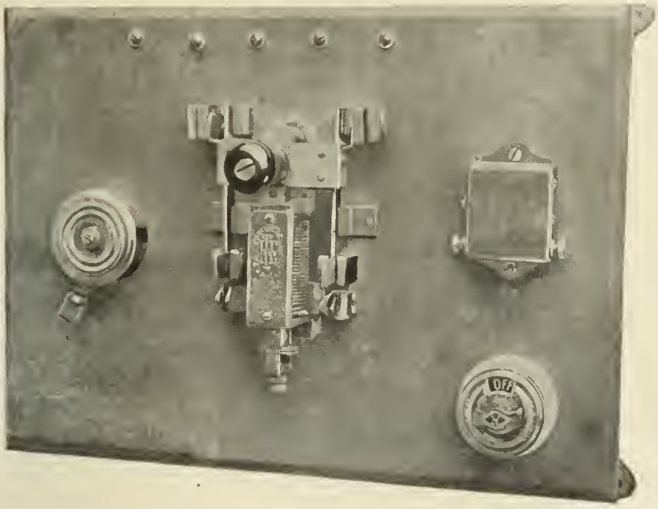
Gain Cutting Saw.

An interesting improvement in gain cutting saws has just been placed on the market by the Kinsman Electric & Railway Supply Company, of 91 Liberty Street, New York City. It is shown herewith, and as will be noted, is a compact tool which will do the work at present accomplished by three ordinary tools—the hammer, saw and chisel. It is so arranged that the saw teeth cut deeper than the chisel, allowing of a smooth movement. When it is desired to work quickly and push things along, the tool can be operated by two men; but in ordinary practice one man will handle it easily.


GAIN CUTTING SAW.

Motor Quick Stop Device.

The increase in the use of electric motors for power purposes has resulted in the introduction of a unique but an exceedingly practical device for a quick stop in the case of accident. For several years, the Consolidated Engine Stop Company, 100 Broadway, New York, has been installing an engine stop and speed limit system in hundreds of the biggest plants all over the country where steam is used for power. This latest addition to their speed limiting and quick stopping devices is an electric motor stop, which places a motor, or a motor-driven machine, under absolute control from any part of the factory.



MOTOR STOP.

Snap switches of an improved dial pattern are placed at different points wherever desired, and one turn of the switch operates a separate battery system which throws the main switch at the board. A bell in the office or engine room, or any part of the plant desired, immediately rings a warning so that the person in charge may know that the power has been shut off. These switches are always available for immediate use, but are protected from meddlesome and unauthorized employees.

The switchboard is an attractive sheet of marble or slate carrying a testing apparatus as well as the main switch. The board itself can be used as a main switchboard or it can be placed in the office or other part of the plant and used only in emergencies. The apparatus can be tested from the switchboard to detect low battery power or short circuits. The system of wiring, which, patented, is so simple that chances of trouble with it are extremely remote. The motor stop can be connected to any size motor running under any voltage, and will stop a machine under load in two to five seconds. It can be applied to protect an entire line, or to a limited number of motors, or a single motor.

A New Ignition Dynamo.

A new dynamo for igniting gas and gasoline engines, shown in the accompanying illustrations, has just been placed upon the market by the Auto-Igniter Company, of 161 Washington Street, New York City. It is an inductor generator type of machine, and is remarkable for having absolutely no wearing parts; it also dispenses entirely with batteries and spark coils. The machine consists of an iron disc, with a portion of the iron cut away and the space filled with non-magnetic metal, revolving between the poles of a powerful compound magnet. The disc is fixed to the engine shaft, either on the end of the shaft or inside the hub of the fly-wheel, and the generator is fixed to the engine frame or to the floor. One of the magnet poles has two cylindrical projections and the active coil is wound upon one of these projections.

As the disc revolves the slot passes the polar projections once in every revolution and the change in flux produced thereby induces an e.m.f. in the coil. This e.m.f. is available to produce current for about 45° of every revolution, which is sufficient for engines requiring no more than one explosion for each revolution of the engine shaft. When more explosions are needed, as in some multi-cylinder engines, the disc is suitably cut away in two or three places. For igniting by mechanical device no spark coil is used, as the inductance of the active coil is sufficient to give a powerful spark at the interrupter. With 200 r.p.m. this spark is equal to that obtained with eight or more cells of Edison-Lalande battery and an ordinary spark coil. The machine is equally applicable for jump spark work by using an induction coil with a mechanical interrupter.

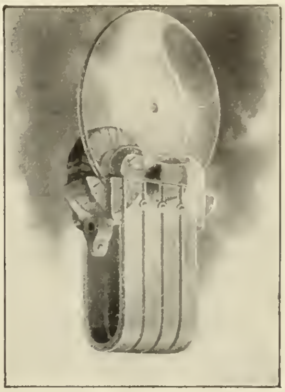


FIG. 1.—IGNITER.

At the moment the slot leaves the polar projections with the active coil a high peak is produced in the e.m.f. This wave is utilized in starting the engine by so setting the inductor that the break of the ignition points occurs just as the iron is leaving the pole; by this means a sufficient current for igniting is produced by turning the engine over by hand or by other means. This is an important feature, as the engine can thus be started with this dynamo without the use of auxiliary starting batteries. By means of the double polar projections used in the design of this machine, the magnetic circuit of the permanent magnets remains closed in every position of the inductor. Actual measurements made on magnets taken from machines in use for some time have shown that these magnets had actually increased in strength while in use. This is a valuable feature, as it secures the permanency of the magnets.

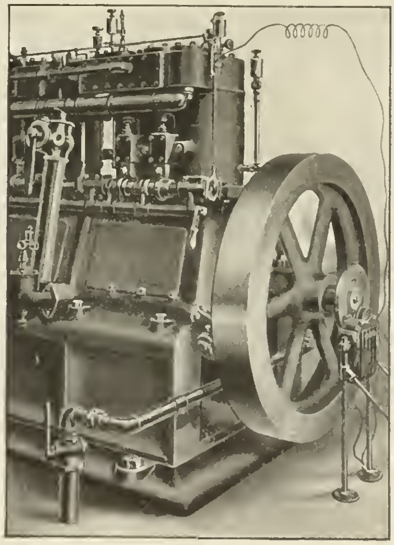
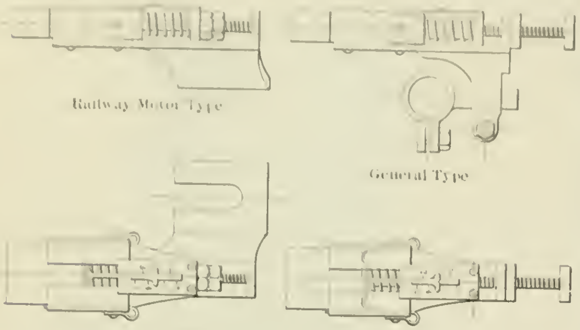


FIG. 2.—APPLICATION OF IGNITER TO VERTICAL ENGINE.

As there is neither a commutator nor brushes nor bearings to wear and require attention, the machine will last indefinitely and incur no expense whatsoever after its first cost. A number of these dynamos are already in use on single and multicylinder engines and are giving excellent satisfaction.

Registering Brush-Holder.

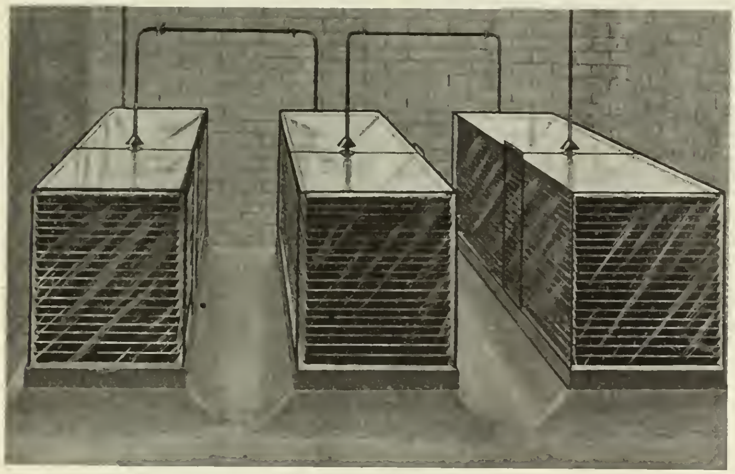
Two forms are shown in the accompanying illustrations of a type of registering brush holder devised by C. H. Hines and made by the Lorain Steel Company, Johnstown, Pa. The brush holder at all times records the exact pressure in pounds on the commutator of the brush, and enables all brushes to be set alike and maintained at equal pressure. The adjustment being double allows for maximum wear of brush. The saving of commutators by use of this holder is claimed to be great. This type of brush is of especial value in laboratories, and in testing, when it is necessary to know the friction of brushes. The railway type enables the brushes to be set at uniform pressure and then locked so that all brushes will wear alike. The construction of the holder, as will be seen, is simple, enabling it to be offered cheaper than most of the older types.



REGISTERING BRUSH-HOLDER.

Smith Storage Battery Plant in Boston.

An interesting installation of combined light and power has recently been made in the new Hotel Carlton at the corner of Boylston and Heminway Streets, Boston, one of the features of which is a large installation of the Smith storage battery, as shown in the accompanying illustration, consisting of 57 trays and having a capacity of 800 ampere-hours at 114 volts. The Smith storage battery was brought out by the Smith Storage Battery Company, of Binghamton, N. Y., and is a radical departure from the beaten path in battery manufacture in style and form, embodying, however, no new principles, the battery elements being lead plates with dilute sulphuric acid as the electrolyte. Jars are dispensed with altogether, the lead plates themselves holding the electrolyte. The gridded plates are formed into oblong trays, any number of which may be nested on top of each other, separators of perforated seats of hard rubber, or other suitable acid-proof material, keeping the trays from contact with each other. There is sufficient space between the trays to hold the electrolyte which is in contact with the bottom of the tray above it, and the inside of the one which holds it. The chemical action takes place between the upper side of one plate and the under side of the one above it.



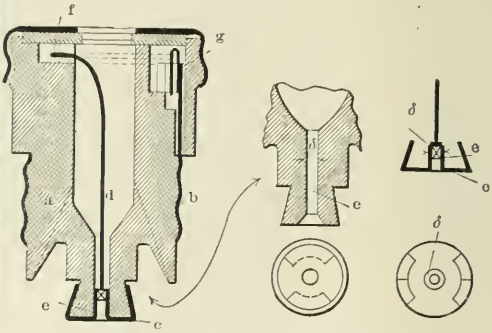
STORAGE BATTERY PLANT.

In the preparation of the plates, the under side of each tray is chemically treated to reduce it to lead oxide, and the upper side reduced to peroxide of lead. This makes the upper side of each tray the positive and the under side the negative electrode of what in an ordinary battery would be a single cell. By adding another tray to the nest the potential is increased by two volts, since the trays are connected up in series. The upper side of the upper tray, and the under side of the bottom tray are plain and inactive. The voltage of any battery will, therefore, be two less than twice the number of trays; thus, a battery of eleven trays will give 20 volts. In ordinary work there is no connection between the plates of the battery, except the electrolyte. The negative terminal is connected to the top of the upper tray and the positive terminal to the top of the bottom tray. However, it is possible to obtain any combination of series-multiple or multiple-series connections by attaching terminals to as many trays as desired and cutting in or out additional trays as the service demands. The arrangement of trays obviates a trouble frequently met with in storage batteries; that is, the deposit in the bottom of the jars of active material which is liable to cause a short-circuit between the plates. In this battery the positive plate, the one from which such deposits usually come, is the upper side of the tray, and hence all particles which become free in this manner will lie where there is no danger of causing a short circuit.

Repairable Fuse Plug.

A patent has recently been granted to Frederick H. Krebs, of Copenhagen, Denmark, on a type of fuse plug which permits a blown fuse wire to be easily replaced. At present the whole plug when a fuse blows, is rendered useless and thrown away; this naturally is a great waste, as only a very small part of the plug is destroyed. The object of the invention is to render it possible to renew the fuse part instead of the entire plug.

In the accompanying illustration, *a* is the plug, of porcelain or other insulating material; *b* is a standard Edison screw thread for fitting the plug in the usual way, and *c* is a detachable plate with fastenings; *d* is the fuse wire and *e* a wire gauge to prevent the insertion of a heavier wire than that for which the plug is constructed; besides this security against a fuse plug being improperly wired, the plugs differ in height for different capacities; *f* is a horizontal channel to accommodate a fuse wire without making the plug of larger size than the ordinary Edison fuse plug and also to provide for higher voltages; *g* is the upper fastening of the wire—here shown as an easily inserted and removable piece of bent plate between which the end of the fuse wire is laid, after which the plate is fastened between springs.



REPAIRABLE FUSE PLUG.

The fuse wires, with or without contact plate, are intended to be supplied separate in packages, say with 12 pieces in each, and marked with the number of ampere capacity.

Railway Telephone.

It is stated that the Delaware, Lackawanna & Western Railroad will equip its entire road with a telephone system as an aid in the operation of its trains.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was offered freely by brokers, and there was an easy tone, the closing rates being 3¾ a 4 per cent for 60 to 90 days, and 4 a 5 per cent. for 4, 5, 6 and 8 months. The stock market was dull and heavy with very limited outside participation and bearishness on the part of the professional interests. False reports concerning steel prices, together with the labor troubles and the uncertain position of cotton speculation apparently offset the influence of easier money, favorable crop news and further increases in railroad earnings. The United States Steel stocks were heavy, and the industrial list was generally lowered. The feature of the traction group was the further decline of Metropolitan securities due to the call which has just been made for a second payment of 25 per cent. on the stock. Both General Electric and Westinghouse common suffered notable declines, as will be noted below. Brooklyn Rapid Transit declined from 66⅜ to 63⅝, closing at 64, this being a net loss of 1 point. Metropolitan Street Railway fell to 129 and closed at 130⅝, a net loss of 1⅜ points. The highest price of General Electric was 193 and the lowest 185¼. It recovered some of the loss and closed at 187½, this representing a net loss of 6¼ points. Westinghouse common made a decline of 7 points, closing at 206; on the other hand, preferred made a gain of 5¼ points, remaining steady throughout the week, at 200¼. Western Union lost 1 point, closing at 84½. Following are the closing quotations of May 19:

NEW YORK.

	May 12.	May 19		May 12.	May 19
American Tel. & Cable	80	78	General Electric	190¼	185¼
American Tel. & Tel	155	154	Hudson River Tel	..	..
American Dist. Tel	30	30	Metropolitan St. Ry	131	130
Brooklyn Rapid Transit	65⅝	64¼	N. E. Elec. Veh. Trns	⅛	.
Commercial Cable	..		N. Y. & N. J. Tel	..	.
Electric Boat	20	20	N. Y. E. V. T. Co	7	7
Electric Boat pfd	41	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1¼	1¼	Western Union Tel	85¼	84
Electric Vehicle	11	9	Westinghouse com	210	196
Electric Vehicle pfd	15⅝	15	Westinghouse pfd	210	196

BOSTON.

	May 12.	May 19		May 12.	May 19
American Tel. & Tel	157	154½	Western Tel. & Tel. pfd	96	95
Cumberland Telephone	..	..	Mexican Telephone	2	1⅞
Edison Elec. Illum	.	..	New England Telephone	137½	137*
General Electric	192	.	Westinghouse	105	97
Western Tel. & Tel	19½	19	Westinghouse pfd	104	98

PHILADELPHIA.

	May 12.	May 19		May 12.	May 19
American Railways	48½	..	Phila. Traction	96¾	96¾
Elec. Storage Battery	74¼*	74*	Phila. Electric	7¾	6½
Elec. Storage Battery pfd	74¼*	74*	Pa. Electric Vehicle	..	..
Elec. Co. of America	8⅞	8¼	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	May 12.	May 19		May 12.	May 19
Central Union Tel	..	..	National Carbon pfd	96	95
Chicago Edison	..	..	Northwest Elev. com	..	..
Chicago City Ry	205	205	Union Traction	4	4½
Chicago Tel. Co	..	.	Union Traction pfd	32	32
National Carbon	24⅛	24			

*Asked.

LONDON UNDERGROUND SCHEME.—The terms of the underwriting plan for the £7,000,000 5 per cent. profit-sharing notes of the Underground Electric Railway Company of London, already noted briefly in these pages were made public recently, and show some novel and interesting features, especially in the provision for the sharing of profits between the company and the subscribers to the notes. The syndicate circular states that the syndicate is to continue until November 1, 1904, unless the managers should dissolve it sooner. The managers also reserve the right to extend the syndicate further for six months from November 1, 1904. The managers are Speyer & Co., Speyer Brothers of London, and the Old Colony Trust Company of Boston. They are to receive as compensation 1 per cent. commission on the entire amount of £7,000,000 notes, or £70,000 ($350,000). This is to be paid by the London Underground Company, while the syndicate members are not to be charged anything by the managers. The syndicate's commission is to be 5 per cent. in cash, so that on the basis of a one-hundred-thousand-dollar subscription the actual payment which would have to be made would be only $95,000. All notes subscribed to by the syndicate are to be held subject to call, in other words, are to be pooled. The first subscription is due June 2. The notes are to be subscribed at 96. They will be payable to bearer in various denominations; £5,000,000 of the notes are to be taken by the shareholders of the company. The notes will be secured by a trust deed, under which will be deposited securities of the underlying properties to the amount of £10,050,000. Of this amount £7,750,000 will be stock of the tube companies. Under the trust deed this stock may be sold by the Underground Company, and if sold at above 95 per cent. the amount of the net profits above that price are to be divided between the company and the noteholders, the latter participating pro rata in each sale at the time of which their notes were still outstanding. In other words, if notes are retired, as they may be, before the sale of any of such stock, they will not share in the profits. The more notes retired before any such stock is sold the greater will be the profit to the underground company.

CHICAGO EDISON COMPANY.—Reports of the Commonwealth Electric and Chicago Edison Companies issued last week for their fiscal year ended March 31, 1903, show an extremely prosperous condition. Gross earnings of the Commonwealth Company increased 30.20 per cent. over the previous year and gross of the Edison Company increased 21.48 per cent. The greater interest attaches to the Commonwealth Electric, since it will absorb the business of the Chicago Edison Company when the latter's franchise expires some years hence. It is the Commonwealth, too, which is building a $6,000,000 plant in the southwestern portion of the city. While the increase in the gross earnings of the Commonwealth was as noted, operating expenses increased but a little over 25 per cent., and the net earnings increased 51.30 per cent. The earnings on the capital stock, all of which is controlled by the Edison Company, were 3.16 per cent. The Chicago Edison Company is erecting a building at 82 and 84 Market Street at a cost of $220,000. It will be eight stories high and will have a frontage of 55 ft. and a depth of 85 ft. The lower stories will be utilized as a sub-station, four 1,000-kw rotaries having been ordered for immediate installation. Provision will be made so that if desirable a storage battery can later be installed in the upper stories. As real estate is so very valuable in the downtown district, it is proposed to rent the rest of the building for manufacturing purposes.

ST. LOUIS TRANSIT BONDS.—A circular to stockholders of the St. Louis Transit Company announcing a meeting to be held on May 23 to vote upon a proposition to issue $20,000,000 in 5 per cent. bonds, had the effect of depressing Transit stock and the shares of the United Railways Company on the local stock exchange. There was surprise at the decline, as nothing new was contained in the circular, and the carnings of the Transit Company during the dedication days fully equaled the company's estimates. Official figures of the earnings of the Transit Company for the three days, April 30, May 1 and 2, were $81,369, which was paid by 1,027,580 revenue passengers. On April 30 the receipts were $32,055, which is the largest single day's receipts in the history of the company. It was generally believed that the announcement of the proposed bond issue, coupled with the favorable dedication report, would tend to advance the price of the securities. The bond issue is a refunding plan, and will result in a substantial saving in interest. The opinion prevails that the bears on the stock took advantage of the fact that the circular was not generally understood to put the market lower. The earnings of the Transit Company for the days of the dedication, April 30, May 1 and 2, were in excess of $81,000, as against about $51,000 for the same period in 1902. These figures give an idea of the increased facilities necessary to handle the traffic during the World's Fair.

AMERICAN MARCONI COMPANY.—At a recent meeting of the board of directors of the Marconi Wireless Telegraph Company of America, Mr. W. H. Bentley was elected second vice-president and general manager of the company. The following is the list of officers and directors of the company: First vice-president, Guglielmo Marconi; second vice-president and general manager, W. H. Bentley; secretary and treasurer, John Bottomley. Directors—E. Rollins Morse, J. J. McCook, Spencer Trask, Guglielmo Marconi, Eugene H. Lewis, Cyrus S. Sedgwick, H. H. McClure, John D. Oppe, W. R. Betts, Samuel Insull, Loyal L. Smith, Robert Goodbody, J. W. Griggs and W. H. Bentley. The offices of the company have been removed from the Maritime Building to the Lord's Court Building, 27 William Street.

KINGS COUNTY ELECTRIC.—Application has been made to the New York Stock Exchange to list Kings County Electric Light & Power Company $650,000 additional capital stock.

NEW WESTINGHOUSE STOCK.—As was announced briefly in this department last week, the Westinghouse Electric and Manufacturing Company offers to stockholders $4,500,000 of new stock, par value $50, at $80 per share. The new stock is part of the issue authorized by the stockholders in 1901 when the capital stock was increased from $15,000,000 to $25,000,000. The new stock is to have the same rights and privileges as the assenting stock, now outstanding. In his circular to stockholders President Westinghouse says that the present prosperous condition of the company's business more than justifies the action of the board until the increase in the company's manufacturing facilities should place it in the strongest financial position. The growth of the company's business has greatly exceeded the expectations of its officers. The following statement is made of sales for the four fiscal years ending March 31:

March 31, 1903:

Year ending March 31, 1900	$12,793,703
Year ending March 31, 1901	15,853,481
Year ending March 31, 1902	19,975,958
Year ending March 31, 1903	23,899,492

To meet the rapid increase in business, additions were made at Pittsburg, which raised the output capacity to the present average of $2,000,000 per month. In addition to the East Pittsburg factories, there are large ones at Newark, Cleveland and New York, and the plant of the Bryant Electric Company, at Bridgeport, Conn. Net earnings from the company's manufacturing operations for the year ending March 31, 1903, were $4,650,000. These earnings, after deductions for depreciations and other purposes, exceed 20 per cent upon the outstanding capital stock. Dividends have been paid at the rate of 7 per cent. per annum on the preferred stock since 1892 and on the assenting stock since August, 1901. It is proposed on July 1 next to make the dates for the payment of dividends on both classes of stock coincide by the payment of a proportionate dividend on the "assenting" shares so that all may share alike in the event of dividend payment at rates exceeding 7 per cent. per annum. The company holds stock in the British Westinghouse Electric and Manufacturing Company, which for the nine months ending April 30, 1903, had annual contracts aggregating $6,500,000. The company's offer of $4,500,000 stock to shareholders leaves in the treasury stock of $2,466,050 par value. The offer is open to holders of record at the close of business May 23 at the rate of one share of such new stock for every four shares of existing stock. Subscriptions must be made before 3 o'clock June 8, 1903, accompanied by a check for $30 for each share subscribed for. The balance of the subscription will be payable as follows: July 23, 1903, $25 per share; September 14, 1903, $25 per share. The second and third instalments may be discounted at the rate of 4 per cent. per annum at the time of subscription. Holders of the new stock will be entitled to participate in dividends declared for the quarter ending September 30 next. The new stock will be listed on the New York Stock Exchange.

SPRINGFIELD (ILL.) CONSOLIDATION.—The organization of the Springfield Railway and Light Company, of Springfield, Ill., has been completed by King, Hodenpyl & Co., of New York, and E. W. Clark & Co., of Philadelphia. The new company has taken over the Springfield Consolidated Railway Company, the Springfield Gas Company, the Springfield Electric Light and Power Company, the Capital Electric Company and the People's Hot Water Heating and Electric Company. Plans for a new power house are now being prepared and many improvements and economies are being introduced. The capitalization is as follows: Twenty-five-year 5 per cent. gold bonds, $3,000,000; stock, $3,000,000. The officers are: Anton G. Hodenpyl New York, president; C. M. Clark, Philadelphia, vice-president; G. L. Estabrook, Philadelphia, secretary and treasurer.

CHICAGO UNION TRACTION.—Judge Grosscup, of the United States Circuit Court, Chicago, has ordered Union Traction to improve its service at once. No detailed report has been submitted by Manager Roach. He said, by certain retrenchments, he could save $75,000 a year, and would submit a report. Judge Grosscup has granted the Union Traction receivers permission to borrow money to pay the West Chicago dividend due May 15 and interest on the floating indebtedness of the North and West Chicago companies, the rate not to exceed 6 per cent. Judge Grosscup further decided that the payment of the West Chicago dividend to the holders of stock not acquired by the Union Traction Company shall have the same force and effect as if paid to the receivers of said West Chicago as rental due and payable under lease.

FINANCING MARCONI COMPANY.—Eugene H. Lewis, Chairman of the Finance Committee of the Marconi Wireless Telegraph Company of America, has made public a statement to the effect that arrangements have been completed to provide the Marconi Company with working capital to the amount of not less than $250,000, and possibly $450,000. The statement says that the arrangements were concluded at the office of the Continental Trust Company, which acts as trustee under the various guarantee and other agreements. The plan includes a privilege to stockholders to exchange their shares of stock for certificates of deposit, of the par value of $5 each, which certificates of deposit will be placed upon the market in lieu of the shares of the company.

AMERICAN LIGHT AND TRACTION.—The relative figures of this company show as follows:

	1902.	1901	Changes.
December, net	$122,805	$93,908	Inc. $28,897
Dividend on preferred	42,864	36,689	Inc. 6,175
December surplus	$79,941	$57,219	Inc. $22,722
Six months net	$566,743	$402,628	Inc. $164,115
Dividend on preferred	257,184	220,134	Inc. 37,050
Six months' surplus	$309,559	$182,494	Inc. $127,065

Preferred stock authorized $25,000,000; issued $8,572,800. Common stock authorized $15,000,000; issued $4,470,600.

A LARGE MERGER IN OHIO.—A dispatch from Cincinnati says, "J. M. Hutton, who has returned from Columbus, says that it is proposed to consolidate the Cincinnati Gas & Electric Company and the Cincinnati Street Railway, and later to combine all public utilities of Cleveland and eventually to combine the principal companies of Cincinnati, Cleveland and Columbus under one management. People directly concerned here are very reticent and say as yet it is too early to speak of any local combination, though President Ernest, of C. N. & C. Light & Traction Company, which is closely identified with the North American Company, says he is not surprised at such a deal."

HAMILTON POWER BONDS.—The Hamilton Cataract Power, Light and Traction Company, Ltd., of Hamilton, Ont., with an authorized capital of $5,000,000, has just sold $600,000 first and refunding mortgage 5 per cent. gold bonds to N. W. Harris & Co., Chicago. The company is a consolidation of electric power and light plants, including three street railway systems operating in Hamilton and adjoining suburbs and cities. The new company now controls the entire electric light and power business and owns and operates sixty-three miles of street railway in Hamilton and neighboring towns, having a combined population of 70,000.

INDEPENDENT TELEPHONE EXTENSION.—A plan is on foot to raise $2,000,000 additional capital to execute certain schemes which are now being developed by the independent telephone interests in Cincinnati. The independents have begun the stringing of wires and will, according to officials, be in active operation by June 1. All of the small towns in Ohio, Indiana and Kentucky will be connected with their service. The material which the independent concern is using is of the highest class, indicating that the 10-year contracts entered into by the several corporations is to be rigidly enforced up to the end.

DIVIDENDS. The directors of the Kings County Electric Light and Power Company, have declared a quarterly dividend of 2 per cent., payable June 1. Books close May 22 and reopen June 1. This is an increase of ½ per cent over the previous payment. American Railways Company's directors have declared a dividend of 1½ per cent. (75 cents) a share, payable June 15 to stock of record May 29.

CLEVELAND LIGHTING BONDS.—Bids will be received until June 15 at 12 o'clock, for $1,180,000 4 per cent. bonds of the City of Cleveland, including $200,000 electric light and power works bonds, due June 1, 1925.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade, building and planting operations and growth have been affected more or less by weather and labor conditions. These drawbacks, however, are looked upon as merely temporary. Wholesale trade, which is usually quiet at this season, reflected the conditions above referred to, but optimistic views still rule as to the outlook. The possible exceptions may be in the case of cotton manufacturing and in building, where the cost of raw material or of operation has been attained to almost prohibitive height. Railroad operations are very profitable and have reached the highest point on record. Collections failed to show much improvement despite the easier tone of money. In iron and steel, pig iron is weaker. There is no sign of weakness, however, in finished products, but there is a feeling that heavy imports of foreign billets may shortly affect prices for that product at seaboard markets. Specifications for new work are coming forward rapidly, and the mills producing finished material are pushed to keep up with the demand. Copper showed a firmer tendency, in sympathy with the condition of European markets. There has been no change, however, as yet, in the ruling quotations, which remain steady at 14⅝ a 14¾c. for Lake; 14⅜ a 14⅝c. for electrolytic in ingots, cakes and wire bars; 14⅛ a 14⅜c. in cathodes and 14c. for casting stock. The business failures for the week ending May 14, as reported by *Bradstreets*, numbered 182 against 175 the week previous and 190 the corresponding week last year.

VOUGHT-BERGER TELEPHONE ORDERS.—Among recent visitors at the plant of the Vought-Berger Company, La Crosse, Wis., were F. E. Davidson, president, and A. C. Miller, secretary, of the Redwood County Rural Telephone Company, Redwood Falls, Minn., who left an order for one hundred bridging telephones and a number of series instruments and pendant telephones and an addition for their Morgan switchboard; Rev. J. C. Siegler, of Nodine, Minn., who ordered a switchboard and fifty bridging telephones for the new farmers' lines centering at Nodine; L. G. Saxvik, of Highlandville, Ia., who ordered a switchboard; D. P. Walter, of Luana, Ia., who gave an order for a switchboard at Postville, Ia.; A. A. Peterson, manager of the Steele County Telephone Company, who bought a toll board for Blooming Prairie, Minn.; G. W. Morgan, of Reedsburg, Wis., who ordered a switchboard for La Valle; Leo Pottratz, of Eitzen, Minn., who left an order for twenty-five bridging telephones; also Mr. Brooks, of the Twin City Telephone Company and the Consolidated Telephone and Telegraph Company. Among other switchboards and equipments recently sold are a 200 drop-board for the Grantsburg exchange of the Consolidated Telephone and Telegraph Company, of Minneapolis; an addition for the Le Sueur board at Le Sueur, Minn.; farmers' line from Decoria to Good Thunder, and also in Apple Creek, Ohio; and Colorado, Tex.; Shiocton, Wis.; Holliday, Mo.; Madison, Mo.; New Hartford, Mo.; Spring Grove, Minn.; Tomahawk, Wis.; Jasper, Mo.; Keystone, Iowa; Goss, Mo.; Somers, Ia.; Clutier, Ia.; Highlandville, Ia.; Decorah, Ia.; Jamison, Ia.; Tonkawa, Okla.; Persia, Ia.; Postville, Ia.; Blooming Prairie, Minn.; Le Sueur Center, Minn.; Lexington, Minn.; New Virginia, Ia.

HEATING AND VENTILATING A COTTON MILL.—The Hope Mills Manufacturing Company, of Hope Mills, N. C., has equipped its mills throughout with the "hot-blast" system of heating and ventilation. All steam-coils are concentrated in a heater in the basement, through which the air is drawn by a fan and distributed to the several rooms through galvanized iron piping and brick flues. The fan is driven by a direct-connected horizontal engine which exhausts into a section of the heater. The remainder of the heater is of such capacity that, using exhaust steam from the mill engines, the buildings can be heated to a temperature of 70 degrees F. when the temperature is 10 degrees above zero out-of-doors. The finishing building and the weave shop each contain two stories, and in addition, provision has been made for furnishing enough heat to the first story of the storehouse to prevent the freezing of the automatic sprinkler apparatus for fire protection, while the second story is to be heated to 70 degrees F. The guarantees are based upon the use of fresh outside air, although when warming up in the morning the air may be drawn from the interior, thus saving a considerable amount of steam. Live steam at 90 lbs. pressure is to be used at night, but, as stated above, the pipe capacity of the heater is sufficient to permit the use of exhaust steam from the power-plant of the mill in the daytime. The entire equipment has been designed and installed by the B. F. Sturtevant Company, of Boston.

2,400-HP GAS POWER PLANT IN CEMENT WORKS.—The Iola Portland Cement Company has recently ordered from Westinghouse, Church, Kerr & Co. a 280-hp, three-cylinder vertical gas engine as an addition to the extensive power equipment of its cement plant at Iola, Kan. The company operates its plant upon natural gas fuel and is one of the largest users of gas power in the cement manufacturing field. The present equipment comprises twelve engines of the Westinghouse vertical three-cylinder and two-cylinder single-acting type, aggregating 2,100 hp. These engines operate various classes of machinery, such as rock crushers, rotary kilns, shafting and generators, for supplying light and incidental power throughout the works. With the additional engine the power plant will comprise six engines of 280 hp each, five 125 hy each and two small engines. The 125-hp engines are used for driving kilns and the 280-hp for the rotary crushers. The machinery is in general arranged in groups upon sections of counter shafting driven by a single engine either direct-connected or rope driven. In point of size the installation has few precedents and its successful operation under such severe conditions demonstrates the many advantages of gas power for industrial establishments of all kinds.

STORAGE BATTERIES FOR POWER PLANTS.—Among recent contracts for installations of the Chloride accumulator in railway service, the Electric Storage Battery Company, of Philadelphia, has closed two with the Portland Railroad Company, located at Yarmouth and Underwood Park, Me. The battery at Yarmouth consists of 216 cells having a capacity of 134 kw-hours, and is located midway from the power-house on the same branch. Contracts have been closed with the Seattle Electric Company, Seattle, Wash., for a battery of 288 cells having a capacity of 628 kw-hours; the Waterville and Oakland Railway Company, Waterville, Me., for a battery of 220 cells with a capacity of 205 kw-hours; the Reading Power Company, at Reading, Pa., for a battery of 264 cells with a capacity of 740 kw-hours. The Portland and Brunswick Railway Company, at Brunswick, Me., has increased the capacity of its battery by the addition of plates, and the Camden Interstate Railway Company, has contracted for the third battery of Chloride accumulators on its system. This last one is to be located at Huntington, W. Va., and consists of 288 cells, having a capacity of 314 kw-hours.

THE EWING MERKLE ELECTRIC COMPANY, of St. Louis and Shreveport is having a large sale of dynamos and motors of the Commercial make, for which it is the general selling agent. Among the sales for complete plants reported by it for the past week are: Huie-Hodge Lumber Company, Hodge, La., 20 kw; Keith Lumber Company, Voth, Texas, 30 kw; Eagle Lumber Company, Eagle Mills, Ark., 40 kw; T. C. Reed, Cerro Gordo, Ills., 60 kw; Shreveport County Club, Shreveport, La., 6¼ kw; Wm. Cameron & Co., Saron, Tex., 30 kw; French Creek Lumber Co., Chidister, Ark., 6¼ kw; Val Ries & Co., Belleville, Ills., 25 hp. This company also reports the sale of a very large amount of supplies and equipment for telephone companies.

JOHNSON-KAHN APARTMENT HOUSE.—The apartment house now being built between Seventy-first and Seventy-second Streets, Riverside Drive, by the Johnson-Kahn Company, 500 Fifth Avenue, New York, is to be equipped with two automatic high-speed engines, of 125 hp each, and one of 100 hp capacity. The Payne Engineering Company, 141 Broadway, took the order. These engines are to be direct-connected to generators of C. & C. build. The larger engine will be coupled to 75-kw generators, while the other engine will be direct-connected to a generator of 60-kw capacity. The switchboard will be supplied by the C. & C. people. The boilers—three units of 150 hp each—will be built by the Titusville (Pa.) Iron Company. The wiring contract has not yet been let.

EQUIPMENT FOR APARTMENT HOUSES, ETC.—Percival R. Moses, consulting engineer, 35-37 Nassau Street, New York, is about to let contracts for the electrical equipment of a number of apartment houses and office buildings now under construction in New York. The Louis M. Jones Building, northeast corner of Broadway and Leonard Street—a 12-story office building—is to be equipped with two 14-in. x 14-in. simple, automatic, high-speed engines for direct-connection to generators of 80-kw capacity each. This outfit is intended for lighting purposes. The Westminster Hotel, East Sixteenth Street and Irving Place, which is being remodeled, is to have a 100-hp simple automatic high-speed engine, to be direct-connected to a 60-kw generator.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, Wis., makes the following important announcement: "The constantly increasing demand for Christensen air brakes and 'Ceco' electrical machinery has made a change of our organization necessary. To accomplish this result, the owners of the stock of this company have organized the National Electric Company, and the assets, good will, etc., of this company have been transferred to the National Electric Company; the purposes, ownership, management and control of the new company are identical with those of the old. We desire and solicit a continuance under our new name of the satisfactory relations which have heretofore existed between us and the trade."

BRITISH CARS, ETC., FOR WELLINGTON, N. Z.—British firms have been awarded the contracts for practically everything in the way of equipment, etc., for the Wellington, New Zealand, municipal electric traction system, through M. A. Cartney, McElroy & Co., Havemeyer Building. The British Electric Car Company will build the car bodies of twelve double-deckers, the same number of single deck and eight combination cars. The contract was placed in England because of better prices and more favorable deliveries having been offered than could be obtained on this side.

THE CHASE-SHAWMUT COMPANY, manufacturer of electrical specialties, 390 Atlantic Avenue, Boston, is now building, among others, theatre switchboards for the following houses: Conservatory of Music, Boston; New York Theatre, Hudson Theatre, New Amsterdam Theatre and New Amsterdam Roof Garden, the last four in New York. It is also at work on an order for twenty-eight switchboards for the United States Engineer's office, Portland, Maine.

J. HOLT GATES & CO., 1436 Monadnock Building, Chicago, have taken the agency of the Skinner Engine Company, of Erie, Pa. They are also acting as representatives of the Quincy Company, of Quincy, Ill., for large Williams vertical, cross compound engines. This firm is now in a position to erect complete steam and electric plants.

GENERAL ELECTRIC.—The General Electric Company will erect three new buildings and add largely to its Lynn, Mass., plant. The company has secured contracts for a complete arc lighting system at Shanghai, and for motors for the new railways at Kobe and Tokio, Japan.

SOME C. & C. FOREIGN AND DOMESTIC ORDERS.—The C. & C. Electric Company has secured a contract through C. R. Heap, 47 Victoria Street, London, S. W., who handle considerable quantities of American machinery, for a 50 hp series parallel equipment to be utilized for operating a Hoe quadruple printing press in the plant of the *Birmingham Daily Post*. The Sherman House Hotel, Chicago, Ill., is to be equipped with a 100 kw C. & C. generator to be direct-connected to an engine built by the Ames Iron Works, Oswego, N. Y. This outfit is intended for lighting purposes. Edward Hueber, electrical contractor of Hackettstown, N. J., has ordered a 20 kw dynamo for direct connection to a Nash gas engine for installation in the Rutherford Stuyvesant resident at Tranquility Farms. The Broadway Tabernacle Church is to be equipped with three C. & C. motors aggregating 50 hp. They will be used for driving Sturtevant blowers. The Rogers Locomotive Works, Paterson, N. J., are to be shipped a 50-hp, also a 75-hp motor. This will make the ninth order received from the same source during the last six months. The Paterson Electrical Supply Company secured these orders on behalf of the C. & C. people. An order has been taken from William J. Thompson, of Washington Park, N. J., for a 100 kw belted generator and a 40-hp motor. This equipment will be used for lighting and for operating various amusement plants at that New Jersey resort. The Bedstead & Bedding Company is to have a motor-generator set for reducing power from 500 volts to 230 volts. Eight motors of 75-kw capacity have also been ordered. The Martin's Creek (Pa.) Portland Cement Company has ordered a 175-kw belted generator and two 80-hp motors, also a 60-hp motor, switchboard, etc. The Metropolitan Printing Company, 222 West Twenty-sixth Street, New York, has just ordered eight motors of 6-hp capacity each, which will make a total of nearly 30 C. & C. machines ordered by that concern. The motors are for direct connection to printing presses. The Brooklyn Terminal plant of the Brooklyn Bridge is to put in a 50-kw generator for lighting use. The generator will be direct-connected to a Reeves engine. The McKeesport (Pa.) *Daily News* plant is to be equipped with a 25-hp series-parallel outfit for operating a Hoe press. The Metropolitan Life Bldg., 1 Madison Square, N. Y., is to be installed with nine motors, aggregating 150 hp. These machines will be used for driving Sturtevant blowers and Blackman exhausters. A 1,000-amp. booster of 125-kw capacity—the fourth order—is to be built by the C. & C. Company for the Brooklyn Edison plant.

CONVEYOR PLANT FOR SOUTH AFRICA.—The New Kleinfontein mines, South Africa, are to be equipped with an extensive conveyor plant, the contract for which has been secured by the Robins Conveying Belt Co., Park Row Bldg., New York, through Fraser & Chalmers, Limited, Johannesburg. The plant will be electrically operated. The New Kleinfontein will be the first South African mine of any size to be equipped throughout with conveying belts, although considerable Robins equipment is already in operation in the De Beers, Witwatersrand Deep, New Primrose, Robinson and Van Ryn mines; also in the Cassel and Natal Glencoe collieries, and in the Imperial cold storage plant. All the New Kleinfontein ore, from the time it is loaded into the headgear until the sands and waste rock are precipitated to the dump, will be manipulated entirely by Robins belts. All coal is to be unloaded from hopper-bottomed trucks into bins, below which will be a Robins conveyor which will take it aside to be crushed to about one-inch cubes, when it will be lifted vertically by means of an elevator to another belt traversing the boiler-house. This latter belt with its traveling tripper will distribute the coal into hoppers, from which it will be drawn into automatic stokers. The main belt to the dump will be carried on a steel trestle work, the upper end of which will be 120 feet above ground. All the conveyors will be driven by British motors—enclosed type, slow speed, back-geared—to be supplied by Dick, Kerr & Co. The motors are to be direct-connected to the driving pulley of each conveyor.

NEW YORK & JERSEY RAILROAD COMPANY.—J. G. White & Co., 29 Broadway, New York City, have been appointed consulting electrical engineers for the New York & Jersey Railroad Company, for which Mr. Charles M. Jacobs is chief engineer. Mr. Jacobs is also chief engineer for the proposed tunnels of the Pennsylvania Railroad Company under the Hudson River,, and was the chief engineer who supervised the construction of the East River gas tunnel. The work of J. G. White & Co., in connection with this appointment, will cover the electrical equipment of the company's tunnels under the Hudson River, and terminals, rolling stock and equipment, system of electrical conductors, signal and interlocking apparatus, electrical lighting of tunnels and terminals, conduits and cables for carrying electric current, and other details connected with the electrical equipment of the above company's system, which will also include the elevators, ventilation and heating of the terminals.

LIGHTING A CIRCUS.—The Ringling Brothers have arranged for the use of Nernst lamps to illuminate the pavilions of their circus, which has been in winter quarters at Baraboo, Wis., and recently opened the present season in Terre Haute, Ind. In order to provide the proper current for running the Nernst lamps, the Ringling Brothers had to sacrifice three direct-current machines, which had been made for them according to special design, construction and weight, and intended to be used for running direct-current enclosed arc lamps. After seeing the Nernst lamp, however, they decided to cancel all orders for direct current apparatus and have installed, instead, three alternating current, 220 volt machines, the lamps being hurried forward by express in order to be in time for the opening performance.

INTERURBAN AT TOLEDO, OHIO.—The Toledo Interurban Construction Company at Toledo, Ohio, informs us that its road is making good progress, and that it has already purchased cars, rails, ties and overhead material. The cars are designed after those of the Lake Shore & Michigan Southern Railroad limited library type, and are finished in mahogany, oak, cherry, natural and antique finishes. They are equipped with four Westinghouse No. 76 motors mounted on Dorner's latest improved M. C. B. trucks and geared to a speed of 75 miles an hour. They are equipped also with Westinghouse automatic air brakes. The company asserts that these are the finest interurban cars ever built.

ABERDEEN (SCOTLAND) TROLLEYS.—At a recent meeting of the Tramways Committee of the Aberdeen Town Council, tenders were opened for twelve new cars to be used on the lines of the Suburban Tramways Company, Aberdeen, Scotland. The contract was given to the British Westinghouse Electric & Manufacturing Company, Limited, and included the British Electric Company's car bodies, Westinghouse equipment and Brill trucks, the total cost being approximately $36,000. These cars are expected to be in operation by the end of June, the equipment being identical in every respect with that already installed in the Aberdeen cars.

THE LUNKENHEIMER COMPANY, of Cincinnati, Ohio, manufacturer of brass and iron steam specialties, etc., has recently placed with the Nernst Lamp Company, of Pittsburg, a large additional order for Nernst lamps of various sizes. The Lunkenheimer plant is now illuminated throughout by this make of lamp, it having been found superior to others in its uniform quality of light, with all sizes of units, a feature that is impossible with a mixture of arc and incandescent lamps.

THE TOLEDO, BOWLING GREEN & SOUTHERN TRACTION COMPANY has recently purchased, from the Westinghouse Electric & Manufacturing Company a 250-kw rotary-converter, which will be used for supplying current to its lines. Power will be received in the form of alternating current from the Maumee Valley Electric Company, which is installing a 250-kw inverted Westinghouse rotary-converter for the purpose, together with three 100-kw raising transformers.

SOUTHERN ELECTRICAL COMBINE.—Three leading electrical firms in New Orleans have consolidated—the Safety Electric Company, the Newman-Spranley Electric Company and Stern & Marks. Though details of the consolidation have not yet been arranged at the time of writing, it is understood that the new concern will be known as the Safety Electric Company. Charles Weinberger, president of the Safety Electric Company, will be the chief executive of the company. Mr. Stern, of Stern & Marks, has been slated for manager.

RARITAN (N. J.) POWER PLANT.—The National Fire-Proofing Company, of Pittsburg, whose New York offices are in the Broadway-Maiden Lane Building, will shortly award contracts for the erection and equipment of a central power station for lighting and operating the company's plants located on the Raritan River, N. J. About $120,000 is to be expended.

MEXICAN LIGHTING PROJECT.—Contracts are pending for the construction and equipment of a lighting plant in the town of Jehuacan, Mexico, which place has a population of about 12,000, and is noted for its medicinal waters and baths. Mocente Sanchez and Ramon de la Fuente are primarily interested in the project.

BALL ENGINE ORDERS.—The Morreau Gas Fixture Company, of Cleveland, Ohio, is to be electrically equipped. The engine will be furnished by the Ball Engine Company, Erie, Pa., and will be direct-connected to Westinghouse generator. The Ball Engine Company has also been awarded a contract for 14 engines, amounting to 2,400 hp, for electrical purposes in sugar factories. The engines will all be direct-connected to Crocker-Wheeler generators.

ELECTRICAL EQUIPMENT FOR JERSEY CITY PLANT.—The A. B. See Elevator Company is about to let contracts for the electrical equipment of its new plant in Jersey City. W. S. Barstow, electrical engineer, Bowling Green Building, New York, is acting as expert in the matter.

CAR HEATERS.—Mr. C. S. Hawley, of the Consolidated Car Heating Company's New York office, has just closed a contract with the Philadelphia Rapid Transit Company for 515 cars.

General News.

THE TELEPHONE.

CRAWFORDVILLE, ARK.—The Crittenden County Telephone & Telegraph Company, of Crawfordville, has filed articles of incorporation, the capital stock being $2,000. The officers are W. Z. Bunn, president; C. L. Campbell, vice-president and general manager; Hugh Chambers, secretary and treasurer.

COLUMBUS, GA.—The Columbus Automatic Telephone Company has been organized with a capital stock of $1,000,000. The Southern Telephone Construction Company will build the system. John T. Norman, of Columbus, has been elected president of the new company. Conduits are being laid for underground wires.

ATLANTA, GA.—The American Telegraph and Telephone Company, of Atlanta, is a new concern which it is believed will build an extensive long-distance telephone system in Georgia. A. Ward Cobb, of Atlanta; M. W. Beck, of Griffin, and others are interested. The company will begin with a capital of $25,000, but asks for authority to increase to $500,000.

OWENSVILLE, IND.—The Number Eight Telephone Company has incorporated. The principal office will be at Owensville. Thos. J. Boren, L. F. Mauck and W. D. Johnson are directors.

TWELVE MILE, IND.—The Twelve Mile Telephone Company has filed articles of incorporation with a capital stock of $5,000. L. C. Miller, J. M. Deniston and Wm. Carson are directors.

WARREN, IND. The Warren Telephone Company is to make improvements to its city lines and is installing a new switchboard with a capacity of 140 drops. This is made necessary to take care of the increasing business.

INDIANAPOLIS, IND.—The Fairview Telephone Company has incorporated with a capital stock of $1,600. The principal office will be located at Sugar Branch, Switzerland County. J. K. Cunningham, Wm. B. Pavey and Joseph Goodner are directors.

SHELBYVILLE, IND.—The girls employed by the Bell Telephone Company in this city as operators went out on a strike because the manager frosted the windows to prevent them from looking out. The business over the lines was at a standstill for several days.

FAIRBANKS, IND.—The Fairbanks Mutual Telephone Company has incorporated to construct lines within Sullivan County. The capital stock is $5,100, and the directors are Levi Drake, E. D. Carrithers, Addison Drake, John Johnson, J. V. Dex, George Fuller and Owen Kisner.

MADISON, IND.—The commissioners of Jefferson County have granted to Capt. William Kirk & Co., a franchise to erect telephone lines and exchanges all over the county, making outside connections. This is said to be a step toward extensive telephone development in this county.

HARTFORD CITY, IND.—The United Telephone Company has decided upon extensive improvements here and at Montpelier.

LAWRENCEBURG, IND.—The People's Telephone Association, of Indiana, has purchased the line of the Dearborn County Telephone Company. The People's Association will make extensive improvements in the lines and property.

INDIANAPOLIS, IND.—H. B. Gates, J. S. Schaf, E. I. Fisher, of this city, and George W. Beers, of Ft. Wayne, are seeking an independent telephone franchise in Cincinnati. The Indiana men think Cincinnati offers an attractive field for an independent telephone system since resident telephones that cost $24 a year in Indianapolis cost $72 in Cincinnati. Business telephones that bring $40 a year here are $125 there. The Indiana men are able to enlist capital and will invade Cincinnati with one million dollars behind their enterprise.

NASHVILLE, IND.—A little over a year ago a telephone exchange was established here by the Morgantown Telephone Company and fifty or more telephones were put in the residences and business houses. A few weeks ago a petition was forwarded to the company asking for free service to Columbus, a few miles distant, and upon refusal, the patrons ordered their telephones out. This will be done and Nashville will be, for the second time, without telephone service. The Bell Company will at once install a new exchange and give the citizens free service to Columbus.

EVANSVILLE, IND.—The stockholders of the Municipal Telephone Company of this city, held a meeting recently and elected James Lauer, president; R. K. Dunkerson, treasurer, and F. M. Petersheim, secretary. The company then employed F. E. Eversole as constructing engineer for the municipal plant. Mr. Eversole has just completed a plant at Dayton, Ohio, and it was for this reason the municipal company was able to secure his services. Preparation is being made for the hearing of the suit to oust the Cumberland Company the first week in June. The attorneys for the Cumberland Company asked Mayor Covert, chief of police Hencke, members of the board of works Albecker and Wonderlick, Councilmen Iglehart and McCutcheon and City Attorney Funkhouser, if each of them held stock in the municipal telephone company. They answered in the affirmative. The object of the inquiry is beyond conjecture since the city charter does not prevent a city official from holding stock in a corporation.

MUSCATINE, IA.—An ordinance has been introduced in the council requiring the placing of all telephone wires in this city under ground.

LE CLAIRE, IA.—The Le Claire Independent Telephone Company has been organized to take over the present system, which will be improved.

COUNCIL BLUFFS, IA.—The Pottawatomie County Mutual Telephone Company has been incorporated with a capital stock of $150,000. Among the directors is C. A. Beno.

THURMAN, IA.—The Fremont County Telephone Company has been organized with a capital stock of $12,000, by H. M. McCartney, C. R. Paul, O. E. McCartney, I. A. Loose, L. S. Amber and R. B. Leecka.

FRANKFORT, KY.—The Pleasant Grove, Bethell & Floyds Fork Telephone Company of Bullitt County has been incorporated with a capital stock of $150.

WEST PARIS, ME.—The Curtis Hill Paris Telephone Company, of West Paris, has been incorporated with a capital stock of $10,000. The promotors are W. H. Lurvey, C. A. Fickett, F. C. Buck, F. L. Wyman, S. C. Curtis, Woodstock; C. S. Dudley, O. G. Curtis, E. L. Porter, W. C. Stearns, J. S. Dudley, J. A. Bicknell, F. H. Packard, S. T. White, C. L. Curtis, John A. Ross, W. W. Dunham, A. J. Abbott, W. E. Curtis, C. W. Chase, Paris.

BLISSFIELD, MICH.—The Blissfield Telephone Company has increased its capital stock from $7,000 to $25,000.

NEWBERRY, MICH.—The Munising Telephone & Electric Company has been awarded the contract by the Michigan Telephone Company to establish a telephone exchange at Newberry.

NORVELL, MICH.—The Brooklyn and Wampler's Lake Telephone Company has filed articles of association, the capital stock being $250. The headquarters of the company will be at Norvell. The directors for the first year are Ed. Hoxsie, Harry A. Blum and Charles Dresser.

ELBOW LAKE, MINN.—The Grant County Telephone Company, of Elbow Lake, with a capital stock of $100,000, has been incorporated by William E. Sandeene, Linnieus V. Barnes, Henry Sampson and Edward J. Scofield.

ST. LOUIS, MO. In the City Council a bill was recently introduced by Councilman Sheehan, providing for a subway system throughout the city. The ordinance grants the right to run underground electric or steam railways, pneumatic tube systems, telephone and telegraph wires, and anything else that can be put underground. The persons seeking the franchise are Eugene Devine, W. T. Coony and John C. Kinney.

LINCOLN, NEB.—The new independent telephone company in this city has purchased a site for its new exchange, which will cost from $12,000 to $15,000. The company claims to have already obtained 2,000 subscribers and expects to increase the number to 3,000.

SOUTH OMAHA, NEB.—The Interstate Independent Telephone Company will establish a system here. The Stromberg-Carlson Manufacturing Company, of Chicago, is interested in the new enterprise. Underground conduits will be laid throughout the business portion of the city. The company will start with 1,000 telephones and will provide for future growth to the extent of 2,000. The franchise of the new company was granted last Fall.

LITTLE FALLS, N. Y.—The Interstate Telephone Company's exchange in this place was destroyed by fire recently, entailing a loss of $10,000.

BLISS, N. Y.—A new telephone company has been incorporated here with a capital stock of $500. It will render local service and build farmers' lines.

PENN YAN, N. Y.—The Penn Yan Telephone Company has been incorporated with a capital of $50,000. Directors: B. G. Hubbell, Buffalo, and T. H. Chew and L. G. Hoskins, Geneva.

CATTARAUGUS, N. Y.—The Pioneer Telephone Company, of Cattaraugus, has been incorporated with a capital stock of $12,000, by Edward C. Isbell, Edward G. Dietrich and Ernest B. Houghton.

DURHAM, N. C.—The Interstate Telephone Company, of Durham, has contracted for a $12,500 switchboard to be installed by June 1.

ASHEVILLE, N. C.—It is announced that the American Telephone and Telegraph Company will build a long distance line from Morristown, Tenn., to Asheville, N. C., and thence to Spartanburg, S. C.

DILLONVALE, OHIO.—The Dillonvale Telephone Company has been incorporated with a capital stock of $10,000. Mr. W. H. Ward is one of the directors.

CINCINNATI, OHIO.—The independent telephone lines in Indiana, Ohio, and Kentucky will secure entrance into Cincinnati, exclusive of the Bell lines. Twelve distinct companies have signed a ten-year contract.

PHILADELPHIA, PA.—The Keystone State Telephone & Telegraph Company has been incorporated with a capital stock of $10,000. The officers are: Treasurer, C. E. Platt; directors: Rob't W. Finletter, James M. Ashcraft, F. V. Kurtz, C. E. Platt, Joseph C. Perry.

EL PASO, TEX.—All the telephone girls in El Paso are on a strike for higher wages, and the city is without service.

FORT WORTH, TEX.—The contract for the switchboard for the Fort Worth Telephone Company has been awarded to the American Electric Telephone Company, of Chicago. The board will have a capacity of 6,000 lines.

BEAUMONT, TEX.—The Beaumont Northeastern Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are J. M. Smith, of Beaumont; W. S. Bruce, of Kountz, and Tony Rulfs, of Nacogdoches.

COLORADO, TEX. The Texas & Pacific Telephone Company, of this city, has purchased the line between Sweetwater and Robert Lee, in Coke County. This gives the company an additional 600 miles of line, which covers a very large part of West Texas. The Southwestern Telegraph & Telephone Company has purchased the line between Waterford and Abilene and is now stringing double copper wires the entire distance.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company will extend its lines throughout the southwestern portion of Utah, following the general line of the proposed San Pedro, Los Angeles and Salt Lake Railway.

SEATTLE, WASH.—Articles of incorporation for the North American Telegraph and Cable Company to lay a submarine cable from Seattle to Alaska and Vladivostok, have been filed here. The capital stock is $5,000,000.

FORT ATKINSON, WIS.—The Jefferson County Telephone Company, of this place, has increased its capital stock from $8,000 to $15,000.

FOND DU LAC, WIS.—The Little Wolf River Telephone Company, which was sold recently to Leander Choate, of Oshkosh, will be re-organized. New capital will be put into the enterprise and the plant will be improved and strengthened.

ONALASKA, WIS.—The La Crosse Gas & Electric Company proposes to extend its wires to this place.

WALWORTH, WIS.—The Walworth Telephone Exchange Company has increased its capital stock from $1,200 to $2,200.

ELECTRIC LIGHT AND POWER.

LITTLE ROCK, ARK.—Arthur Neill is about to petition the Council for a franchise for an electric light plant.

PARIS, ARK.—The Paris Electric Light & Power Company, of Paris, has been incorporated, capital, $6,000. August Bartsch, president, Ed. Bartsch, secretary.

CORONA, CAL.—Bids will probably be received Sept. 1 for an electric light plant, to cost about $45,000. H. A. Wood is City Clerk.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company was organized in 1897 with 200,000 shares at $100. At present it has 180 miles of wire, operating 2,600 arc and 320,000 incandescent lights.

LOS ANGELES, CAL.—Representatives of the Spreckels Independent Electric Lighting Company, of San Francisco, are reported to be in Los Angeles for the purpose of purchasing a site for the erection of an electric power plant.

SAN FRANCISCO, CAL.—The San Luis Gas & Electric Company, of San Francisco, has been incorporated, capital, $200,000. W. F. Boardman, Wm. Thomas and Woodley R. Smith, of San Francisco, are among the directors.

LOS ANGELES, CAL.—The Monterey Electric Light & Development Company was absorbed last year by the Monterey Gas & Electric Company, which has also taken in the Monterey & Pacific Railway. The present management has spent some $200,000 in improvements.

DENVER, COLO.—The Denver Highlands Electric Company shows an increase in incandescent lighting, having 8000 16-cp lights.

SALIDA, COLO.—The Edison Electric Light Company has 15 miles of copper wire circuit, 50 2,000-cp and 25 enclosed arcs, and 3,000 16-cp incandescent lights.

TELLURIDE, COLO.—The Telluride Electric Light & Power Company purchases power from the Telluride Power Company for 27 2,000-cp arc lights and 2,500 incandescents.

ASPEN, COLO.—The Roaring Fork Electric Light & Power Company is running 24 electric motors at 22½ cents per hp-day. It also furnishes heating for underground mine stations.

SILVERTON, COLO.—The Silverton Electric Light & Power Company uses the General Electric system and has 30 5-amp. G. E. enclosed arc lights with 2,200 incandescents. We are indebted to the manager, Mr. J. Crawford, for this information.

IDAHO SPRINGS, COLO.—The Cascade Electric Company which buys its current from the United Light Company, of Georgetown, Colo., operates a 15-mile circuit at 10,000 volt and 8 miles at 2300 volts. There are 20 2000-cp arc lights and 2,400 incandescents.

RIDGEFIELD, CONN.—An electric light plant will probably be constructed here. Thos. E. Wing, 20 Nassau St., New York City, is reported interested in the matter.

UNIONVILLE, CONN.—The Union Electric Light & Power Company has $40,000 capital stock. It uses Nernst lamps, single glower, for street lighting, and has about 3,000 incandescents for other use. Five electric motors are employed, also.

NEW BRITAIN, CONN.—The Connecticut Railway & Lighting Company is stated to have awarded to the H. Wales Lines Company, of Meriden, the contract to erect power plants in New Britain, Waterbury and Meriden, for about $105,000. The construction of these plants is a part of the plan to utilize the motive power about to be generated at the water privileges along Housatonic River in Litchfield County by the New Milford Power Company.

MILFORD, DEL.—It was voted to issue $20,000 bonds for electric light and other improvements.

OCALA, FLA.—The city has a municipal plant with E. C. Bennell, superintendent. It has 35 1,200-cp arc and 1,800 16-cp incandescent lights. At present it needs a 200-kw alternating current generator direct connected to 250-hp engine and two 125-hp boilers.

CALHOUN, GA., has no electric lights, but the mayor, Mr. Millhouse, contemplates putting in a plant.

CARROLTON, GA.—The Carrollton Electric Company is at present installing a 125-hp high pressure boiler and contemplates the erection of an ice and cold storage building in connection with the present works.

ATLANTA, GA.—The Pope Electrical Company, of Atlanta, will erect a plant between College Park and East Point to supply these towns with light, a contract to this effect having been made.

FITZGERALD, GA.—The water and light plant is under the management of the city officials. It operates a General Electric system, has 10 miles of circuit, 28 arc lights and 1,000 16-cp incandescents. A new boiler, a dynamo and engine will be required later.

ASHLEY, ILL.—The citizens have voted to issue $5,000 electric light bonds.

MASON CITY, ILL.—The Mason City Electric Light plant needs a 75-kw, 125 cycle alternator.

VIRGINIA, ILL.—The Virginia Electric Light Company has increased the number of its lights to 2,000.

BLOOMINGTON, ILL.—The Union Gas & Electric Company has practically left the electric lighting field.

RAYMOND, ILL.—It is reported that this city will install a municipal electric light plant, to cost about $8,000.

NEW ATHENS, ILL.—We note an increase in electric lights in the New Athens Electric Light & Power Company.

HURON, ILL.—The Consolidated Gas & Electric Company, of Huron, has been incorporated with a capital stock of $25,000.

DECATUR, ILL.—It is stated that the Decatur Gas Company will expend about $20,000 in improving its plant this summer.

CHICAGO, ILL.—The Dearborn Lighting Company has increased the number of its lights, having now 45 arcs and 1,500 incandescents.

ARCOLA, ILL.—S. L. Woodworth is the owner of the electric light plant, which operates 40 direct arcs, one Ball arc and 2,000 16-cp incandescents.

BARRINGTON, ILL.—The Barrington Electric Light Company runs a 50-hp motor for pumping city water. The rate is 5 cents per thousand gallons.

GILLESPIE, ILL.—The Gillespie Light Company operates 14 2,000-cp arc lights and 400 16-cp incandescents. It also runs two motors at a flat rate.

MENDOTA, ILL.—The Mendota Light & Heat Company has $10,000 capital, operates one motor circuit, 25 2,000-cp arcs and 1,200 16-cp incandescent lights.

DE KALB, ILL.—The DeKalb-Sycamore Electric Company, organized in 1902, has $200,000 capital stock and $175,000 bonds. It operates 762 enclosed arc lights.

DIXON, ILL.—The Dixon Power & Lighting Company has $100,000 capital stock and $50,000 bonds. It has 55 miles of wire, 90 arc and 7,000 incandescent lights.

BEARDSTOWN, ILL.—The Beardstown Electric Light & Power Company notes a fair increase. It operates 100 arcs of 1,200-cp and 2,000 incandescent lights of 16-cp.

AURORA, ILL.—Plans have been completed for the power house of the Fox River Light, Heat & Power Company, which will cost with equipment about $100,000.

SPARTA, ILL.—The Sparta Gas & Electric Company, L. W. Barker, president, wants the following machinery, all second-hand; two 25 or 30-kw direct current belted dynamos; one 100-hp engine.

MORGAN PARK, ILL.—The electric light plant is owned and operated by the village. It has 53 arc lamps of 1,200-cp, but requires an entire new plant for street lighting, with capacity of 100 arcs.

HOOPESTON, ILL.—The Hoopeston Electric Light & Heating Company has 40 miles of circuit, 35 arc lights and 4,500 incandescents, and is showing a steady increase. Mr. C. J. Wakeman is manager.

CHADWICK, ILL.—This place has a municipal plant with $5,000 capital. C. M. Kingery is manager. It operates 400 lights, and has need of a second-hand boiler and engine—80-hp boiler and 60-hp engine.

MOUND CITY, ILL.—The Mound City Water, Light, Power, Heat & Mfg. Company, organized in 1900, with $60,000 capital stock and $50,000 bonds. It operates 26 2,000-cp and 25 1,200-cp arcs and 2,000 16-cp incandescent lights.

SHELBYVILLE, ILL.—The Shelbyville Water & Light Company has secured the city contract for ten years. The cost of arc lights will be $60 each; incandescent lights, $18 each. The company will expend $15,000 in improving its plant.

CENTRALIA, ILL.—The Merchants' Co-operative Lighting Company has been incorporated with a capital of $5,000. It is proposed to furnish electric light, heat and power. The incorporators are William B. Smith, J. V. Parkinson and William Benjamin.

PARK RIDGE, ILL.—Mr. M. Schiessle is the proprietor of the Park Ridge electric light plant. He reports a first-class opening for an electric railway from Jefferson Park, Lawrence to Northwood and Fox Lake, also from Lawrence to Crystal Lake through Park Ridge.

CARTERVILLE, ILL.—The electric light plant is the property of A. C. Hope & Sons and supplies five acres and from 700 to 800 incandescents. Considerable new machinery has just been installed. Mr. Hope thinks there is need of a foundry or machine shop, for which he could supply power.

PONTIAC, ILL.—The Pontiac Light & Water Company, organized in 1902, with $265,000 capital, operates 40 miles of circuit and has 150 arcs and 6,000 16-cp incandescent lamps. Also 36 motors at 6⅔ cents per kw-hour. The company pretty well covers the electrical field, except manufacturing supplies and apparatus.

OAK PARK, ILL.—The village of Harlem Water Works and Electric Light plant is under municipal ownership, being managed by a president and six trustees. The system is now being changed from direct to alternating and the old direct apparatus, with lamps, is for sale. The plant supplies 125 2,000-cp arc lights.

CHICAGO, ILL.—The Keenan & Hyland Mfg. Company will erect a large plant in this city at the corner of Campbell Ave. and Taylor Street, at an estimated cost of $150,000. The buildings will be electrically equipped and lighted. The plans are being prepared by Mr. D. E. Postle. The company manufactures bank, store, office and bar fixtures.

CANNELTON, IND.—The city has just bought the electric plant.

REDKEY, IND.—We learn that this place is in need of an electric lighting plant.

TELL CITY, IND.—The Tell City Electric Company has four arcs of 1,200-cp and 1,200 16-cp incandescents.

ANDERSON, IND.—The city electric light plant will be enlarged and improved at a probable cost of $75,000.

KENDALVILLE, IND.—This city shows an increase in incandescent lighting, having about 2,500, and 50 arc lamps.

KNOX, IND.—The Electric Light & Power Company has 46 arcs and 950 incandescent lights. It also supplies power for street cars.

ANGOLA, IND.—The National Mill, Water & Light Company shows an increase in lighting, having 52 arc and 3,000 incandescent lights.

LA GRANGE, IND.—The La Grange Electric Light Company operates 30 2,000-cp arc lights and about 2,200 8 and 16-cp incandescent lights.

RUSHVILLE, IND.—The electric light plant is owned by the city. It operates 54 2,000-cp arc lights and 1,700 16 to 60-cp incandescents.

SOUTH BEND, IND.—The South Bend & Elkhart Power Company is preparing to construct a transmission line from the Hen Island Dam to South Bend.

MT. VERNON, IND.—This plant is the property of W. Gonnerman & Co., who report an increase of incandescent lighting, the number of lamps now being 2,500.

FAIRMOUNT, IND.—Messrs. La Rue and Patterson operate an electric light plant which furnishes 52 arc lights and 2,200 16-cp incandescent lights. They require supplies for an increase of 100-hp.

BRISTOL, IND.—Attorney Jas. DuShane, of South Bend, representing the Bristol Power Company, is reported to be securing options along St. Joseph River. The company intends building a water power near Bristol.

MARTINSVILLE, IND.—The Martinsville Light, Heat, Power & Water Company informs us through Mr. C. Blank, that it has just acquired control of the electric light and gas plant and contemplates a general overhauling.

VINCENNES, IND.—We are indebted to Mr. Rothuck, manager of the City Electric Lighting Company for the following. This company organized in 1899; has a capital of $150,000, and operates 225 arc lights and 2,000 incandescents.

ROCKPORT, IND.—The Rockport Water Works Company, represented by A. H Kennedy, reports a fair prospect for an electric railway. The company operates five enclosed arc lamps and 1,200 incandescents. A fine brick station accommodates the plant as well as water works.

OSGOOD, IND.—The Osgood Light Company, organized in 1902, has $2,000 stock and $10,000 bonds. Mr. E. D. Freeman, president; C. A. Baylor, vice-president; O. R. Jenkins, secretary, and W. R. Glasgow, treasurer. We are indebted to the first-named gentleman for information kindly furnished. The company operates 28 G. I. arc lamps and 500 incandescents. The officers are now organizing a company for the manufacture of storage batteries, under the H. P. King patent.

VINCENNES, IND.—The Vincennes Electric Light & Power Company furnishes 4,000 incandescent lights and motor power at 10 cents per kw-hour for maximum demand for 30 hours per month, 5 cents per 1,000 kw-hours for any further consumption. The consumer agrees to pay the company, as a minimum charge, $2.50 each month for one horse power and less rated capacity of motor installation; $4 each month for two horse power and less rated capacity; and for each additional horse power and less (nominal rated capacity) $1.00 per month, no such charge of less than $2.50 per month to be made.

BELLEVUE, IA.—The Bellevue Electric Light plant, organized in 1896, cost $16,000. Z. J. Hauck is general manager.

SPIRIT LAKE, IA.—The Spirit Lake Light & Power plant requires a feed water heater of about 150-hp and some arc lamps.

PERRY, IA.—The Perry Electric Light, Power & Heat Company reports an increase in electric lighting.

DAVENPORT, IA.—The Davenport Gas & Electric Company has 200 miles of circuit, 480 2,000-cp arcs for street use and 100 incandescents.

EAGLE GROVE, IA.—The Eagle Grove Electric Company, which was organized 1894, is now a private enterprise, articles of incorporation having expired.

GUTHRIE CENTER, IA.—Prof. G. W. Bissell, of Ames, has been employed to prepare plans for an electric light plant for the Guthrie Center Electric Light Company.

DENISTON, IA.—The Deniston Electric Light & Power Company has 36 1,200-cp arc lights and 3,000 16-cp incandescents. It also runs one motor circuit at 10 cents per kw-hour.

ORANGE CITY, IA.—The Orange City Electric Light Company, capital stock $14,000, president, E. H. Casjens, will be in the market for one 50-kw alternator, 133 cycle, and one 60 to 70-hp engine.

JEFFERSON, IA.—We are informed by Mr. P. Gray, manager of the Jefferson Light, Heat, Power & Water Company that there is a probability of important changes in his company in the near future.

MANCHESTER, IA.—The electric light plant is the property of E. W. Hoag. It employs the Westinghouse system and operates five acres and 1,500 incandescent lights. A 100-hp Corliss condensing engne and boiler are to be put in in the near future.

WATERLOO, IA.—The Waterloo Gas & Electric Company, organized in 1901, has $345,000 capital stock, 150,000 bonds. G. McLean is president and A. Burt manager. It supplies 110 arc lights and 5,000 16-cp incandescents. The company also runs 10 electric motors at the following rates: Base rate.—Ten cents per 1,000 watt-hours. Reduced rate.—Thirty per cent. of the base rate. Turning point.—¼-hp, $2.00; ½-hp $4.00; 1-hp, $7.00. Each additional hp up to 10-hp, $4.00; each additional hp over 10-hp, $3.00. Elevator service, half of above rates. Minimum charge. Half of the turning point.

EUREKA, KAN.—The Eureka Light & Power Company operates 18 arc and 3,000 incandescent lights. It needs one Corliss engine.

IOLA, KAN. The Iola City Light & Water Works commenced operations in 1901. The light department has 78 arcs and 400 incandescent lights.

TOPEKA, KAN.—The Edison Electric Illuminating Company has 57 miles of mains and 20 miles of feeders. It has 600 enclosed arcs and 26,000 incandescent lights; 1,385-hp in motors at 2½ cents to 7½ cents per kw-hour. The company runs 30 cars on meter basis.

BEECHMONT, KY.—The Village Improvement Society is considering the construction of an electric light plant.

BARBOURSVILLE, KY.—The Barboursville Electric Light, Heat & Power Company has increased the number of electric lights to 560.

LEBANON, KY.—The Lebanon Light, Ice & Power Company reports an increase in incandescent lighting, having 1,000 16-cp lamps. There is a good opening for an electric railway to adjacent towns.

STANFORD, KY. The Stanford Water, Light & Ice Company was organized in 1892 with $56,000 capital stock and bonds. W. G. Welch is president, G. L. Penny, secretary and treasurer. It has a Thomson-Houston plant, 9½ miles of circuit, 30 1,200-cp arc lights and 750 16-cp incandescents.

WATERVILLE, ME. The Union Gas & Electric Company, R. J. Patterson, general manager, has six arc and 3,000 incandescent lights, and six motors, at flat rates of about $20 per hp per year.

NORWAY, ME.—The Oxford Light Company operates 30 1,200-cp arc lights and 3,000 16-cp incandescents. It runs motors of 200-hp at 5 cents per kw-hour and furnishes power for the N. & P. Street Railway.

WATERVILLE, ME.—The Waterville & Fairfield Railway & Light Company operates 105 1,200-cp arc lights and 1,200 16-cp incandescent lights. It runs 25 electric motors at 50 cents per hp per month and 2 cents per kw-hour; also electric cars at 1½ cents per kw-hour.

BANGOR, ME.—The Public Works Company which furnishes all the commercial lighting in Bangor has its power station at Yeazie, about five miles from the city. It was established in 1890, thus putting it among the earliest power transmission plants from water power. It also lights Old Town. The lighting service extends about 10 miles north and south of the station. We are indebted to Mr. J. W. Cartwright, secretary of the above for particulars.

ROCKVILLE, MD. The electric light plant which was burnt out in 1901, has never been rebuilt.

WESTMINSTER, MD.—The Carroll County Electric Light & Power Company reports an increase in number of incandescent lights. The officers are G. M. Parke, president; C. C. Gorruch, vice-president; A. H. Huber, secretary and treasurer.

SALISBURY, MD.—We are indebted to Mr. F. Dalmas, manager of the Salisbury Light, Heat & Power Company for the following: The company, which was organized in 1901, has already increased the capacity of its plant by installing a new engine and switchboard. A return tubular boiler of 150-hp capacity and new turbines are to be added. It now furnishes 26 arc and 3,000 incandescent lights.

WARE, MASS.—The Ware Electric Company has a capital stock of $30,000 and operates 46 arc lights and 1,784 incandescent lights.

WEBSTER, MASS.—The Webster Electric Company shows an increase in lighting, having 66 series, 21 multiple arc, and 2,200 16-cp incandescent lamps.

FRAMINGHAM, MASS.—The Framingham Electric Company has 126 miles of copper wire circuit, and supplies 17 arcs and 6,000 incandescent lights.

GLOUCESTER, MASS. The Gloucester Electric Company supplies 80 public arc lights and 12,000 incandescent lights, furnishing power also for street cars.

SOMERVILLE, MASS.—The Somerville Electric Light Company has $274,700 capital and $50,000 bonds. President, C. L. Edgar; treasurer and manager, F. E. Smith. It has 586 enclosed arc lamps and 23,000 16-cp incandescents.

ANDOVER, MASS. The Andover Electric Company was formed in 1889 with $30,000 capital stock and $25,000 bonds. W. H. Coleman is treasurer. The company's machinery being out of use, it buys power from Lowell, Mass., the feeder being 9 miles long.

FITCHBURG, MASS.—The capital stock of the Fitchburg Gas & Electric Light Company is $275,000—$45,000 ten-year coupon notes. Having outgrown its old plant, the company has installed a new one of 1,500-hp on the General Electric system. It is running 40 motors, and has 320 2,000-cp arc lights and 12,000 16-cp incandescent lights.

HUDSON, MASS.—The light and power department of the Town of Hudson plant (municipal) is under the management of W. G. Lawrence. There are 25 2,000-cp arc lights and 6,000 16-cp incandescents. A 250-kw generator with cross-compound engine is to be put in; single-phase generators are to be replaced with three-phase, and motor business is to be taken up. A new sewer system is to be installed and all of the pumping is to be done by electric drive.

SPRINGFIELD, MASS.—The United Electric Light Company was organized in 1887 with $800,000 capital. The officers are R. W. Day, president; W. A. Lincoln, treasurer; W. A. Mulligan, manager. The company has 1,500,000 feet of overhead arc wires, 400,000 feet underground cables and 500,000 feet alternating overhead wires; 911 street lights, 600 commercial, 1,200-cp, and about 50,000 incandescent lights, averaging 16-cp. It runs about 100 motors, from 2 to 4 cents per kw-hour; has about 50 heaters and charges several automobiles at the rate of 5 cents per kw-hour.

ST. JOHNS, MICH.—This municipal plant operates 66 arc lights and about 2,500 incandescents.

GLADWIN, MICH.—The electric light plant is owned by Schulz & Prindle. It has a Westinghouse alternating system.

BELDING, MICH.—The City's Light Company has 2,000-cp arc lights and 2,000 16-cp incandescents. It also operates 6 motors at a flat rate.

ESCANABA, MICH.—Mr. C. E. Smith is manager of the Escanaba municipal lighting plants which furnish 75 arc lights of 1,200-cp, and 4,000 16-cp incandescent lights.

BAY CITY, MICH., has a municipal plant which furnishes 270 2,000-cp arc lights and about 700 16-cp lamps wired in. The city offers the promise of success for other electrical enterprises.

WEST BRANCH, MICH. The Rifle River Electric Lighting Company has $20,000 capital. This is a co-partnership with W. W. Vaughan manager. Thirty 2,000-cp arc and 1,800 incandescent lights are in use.

JACKSON, MICH.—The Jackson & Battle Creek Power Company has been incorporated, with a capital of $100,000, by J. H. Rootes, Chas. Zang and others, to furnish light and power in Jackson and Calhoun counties.

SHELBY, MICH.—The village has a municipal plant which provides for 20 1,200-cp arc and 1,400 16-cp incandescent lights. At present it operates a Westinghouse 80-hp engine, but will require heavier ones this year.

YPSILANTI, MICH.—The Washtenaw Light & Power Company, of Geddes, Mich., B. M. Delameter, president, was organized in 1902 with $200,000 capital, and $300,000 bonds. The circuit covers 210 miles. There are 350 arc lights and 23,000 incandescents, also 60 motors.

ATHENS, MICH.—The Athens Electrical Company, J. M. Standiford, superintendent, operates 24 arc and 1,200 incandescent lights. The company needs a new 60-kw alternator, and thinks there is a good opening for an electric railway from Battle Creek to Coldwater through Athens and Union City.

LUDINGTON, MICH.—The Stearns Lighting & Power Company was formed in 1901 with $50,000 capital. J. S. Stearns is president; R. L. Stearns, vice president; U. T. Culver, secretary. It operates 49 enclosed arcs and 7,000 16-cp incandescent lights, having also 14 motors at 3½ to 2 cents per hp-hour.

FRANKFORT, MICH.—The plant of the Frankfort Electric Light Company is for sale. It was organized in 1891, and is owned by Mr. Thos. Kenny. It is operated on the Wood system; two dynamos, transformers of 25-hp, 18 miles of wire, 18 arc lights, 1,500 incandescents and three 200-hp Allis-Corliss boilers.

MARINE CITY, MICH.—The Marine City Roller Mill Company was established in 1888, and incorporated in 1903, with $15,000 capital. A. Arnold is president; A. A. Manion, vice-president; E. Arnold, secretary; R. Monn, treasurer. The company operates 15 arc and 2,500 incandescent lights, and small fan motors.

PORT HURON, MICH.—We are indebted to Mr. W. F. Davidson, secretary of the Port Huron Light & Power Company, for the following interesting item. The Port Huron Company succeeded to the properties and franchise of the Excelsior Electric Company on July 1, 1901. The property at that time consisted of a fire proof building 125 ft. x 138 ft. in size, operating two cross compound 500-hp engines and one tandem 1,200-hp compound engine, with 3-phase, 60 cycle generators; also three 100-kw, 500 volt direct current generators for power purposes, besides 3 Brush 150-light arc machines and 4 T-H 50-light series arc machines. It has a transmission line 12,000 volts, 3-phase, 60 cycle, operating a large factory district about three miles from its central station, known as South Park, where there are a great many manufacturing plants located employing about 1,000 men. Polyphase motors are used on the power circuits and all of the electric light is furnished by the company's central station. In October, 1902, the company made a contract with the General Electric Company for a Curtis 1,500-kw turbo-alternator and with the Alberger Company, of New York, for a surface condenser, including pumps and all the necessary apparatus. This company has erected an entire new fire proof building adjoining its present plant, in which will be installed the steam turbo-alternator, the condensing outfit, steam driven exciters, and the new switchboard for the entire plant, which will have a capacity of 5,000-hp.

WINNEBAGO CITY, MINN., has a municipal plant which operates 14 1200-cp arcs and 2,400 16-cp incandescent lights.

SPRING GROVE, MINN.—Bids will be received June 2 by F. E. Joerg, Village Recorder, for $5,500 electric light bonds.

JORDAN, MINN.—The Jordan Electric Light & Heating Company organized in 1902, has $15,000 capital. C. H. Casey is president and S. L. Sly, manager.

FOSSTON, MINN.—Bids will be received May 18 by the Common Council for furnishing and delivering a direct-connected and combined 125-hp simple non-condensing engine and generator. W. E. Black is Village Recorder.

WINONA, MINN.—The Winona Railway & Light Company in addition to its lighting—281 1,200-cp arcs and 10,000 16-cp incandescents—is running 100 motors 12 to 6 cents per kw-hour; does automobile charging and operates the street railway.

FARIBAULT, MINN.—The Polar Star Electric Company, organized in 1894, has $30,000 capital and has just purchased a water power four miles from this city which will be developed in the near future and operated in connection with the present water power, when the steam plant will be shut down. A 500 to 600-hp generator is to be installed. Motors are now being put in with an aggregate capacity of 44-hp.

CROOKSTON, MINN.—The Crookston Water Works Power & Light Company dates from 1885. Its capital is $175,000 and bonds $160,000. The company needs about one mile of vitrified clay ducts for underground work and 6,000 feet of stranded bare cable for feeders overhead, all of 500,000 circ. mils. It also reports the need of an electric railway to run from Grand Forks, N. D., through Cookston to a popular summer resort called Maple Lake, 25 miles east, for which a good opening offers.

DURANT, MISS., has a municipal plant with 29 arc lamps and 1,000 incandescents.

McCOMB, MISS.—The McComb Electric Light & Power plant, the property of J. J. White, has 56 arc lights and 3,000 incandescents. The boiler plant operates a saw mill in connection with its plant.

BOONEVILLE, MISS.—The Booneville Electric Light & Telephone Company owns only one arc light and 410 16-cp incandescents. It contemplates enlarging its plant and for that purpose needs one 60-hp boiler, one 60-hp engine and one 25-gallon steel tank.

DEER LODGE, MONT.—The Deer Lodge Electric Company furnishes 30 2,000-cp. arc lights and 3,000 16-cp incandescents.

HELENA, MONT.—The Helena Light & Traction Company owns the street railway and operates 245 425-watts enclosed alternating current arcs and 20,000 incandescent lights.

GREAT FALLS, MONT.—The citizens have voted to grant a 25-year franchise to John D. Ryan & Co. for an electric light plant and street railway, and City Council has passed the necessary ordinances for the same. C. W. Swearingen is City Engineer.

CLAYTON, MO.—The West St. Louis Water and Light Company has filed a first mortgage on its property in St. Louis County for $1,000,000, in favor of the Colonial Trust Company. The loan was effected in August, 1902, and is to run for 20 years at 5 per cent., payable in gold, semi-annually. The mortgage covers the property and franchises of the mortagager in St. Louis County and in towns of Kirkwood, Webster Groves and Ferguson.

ST. LOUIS, MO.—The Carondelet Electric Light Company has applied to the St. Louis County Court for a franchise to string wires along certain portions of the Lemay Ferry Road, south of St. Louis, in Carondelet Township. If the franchise is granted it will insure lighting facilities for every section of St. Louis County except Meramec Township, and farmers can gather their vegetables and cultivate their crops by electric lights, the same as their customers in St. Louis do other work, after the close of day.

LINCOLN, NEB.—Bids will be received May 25 by Beman C. Fox, City Treasurer, for $65,000 street lighting bonds.

WAYNE, NEB., has a municipal plant which cost $35,000. It has six arc and 2,800 incandescent lights. Motor rates are 10 cents per kw-hour.

KEARNEY, NEB.—The Northwestern Electric Heat & Power Company, under the management of L. E. Watson, furnishes 38 arc lamps and 3,200 incandescent lights. Twelve motors supply 500-volt service at from 10 cents to 6 cents per kw-hour.

BLAIR, NEB.—The Blair Electric Light & Power Company operates 13 1,200-cp arc lights and 2,000 16-cp incandescents. It runs a 1½-hp Wagner motor for which the charge is 10 cents per kw-hour.

ASHLAND, NEB.—The National Bank, of Ashland, owns and operates the electric light plant. It has five arc and 1,000 incandescent lights, and will require supplies, as a new turbine water wheel is to be put in this summer.

NEWPORT, N. H.—Mr. M. W. Tenney, superintendent of the Newport Electric Light Company informs us that there is an opening for an electric road in the town.

LACONIA, N. H.—The Laconia Electric Lighting Company has recently purchased a new Lombard water wheel governor and a 160-hp water wheel. J. F. Merrill is general manager.

WEST STEWARTSTOWN, N. H.—The W. F. Allen Electric Company operates 1,000 16-cp and 50 32-cp incandescent lights, and is beginning to introduce electric heating devices. The company intends extending its lines 2½ miles to Beecher Falls, Vt., and Riverside, N. H., in the near future. A good opening for any electrical enterprise is assured by ample water power. Current is furnished for lighting Colebrook, N. H.

ALAMAGORDO, N. M.—Mr. M. H. Fisher is the lessee and general manager of the Alamagordo electric light plant which furnishes 50 arc lights and 1,500 incandescents. Rates for motors are $2.50 and $5 per month. Mr. Fisher informs us that a complete equipment for a 100-kw plant is wanted for Tucumconi, N. M., including Corliss engine and alternator and tubular boiler.

LE ROY, N. Y.—The Leroy Hydraulic Electric Company operates 50 arc lights and 7,000 16-cp incandescents.

MEXICO, N. Y.—The Mexico Electric Company, organized in 1890 with $20,000 capital, shows an increase in electric lighting.

COBLESKILL, N. Y.—The Courter Electric Company has $15,000 capital and $8,000 bonds. Stanton Courter is president; D. C. Dow, treasurer.

GREENE, N. Y.—The village has just purchased the electric light plant but nothing has yet been settled in regard to future arrangements.

COOPERSTOWN, N. Y.—The Clinton Mills Power Company reports an increase in its lighting service having 70 arc lights and 4,700 incandescents.

EAST HAMPTON, N. Y.—The East Hampton Electric Light Company, which was formed in 1902 with $48,000 stock, has not yet installed its plant.

FRANKFORT, N. Y.—The Frankfort Electric Light plant (municipal) is now installing an entirely new equipment, including building and machinery.

GENESEO, N. Y.—The Geneseo Gas Light Company has a capital stock of $16,000 and $12,000 bonds. It has 46 2,000-cp arc lights and 700 incandescents.

RICHFIELD SPRINGS, N. Y.—The number of lights of the Richfield Springs Electric Light & Power Company shows a steady increase, there being now 2,500 incandescents.

CLINTON, N. Y.—Thos. F. McBride, of Clinton, has purchased the old grist mill and property adjacent at Millburn, near Clinton, with the intention of developing a power plant.

AUSABLE FORK, N. Y.—The Ausable Electric & Power Company was organized 1902. It has six arc and 1,225 incandescent lights. The company expects to enlarge its plant this year.

FORT PLAIN, N. Y.—The Fort Plain Gas & Electric Light, Heat & Power Company does a small business in electric motors and has 65 2,000-cp arc lights. Private houses have meters.

DUNKIRK, N. Y.—The Board of Water Commissioners has decided to put in a 300-kw generator and outfit for city lighting, to be used for lighting the outskirts of the city, not now covered by electric light.

NEW YORK, N. Y.—The Toluca Electric Light & Power Company has been incorporated in Brooklyn with a capital stock of $300,000. The incorporators are David H. Valentine, T. S. Williams and H. Seibert.

SAUGERTIES, N. Y.—The Ulster Electric Light, Heat and Power Company, of Saugerties, has been incorporated; capital, $30,000. Directors: William A. Hanna, Ada H. Eckert and Jennie G. Hanna, Saugerties.

ALBION, N. Y.—The Albion Power Company, which also operates the gas plant, has a capital of $200,000. There are 105 arc lights and about 7,000 incandescents of 16-cp. There is a fine opening for electric railway work.

DUNKIRK, N. Y.—The electric light plant is controlled by the Water Commissioners. M. J. O'Donnell being president. It operates 55 miles of circuit and has 90 arc lights, 3,500 incandescents and runs 6 motors at 8 cents per kw-hour.

CORNING, N. Y.—The Corning Gas & Electric Company was organized in 1900 with $375,000 capital. It furnishes power to operate the street railway, has 30 miles of wire, 93 2,000-cp arc lights and 2,500 8 and 16-cp incandescents.

HOLLEY, N. Y.—The Holley Electric Company is a municipal plant of which R. O. Bronson is superintendent. The number of incandescent lights is 2,000 and capital stock and bonds amount to $15,000. The company contemplates buying a boiler this summer.

DEPOSIT, N. Y.—The Deposit Electric Company, which operates a General Electric alternating plant, has a capital stock of $100,000. J. M. Briggs is president; C. P. Knapp, treasurer; A. E. Lovejoy, secretary. It supplies at present about 2,000 incandescent and 30 arc lights.

AMITYVILLE, N. Y.—The president of the Amityville Electric Light & Power Company, Mr. E. W. Davis, sends us the following: The company, which was formed in 1892, has a capital ot $25,000 and $15,000 bonds. It operates 15 miles of circuit and 5,000 incandescent lights of 16-cp.

GREENWICH, N. Y.—The Consolidated Electric Company, of Greenwich, has recently purchased the pole lines and machinery of the Washington Electric Light & Power Company of this place. The water power which the Washington Company proposes to develop, was sold to the American Wood Board Company.

SAYVILLE, N. Y.—The Sayville Electric Company, incorporated November, 1900, has a capital of $15,000. It operates a General Electric alternating plant, two dynamos, 50 transformers and has 11 miles of circuit with 2,000 incandescent lights. There is an opening for electric cars in Sayville. Mr. D. D. White is president of the Sayville Electric Company.

ROCHESTER, N. Y.—The Rochester Light & Power Company, capital stock $500,000 and bonds $500,000, has been organized the present year, with H. R. Wilson, president; J. C. Havemeyer, secretary, and J. G. Kaelber, general manager. The company has under consideration the erection of a big plant for arc and incandescent lighting, the plans for which are now being prepared.

LOCKPORT, N. Y.—The Lockport Gas & Electric Light Company, a unique one of its kind, uses three sources of power—steam, water and energy from Niagara, which can be operated interchangeably. With such unlimited supply the company prospers accordingly and has 260 2,000 arc lights and 3,014 incandescent lights. We are indebted to the courtesy of Mr. Slade the superintendent, for these particulars.

UTICA, N. Y.—The Utica Gas & Electric Company, organized in 1902, has a capital stock of $2,000,000 and bonds of $2,000. The officers are A. N. Brady, president; W. E. Lewis, vice-president; W. J. Cahill, secretary; G. Stack, treasurer; A. B. Johnson and M. J. Brayton, managers of the gas and electrical departments, respectively. The company operates 1,700 arc and 35,000 incandescent lights, besides supplying motors aggregating 3,500-hp and 3,000-hp to the street cars.

ROCHESTER, N. Y.—At a recent meeting of the stockholders of the Rochester Gas and Electric Company directors were elected as follows: George W. Archer, Frederick Cook, A. H. Harris, J. R. Judson, W. L. Cole, Rochester; William Runkle, Walter Johnson, New York; C. B. Judson, George C. Hollister, Granger A. Hollister, George A. Redman, Harry L. Brewster, John N. Beckley, Rochester. The officers re-elected are: President, George W. Archer; first vice-president, Charles B. Judson; scond vice-president, William Runkle; secretary and assistant-treasurer, J. R. Judson; treasurer, W. L. Cole; attorney, A. H. Harris.

MARION, N. C.—Col. Sinclair is stated to have secured a franchise for an electric light plant.

ELKINS, N. C.—The Elkin Light & Power Company has $3,000 capital stock and operates nine arc and 600 incandescent lights.

MT. AIRY, N. C.—The Mt. Airy Power Company, a municipal plant, is not yet installed, but water and lights will be available this year.

STATESVILLE, N. C.—The city electric light department has increased its output, having now 56 1,200-cp arc lights and 800 16-cp incandescent lights.

GASTONIA, N. C.—The Gastonia Municipal Electric & Water Works began operations in 1900 with $30,000 bonds. It is under the jurisdiction of the Director of Public Works. Ninety-nine arc and 99 incandescent lamps are in service.

GRAFTON, N. DAK.—The electric light plant of this city supplies current for electric heating. An institution under course of construction, will require about 400 lights, and another to be built in the summer will also require a number. Rubber covered wire will be used inside the buildings, and weatherproof on the lines.

NEW LONDON, OHIO, has a municipal plant on the General Electric system.

HUBBARD, OHIO.—The citizens have voted to issue $10,000 bonds for an electric light plant.

WESTERVILLE, OHIO.—The Westerville Electric Company requires some general supplies, such as wire, sockets, etc.

RICHWOOD, OHIO.—E. A. Schambs is the owner of the electric light plant which operates 32 arcs and 1,400 incandescent lights.

CRESTLINE, OHIO.—The Crestline Illuminating Company has $55,000 capital. It operates 75 1,200-cp arc lights and 2,000 incandescents.

NEW LEXINGTON, OHIO.—The New Lexington Electric Light & Power plant is managed by T. J. Smith and has 51 arc and 1,800 incandescent lights.

READING, OHIO.—The Board of Public Affairs manages the electric light plant and takes care of 50 2,000-cp arc lights and 2,000 16-cp incandescents.

SHREVE, OHIO.—The Shreve Electric Light & Power Company has $8,000 capital and operates 600 incandescent lights. It is in need of one 125-hp engine.

MONTPELIER, OHIO.—The Montpelier municipal plant operates 54 arc lamps and 2,300 incandescents. It reports that an electric railway is in contemplation.

SALEM, OHIO.—The Salem Electric Light & Power Company operate 200 arc lights and 2,300 incandescents, besides running eight motors and three electric cars on contract basis.

CINCINNATI, OHIO.—The stockholders of the Cincinnati Gas & Electric Company have voted to increase the capital stock by $2,000,000 for improvements and extensions.

CALEDONIA, OHIO.—The C. D. Resler Electric Light & Power Company was incorporated in 1902 with $5,000 capital. It runs two motors and has 16 arc lamps and 500 incandescents.

VAN WERT, OHIO.—The Gas, Electric Light & Power Company, organized in 1899 with $100,000 capital and $60,000 bonds, has about 73 street lights and 5,000 incandescents. J. M. C. Marble is president.

MARYSVILLE, OHIO.—The Marysville Light & Water Company runs 21 motors of 93-hp at rates from 4½ to 7 cents per kw-hour. It operates 48 2,000-cp open arc lights and 4,000 16-cp incandescents.

COSHOCTON, OHIO.—The Coshocton Light & Heating Company, organized in 1902, has an authorized capital of $250,000. It furnishes 126 arc lights and about 7,000 incandescents; also runs two motors of 100-hp each.

CHILLICOTHE, OHIO.—The Chillicothe Electric Railway, Light & Power Company runs electric cars and motors; does electric heating and automobile charging and operates 216 1,200-cp arc lights and 10,000 incandescents.

COLUMBUS, OHIO.—The contract for the erection of a building for the municipal electric light plant has been awarded to D. W. McGrath, of Columbus, for $68,675. Bids for poles and wires are still under consideration.

TROY, OHIO.—The Troy Electric Works (municipal plant), organized in 1897, has $27,000 capital. L. A. Pool is superintendent. There are 94 1,200-cp arc lamps and 8,000 16-cp incandescent lights. Sixty motors are supplied with power at 6 cents per kw-hour.

DAYTON, OHIO.—The Dayton Electric Light Company operates 600 2,000-cp arcs and 30,000 16-cp incandescent lights. It charges a few electric automobiles and supplies power for electric motors aggregating 600-hp at 7½ cents per kw-hour.

MEDINA, OHIO.—The Medina Electric Light & Power Company was organized in 1897 and is a private concern, with A. G. Oatman as manager. To meet increasing business, the purchase of a 100-hp water tube boiler and a 60-80-hp engine, is contemplated.

SALINEVILLE, OHIO.—The Salineville Electric Light, Heat & Power Company was organized in 1901. F. Duncan is superintendent. It employs Western Electric and Westinghouse apparatus; has 18 miles of circuits; 49 2,000-cp arcs and 900 incandescents.

NEW BREMEN, OHIO.—In 1896 this plant was purchased from the town, and now operates 35 enclosed arc lamps and 3,500 incandescents. The company proposes to rebuild the plant this summer, connecting up other towns and furnishing both light and power. F. H. Plaice is manager.

CLEVELAND, OHIO.—C. E. Phelps, Jr., of Baltimore, Md., is here for the purpose of advising with the city officials in regard to the establishment of a municipal electric light plant. He estimates the cost of establishing a municipal electric light plant for Cleveland at $400,000. An ordinance has been introduced in Council, providing for the issue of $200,000 bonds for the purpose of constructing an electric light and power station.

TORONTO, ONT.—The Toronto & Niagara Power Company is making satisfactory progress in erecting its power plant at Niagara Falls. The specifications for the plant are completed and call for five generators of 12,000-hp each, making 60,000-hp in all. The company expects to deliver electricity in Toronto in about two years.

OTTAWA, ONT.—It is stated that the directors of the Mexican Light & Power Company have decided that the company should, in addition to acquiring the properties of the City of Mexico Electric Light Company, owned by Siemens and Halske, secure the properties of the City of Mexico Electric Tramway Company, owned by Werner Beit & Company, of London, Eng. By securing these interests the Mexican Power Company will control the companies using the largest amount of electric power in the Mexican Republic.

HEPPNER, ORE.—A. M. Slocum will install an electric plant at his mill to utilize water power and transmit electric power to this city. The plant complete will cost $20,000.

ASHLAND, ORE.—The Siskiyou Electric Power & Light Company has purchased the plant and equipment of the Ashland Electric Power & Light Company. The new company will greatly increase the capacity of the present plant.

MANSFIELD, PA., shows an increase in lighting, having 2,500 16-cp incandescent lights.

KUTZTOWN, PA.—The Kutztown Electric Light & Power Company has not yet put in its plant.

MEADVILLE, PA.—The municipal plant here is under the supervision of Mr. H. Ellsworth, and operates 120 2,000-cp arc lights.

KITTANNING, PA.—The Kittanning Electric Light, Heat & Power Company has assigned to the Armstrong County Trust Company.

MILLVALE, PA.—The Millvale Water & Light Company has 64 1,000-cp arc lights, and thinks that an incandescent plant is needed.

SHIPPENBURG, PA.—The Shippenburg Electric Light, Heat & Power Company supplies 36 enclosed arcs and 1,600 incandescent lights.

POTTSTOWN, PA.—The Town Council has appointed a committee, with L. W. Z. Fillmen as chairman, to consider the construction of water works and an electric light plant.

CONSHOHOCKEN, PA.—The Conshohocken Electric Light & Power Company, W. M. Bell superintendent, is installing a new 150 kw 500 volt generator for motor circuits.

HAMBURG, PA.—The Hamburg Electric Light & Power Company was organized in 1892 with $17,500 capital stock. Westinghouse incandescent and Fort Wayne arc systems are installed. It operates 40 arc lights of 2,000 cp and 1,300 incandescents of 16 cp.

UPPER MERION TOWNSHIP, PA.—The Upper Merion Electric Light Company has been incorporated to furnish heat and light for Upper Merion Township, capital, $10,000. Directors: Edw. H. Wert, C. Ramond Fritcher and Herbert I. Harris, all of Harrisburg.

LANCASTER, PA.—It is stated that a syndicate of Philadelphia capitalists, consisting of Ervin Lyndall, John I. Kyle, and others, are about to apply to the State Department for charters for three companies to develop water power in Coleraın, Providence and Conestoga Township.

EAGLES MERE, PA.—The Eagles Mere Light Company was organized in 1900 with $25,000 capital, (issued $12,250) and $25,000 bonds (issued $13,000). President, C. La Rue Munson; secretary-treasurer and general manager B. G. Welch. At present it furnishes 1,500 16-cp incandescent lights and will run one 40-hp motor for the Eagles Mere Water Company to drive pumps.

SHARON, PA.—The Shenango Valley Electric Light Company is owned by the Youngstown-Sharon Railway & Light Company, of Youngstown, Ohio. It operates 200 arc lights and 5,000 incandescent lights; 100 motors at rates of 6 to 2 cents per kw-hour and 40 miles of street railway charging by meter at the switchboard of main power house.

SENECA, S. C.—The Seneca Cotton Mills has a General Electric plant which furnishes 75 arcs (which light the mill) and about 50 incandescent lights. The mill is run with motors—four 100-hp, one 50-hp and one 30-hp. T. C. Duncan is president and treasurer; F. M. Jordan, secretary.

GEORGETOWN, S. C.—The present Georgetown Electric Company dates from 1901. Stock issued $25,000; bonds issued $31,000. Forty-six arc lights of 2,000-cp and 2,000 16-cp incandescents are in operation. The company also runs six motors and supplies current for electric irons. We are indebted to Mr. S. S. Ingman, the manager, for some interesting details of improvements just completed in every branch rendering the plant up-to-date in every respect.

RAPID CITY, S. DAK. There is an increase in electric lighting by the Rapid City Electric & Gas Light Company.

STURGIS, S. DAK.—Mr. S. A. Oliver is the owner of the electric light plant which supplies 21 arc and 1,200 incandescent lights. Mr. Oliver expects to install a new boiler in the near future.

HURON, S. DAK.—The Electric Company, of which E. J. Bowen is owner and manager, kindly furnishes the following: A Corliss engine has been recently started, and the National machine has to be enlarged to meet rapidly increasing business. A new armature is required for it, besides other machinery, so as to practically duplicate the plant.

WATERTOWN, S. DAK.—The Kirlin-Gray Electric Company operates 60 1,200-cp arc lights and 4,000 16-cp incandescents. It has a few electric motors. The company favors us with very interesting notes of the rapidly growing town and its surroundings, making obvious the need of an electric railway along an already graded line. It would gladly co-operate with any others seeking to engage in such an undertaking. W. F. Gray is president; O. M. Kirlin, secretary and manager.

HENDERSON, TENN.—The Henderson Electric Light Company is in the market for one 125-hp automatic engine, one 75-kw alternator, switchboard instruments and transformers.

BRISTOL, TENN.—The Bristol Gas & Electric Company was re-organized Jan. 1, 1902. B. L. Dulaney is president; M. D. Chapman, secretary and treasurer. It now operates 50 1,200-cp arc and 3,000 16-cp incandescent lights.

CHATTANOOGA, TENN.—The entire plant of the Chattanooga Light & Power Company is being remodelled and will be equipped with four 500-kw Curtis steam turbines and three-phase alternators; four 300-kw rotary converters and four 300-kw static transformers; also a 30-panel switchboard. We are indebted to Mr. B. T. Burt, general manager of the company, for this information.

MEXIA, TEX.—The Mexia Light Company, H. O. Cravens, manager, is extending its plant.

NAVASOTA, TEX.—The Bridges & Holly Electric Light Company has increased the number of its lights to 1,600 incandescents.

TERRELL, TEX.—The Electric Light Company was organized in 1902, with $50,000 capital. M. A. Loy is president; M. W. Raley, vice-president, and S. E. Noble, secretary. It has 14 arc and 3,850 incandescent lights.

BEAUMONT, TEX.—The Beaumont Ice, Light & Refrigerating Company, J. C. Ward, president, has $300,000 capital, and operates 225 enclosed arcs and 25,000 incandescent lights. The meter rate for motors is 7 cents per kw-hour.

LLANO, TEX.—The Llano Milling and Manufacturing Company, which succeeded the Llano Water, Light & Power Company, February 1, 1903, has about 700 incandescent lights. It is putting in a 25-kw Wood direct current generator and a 10-ton ice plant.

MANCHESTER CENTRE, VT.—Mr. R. Colvin sold his electric plant to the Vail Light & Lumber Company.

RICHFORD, VT.—The Sweat-Comings Company has a capital of $50,000. C. A. Powell is president; H. C. Comings, treasurer.

BRADFORD, VT.—The Bradford Electric Lighting Company was organized in 1897 with $15,000 and has one arc light and 1,200 8, 16 and 32-cp incandescents.

WHITE RIVER JUNCTION, VT.—The Mascoma Electric Light & Gas Company, A. Barnes, president, is contemplating the purchase of 2 100-kw step-up transformers.

ST. JOHNSBURY, VT.—The St. Johnsbury Electric Company has a capital of $75,000 and bonds $50,000. The company furnishes electric heating on a two-rate basis from 6 a. m. to 6 p. m. at 5 cents per kw-hour.

SPRINGFIELD, VT.—The Springfield Electric Company operates 50 arc and about 3,000 16-cp incandescent lamps. Motors of about 200-hp take power at from 1 to 4 cents, according to quantity and hours used. Ten cars are heated in winter by electric heaters on a flat rate basis.

ISLAND POND, VT.—The Island Pond Electric Company, established in 1896, was re-organized in 1902, with a capital stock of $75,000, and $40,000 bonds. The installation is not yet quite complete, but the company expects to supply about 5,000 incandescent lights, and hopes to take care of other electrical enterprises.

BURLINGTON, VT.—The Consolidated Electric Company, of this city, is sending to its customers a statement showing the cost of electric lights in Burlington and other places. The present price in Burlington for arc light all night and every night is $80 per lamp per year. The company is offering a reduction from that price on a new contract. Meter rates are 6½ to 10 cents per kw-hour, and lamp renewals are offered free.

ST. ALBANS, VT. All arrangements for the development of the water power of the Vermont Power and Manufacturing Company, at Fairfax Falls, have been completed, and all the details of the merging of the St. Albans Electric Light & Power Company into the Vermont Company above named are also concluded. The National Gas & Construction Company, of Philadelphia, has the general contract for the development of the power.

CHATHAM, VA., has nothing in the way of an electric plant.

CHRISTIANSBURG, VA., has a municiapl electric light plant which furnishes 23 2,000-cp arc lights and 650 16 and 32-cp incandescents.

SALEM, VA., has a municipal plant which is under the management of T. R. Boon, and has 55 arc and 850 incandescent lights.

FRONT ROYAL, VA.—The Royal Light, Heat & Power Company is controlled by the Town Council. It operates about 88 16 and 32-cp incandescent lights.

WYTHEVILLE, VA. A franchise for light and power is to be advertised and sold about the beginning of June. The Brown Electric Company is going out of business.

BLACKSBURG, VA. The electric light department of the Virginia Polytechnic Institute was organized in 1891. Mr. C. Lee is superintendent. We are indebted to Prof. S. R. Pritchard who informs us that enlargement of the plant is sadly needed, but financial difficulties prevent.

RADFORD, VA.—The Radford Water Power Company operates the electric light plant and runs three cars also owned by the same company. It will install an electric power pump of about 1,200 gallons per hour capacity as an auxiliary to its present steam pumping plant, and suggests that with cheap power good openings for new enterprises are offered.

MARTINSVILLE, VA.—The Town Council will, according to press reports, receive bids until May 23 for a franchise to use the streets for poles, wires and other appliances for the transmission of electric power. The party to whom the franchise is granted is required to establish and operate an electric power plant of not less than 650-hp and an electric lighting plant, the price to be paid by the town for each 2,000 cp electric arc light being $75 per year.

CEDARBURG, WIS.—It is stated that bids are wanted for $11,000 electric light bonds. W. P. Jochem is Mayor.

SEATTLE, WASH.—The Seattle Gas & Electric Company has sold all its electric business.

BALLARD, WASH.—The City Council has passed a resolution leasing the municipal plant to the Kilbourne-Clark Company.

SPOKANE, WASH.—The Washington Water Power Company operates 1,100 arc lights and 48,000 incandescents; 2,000-hp in small motors, for which the maximum rate is 9 cents per kw-hour and 60 cars—the company owning the street railway.

GRAFTON, W. VA.—The Grafton Gas & Electric Light Company shows an increase to 2,500 incandescent lights.

CLINTON, WIS.—The Standard Electric Company has gone out of business.

OCONOMOWOC, WIS.—The lighting department of the City of Oconomowoc furnishes 46 2,000-cp open arc lamps and 3,000 16-cp incandescents.

MANITOWOC, WIS.—The Electric Light Company shows an increase in lighting, having now 100 200-cp arc lights and 10,000 16-cp incandescents.

LADYSMITH, WIS.—It is stated that the Ladysmith Light & Power Company contemplates constructing a dam across Flambeau River near Ladysmith.

ASHLAND, WIS.—The Ashland Light, Power & Street Railway Company runs six cars in addition to furnishing 140 1,200-cp arc lights and about 3,500 16-cp incandescents.

TWO RIVERS, WIS.—The Two Rivers Water & Light plant is a municipal undertaking, with A. Hudson, superintendent. It supplies 43 arc lights and 2,500 incandescents.

STOUGHTON, WIS.—The Stoughton Electric Light & Power Company does not report much change except in incandescent lighting, the number of lamps now being about 3,000.

SHEBOYGAN FALLS, WIS.—Charles S. Weisse & Company, proprietors of the electric light plant, operate 30 arc lights, 1,200 16 and 32-cp incandescent lamps, and 15 motors. We are informed that there is a good opening for an electric railway from Sheboygan to Plymouth.

BRODHEAD, WIS.—The Brodhead Electric Light Company, after many changes, was finally re-organized in February, 1903, and is now operated by F. W. Nuzum and G. M. Pierce as equal co-partners. It operates eight 1,200-cp enclosed arcs and 100 16-cp incandescent lights. A factory for machinery and supplies might locate here with advantage.

PERSONAL.

ELECTRICAL STAFF OF ST. LOUIS EXPOSITION.—Mr. Thos. A. Edison has accepted the position of Honorary Chief Consulting Electrician to the St. Louis Exposition and has written President Francis a cordial letter in praise and support of the enterprise. The other members of the strictly electrical staff are Prof. W. E. Goldsborough, Cloyd Marshall, P. E. Fansler and F. Welz, in order of rank. We present their portraits herewith, accompanied by a little biographical data. Prof. Winder Elwell Goldsborough was born in Baltimore, Maryland, October 10, 1871. In 1892 he graduated from Cornell University with the degree of M. E. A little later he took charge of the electrical work of the International Correspondence School of Scranton, Pa. In March, 1893, he accepted the appointment of Professor of Electrical Engineering at Arkansas University, Fayetteville, Ark. Just a year later he was called to Purdue University as Associate Professor of Electrical Engineering. In 1896 he was made full professor, and in 1897 was appointed Director of the Electrical Laboratory of the University. In January, 1902, Prof. Goldsborough accepted the position of Chief of the Department of Electricity of the Louisiana Purchase Exposition. He is a member of numerous engineering and scientific societies, among which may be mentioned the American Institute of Electrical Engineers, the Institution of Electrical Engineers of England and the Society for the Promotion of Engineering Education, and is a contributor to the proceedings of the societies and to the technical press. Mr. Cloyd Marshall, Superintendent of Electrical Machinery in the Department of Electricity, was born in Lafayette, Ind. After graduation from the School of Electrical Engineering of Purdue University in 1895, he was retained as an assistant in the electrical laboratory. Later he occupied the position of electrical editor of the *Street Railway Review*, of Chicago, and, during the period of this connection, from 1896 to 1898, he served as secretary of the Chicago Electrical Association. Mr. Marshall then accepted the position of designing and testing engineer for the Jenney Electric Mfg. Company, at the same time doing a considerable amount of experimental work for the Railway Materials Company, of Chicago. In 1901 he accepted the position of plant engineer, and, later, of engineer of the sales department of the C. W. Hunt Company, New York. He has occupied his present position since February, 1903. Percival E. Fansler, Chief Clerk, was born in Grand Rapids, Mich., in 1881. He graduated from the Chicago Manual Training School in 1898, and from the School of Electrical Engineering of Purdue University in 1901. During the following year he pursued a post-graduate course, making a special study of the electrical interurban problem. He conducted an important test on the interurban system of the Union Traction Company, of Indiana, which will be made the subject of papers to be presented at the general convention of the American Institute of Electrical Engineers at Niagara Falls, this June. Frank Welz, Technical Clerk, was born in Neu-Offingen, Germany, in 1875. He entered the Royal Bavarian "Kreisrealschule" at Munich in 1885, and graduated in 1891, after which he spent three years in the Royal Bavarian Industrielschule at Munich. From 1894 until his appointment on the staff of the Department of Electricity of the World's Fair, he was in the employ of the Allgemeine Elektricitats Gesellschaft, advancing in six years from electrical engineer in the branch office at Munich to engineer in charge of the Cassel office. He was then sent to Bruxelles, where he had charge of electrical installations in Belgium and France until the Fall of 1902, when he came to the United States, assuming his present duties in January, 1903.

PROF. W. E. GOLDSBOROUGH.

CLOYD MARSHALL.

PERCIVAL E. FANSLER.

FRANK WELZ.

MR. GEO. M. COLE has resigned as manager of the Plattsburgh, N. Y. Traction Company. His successor is Mr. Albert E. Reynolds.

MR. P. A. B. WIDENER, the Philadelphia traction leader, has sailed for Europe, and says he has nothing to do with the London "tube" system.

MR. G. MARCONI is said to be in poor health as a result of his recent work, and has been ordered to the Riviera.

MR. C. T. YERKES is disposing of his Chicago trolley interests and other property in that city.

PROF. J. J. THOMSON has arrived in this country for the purpose of delivering the course of lectures at Yale University on the latest ideas in molecular physics, etc., as already noted in these pages.

MESSRS. S. G. VINSON, manager of the Phœnix Electric Company, of Mansfield, Ohio, and S. H. Suenerfauth, superintendent of the same company, have resigned to take effect as soon as their successors are appointed. The gentlemen contemplate going into a new line of business.

MR. CHAS. A. SCHIEREN, the eminent belt manufacturer, presided last week at the annual meeting of the Savings Bank Association of the State of New York in New York City, and was re-elected president for the ensuing year.

THE DUKE OF MARLBOROUGH, following the example of other progressive members of the British aristocracy, has ordered two electric elevators with push-button control from the Otis Elevator Company. These are to be installed in his city home, Blandford House, Curzon St., London.

MR. MARIANO SCHIAFFINO, the consulting engineer for the Guadalajara Tramways Company, is at present in the United States with a view to placing contracts for equipments, etc., for the electric traction system about to be built in that Mexican city. The initial length of the line will be somewhat over 30 miles.

MR. I. STERNEFELD, the manager of the electrical department of G. & O. Braniff, Mexico City, representing the Westinghouse interests in the Southern Republic, has left for home, after several weeks visit to the States. He is of charming personality and made a great many new friends while on this trip.

MR. W. B. REED, manager of an electric light plant at Managua, Nicaragua, also representative in that country of the Bullock Electric Company, is in Cincinnati endeavoring to form a company to build an electric railway at Managua. Mr. Reed claims to have secured an exclusive franchise from the Nicaraguan government for such a system.

MR. ARTHUR BERGTHEIL, of the British engineering and contracting firm of Bergtheil & Young, Camomile Street, London, E. C., which concern represents the Bullock Electric Company in Great Britain, is at present on a visit to the United States. He is now in the West, but is expected to return to New York early next week. While in this city he will stay at the Hotel Savoy.

MR. ERNEST THOMPSON, one of the managing directors of the well-known firm of Nalder Bros. & Thompson, Ltd., manufacturers of electrical instruments, London, was a visitor in New York last week. On account of a breakdown in health, he has been making a trip around the world for some months past. From New York Mr. Thompson proceeds to Montreal and thence home.

PROF. A. G. BELL.—Prof. Alexander Graham Bell has resigned the presidency of the National Geographical Society, and his resignation has been accepted by the Board of Governors to take effect on the election of his successor, which will not occur until next winter. Prof. Bell's reason for relinquishing the office is that all his time is employed and will be for more than a year to come in perfecting his new kite flying machine.

MR. GEORGE WESTINGHOUSE was a member of the party invited by Mr. G. W. Perkins, of the firm of J. P. Morgan & Co., to meet at luncheon last week Baron Von Rheinhaben, Prussian minister of Finance, now visiting this country. The luncheon was given at the Lawyers' Club.

MR. J. P. WINTRINGHAM, the stock broker, who has a very large acquaintance and connection in the electrical field has moved his offices to the Mills Building, 35 Wall Street.

MR. DUDLEY FARRAND.—It is stated that President Thomas N. McCarter, of the new Public Service Corporation, formed to operate the trolley, electric light and gas plants in Northern New Jersey, has appointed Dudley Farrand, of Newark, the general manager of the United Electric Company and general manager of all the electric light and power interests of the company, including the trolley plants. Mr. Farrand is well known as a successful manager in the light and power field.

MR. W. W. BRADFIELD. chief engineer of the Marconi Wireless Telegraph Company of America, is in Chicago where he is engaged in the equipment of a wireless station on the lake front. A connecting station is undergoing construction and equipment at Milwaukee, and both stations are expected to be completed and in running order within ten days, when wireless messages will be exchanged between the two cities. Plans are being laid for extensions of the Marconi system along the Atlantic coast, the great lakes and the Pacific coast.

MR. FRANK S. GANNON has been elected vice-president of the Interurban Street Railway Company, of New York. Mr. Gannon began his railroad training in 1868 as a telegraph operator. He has been successively train despatcher; master of transportation on the Long Island Railroad, President of the New Jersey Midland, general superintendent of the New York & Northern, general superintendent of the Staten Island Rapid Transit and third vice-president of the Southern Railway.

MR. E. H. ABADIE, of St. Louis, formerly well known in connection with the Wagner Electric interests there, has become general manager of the Elblight Company of America, and with Mr. Russell Spaulding will have an equal partnership in its control. Without giving up his business connections in St. Louis, Mr. Abadie will have headquarters also in New York City, and with Mr. Spaulding will now make an exhibit at the Chicago Electric Light Convention. It may be noted that Mr. Abadie was the agent through whom the Safety Insulated Wire & Cable Company secured their contract for over $200,000 for wires and cables at the St. Louis Exposition.

MR MORITZ BOKER, of the German iron and steel firm of H. H Boker & Company, is at present in the United States with Baron Von Rheinhaben, the Prussian Secretary of Finance, reference to whose visit has already been made in these columns The Boker people act as German representatives for the St Louis Car Company. The cars are shipped "knocked down" and are assembled at the Boker shops. They are used on the Berlin electric traction system. The German visitors left New York Monday for the West They will return in a fortnight. While in New York they will be guests at the Hotel Netherlands.

MR. WM C. BOYRER, of the engineering department of the New York Telephone Company, presented an interesting paper on "Some points to be observed in the installation of the common battery system in telephone exchanges," before the Brooklyn Engineers' Club, Thursday evening, May 14 Mr. Boyrer illustrated his remarks by charts and gave an interesting account of the difficulties encountered in changing from one system to another. After an informal discussion in which many of the intricate details of telephone operation were explained, light refreshments were served, and a very enjoyable evening brought to a close.

MR. F. S. PEARSON, of New York, vice president of the Mexican Light & Power Co., who has just reached home from Europe, has advised a Montreal director that he has concluded arrangements with Messrs. Siemens & Halske, the Berlin bankers, for the acquisition of the Electric Light Company of the city of Mexico of which they are the owners. Messrs. Pearson and James Ross, who are so prominently associated with Canadian and other enterprises, some time ago obtained valuable water-power concessions from the government of Mexico and the existing plant in the city of Mexico was essential to the success of the undertaking. Details have already been given on the subject in these columns.

MARQUIS MARTIN MALONEY.—Cardinal Satolli recently applied to the Pope to confer a title of nobility on Martin Maloney, of Philadelphia, because of his large church offerings and his efforts to further Catholicism, especially in constructing a parochial church at Trenton, N. J. The Pontiff, after receiving satisfactory information from the Archbishop of Philadelphia and the Bishop of Trenton, has issued a brief creating Mr. Maloney a Marquis. Mr. Maloney built a handsome church at Spring Lake, N. J., last year in memory of his daughter Catherine. The Maloneys have a large summer home at Spring Lake. Cardinal Satolli is an intimate personal friend of Mr. Maloney, who is well known in electrical circles from his prominent and active participation in electric light, tracton and storage battery enterprses, etc.

MR. THOMAS M. MOORE, chief of the Machinery Department of the St. Louis Exposition, has been visiting New York City for the purpose of arranging for space for New York exhibitors, accompanied by Lieut. Godfrey L. Carden, of the same department. Mr. Moore said that the space in Machinery Hall had been applied for many times over. Mr. Moore and Lieut. Carden came partly to receive Col. C. M. Watson, Secretary of the Royal British Commission. Mr. Moore is very much gratified over the prospects which the great power plant of the exposition offers as a drawing feature. This power plant will consist of about 40,000 horse power. Instead of utilizing a few simple type engines of local manufacture, the power plant will be made up of the latest forms of engines known to the world to-day, and for the most part these engines will come from Europe.

MR. WALTER B. SPELLMIRE.—The Bullock Electric Mfg. Company, of Cincinnati, Ohio, announces the appointment of Mr. Walter B. Spellmire as district manager of the Atlanta office of the company. He will assume his duties at once with headquarters in the Empire Building of that city. Mr. Spellmire has been with the Bullock Company some seven or eight years, during which period he filled the position of chief of the testing department; after which time he was sent to London and Paris by the company to look after some important installations at those places. After being abroad one year, he returned to the United States to fill the position of sales engineer in the New York office, from which position he has just been appointed district manager at Atlanta. From a knowledge of Mr. Spellmire's work with the Bullock Company, it is only fair to presume that he wll attain even greater success in his present position, in which he will have a very much broader field of operation.

GEN. W. A. GREELY, U. S. A., the head of the signal corps, started for Europe on May 13 in the American liner *Philadelphia*, to attend several conventions in London. The General said he expected to return about June 13. "I am going over chiefly to attend the convention of the International Telegraphers in London, on May 28. Every country, with the exception of the United States, is a member of the association. I do not know why the United States is not. I am going over there as a delegate, but without the power to vote. I will be permitted to get up and talk however. I am also to attend the convention of the International Colonial Institute, which is also to be held in London, two days before the telegraphers' meeting. The subject of wireless telegraphy will be most generally discussed. The German Emperor tried to get up an international conference on this important subject, but it came to nothing, as some countries would not join."

MR. W. G. WILGUS, the fifth vice-president of the New York Central Railroad Company, is the subject of an interesting interview in the *New York World*, in regard to the use of electricity on part of the system. This article includes also a neat thumb nail sketch of a quite striking personality. "His success has been due absolutely to his own worth, for it so happens that when he first applied to the New York Central Railroad for a job about eighteen years ago, he was turned down. He has been connected with this road for only ten years, but in that time he has risen by rapid stages from assistant engineer of a division to the fifth vice-presidency. Mr. Wilgus is a clean-cut man in every sense. His ideas are precise and at his tongue's end. He speaks frankly and tersely and leaves his listener in no doubt as to what he means. He is a man of medium build. Even a beard and glasses do not add any appearance of elderliness to his obvious youth. He is distinctly a young man, with the spirit, energy and enthusiasm of youth."

MR. JAMES BLAKE CAHOON has organized a Bureau of Expert Investigation and Construction to undertake the critical examination and valuation of properties and projected enterprises, the investigation of corporate charters, franchises, patents, etc, the conducting of tests, the preparation of plans and specifications for all classes of work, the supervision of contracts, and the organization and management of properties with a view to securing the highest degree of economy and the maximum of returns. Following is the personnel of the bureau, which has offices at 35 Nassau St., New York: Electrical and Mechanical Engineers, Horatio A. Foster, Frank B. Rae, GeorgeT. Hanchett and Thorburn Reid. Hydraulic Engineers, George W. Birdsall and Ira H. Carpenter. Civil and Mining Engineers, M. H. Alberger and Walter A. Calhoun. Chemist, Dr. William McMurtrie. Counsel, Cecil Campbell Higgins and Joseph T. Brown, Jr. Patents and Patent Laws, Howard P. Dennison and Thos. J Johnston. Director, James Blake Cahoon.

LEGAL.

WESTERN UNION LOSES. The Pennsylvania R. R. had had a contract with the Western Union Telegraph for 20 years, which gave the latter company the privilege of using wires and poles on the Pennsylvania lines and maintaining offices, etc. After 20 years it was provided that on six months' notice the Western Union must vacate the Pennsylvania lines. Such notice was given and it terminated last December. The Western Union began proceedings first of condemnation and filed a bill to enjoin the Pennsylvania from ousting the Western Union Company, alleging that under the act of congress with respect to post-roads the Western Union Company has a right to conduct the telegraph business on the Pennsylvania as they were a post-road under the law. Judge Buffington, in the United States circuit court at Pittsburg, refused the application of the Western Union for an injunction, and Decided all points in favor of the Pennsylvania. The United States court of appeals now affirms Judge Buffington's decision, and by this ruling a similar case in the United States court of New Jersey, which court granted an injunction against the railroad company, is decided adversely to the telegraph company. The Western Union has at once cut its wires, but the Postal is not yet ready for service.

OBITUARY.

MR. E. T. GILLILAND.—It is with deep regret we note the death on May 13, of Ezra T. Gilliland, the inventor of many of the improvements of the American Bell Telephone system. He died of Bright's disease at his home in Pelham Manor, a suburb of New York City. He began life as a telegraph operator, took up the telephone at the start, and soon distinguished himself as a meritorious inventor. He had a great deal to do with the perfection of the long distance transmitter. Mr. Gilliland was interested in the Gilliland Electrical Company, which has large factories in Adrian, Mich., and when he had perfected and patented his inventions he sent the models there to be duplicated for the market. He employed seven expert electricians in the laboratory at his home. He was also prominent in the affairs of Pelham Manor, and served as trustee and president of the village. Mr. Gilliland was born in Cuba, N. Y., 56 years ago, and lived most of his life in New York City. He was a member of the Reform, Manhattan, Colonial, Pelham Manor, New York Athletic and Columbia Yacht clubs. He leaves a widow, who was Miss Lillian Johnson, of Indianapolis.

Trade Notes.

DECORATIONS AT THE CHICAGO CONVENTION.—The Elblight Company will decorate the reception room at the Auditorium Hotel, at Chicago, on the occasion of the Electric Light Convention, and the Chicago Edison Company will furnish the current. A brilliant effect is promised.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., on account of the large number of orders recently secured in and around New York City, has established a branch office in the St. Paul Building, 220 Broadway. This will enable it to keep in closer touch with important interests in the city.

THE NERNST LAMP COMPANY is rapidly invading sections of the country heretofore uncovered. New York, Pennsylvania, the New England and Atlantic Coast States have agencies in every city of importance, while additions have been made in Salt Lake City, Denver, Lincoln, Neb., San Francisco, Los Angeles, Seattle and generally throughout the Mississippi and Western States.

THE CHRISTENSEN ENGINEERING COMPANY'S constantly growing business has made it necessary for the company to provide increased office facilities in Chicago; consequently a large office, fully equipped with every convenience, has just been opened in the Old Colony Building, where representatives of both the air brake and electrical sales departments will be pleased to welcome the customers and friends of the company. Mr. Chas. G. Burton, manager of the Chicago agency for the sale of the company's "Ceco" electrical machinery, has removed from the Merchants Loan & Trust Building into the new office. The air brake department is in charge of Mr. J. E. Eldred, Jr., who is well known in the electric railway field, having for a considerable time represented the company in the sale of air brake equipments.

AEOLICRAFT.—The Franklin Model Shop, 129 West Thirty-fourth Street, New York, has brought out an ingenious toy called the "Aeolicraft," which is a model yacht designed to sail on a tight wire stretched between two trees or other convenient points of support. The craft is suspended upon the wire by a truss and carrier frame shaped like an inverted triangle and having two pulleys in the upper corners with travel on the run wire. It sails along the wire just as a ship does in the water and when it reaches the end of the course goes about automatically, sailing back to the starting point to repeat the evolution. Where space permits three posts can be set in an open lot and three wires strung to form and equilateral triangle. One of these wires will always be available to catch a good wind. This land yacht will afford much enjoyment as a pastime for young people with yachting proclivities, without the attending dangers of similar sport on the water. With two outfits, races can be sailed and the enjoyment thus greatly enhanced. A booklet describing and illustrating this interesting device has been issued, a copy of which can be had on application.

PROCTOR'S THEATRES.—The Summer plans for the F. F. Proctor circuit of theatres have been practically completed, and unless all present signs fail, the outlook is a brilliant one promising success for the management, steady employment for the large band of actors in Mr. Proctor's employ, and a gay season of highly entertaining shows for the public at large. Later on, there will be a revival of several of last season's biggest hits, and then there will be produced in quick succession half a dozen gay pieces never before seen in New York. All those productions will be as carefully made as though the season were at its height, for it is never Mr. Proctor's idea to curtail expenses, be the season early or late. At his Twenty-third Street Theatre, New York City, the plan of presenting all vaudeville shows will be continued throughout the Summer, the bills being made up with especial reference to the warm weather. At his One Hundred and Twenty-fifth Street house, the favorite stock company will continue its excellent work, strengthened immeasurably by the reappearance of Miss Adelaide Keim, who resumes her stage work after a much needed period of rest. The Twenty-third Street Theatre is now being fitted with cold storage pipes, which will insure cool temperature even on the hottest days. The show bills have been booked well ahead, and only the newest and best novelties will be shown this season. The Albany house has also undergone extensive improvement.

THE STANDARD VITRIFIED CONDUIT COMPANY is to have an exhibit of its conduit at the Auditorium Hotel, Chicago, Ill., during the National Electric Light Association Convention, in charge of Mr. B. S. Barnard, vice-president and secretary of the company. The new factories of this company at South River, N. J., are now in full operation, in addition to the old factories, and have a daily capacity of multiple and single duct conduit equal to the entire demands of the United States, and after July 1st, it can supply the world. The company has secured practically all of the orders for conduit in the New England States this season, and a greater part of the orders east of the Ohio River. Upwards of 1,000,000 feet of conduit was recently purchased through it for Salt Lake City, Utah, by the Stromberg-Carlson Company. This will be shipped from Western factories, which goes to show that the Standard Company is in a position to supply conduits in any part of the United States. It recently secured an order for one-half million feet for Memphis, Tenn., and the following corporations who are well known in the trade are using its product this season, in large quantities. Philadelphia Rapid Transit Co., Bell Telephone Co., Rapid Transit Subway Co., New York, Metropolitan Traction Co, New York, Brooklyn Rapid Transit Co., Brooklyn, N. Y., Boston Elevated Railway Co., Boston, Mass., Springfield St. Railway Co., Springfield, Mass., Mobile Light & Railway Co., Mobile, Ala., Consolidated Subway Co., New York, Niagara Falls Power Co., Niagara Falls, N. Y., and many other large corporations. It is likewise doing a great business in third rail insulators, so it would be well for engineers interested in conduit to secure the privilege to visit its factories, which would be interesting and instructive, in order to appreciate its exact position in the trade. The concern states that it is independent in every way. Its catalogue as issued to the trade is a work of art, acknowledged to be the finest book yet published on conduit and is strictly up-to-date, with many new suggestions, especially on manhole construction. Its stock is sold up for at least six months to come, small orders, however, could be filled promptly.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 12, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

727,567. ELECTRIC SWITCH; Vincent G. Apple, Dayton, O. App. filed June 16, 1902. A switch arranged to automatically indicate the relation of the dynamo and the batteries in the circuit in which they are contained.

727,568. DYNAMO ELECTRIC MACHINE; Vincent G. Apple, Dayton, O. App. filed Oct. 20, 1902. One head of the machine is hinged to the ironclad field in such a way that when swung open the commutator is entirely exposed.

727,569. SHUNT WOUND SERIES ARC LAMP; Malcolm H. Baker, East Liberty, Pa. App. filed Mar. 11, 1902. A small auxiliary magnet is connected in series with the carbons to operate an iron core of sufficient weight to overcome the normal counter-balance for the upper carbon and thus maintain the carbons in contact before the starting of the lamp; this prevents an abnormal strain on the lamp which sometimes occurs at the instant of throwing on the current.

727,571. BRUSH HOLDER; Asa F. Bachelder, Schenectady, N. Y. App. filed Sept. 3, 1901. Details.

727,573. ELECTROMAGNETIC CLUTCH; Erl V. Beals, Boston, Mass. App. filed Oct. 8, 1900. The clutch has two coils of different strength actuating two different clutch members.

727,590. LAMP SOCKET; William H. Cole, Watertown, Mass. App. filed Aug. 19, 1902. Details.

727,596. ELECTRIC-ARC LAMP; Albert G. Davis, of Schenectady, N. Y. App. filed September 16, 1901.

727,601. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Fred T. Dow, of Schenectady, N. Y. App. filed July 19, 1900.

727,605. ANTI-HUNTING DEVICE FOR DYNAMO-ELECTRIC MACHINES; Hermann F. T. Erben, of Schenectady, N. Y. App. filed November 8, 1901.

727,606. METER; Walter C. Fish, Lynn, Mass. App. filed Sept. 24, 1902. To reduce the friction between the shaft and bearings, a symmetrical current-carrying coil is used in conjunction with an electro-magnet system for the purpose of reducing the pressure between the shaft and the bearings.

727,608. CONTACT DEVICE FOR TROLLEYS; Charles L. Fitch, Grand Rapids, Mich. App. filed July 1, 1902. A small roller or ball takes current from the under side of the wheel.

727,611. APPARATUS FOR MAINTAINING UNIFORM RESISTANCE IN ELECTRIC CIRCUITS; Frederick A. Gilbert, Brookline, and Emil O. Lundin, Beachmont, Mass. App. filed Nov. 22, 1897. An arc lamp having a series coil, a shunt coil composed of two conductors of different resistance and means for cutting out one of them at a determined temperature.

727,624. TIME LIMIT CIRCUIT CONTROLLER; Caryl D. Haskins, Schenectady, N. Y. App. filed July 30, 1901. A liquid reservoir having two chambers connected by a passage, is tilted to allow the liquid to flow from one chamber to the other, the liquid serving to close a circuit; adjustable weights are used to regulate the time intervals.

727,625. PERIODIC CIRCUIT CLOSER; Caryl D. Haskins, Schenectady, N. Y. App. filed Aug. 9, 1901. A modification of the preceding patent.

727,633. ELECTRIC BASE BALL REGISTER; John M. Humphreys, Trenton, Canada. App. filed June 21, 1902. The player's gloves and shoes are fitted with contacts which co-operate with contacts on the field to automatically show whether a player is "safe" or "put out."

727,634. TELEPHONE; Miller Reese Hutchison, of New York, N. Y. App. filed November 15, 1901. (See page 887.)

727,640. ELECTRIC METER; Elton J. King, Fort Wayne, Ind. App. filed Oct. 11, 1901. The object is the production of a meter of cheap construction which is capable of accurate results on alternating current circuits regardless of the power factor and which can be adapted to circuits of different frequencies without reconstruction.

727,641. MAGNETIC CLUTCH; Edgar Knowlton, Schenectady, N. Y. App. filed Oct. 3, 1902. The clutch members are drawn together by means independent of the magnetizing coil, the circuit of the latter being automatically closed when the members are in contact; this avoids sudden locking of the members.

727,649. TROLLEY CATCHER; Eugene Limauge, Brussels, Belgium. App. filed Dec. 3, 1902. Details.

727,662. INDUCTION MOTOR FOR VARIABLE SPEEDS; August Meuschel, Montreal, Canada. App. filed Oct. 5, 1901. Intermediate speeds are obtained by passing only a small portion of the useful armature current through a special armature resistance and full speed by armature circuits of very low resistance.

727,684. ELECTRIC MOTOR SYSTEM; William B. Potter, Schenectady, N. Y. App. filed Oct. 31, 1900. A car is started with battery current and maintained at speed from the trolley, the battery being meantime charged.

727,685. COOLING DYNAMO ELECTRIC MACHINES; Edward D. Priest, Schenectady, N. Y. App. filed Nov. 2, 1900. The construction includes fan-blades in the inner parts of the machine which draw air through various passages in the armature and field frame.

727,686. MEANS FOR COOLING DYNAMO ELECTRIC MACHINES; Edward D. Priest, Schenectady, N. Y. App. filed Jan. 18, 1902. A modification of the preceding patent.

727,687. LIGHTNING ARRESTER; Henry Raymond, Schenectady, N. Y. App. filed July 22, 1899. The opposing surfaces of the arrester are made of large area by giving them a cup-shape and placing one within the other.

727,688. LIGHTNING ARRESTER; Henry E. Raymond, Schenectady, N. Y. App. filed July 22, 1899. The mass of the dischargers is reduced but they are made hollow and of large surface to easily conduct away the heat.

727,689. MAGNETIC CLUTCH; Henry G. Reist, Schenectady, N. Y. App. filed Oct. 3, 1902. The clutch has two coils, one of which is weaker than the other and serves to bring the members together and create a certain amount of friction, after which the second coil is brought in to establish the lock.

727,690. ELECTRIC ARC LAMP; Edwin W. Rice, Jr., Schenectady, N. Y. App. filed Aug. 26, 1901. An arc lamp having a bi-pass around the regulating coil and a magnet of shorter time-constant than the coil responsive to the lamp current to control the same.

727,701. TELEPHONE SYSTEM; Charles B. Smith, New York, N. Y. App. filed Dec. 31, 1897. (See page 887.)

727,702. ELECTRICAL SIGNALING OR CALLING SYSTEM; Charles B. Smith, of New York, N. Y. App. filed December 13, 1899. (See page 887.)

727,703. ELECTRICAL SIGNALING OR CALLING SYSTEM; Charles B. Smith, of New York, N. Y. App. filed December 13, 1899. (See page 887.)

727,704. ELECTRICAL SIGNALING OR CALLING SYSTEM; Charles B. Smith, New York, N. Y. App. filed March 3, 1900. (See page 887.)

727,713. MEANS FOR ACCENTUATING ELECTRICAL CONTACTS; Elihu Thomson, Swampscott, Mass. App. filed Sept. 29, 1900. Mechanical and electrical devices for performing the function indicated by the title.

727,714. ELECTRIC ARC LAMP; Elihu Thomson, Swampscott, Mass. App. filed Oct. 26, 1901. An extra coil sensitive to fluctuations is utilized to produce a prompt and vigorous actuation of the clutch.

727,756. DEVICE FOR REINSULATING ELECTRIC AND AERIAL TELEPHONE OR OTHER CABLES, John Daggett, of Elyria, Ohio. App. filed Nov. 14, 1902. (See page 887.)

727,763. ELECTRICAL SWITCHBOARD, Edward H. Ellicott, Chicago, Ill. App. filed April 26, 1901. Details.

727,764. ELECTRICAL PROTECTIVE DEVICE, Edward H. Ellicott, Chicago, Ill. App. filed Dec. 17, 1901. Details of a spring held plunger which is released by an electro-magnet and permitted to make a long movement in breaking the circuit.

727,792. PRODUCTION OF PERMANGANATES, Wilhelm Hickman, Frankfort on the Main, Germany. App. filed March 3, 1903. A process for producing other permanganates than those of potassium and sodium.

727,801. TELEPHONE CALL ANNUNCIATOR, George K. Jackson, of Reece, Kan. App. filed Aug. 5, 1902. (See page 887.)

727,823. ELECTROLYTIC MANUFACTURE OF CHLORATES AND PERCHLORATES, Pierre Lederlin, Chedde, France. App. filed July 11, 1902. A method for the manufacture at a high constant yield of chlorates and perchlorates by the electrolysis of a chloride solution with the previous addition of a corresponding neutral chromate, consisting in maintaining the electrolyte during the electrolysis in a non-alkaline state by the addition of hydrochloric acid.

727,828. ELECTRIC TIME SWITCH, Myron A. Nickerson, Canton, N. Y. App. filed Jan. 28, 1903. Details.

727,829. CABLE TERMINAL; Joseph J. O'Connell, Chicago, Ill. App. filed Oct. 13, 1902. The conductors at the end of the cable are returned on the outside thereof and covered by a cap, the space between the cable end and the cap being sealed with a suitable insulation.

727,842. CEILING OR WALL BOX; James T. Robb, Brooklyn, N. Y. App. filed Nov. 12, 1902. The box has a tapering nipple in which a wedge-shaped head engages, insulating material being interposed between the head and nipple.

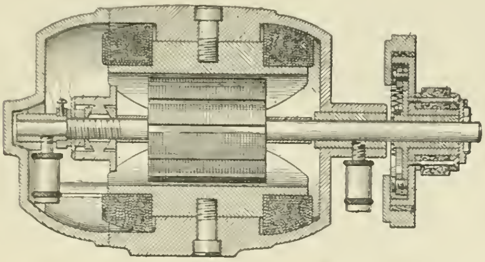
727,848. APPARATUS FOR BOILING BY ELECTRICITY; Robert C. Sayer, Bristol, England. App. filed June 25, 1900. The fluid is supplied to an open vessel situated within a closed vessel and is there heated by electrodes supplied with current automatically regulated by the pressure in the vessel.

727,865. GROUND DETECTOR FOR ELECTRIC CIRCUITS; Thomas W. Varley, New York, N. Y. App. filed Dec. 7, 1901. In connection with the supply circuit of a distribution system there are used means for deriving a local high resistance grounded circuit, means for indicating the flow of current from any ground portion of the system through said grounded circuit and means for transmitting and receiving signals through the circuit thus established.

727,870. INTERMITTENT AUTOMATIC SWITCH; Henry Wolf, Jr., Cincinnati, Ohio. App. filed Dec. 22, 1902. A quick-break electro-magnetic switch.

727,889. ELECTROLYTIC APPARATUS; Frank J. Briggs, Everett, Mass. App. filed May 21, 1902. Diffusion of the liquids in the different compartments by leakage is overcome by the employment of a pair of floating dialyzers practically independent of each other, but operating with relation to each other.

727,996. ELECTRIC PUSH BUTTON; John Y. Parke, Philadelphia, Pa. App. filed Jan. 27, 1903. The contacts co-operating with a number of buttons on a single plate are mounted on a post of insulating material fixed to the back of the plate.



727,568.—Dynamo Electric Machine.

728,015. INSULATING JOINT; James T. Robb, New York, N. Y. App. filed Dec. 4, 1902. A modification of No. 727,842.

728,017. REFRIGERATOR; John Rossi, Joliet, Ill. App. filed Jan. 12, 1903. The circuit of a lamp in the refrigerator is controlled by the latch on the door.

728,023. METHOD OF ELECTRIC WELDING; Joseph Schurek and Franklin B. Giesler, Milwaukee, Wis. App. filed March 31, 1900. For welding joints of different area in the same ring or body, the surfaces of one joint are held together while the other is being welded and thereafter the first point is welded.

728,034. REGULATOR FOR ELECTRIC CURRENTS; Thomas Spencer, Philadelphia, Pa. App. filed Dec. 16, 1901. A swinging solenoid and a fixed core, the relative positions of which determine the impedance of the coil which is used for regulating purposes.

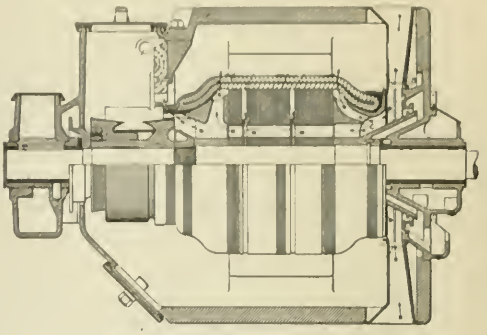
728,038. ALTERNATING CURRENT ELECTRIC MOTOR; Bernard A. Stowe, Cleveland, Ohio. App. filed July 12, 1902. Two coils disposed in inductive relation and connected in series in such way that the currents flow therein in opposite directions in connection with a low resistance conductor shunting one of the coils to prevent sparking.

728,039. ELECTRIC MOTOR; Bernard A. Stowe, Cleveland, Ohio. App. filed July 24, 1902. A modification of the preceding patent.

728,060. SWITCHBOARD INCANDESCENT LAMP; Allen D. Whipple, Chicago, Ill. App. filed Jan. 17, 1902. An insulating cap is cemented to the end of the lamp to protect the terminals.

728,076. GALVANOMETER, Andre Blondel, Paris, France. App. filed Jan. 3, 1901. The invention essentially consists in the employment of very thin and narrow bands of iron on which a mirror is secured, the bands being stretched on a support immersed in an oil containing case.

728,092. CONNECTOR FOR ELECTRICAL BATTERIES, William Rowland Edwards, Weybridge, England. App. filed March 17, 1903. A washer is inserted between the clamping surfaces to prevent access of corrosive materials to the inner parts of the connector.



727,685. Cooling Dynamo Electric Machines.

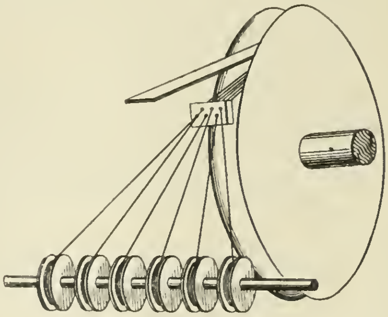
728,119. AUTOMATIC ELECTRIC CHAIN WELDING MACHINE; Carl A. Weuenberger, Biel, Switzerland. App. filed Aug. 28, 1902. When the welding heat has been attained and the ends of the link have been amalgamated by the pressing jaws, this pressure is made use of to effect the return of the electrodes to their position of rest and bring about the further sequence of processes.

728,134. LOCK; Christopher J. Roach, Hartford, Conn. App. filed Oct. 2, 1901. Devices whereby the opening of several mail boxes embraced in a circuit is dependent upon the proper successive operation of each.

728,147. TELEPHONE SELECTING DEVICE; William D. Watkins, San Jose, Cal. App. filed Dec. 2, 1901. (See page 887.)

728,152. INSULATING MEANS FOR ELECTRICAL APPARATUS; Asa F. Batchelder, Schenectady, N. Y. App. filed Sept. 3, 1901. An insulating sleeve is interposed between a pin and the walls of an orifice to obtain a driving fit between the parts which are at the same time insulated.

728,161. COMBINED TELEPHONE AND FIRE-ALARM SYSTEM; William Livingston Denio, of Rochester, N. Y. App. filed May 9, 1902. (See page 887.)



728,183.—Process of Winding Electrical Coils.

728,162. TELEPHONE; William L. Denio, of Rochester, N. Y. App. filed Feb. 6, 1903. (See page 887.)

728,164. SIGNAL CONTROLLING SYSTEM FOR ELECTRIC RAILWAYS; George Gibbs, New York, N. Y. App. filed May 22, 1902. To prevent excessive draughts of current from a sub-station of the road due to the practically simultaneous movement of an abnormal number of trains that may have been held up or delayed, the clearing of the signals is made dependent upon the amount of current drawn by the trains.

728,165. SIGNALING APPARATUS FOR TELEPHONE LINES; Fred E. Green, Newburyport, Mass. App. filed Jan. 2, 1902. (See page 887.)

728,183. PROCESS OF WINDING ELECTRICAL COILS; Richard Varley, Providence, R. I. App. filed Feb. 4. 1903. A process of coiling ribbon wire consisting in interposing a mechanical separator between the turns at the time of winding and afterwards removing the mechanical separator and substituing permanent insulating material, preferably of such nature as to become enamel after baking.

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CONTENTS.

Editorial 915
Institute Leaders on the Union Building 918
Philadelphia Meeting of the A. I. E. E. 918
Electricity on the Manhattan 918
The 25,000-volt Transmission Plant of the South Bend Electric Company 919
The Technolexicon of the Society of German Engineers 924
Rankine as a Poet 924
Telephone Meeting of the Chicago Branch A. I. E. E. 925
Western Union and Pennsylvania Railroad 926
Programme of the A. I. E. E. Niagara Meeting 926
Commercialism in Universities 927
Recent Electrochemical Developments. By Clinton Paul Townsend 928
New Telephone Patents 928
Municipal Plant Lighting for New York City 930
Meeting of the New York Electrical Society 930
Chicago Convention of the National Electric Light Association 931
Current News and Notes 935
Letter to the Editors:
  The Mechanical Cause of Gravitation. By Robert Stevenson 935
Digest of Current Electrical Literature 936
New Books 939
Weston Employees' Club 940
Ferro-Manganese Plant in Canada 941
Ventilated Cell Diverter 941
Bullock Generators for Massena 941
A New Telephone Receiver 942
Extensive Electrical Equipment for North German Lloyd Docks 942
Departments:
  Financial Intelligence 943
  Commercial Intelligence 944
  General News 946
  Trade Notes 950
  Record of Electrical Patents 951

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

We have had occasion so frequently during the past several years to refer to meetings and conventions as the "most successful in the history" of the respective organizations considered, that the phrase has become somewhat hackneyed. The present era of prosperity is, however, to be held largely accountable, and this week's Chicago Convention of the National Electric Light Association calls for a repetition of the statement with reference to that body. With an attendance at the end of the first day's session falling little short of 600, a record is made that it will be difficult to surpass. Without doubt this record-breaking attendance was largely due to the great increase of membership during the past year, amounting to no less than 225 per cent. Nevertheless, the present membership of 532 includes but 452 of the 3,800 central stations of the United States, and there is thus left an immense constituency from which to make further additions to the roll. Until Mr. H. L. Doherty inaugurated a new programme of lively solicitation for membership, many of those who had followed closely the life of the Association for the preceding decade yearly felt greater apprehension as to its future. During that period its growth was almost at a standstill while the industry which it assumed to represent was advancing with leaps and bounds. The membership of 150 or less represented few others than the "old timers," and the Association promised soon to be little more than a reminiscent body like that of the "War-Time Telegraphers." Happily, before too late regeneration began, and if the recent pace is kept up, the body will in few years be in every sense what for a time it had only been in name—a national association. The revival in activity has also been evident in the programme of papers of the past two conventions. While the merely perfunctory paper has not been entirely absent, the subjects have with few exceptions been of live, practical interest to the central station man, and treated by engineers and others selected as being thoroughly competent for the tasks assigned. A feature of the greatest importance is the "Question Box," this year greatly enlarged, from which mine of practical information we shall again draw largely in succeeding issues, when also the more important papers will be separately taken up for comment.

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THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The report of the Board of Directors presented at the recent annual meeting of the American Institute of Electrical Engineers is extremely interesting from its showing of the remarkable advance which during the past year the Institute has made in certain directions. During this period no less than 695 associate members were elected and qualified, and the total membership rose from 1,549 to 2,229, or an increase of 44 per cent. The activity of the Institute is also indicated by the disbursements, which rose to $30,181.25 for the past year, exceeding the disbursements of the previous year by $9,262.61 and those of 1901 by $14,102.35. One of the remarkable developments during the year was in the organization of local branches. Whereas previously Chicago stood alone as a place of meeting outside of New York City, the report shows that during the past year no less than eighteen additional local branches were organized, principally at universities. Among many other new features inaugurated were a grade of membership for students; provision made for selecting and publishing in the *Transactions* theses of graduating electrical students, and the collection and publication of engineering data. President Scott, the chairmen of committees and others who have co-operated with him, are entitled to the highest credit for a progressive work during the past year which stands without parallel in the history of the Institute.

On the other hand, it must be recognized that time alone will determine whether the Institute can in the future successfully accomplish all of the great work that during the past year has been mapped out for it. Bearing in mind the difficulty that in the past has been experienced in Chicago in keeping up interest in the local branch established there some years ago, a great task will be imposed upon the future presidents of the Institute in keeping active life in the numerous branches recently established. While the increase of membership is most gratifying, the accession in great numbers has been so sudden that a doubt arises as to the stability of the present membership list as compared with that of the past—a doubt that will be tested at the first pinch of hard times. Turning to the financial side, we find that notwithstanding the very great increase in the income of the Institute, the balance from the year's operations was only $621.58; and we note furthermore that although the financial statement contains among the assets accounts receivable, there is no entry under liabilities for bills payable, which may imply that instead of a small balance, future payments may actually determine a deficit. Part of the abnormal increase in expenses is to be ascribed to the great expansion of the *Transactions* for 1902, which will be issued in two volumes; the amount expended on this account during the past year was $7,254.16, as against $4,135.62 the previous year, and $2,757.75 in 1901. Similarly, miscellaneous printing and stationery increased from $501.91 in 1901 and $830.24 in 1902 to $2,148.15; postage from $589.20 in 1901 and $797.70 in 1902 to $1,543.50; and salaries from $2,541.64 in 1901 and $4,318 in 1902 to $5,350. In presenting this reverse side of the picture, there is no intention of conveying criticism of the management or of damping ardor in extending along as many lines as practically possible the usefulness of the Institute. The financial showing, however, is a subject for grave concern, not only in view of a possible future contraction of income, but also on account of additional obligation which the Institute may have to assume in connection with the proposed Union Engineering Building.

A NOTABLE SEMI-CENTENNIAL.

Fifty years ago last week may almost be said to have been the birthday of modern American railroading, for on May 17, 1853, the New York Central Railroad was incorporated, and shortly afterward took over the components of the first important railroad consolidation. Prior to that period the traveler from New York westward worked his way up the Hudson by boat or by the Hudson River Railroad, then a powerful independent line, and then headed for Buffalo via a group of ten little roads operated on more or less discordant terms, according to circumstances, and with difficulty managing to shuffle passengers across the State. West of Buffalo the outlook for progress was harder still. It was another and an earlier era in transportation, and it is almost impossible for us now to realize how incomplete and weak were the links that bound together the interests of the continent. Still harder is it to realize that it was fourteen years later before the rail route from New York to Buffalo was under one coherent management. Even then the ways of travel were crude; indeed, the sleeping car was almost an unknown quantity, and the hapless traveler was shuffled from car to car along his devious way in a fashion that would now lead to riot. If the virtues of consolidation are anywhere more conspicuous than in the promotion of through railway traffic, we have yet to find the place. To-day travel is a pleasure instead of a burden, and the coast is nearer than was the Mississippi a generation ago. It is the shrewd and wise enterprise that formed the New York Central which set the pace for future development and has enabled the nation to grow without losing common interests, and to develop a homogeneous whole. No one man or railroad can claim all the credit, but the New York Central has been a road of rare importance in the national growth.

THE TROUBLES OF THE TECHNOLOGICAL HISTORIAN.

A few weeks ago an astonishing and incongruous lawsuit came to a hearing in England, which illustrates how hard it is to write a historical chapter in a technological text book, and to please everybody, at the same time. Prof. S. P. Thompson's well-known text-book on "Dynamo Electric Machinery" has passed through several editions. In the chapter on the historical development of the dynamo, allusion is made to the fundamental work of Faraday, who was the discoverer of electromagnetic induction, the basis of dynamo action, Faraday having been the first to construct an actual small dynamo, i. e., a magneto-electric machine. Credit is also given to Mr. Henry Wilde for having constructed, in 1866, a dynamo with a separately excited magnetic field. The credit here urbanely offered to Mr. Wilde, F. R. S., does not appear to have been sufficiently luscious and eulogious to satisfy that gentleman, who is reported as bringing an action in Chancery for an injunction restraining the publishers from printing a new edition of Prof. Thompson's "Dynamo Electric Machinery," for the reason that the statements therein, and above referred to, were false; that they constituted libels on the plaintiff, and injured his reputation as a discoverer and inventor. The plaintiff also sought redress in damages and in costs.

If every inventor brought action for injunction for restraint of publishing a book in which the credit to said inventor was deemed by him inadequate, how few historical text-books would be published. The court, in giving judgment, made light of the charge of libel, designating the pleading as pure nonsense. The action was, therefore, dismissed with costs. The new edition of the book will, therefore, be free to go to press with the alleged libel and all. It was really very presumptuous of Faraday to have made a dynamo so early. The plaintiff in this litigation is the same man who, when several years ago awarded a medal by the Society of Arts, "For the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small"—in other words, for his part in the work in making the dynamo auto-exciting—refused the medal, issued a writ against the printers of the *Journal* of the Society prohibiting the publication of the terms of award, and demanded that they be amended as follows: "For the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small—his invention of the dynamo-electric machine, founded on this discovery, and its application by him to the production of the electric searchlight and to the electro-deposition of metals from their solutions." Surely, the fool-killer of the British Isles has been neglecting his work.

RECENT ELECTRICAL DESIGN.

A paper by Mr. W. B. Esson in the last number of the *Transactions* of the British Institution of Electrical Engineers, entitled, "Notes of Recent Electrical Design," gives a general view of the various types of dynamo-electric machines in modern use. It is remarkable to contrast the recent conditions in dynamo machinery with those existing say twelve or fifteen years ago. At that time a large variety of types existed, with very different shapes, dispositions and magnetic circuits. Each inventor or designer claimed some special advantage for his own particular type of dynamo. At the present time, however, there are only a few types surviving, although the number of dynamos in use is constantly on the increase. There are, moreover, but few differences between American and European types of modern dynamos. Of course, there is a marked difference between the styles of different countries manufacturing one and the same type. It is not difficult to distinguish between a German, an English, a French or an American machine by its style; but the structural type may be essentially the same.

In Europe the armatures are commonly tunnelled, and in America slotted. That is to say, the conductors of European machines are commonly threaded through holes or tunnels provided in the armatures parallel to the axis and close beneath the surface; whereas in American machines, the conductors are usually in form-wound coils laid into slots or grooves in the surface of the armature. Even this difference has, of recent years, been minimized by the custom of slitting open the tops of the tunnels in the European machines, so as to transform them into slots of an overarched form. Mr. Esson points out that British alternator designs tended until recently to make the machines unduly heavy for their output, through aiming at an inherent regulation of 2 or 3 per cent. The customary regulation in this country and on the European continent has been from 5 to 7 per cent., on the basis of full non-inductive load. The paper points out that a great saving in material is effected by coming down from an unduly high capability for inherent regulation, and adopting 5 or 6 per cent. for a power factor of unity and also 30 or 35 per cent. for a power factor of zero. The additional specification in this way, of the regulation for zero power factor is quite a good innovation, and might well be adopted. From these two data, the regulation at any intermediate power factor may be closely approximated to by a very simple formulas.

In regard to polyphase transformers, there is a distinct divergence between American and European practice. With us, two small single-phase transformers are used, in association, to give step-down three-phase consumption currents. When the load is sufficiently great, three single-phase transformers are used, one on each side of the three-phase triangle. In Europe, however, three-phase transformers are the almost invariable rule, the magnetic circuit being triple, and the fluxes in triphase relation, so that the secondary coils on the same transformer generate three-phase electromotive forces. It is difficult to see why this plan has not been more generally adopted with us. The usual defense for single-phase transformers is that they are simpler, and that if any accident happens to them, it is usually to but one of three, whereby the service may be temporarily maintained by the other two. But we may expect to see the three-phase transformer eventually take its place in American installations, since there is a saving in material and an improvement in regulation consequent upon its use.

THE SOURCE OF ACTIVITY IN RADIUM.

It was mentioned by Mr. W. J. Hammer in his recent paper, before the American Institute of Electrical Engineers, on "Radium and Other Radio-Active Substances," that Lord Kelvin had been quoted to the effect that the discovery of Becquerel radiations had placed the first question mark against the principle of the conservation of energy since the principle had been enunciated. In a recent number of *Nature* (April 30th), Prof. J. J. Thomson discusses the cause of the remarkable activity of radium. It is well known that the samples of radium and radium salts recently produced are self-luminous, and are radio-active. Moreover, it is now stated that a sample of radium enclosed in a block of ice, melts the ice in its immediate neighborhood at a rate of about its own weight in two hours, representing a very appreciable liberation of energy. Since it takes nearly 80 gramme-calories, or 335 joules to melt a gramme of ice, one gramme of radium, according to the preceding statement, liberates 167.5 joules per hour, or 465,000 ergs per second (0.0465 watt).

Prof. Thomson points out that much discussion has arisen over the source of this power. Some have suggested that radium had the power of absorbing and redistributing radiation energy derived from without, as for example, when the sun's rays falling upon a pebble immured in a block of ice, warm the pebble and enable it to melt the ice in its immediate vicinity. There is, however, no evidence in this case of power of such magnitude reaching the radium from without. The article points out that the facts are in conformity with the hypothesis that a few of the atoms of the substance attain a condition of instability wherein they disrupt and liberate energy in transformation to a new condition of stability in which the intrinsic energy is much smaller. A gramme of carbon will liberate about 3.4×10^{11} ergs when combining with oxygen to form carbonic acid. On the supposition that the carbon and the oxygen each contribute half of this enregy, the carbon gramme may be credited with 1.7×10^{11} ergs to expend. It could keep up an expenditure of 465,000 ergs per second, radium's alleged activity, for 3.66×10^5 seconds, or 4.25 days. But the carbonic acid formed may still possess a relatively large quantity of intrinsic energy, although not in an available condition for recovery, so that this may be but a small part of the total intrinsic energy of carbon.

According to the data assumed by Thomson for the constituent charges or ionic charges in the radium atoms, their disruption would supply the observed amount of power for 30,000 years before the internal energy was all exhausted. This indicates how much energy may be stored away in matter, and the possibility that at some future time the discovery may be made of a process for extracting some of this energy by bringing substances into a condition at which the energy may be readily delivered. The process of combustion is really a particular method of effecting this result thermodynamically. Two kinds of matter, each in stable atomic equilibrium, are brought into contact under suitable conditions whereby they change their atomic conditions, and evolve a certain portion of their original intrinsic energy. It does not necessarily follow, however, that this is the only means that the range of natural law will permit for squeezing the internal energy out of atoms. It is quite conceivable, even though it should never be realizable, that matter might be brought by definite physical processes to a condition of instability with the absorption of but a small amount of energy, and that it would then automatically collapse into a new atomic structure in which the intrinsic energy was much lower. The excess of the original intrinsic energy over that required for the new condition, should then be liberated in some form, say, either as heat in a furnace, or electrically in some voltaic combination.

This speculation is fostered by the seeming facts concerning radium, wherein, if Thomson's theory is correct, the radio-activity of one atom of the substance excites neighboring atoms to the limits of instability. Here, then, is a substance which at ordinary temperature and pressures, breaks down atomically with the liberation of radiation and ultimate thermal energy. The great difficulty is, of course, that any useful substance for yielding internal energy, must be cheap, and must take but little energy inpact to bring it to the unstable state. Such substances, nearly unstable of their own accord, are not likely to be plentifully distributed in Nature.

Institute Leaders on the Union Building.

As was noted briefly in these pages last week, a number of interesting letters were presented at the annual meeting of the American Institute of Electrical Engineers, applauding the Carnegie gift of one million dollars for a union engineering building and urging the Institute to do its share in making the opportunity productive of good. Mr. T. A. Edison, for example, addressing President Scott, said:

"I am delighted to note the sequel of the Institute library dinner which I had the pleasure of attending last February and am heartily glad to be able to congratulate you on the generous gift of Mr. Carnegie of one million dollars to the Institute and its sister societies. I have the greater pleasure, in this benefaction to the society, because it comes from one of ourselves, who began at the key and has shown himself so worthy of the great wealth that has come to him since he was a humble telegrapher. I am convinced that all the societies concerned will feel it their duty to unite in the disposing of this gift so as to render it of the utmost value and profit to the professions they represent and to the arts and sciences in general."

Dr. A. E. Kennelly, past president, in his letter, remarked: "It seems to me that no more valuable endowment could be made for engineering than that which will harmonize and unite the various engineering societies, bringing these bodies into one building, and building them into one body. It would bring into closer co-operation the branches of that guild whose past industry has made possible the greater co-operation and the grandest civilization that the world has already won. I regard it not merely as a lasting benefit to engineers, but also through their labors, and the work that they will carry on in the union Engineering Building, as a distinct gain to all the nations of the world."

Mr. Carl Hering, past president, said: "Those of our members whose fortunes have been made in the electrical industry and profession now have an opportunity to follow the generous example set to Mr. Carnegie by recognizing in a substantial way the institution which has been such a potent factor in the marvellous development of an industry which has brought fortunes to many. This Institute is now recognized to be of national importance, and during the past few years its reputation and standing is beginning to be recognized abroad. It has no rival in its branch of engineering in this country. National questions are referred to it and its opinion on international matters is respected. Although the youngest of the national engineering societies, it has been the most active in the efforts to realize that long-cherished dream of so many engineers, a Union Engineering Building in the Metropolis of our country. We should, therefore, not be the last to assure Mr. Carnegie that he has not overestimated our abilities to maintain the magnificent home which he has so generously offered us."

Prof. W. A. Anthony, past president, said: "I have felt the keenest interest in its work, and I know that the papers that have been read and the discussions that have followed upon various subjects have helped very greatly to advance the interests of the electrical art, and if a building can be secured where the Institute can have permanent quarters in connection with the other engineering societies I am sure it will increase greatly the efficiency, not only of its work, but of that of the other societies also."

Mr. Frank J. Sprague accompanied his donation of $2,000 with an admirable letter in which he said: "While it is perhaps natural that such a building shall have as its principal attraction the technical libraries of the different societies, which should, under suitable restrictions, be accessible to all members, it would seem proper that it might also have in its equipment as a source of inspiration and instruction, a collection of models of the original apparatus illustrative of important departures in engineering practices. As a member and a past president of the Institute, I am in hearty accord with the general plan which has been proposed for a building to be occupied as a common home, and I will gladly bear some portion of the burden which will fall upon our particular Institute."

Prof. Elihu Thomson, past president, sending $5,000 to the endowment fund, said: "It is not conceivable that any member can fail to be deeply interested in the new possibilities and opportunities which arise out of the munificent offer of Mr. Carnegie. By his most generous gift he has shown his own deep interest in the work and in the future co-operation of our chief engineering bodies. The membership of those bodies now have the duty of seeing to it that the gift is largely used and in a way to redound forever to the credit of American engineers. There is no need to dwell upon the importance of the work of our Institute in the past. Who can doubt that with the enormously enlarged opportunities now to be afforded that there will be a great extension of its usefulness in the future?"

Mr. J. G. White has given $1,000 flat and $1,500 conditional. He made the motion which committed the Institute to the plan, and said: "I should like to see the entire amount to be supplied by the Institute provided by subscriptions and contributions and not by mortgage on the land. I understand it was at first suggested that the money might be secured in this way. It seems to me it is possible to secure sufficient funds to pay for our proportion of the necessary land without reference to a mortgage loan. With contributions from the Westinghouse Company, the General Electric Company and others who will undoubtedly contribute, and also from Prof. Thomson and the other members of the Institute, it ought to be quite possible for us to provide our portion of the amount. If that is not done, it seems to me we might go to what would be the next best position—if we cannot get the full amount at once, get in position where we could gradually go ahead without a jar, and that would be to have a sinking fund, instead of a long-time loan, have bonds in a sinking fund which would gradually retire the ownership, so that ultimately your proportion of the land will be paid. I hope the effort to secure the entire amount by subscription and contribution will be first made, and I believe it is quite possible to do it."

Philadelphia Meeting of the A. I. E. E.

The regular meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held on Monday evening, May 11, at the Engineers' Club, of Philadelphia. The chairman, Mr. Carl Hering, in an opening address, gave details of Mr. Carnegie's offer for the Union Engineering Building, his remarks on the subject being enthusiastically received by the members.

Mr. Philip Torchio, of the New York Edison Company, was present, and presented, with some addition, the paper on "Safety Devices in Central Stations and Sub-Stations," which he had read at the New York meeting. Mr. H. A. Foster gave an abstract of the paper presented by Mr. H. A. Lardner at the New York meeting, entitled, "Economical and Safe Limits in the Size of Central Stations." Mr. J. T. Hutchings, of the Philadelphia Edison Company, gave an abstract of the paper Mr. Peter Junkersfeld presented at the New York meeting, on "Multiple Versus Independent Operation of Units and Central Stations." Mr. A. R. Cheyney, of the Philadelphia Electric Company, presented a concise abstract of the discussion held in New York on the three papers.

The general discussion was participated in by Messrs. W. C. L. Eglin, Horatio A. Foster, Carl Hering, Philip Torchio, Paul Spencer and J. T. Hutchings. The meeting was well attended, and about fifteen members were present at the informal dinner at Boothby's restaurant, before the meeting.

Electricity on the Manhattan.

The statement of the Manhattan Railway Company to the State Railroad Commission for the quarter and the nine months ended on March 31 shows that the total number of passengers carried in the first three months of this year was 65,193,975, which compares with 58,037,249 in the corresponding period of 1902, and 50,448,918 in the same period of 1901. For the nine months the total number of passengers carried was 180,481,586, an increase of 22,921,489 compared with the nine months ended March 31, 1902.

The gross earnings for the quarter showed an increase of $351,828, with an increase in operating expenses of only $63,750. This was construed in Wall Street yesterday as an indication of the economical working of the third-rail system. For the nine months the gross earnings showed an increase of $1,127,888, with an increase in operating expenses of only $41,225.

The elevated railroads of Manhattan are now maintaining a service representing 165,000 car miles a day on 110 miles of track, which is more than equivalent to a service of 400 cars a day between New York and Pittsburg.

The number of persons carried daily by the elevated trains now averages about 800,000. They travel on the average about four miles, so that the average fare is about 1 cent a mile. The electrical horse-power used in train movement is about 45,000, continuously exerted.

The 25,000-Volt Transmission Plant of the South Bend Electric Company.

A HIGH-TENSION power-transmission installation for supplying current to the system of the South Bend Electric Company, has just been put in operation by that company. The plant is situated at Buchanan, Mich., on the St. Joseph River, about 16 miles north of South Bend, Ind. This is a typical installation, exemplifying up-to-date practice in hydraulic and electrical engineering. It is not the purpose of this article to discuss the value of such an installation, when operated in connection with a steam plant, from an economic standpoint, but rather to call attention to the flexibility and the readiness with such a combination lends itself to any and all conditions which arise in the operation of an electric light and power system.

A large part of the current will be used for supplying the system of the company at South Bend and that at Buchanan. There is a municipal plant at Niles, about five miles south of the former place, and as this is in need of additional power, it is quite likely that this will become a consumer. There is a possibility of the lines being extended to St. Joseph and to Benton Harbor, Mich., about 25 miles distant, should the demand at those places warrant it. As the Indiana Railway Company's line now building from South Bend to Niles parallels the high-tension transmission lines between those two points, the operation of that part of the road by rotary converter sub-stations with current supplied from the transmission lines, is being considered.

The South Bend Electric Company is engaged in the usual lighting and power business in the city of South Bend, and also operates a small system recently acquired in Buchanan. The company was incorporated in 1884, and began business with six series arcs. Since then the business has grown to such an extent that some 1,800 customers are supplied at the present time. About 15,000 16-cp incandescents are connected to the system, as well as 460 Adams-Bagnall constant-potential enclosed arc lamps. The motors, some 125 in number, are mostly 500-volt, and range from 2½ to 60-hp. The company does the city lighting, for which 407 arcs, nearly all of the open series direct-current type, are used.

The accounting system conforms as nearly as possible to that recommended by the National Electric Light Association, and the office methods employed are up-to-date in every respect. As arc lights and incandescent lamps are connected to the same meter, a uniform charge of 15 cents per kw-hour is made, and in case of payment before the 10th of the month, a discount is allowed, depending upon the gross amount of the bill. A minimum of $1 a month is charged for residence lighting and also for store lighting, but in the latter case a minimum charge of 15 cents per outlet is made when these exceed seven in number. Power is charged for at the rate of 10 cents per kw-hour, with a discount depending upon the gross amount of the bill, and the minimum charge is based on the size of the motor installed. The city pays at the rate of $62.50 and $90 for each arc for midnight and all-night service respectively. In case of the non-payment of a bill within a reasonable length of time, it has been found that an immediate cut-off has led to prompt collections, which furthermore have been prompted by the fact that a fee of $1 is charged for each reconnection to the system. The business has enjoyed a healthy growth in the last few years, and is in a very good condition at the present moment.

A small electric light plant which was installed at Buchanan, Mich., some years ago, has been acquired, and will be run from the hydraulic plant at that place. An office is located there to take care of the local business, although of course all the accounting, system of charges, etc., conforms to that employed at South Bend. There are 36 city arcs, a number of commercial arcs, and about 1,100 incandescent lamps connected with this system; likewise several motors, the largest of which is a 3-phase, 50-hp induction, used for driving a brickyard. At the present time the motors are operated from a separate circuit, but later on it is proposed to use the 3-phase circuit for all purposes, the lighting transformers being, of course, single-phase. The old plant, which was built about 1893, contains three 48-in. water wheels, a small Westinghouse automatic engine which ran the plant during the construction of the new one, and several small generators, and will be dismantled as soon as the circuits can be operated from the new plant. Although the amount of the business at Buchanan is not very large, it is an important link in such a combination.

The steam power house at South Bend, since the completion of the hydraulic plant at Buchanan, is used as a sub-station and distributing point merely. The steam plant is operated only at such times as is required because of interruption in the power supply from the latter point, or in case the load at South Bend becomes such that it cannot be taken care of from Buchanan, which it is expected will happen only in case of extreme low water or at times of a heavy peak. The physical plant of the company at South Bend is that usually met with in steam stations of such a size. This is true not only as regards the power house proper, but also as regards the other departments which necessarily are required for the successful operation of a central station. It is not necessary, therefore, to enlarge upon these, except to call attention to the methods and apparatus used.

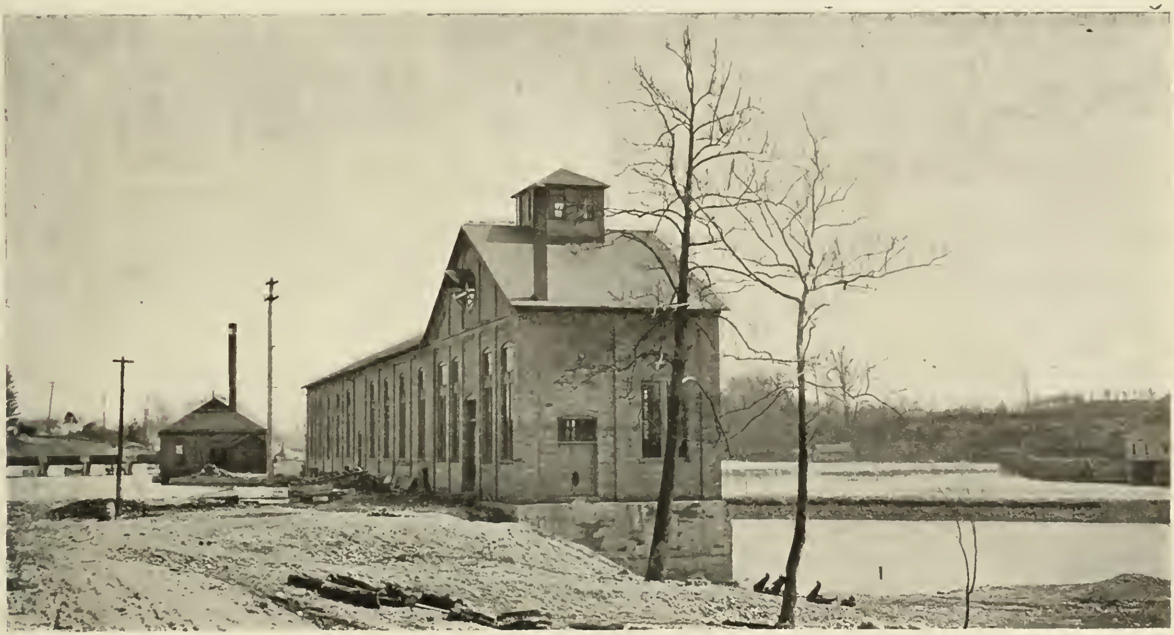


FIG. 1.—VIEW OF POWER HOUSE. OLD POWER HOUSE IN BACKGROUND.

Two 500-volt power circuits are in use in the down town districts. All elevators which are especially objectionable to the regulation of any system, are connected to these and such other motors as are located in that district. It is the intention of the company to connect all elevator motors to these circuits in the future, but all growth in the motor business will be taken care of by means of a 3-phase circuit supplied from the same buses as the lighting circuits. The lighting circuits, three in number, are single phase, but operated from the 3-phase bus, potential regulators being installed in each circuit for regulating purposes. Thomson recording wattmeters and Westinghouse single-phase meters are used extensively on the circuits. The transformers, however, are of several makes, although these are being standardized as much as possible. Because of the scattered lighting, it has not been possible to introduce 3-wire secondary circuits to as great an extent as is the case in some other cities. The series direct-current arcs for store lighting have been entirely superseded by constant-potential lamps on the lighting circuits, but the former are still used for the city lighting. The latest methods and apparatus are being introduced as fast as conditions warrant such a course.

It may not be amiss to call attention to the various features embodied in the design of the steam plant, which was erected in 1891. Although this is used as a sub-station now, it was in operation until a very short time ago, and is of good construction throughout. An anomaly which is rather striking is the fact that although the plant is located on a branch of the St. Joseph River, thus having a constant and ample supply of water, all of the boiler feed and the larger amount of the water used for condensing purposes, is taken from two 8-in. artesian wells.

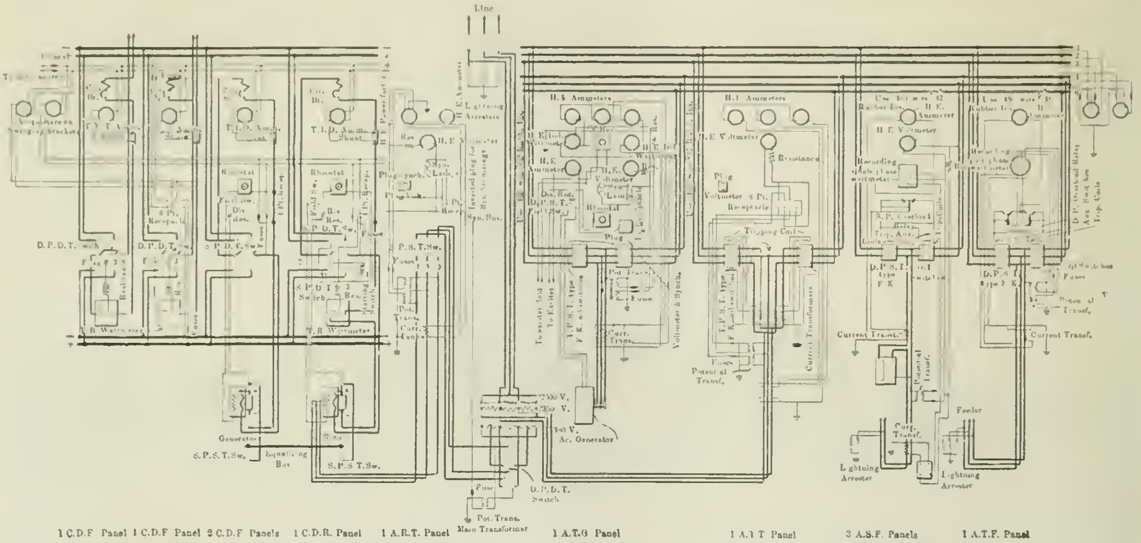


FIG. 2.—WIRING DIAGRAM OF SOUTH BEND STATION.

The boiler house contains the usual equipment of boilers and other apparatus to be found in such a plant. There are three 250-hp vertical and one 200-hp horizontal Wickes water tube boilers, and one 250-hp Babcock & Wilcox boiler, all of which are equipped with Wickes shaking grates. There are two guyed steel stacks, one 150 ft. high and 75 in. in diameter, and one 137½ ft. high and 37 in. in diameter. One duplex Blake, one single-cylinder Knowles and one duplex Snow pump supply the necessary boiler feed, which passes through an open heater of home make, before entering the boilers. Steam is generated at 125 pounds, and is supplied by means of steam piping underneath the floor to three engines, of which two are Cooper-Corliss cross-compound, 22 and 36 x 48, and one is a Noye tandem-compound, 21 and 38 x 36. Jet condensers are used, of which one is a 1,000-hp Worthington steam-driven, and two are of Cooper make of 500 hp each, and are driven from the crank shafts of the engines. The condensing water for one of the Cooper engines and the Noye, is taken from the wells, whereas that for the other is taken from the river. A jack shaft extends the entire length of the power house, and can be separated into units by means of clutches. This can be driven by the three engines mentioned, or by means of a 3-phase motor, which is installed in such a manner that its armature shaft forms part of the main line of the jack shafting.

The electrical equipment of the steam plant includes a 600-kw Westinghouse single-phase alternator installed on the jack shafting as already mentioned. This has recently been changed such that it can be operated either as a 3-phase generator or as a 3-phase synchronous motor. This was necessary, as in changing over to an electrically operated sub-station, it of course was essential to provide the means for operating the jack shafting formerly driven by the steam engines. A convenient and at the same flexible arrangement was secured as a result of the change. Under existing conditions the steam plant can be operated as formerly, and the 3-phase generator thrown in parallel with the buses energized from the Buchanan plant, or this machine can be operated separately and loaded with such circuits as may be desired. This can be readily accomplished, as there are two sets of 2,300-volt buses, and each circuit and generator is supplied with two oil switches, which are distinguished by the color of the handles. The other link between these two systems is a 300-kw, 60-cycle rotary-converter, which, through a coupling on its extended shaft, can be driven from the line shaft. By energizing the shunt field on this machine, which on the direct-current side delivers current at 500 volts, it can be operated as a 3-phase generator, which was the case before the plant in Buchanan was started, as at that time the generators installed in the South Bend plant were not of a large enough capacity. The rotary, when operated from the direct-current side, will deliver 3-phase, 60-cycle alternating currents at a potential of 333 volts. This in the transformers is then stepped up to 2,300 volts, and at this potential can be used for the alternating-current distribution. The purpose for which it will be ordinarily used, however, is to furnish 500-volt direct current for the power circuits, although this can also be accomplished by running the large 3-phase motor connected to the line shafting, and in turn the 500-volt direct-current generators. Usually the high-potential current when stepped down will be delivered directly to the 2,300-volt, 3-phase buses, from which the circuits will take their supply.

The electrical equipment of the steam plant includes, in addition to the altered 600-kw single-phase alternator and the 300-kw rotary-converter already mentioned, one 150-kw, 2,300-volt Westinghouse single-phase alternator and one 100-kw and one 150-kw, 500-volt General Electric direct-current generators. Four 100-light, 9.6-amp. Western Electric and two 125-light, 9.6-amp. Brush direct-current series arc machines are used for the city lighting. For the arc circuits the old switchboard is used, whereas the new board recently installed, is used for all other circuits.

As at present no switching whatever is done on the high-tension side of the transmission line, it has not been necessary to provide any switchboard facilities for that purpose, and as a consequence the apparatus installed at South Bend is quite simple. Where the high-tension line enters the building, long, heavy porcelain tubes are used, which in turn are supported in the centers of two hard maple discs placed in the ends of a large sewer crock built into the wall of the building. After passing an ordinary air-break, knifeblade switch, the lines pass to the step-down transformers. A multiple-unit lightning arrester connected to the line on the station side of the switch, is thoroughly grounded by a copper plate buried in the subsoil. The air-break switch is used merely to open the circuit after the line is dead. Three 500-kw General Electric step-down transformers of the oil-insulated, water-cooled type are used, with a primary winding for a voltage of 24,500 D or 42,500 Y, and 360 and 2,300 volts secondary. The transformers are connected with the switchboard by means of lead-covered, rubber-insulated cables. A small 5 x 5 single-cylinder, double-acting pump, drive nby a 1-hp General Electric, 3-phase induction motor, supplies the cooling water for the transformers from the artesian wells. The 360-volt secondary taps are, of course, brought out for the rotary-converter, which as a consequence can by means of the step-up transformers, deliver 2,300-volt current to the buses of the switchboard. The 2,300-volt leads from the step-down transformers are taken to a transformer panel on the switchboard, which will be described in connection with the latter.

A modern marble switchboard of General Electric make, as will be seen by the photograph, has been installed at the South Bend plant. This consists of the various panels required by the different apparatus installed, and contains the necessary instruments, switches, etc. Proceeding from right to left as one faces the board, the first two panels are devoted to the 500-volt circuits. Two voltmeters, one for each of the two panels, are provided on swinging brackets at the side. Two sets of buses are installed for the 500-volt generators and circuits, so that the former can be thrown in parallel or used separately, or any other combination that may be desired, secured. Each circuit is provided with a single-pole circuit-breaker, an ammeter for indicating the load on the circuit, a double-pole, double-throw, quick-break switch, so that the circuits can be thrown on either one of the two buses, and a Thomson integrating wattmeter.

The two 500-volt panels contain, in addition to the circuit-breaker

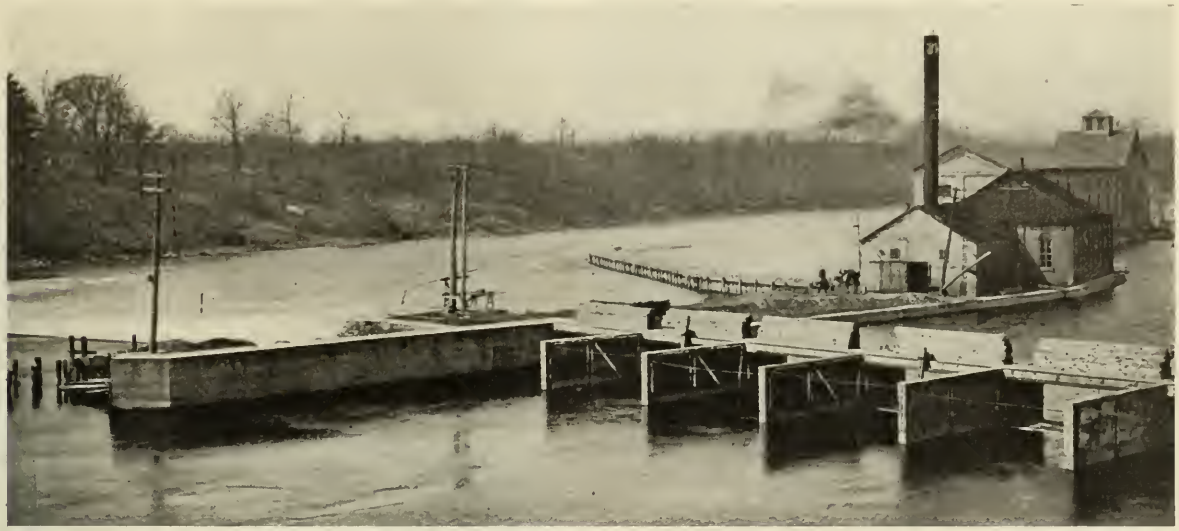


Fig. 3.—Buchanan Power House on the St. Joseph River.

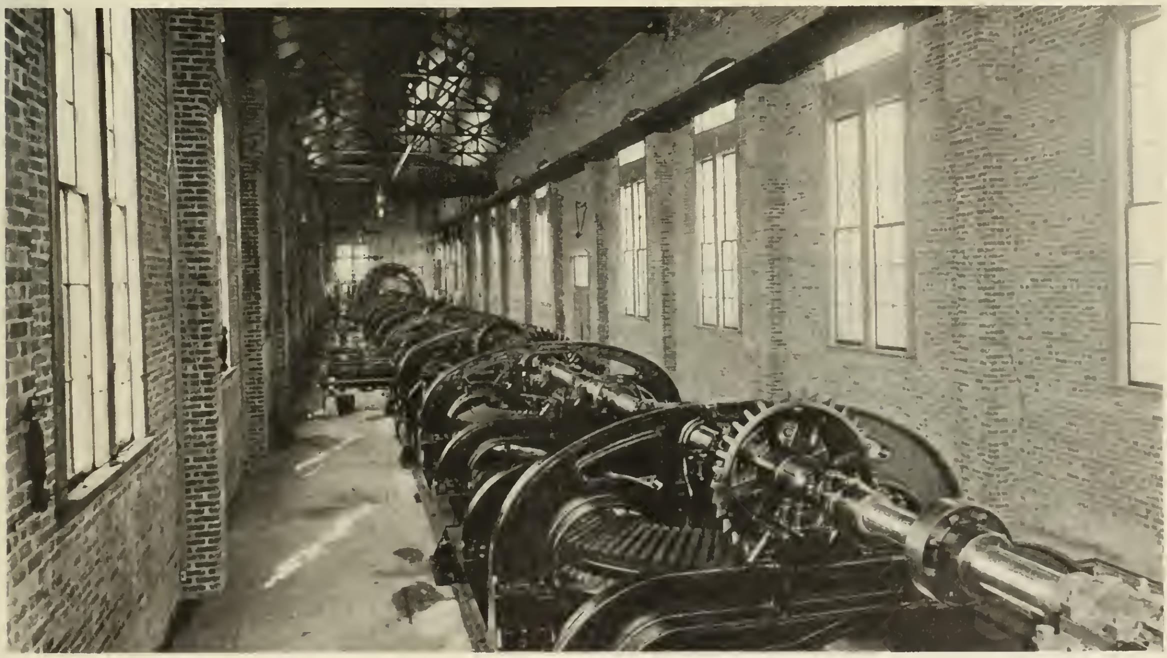
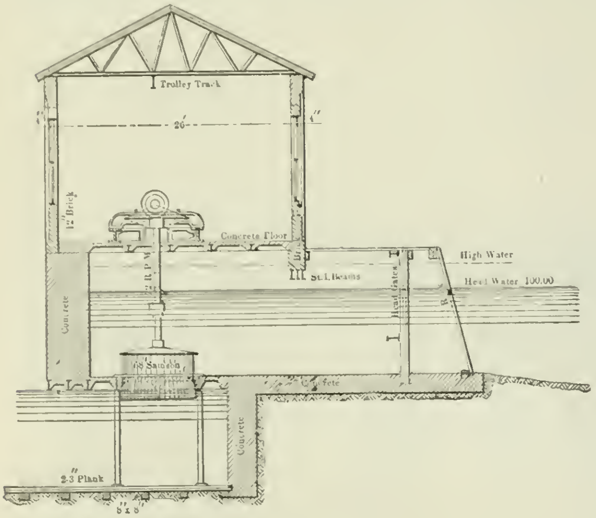


Fig. 4.—Interior of Buchanan Power House.

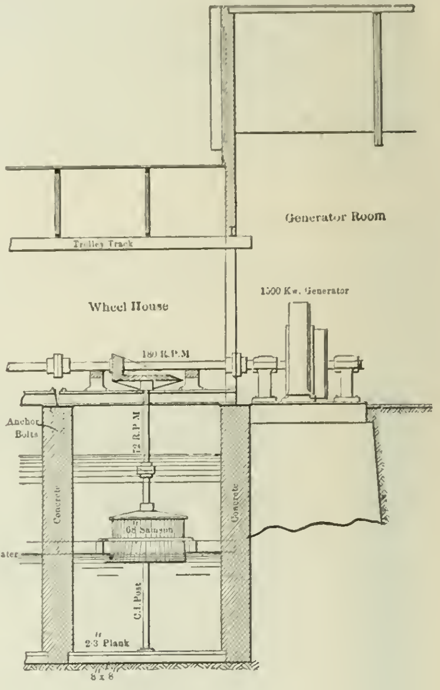
and ammeter, a single-pole discharge resistance field switch, rheostat handle, a potential plug switch, two single-pole, double-throw, quick-break knife switches for throwing the generators on either of the two buses. On the lower left-hand panel will be noticed two single-pole, single throw equalizer switches.

The panel devoted to the direct-current side of the rotary converter contains a 500-volt circuit-breaker, an ammeter, rheostat handle, a four-point potential plug switch, a discharge resistance field switch, and two single-pole, double-throw, quick-break switches. A single-pole, double-throw switch is provided for energizing the shunt field of the rotary from either bus in case the rotary is run as a 3-phase alternator. The alternating-current panel contains an ammeter, power factor indicator, a synchronizing voltmeter and lamp, and three single-pole, single-throw quick break switches. The starting panel of the rotary is located at the machine, and contains a 500-amp., double-pole, double-throw switch. The machine is started on 144 volts, the transformer taps being brought out in such a manner as will be seen from the diagram of the board, as to form an open delta, whereas when running, the delta is closed and the voltage is increased to 360.

One panel is provided for operating the 3-phase motors. This contains three ammeters, one in each leg of the circuit, two indicating wattmeters, a synchronizing voltmeter and lamps, a potential plug switch, an ammeter for the exciter circuit, a double-pole, single-throw, discharge resistance field switch, and two automatic oil switches. Two sets of bus-bars extend back of this, the transformer and the circuit panels, so that any desired arrangement can be secured.



Cross Section of Wheel House



Longitudinal Section

FIG. 5.—LONGITUDINAL AND CROSS SECTIONS OF BUCHANAN POWER HOUSE.

The 2,300-volt low-tension currents only are brought to the switchboard from the transformers, and the panel devoted to these contains three ammeters, a voltmeter and a potential plug switch. Two automatic oil switches are provided for the necessary switching.

Three single-phase circuit panels are each provided with two ammeters, one potential regulator and two 2,300-volt triple-pole single-throw oil switches, interlocked on the back of the panel and provided with overload relay. An induction meter on the back of each panel measures the output of the circuits. The three-phase motor panel contains an ammeter and two oil switches, also a 3-phase integrating wattmeter on the back of the panel. Two 3-phase static ground detectors connected to the two sets of buses are mounted on a swinging bracket at the end of the board. Thomson horizontal edgewise instruments are used exclusively.

The transmission line, except where it crosses the St. Joseph River, presents no unusual features, a standard construction having been adopted. No. 0 soft-drawn bare copper is used, the size obviating a large loss in transmission. In the city of South Bend 60-ft. Idaho poles are used. Further out, where the line passes Notre Dame University, this has been decreased to 55, and the rest of the way to Buchanan the poles are 40 ft. in length, but of Michigan cedar. In the city especial precautions have been taken to build a very substantial line, double cross arms being used whenever the line crosses telephone or other leads. A spacing of 100 ft. is used. Very sharp corners are avoided, and whenever a turn is made this is well guyed. The cross arms are 4 in. x 5 in. in size, of Southern pine covered with two coats of paint, the lower being 10 and the upper 7 ft. in length. Provision is made for two circuits, the second one of which will be installed this summer. A spacing of 4 in., 36 in., 40 in., 36 in., 4 in., is used on the lower arm, and 4 in., 76 in., 4 in. on the upper. The pins are of locust boiled in paraffine and of special design. Locke insulators are being used, tested to 80,000 volts at the factory. The wires form an equilateral triangle with the apex at the upper end, each side of the triangle being 36 in. long. Three complete transpositions are made in 18 miles, a partial one being effected every second mile. A private telephone line is also carried on the same poles. As a span of 750 ft. is necessitated by the crossing of the St. Joseph River, special precautions had to be taken, and this is accomplished in the following way: At each shore end four poles are erected in the form of a rectangle, and these are guyed back to the pole line. A ½-in. stranded galvanized iron cable is used as a messenger wire, from which three insulators are suspended in their usual vertical position. To the pin, however, is fastened an eye-bolt, which supports the copper line wire.

The development at Buchanan dates from the fall of 1901, when work was commenced on the new power house. The old water power plant which was used for lighting the city of Buchanan, was purchased in 1900, and the water rights secured for a distance of ten miles to Berrien Springs. The dam is located about a mile from the village on the St. Joseph River. It is estimated that this will furnish a minimum of 2,000 hp for from four to six weeks in a year, while the maximum will reach the 5,000-hp mark. On an average 2,500 hp is available for about three months and 4,000 hp for the remainder of the year. At present one 1,500-kw generator is installed, but work will be commenced this summer to double the size and capacity of the power house.

The dam in use was constructed eight years ago. This is of the gravity type, built of wood with two rows of sheet piling below and one above it. The dam is about 400 ft. long, and a short distance above the new power house, which is 215 ft. long and 40 ft. wide. The latter is built of stone and iron with concrete foundations, and has a slate roof. It parallels the river, so that the water from the turbines is discharged directly. The head race is short, and as it was cut through a bank of gravel of excellent quality it is lined with a concrete wall on the river side only, which extends from the regulating gates to the power house proper. At the former, both banks of the head race are lined with concrete walls, as well as the bottom at that point. The regulating gates are seven in number, and are operated by racks and pinions.

Because of the low head of water, which averages about 10 ft., comparatively small units in water wheels have been installed. There are ten 68-in. Leffel water wheels of 300 hp each. These are of the vertical type, and are geared to a line shaft which extends nearly the entire length of the building, and to the end of which the generator is coupled. A small vertical 40-in. Leffel wheel is used for driving the exciter, which is belted to an intermediate shaft, driven by gears. The line shaft is divided into three units such that either four, seven or ten wheels can be used for operating the generator, depending upon the load carried. In addition, the gears on the line shaft can be thrown out of mesh, so that any water wheel can be repaired if necessary. Two Lombard water wheel governors are installed for regulating purposes, being driven from the line shaft. The special work required for the line shaft and turbines can be clearly seen in the view. A 20-ton hand-operated Whiting Foundry Company's crane, which serves all the apparatus in the building, can also be seen.

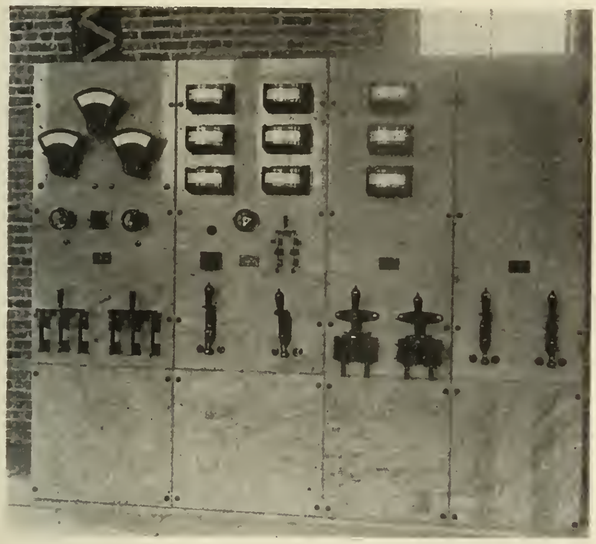


FIG. 6.—EXCITER SWITCHBOARD, BUCHANAN POWER HOUSE.

A 1,500-kw, 60-cycle General Electric revolving field type alternator is installed and supplied 3-phase current at a pressure of 2,300 volts, which is conducted to the generator panel of the switchboard by means of lead-covered, rubber-insulated cables. The exciter is a 60-kw, 125-volt direct-current generator. The switchboard, as well as the step-up transformers, are located in one end of the building near the generator which, when the other half is added, will be the middle portion of the completed structure. The switchboard at Buchanan was installed some time before that at South Bend, and as planned at that time, contemplated the installation of switches both on the high and low-tension side of the step-up transformers. It was the intention to instal two sets of switches, so that as finally constructed either generator could be connected with either set of transformers, and the same could be done with the transmission lines. However, this idea has been only partially carried out, the high-tension switches not being used at present, though installed. As a consequence, the switching operations are all performed on the low-tension side of the transformers. It will be noted that the step-up transformers are not provided with any special leads, inasmuch as no rotary-converter or similar apparatus requiring an alternating current of lower potential than that of the generator, is installed in the power house. The transformers are of the same size and type as those installed at South Bend, but the voltage is as follows: Primary, 25,300 △, or 43,800 Y, and 2,300 volts secondary. A 5 x 7 single-acting Gould pump driven by belt from the main line shaft, supplies the water for the transformers from the river. The high-tension lines are taken to the transformers and protected in the same way as at the other end of the line.

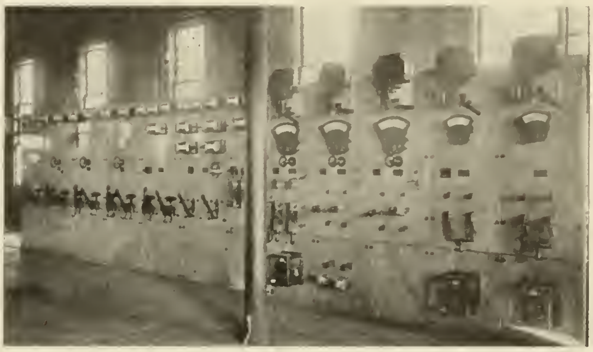


FIG. 7.—SWITCHBOARD SOUTH BEND SUB-STATION.

The switchboard consists of one exciter panel, one generator panel, two low-tension transformer panels, one of which is not in use, and one high-tension line panel, which also is not used. This board contains the same instruments, switches, etc., as the corresponding panels at South Bend, and as a consequence it is not necessary to enumerate them.

From an operating point of view, the system is seen to be very flexible, and lends itself readily to any and all conditions which may arise in the operation of the system at any point. At the time of the writer's visit, trouble had occurred on the transmission line, and for that reason it had been necessary to start up the steam plant. As this is always kept in such shape as to be put in operation at a moment's notice, no serious interruption to the service was experienced. Neither was there any delay in starting up the station, enough men from the other departments being used to complete the force, a chief engineer and two assistant engineers being permanently employd. As this article has been confined to a description of the engineering features and operating conditions of the system, it is not the intention here to discuss the economic value of the same.

In conclusion it may be said that Messrs. O'Keefe and Orbison, of Appleton, Wis., were the consulting hydraulic engineers, and Mr. George M. Brill, of Chicago, the consulting electrical engineer, no little credit being due to these for carrying out the work. Mr. Charles A. Chapin is the principal owner of the South Bend Electric Company, of which Mr. F. A. Bryan is the general manager and secretary.

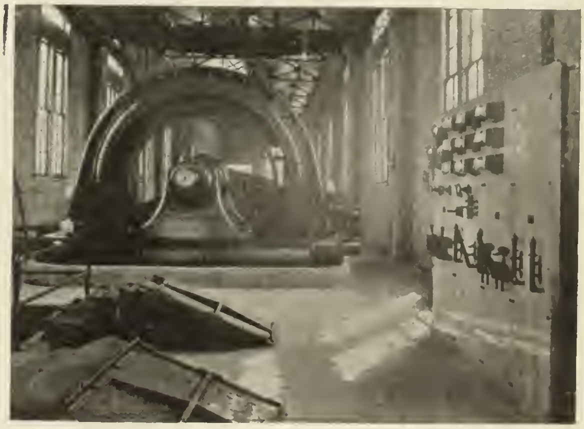


FIG. 8.—2,500-KW GENERATOR AND EXCITER SWITCHBOARD.

The Technolexicon of the Society of German Engineers.

At the beginning of 1901 the Society of German Engineers (Verein Deutscher Ingenieure) began the compilation of a universal technical dictionary in the three languages—English, German and French. Societies and individuals have responded generously to an invitation to collaborate, and up to May, 1903, there are 341 societies (42 in English, 272 in German, and 27 in French-speaking countries) co-operating in the work, either by the systematical collection of technical expressions of the specialties represented by them or in other ways, especially by the enlistment of collaborators and by placing technical publications in more than one language at the disposal of the "Verein," such as catalogues, price lists of machines, handbooks, etc. Through these societies the Technolexicon has found helpers in Great Britain, Germany, France, the United States, Austria, South Africa, India, Australia, Belgium, Canada, etc.

Among the English societies are the Institution of Mechanical Engineers, London; the Institution of Electrical Engineers, London; the Junior Institution of Engineers, London; the Society of Chemical Industry, London; the Institution of Mining Engineers, Newcastle on Tyne; the Iron and Steel Institute, London; the Society of Architects, London; the British Optical Association, London; the Optical Society, London; the Cycle Engineers' Institute, Birmingham; the South African Association for the Advancement of Science, Cape Town and Johannesburg, etc. Of American societies may be mentioned the American Society of Civil Engineers, New York; the American Society of Mechanical Engineers, New York; American Railway Engineering and Maintenance of Way Association, Chicago; the American Chemical Society, Brooklyn; the Western Society of Engineers, Chicago, etc. In Germany there is first of all the large majority of the local sections of the Society of German Engineers; then there are the Verein Deutscher Eisenbahnverwaltungen, the Verein Deutscher Chemiker, the Zentralverband der Preussischen Dampfkesselüberwachungsvereine, the Verband Deutscher Patentanwalte, the Deutsche Schiffbautechnische Gesellschaft, and many others. In France we mention: Société des Ingénieurs Civils de France, Paris; Association Amicale des Anciens Élèves de l'École Centrale, Paris; Société Internationale des Électriciens, Paris; Societé d'Encouragement pour l'Industrie Nationale, Paris; Société Française de Photographie, Paris; Syndicat Général de l'Industrie des Cuirs et Peaux de la France, Paris, etc., etc.

Assistance has so far been promised—and partly already rendered—by 2,185 industrial establishments and individual collaborators. Among the industrial establishments may be mentioned the Westinghouse Brake Company, London and New York; J. J. Griffin & Sons, London; the W. T. Henley's Telegraph Works Co., London; Fraser & Chalmers, Erith (Kent); Twyfords, Limited, Hanley (Staffs); Sherwin & Cotton, Hanley (Staffs); Walter E. Mason, Horwich (Lancashire); the Trenton Iron Company, Trenton, N. J.; the B. F. Sturtevant Company, Boston and Berlin; the Thomas D. West Company, Sharpsville, Pa.; Manning, Maxwell & Moore, New York; the Fairbanks Company, New York and London. Fried. Krupp in Essen, and the Fried Krupp-Grusonwerk in Buckau-Magdeburg; the Kaiserliche Torpedowerkstatt in Friedrichsort-Kiel; Siemens & Halske, Aktien-Gesellschaft, Berlin and Charlottenburg; Vereinigte Königs and Laurahütte, Königshütte (Silesia); Arthur Koppel, Berlin, New York, Cape Town, etc.; Gebr. Körting, Körtingsdorf, near Hanover, London and Paris; Blohm & Voss, Hamburg; Elsässische Maschinenbaugesellschaft, Mülhausen and Grafenstaden; Whitehead & Co., Fiume. J. & A. Niclausse, Paris; Panhard & Levassor, Paris; Delaunay-Belleville, St. Denis; Schneider & Co., Le Creusot; Administration des Chemins de fer Paris-Lyon-Méditerranée, Paris; Fabrique nationale d'armes de guerre, Herstal-Liège; Société anonyme John Cockerill, Seraing, near Liège; Administration des Mines, Morlanwelz, near Mons, etc., etc.

Excerpts from dictionaries like Sachs-Villatte, Muret-Sanders, Tolhausen, etc., and of thousands of catalogues and price lists, of handbooks, store lists, custom tariffs, etc., have yielded 1,200,000 filled-out word blanks up till May, 1903. To them will be added within the next two years the hundred thousands of words the contribution of the collaborators will supply. For convenience the Society of German Engineers has provided handy note books (each with 3 indices A—Z) for the collaborators. These books will be called in by the editor-in-chief in the course of 1904. So far already 207 filled out note books have been forwarded voluntarily to the office at the address given below.

As the contributions will not be called in before 1904, all who wish to help in the compilation of the Technolexicon have still time and opportunity to assist in the preparation of their specialties. Contributions from all technical branches (including the handicrafts) are welcomed, and it is obvious that small contributions from a host of various collaborators will be more useful than large ones compiled by a few men, who naturally cannot cover so many specialties. Attention is directed to the fact that contributions in only one language are also most acceptable, though of course those in two or three languages are the most valuable, as also polyglot business catalogues and other technical publications. Contributions, if received before the end of 1906, when the matter will go to press, can still be made use of The editor in chief will give any further information requested, and may be addressed as follows: Technolexicon, Dr Hubert Jansen, Berlin (N. W. 7), Dorotheenstr. 49

Rankine as a Poet.

That the controversy over the metric system is not new, and that the line of argument put forth by its opponents undergoes little change with generations, are points illustrated in the following verses, written by W. J. Macquorn Rankine, in 1864, which also recall the singular fact that almost all great mathematicians have shown a decided propensity for poetry:

THE THREE-FOOT RULE—A SONG ABOUT STANDARDS OF MEASURE.

I.

When I was bound apprentice, and learned to use my hands,
Folk never talked of measures that came from foreign lands;
Now I'm a British Workman, too old to go to school;
So whether the chisel or file I hold, I'll stick to my three-foot rule.

II.

Some talk of millimetres, and some of kilogrammes,
And some of decilitres, to measure beer and drams;
But I'm a British Workman, too old to go to school;
So by pounds I'll eat, and by quarts I'll drink, and I'll work by my
three-foot rule.

III.

A party of astronomers went measuring of the earth,
And forty million metres they took to be its girth;
Five hundred million inches, though go through from pole to pole;
So let's stick to inches, feet and yards, and the good old three-
foot rule.

IV.

The great Egyptian pyramid's a thousand yards about;
And when the masons finished it, they raised a joyful shout;
The chap that planned the building, I'm bound he was no fool;
And now 'tis proved beyond a doubt, he used a three-foot rule.

V.

Here's a health to every learned man that goes by common sense,
And would not plague the workman on any vain pretence;
But as for those philanthropists who'd send us back to school,
Oh, BLESS their eyes, if ever they tries to put down the three-
foot rule!

Awards to Scientists.

The Executive Committee of the Carnegie Institute, Washington, reports that the entire sum of $200,000 allotted to grants for original research has been distributed, and that of the $40,000 set aside for publications to be made this year, $20,000 has been assigned to special publications, leaving $20,000 still at the disposal of the Executive Committee. No more grants for researches will be made until after the next meeting of the Board of Trustees, which will be held in December. At the meeting of the Executive Committee last week the question of giving more publicity to the grants of the institution was not taken up. The policy hitherto has been to permit the receivers of grants to make them public, but for the officials of the institutions to refrain from giving out names of the fortunate scientists who receive these grants. It is probable that this policy will be continued.

Telephone Meeting of the Chicago Branch, A. I. E. E.

A most successful and well-attended meeting marked the close of the spring programme of the Chicago branch of the A. I. E. E. on May 19. The evening was devoted to the reading of several papers on telephone work by representatives of both the Bell and independent interests. The programme was prepared under the able direction of Mr. Kempster B. Miller, engineer of the Kellog Switchboard & Supply Company, and Mr. Angus S. Hibbard, general manager Chicago Telephone Company.

S. G. McMeen, engineer Western Electric Company, read a paper "Concerning the Telephone Engineer," in which he discussed the status of the professional standing of the telephone engineer. In conclusion he offered the following definition of a telephone engineer: "A telephone engineer is one who practices the design and construction of telephone apparatus, telephone circuits and telephone operating methods, and the correlation of all three into systems of telephone communication. If this definition be granted, then a place for him may be claimed among the engineers of more classical reputation, giving him credit for his accomplishment and our best wishes for his future."

Mr. J. G. Wray, Chicago Telephone Company, discussed "Some Features of Telephone Traffic and Their Effect upon Service." This paper brought out very interesting data concerning the operation of different telephone systems, and forcibly illustrated the fact that the central station man alone is not confronted with the problem of caring for an ever fluctuating load.

In a typical telephone exchange, he said, the load curve indicating the volume of traffic shows during the midnight hours a value of from 1/10 of 1 per cent. to perhaps 5 per cent. of the maximum hourly load. This period of light load will vary from seven to fourteen hours, depending upon the location of the exchange and the habits of the telephone users. In the offices of the business district of a city like Chicago, very few calls are made between 7 P. M. and 7 A. M. Between the hours of 7 P. M. and 7 A. M. the calls per hour will vary from 1/10 of 1 per cent. to perhaps 1 per cent. of the maximum. Between the hours of 7 and 8 in the morning, traffic will rise to perhaps 5 per cent. of the maximum. The rise will be extremely rapid until the maximum load of the exchange is reached between 10 and 11 in the morning. About the noon hour, there is a cessation of business and the telephone traffic curve shows a drop of perhaps 40 per cent. below the maximum. After the lunch hour, when business has been resumed, the traffic curve rises to an afternoon maximum between 2 and 3 o'clock. This maximum will be less than the maximum in the morning and will in a typical office approximate 80 per cent. of the maximum traffic of the day. From 3 o'clock until 5 or 5.30 P. M., there will be a rapid decrease in the traffic load, with an almost complete cessation of business at 6 o'clock.

In a residence district, the slump of traffic at noon time is not very well marked. There is, however, a decrease in the number of calls made late in the afternoon and a corresponding increase in the number of calls for the telephones of a residence district, the latter arising from the fact that the head of the house wishes to explain why he cannot come home to dinner or to announce that he wishes to bring a friend. The evening traffic is also a feature of the residence district. Social calls are made, appointments for the theatre, invitations, etc., etc. Evening traffic of a residence district often continues heavy until 9 or 10 o'clock; indeed, in one of the Chicago offices the evening traffic runs from 30 to 60 per cent. of the maximum, and heavy traffic is maintained until nearly midnight. The curve of traffic indicates in a measure the habits of the people in the district.

In the main office district here in Chicago the business day may be said to have begun at 8.30 in the morning. There is a partial cessation of business for lunch in between 12.30 and 1.30 o'clock, and the business day closes at about 5.30 P. M.

For central office also in the down-town district the business day is from 8.30 in the morning until 5.30 in the afternoon, with scarcely any let-up for lunch. Lawyers predominate in the central district.

In the Harrison office the day is the same as for central and main, but there is a marked reduction in the traffic between 12.30 and 1 o'clock.

The South office business day is practically from 8 o'clock in the morning until 9 o'clock in the evening, and even later, with no indications of a luncheon hour. North office telephone users are satisfied with a shorter day than the people of the South office district, the limits being from 8 o'clock in the morning until 8 o'clock in the evening. For West office the limits are from 8.30 in the morning until 9 in the evening.

For the Monroe office the traffic shows heavy business from 7.30 in the morning to 6 o'clock in the evening, with a distinctly marked lunch hour between 12 and 1. This is a manufacturing district.

In the Wentworth district, out in Englewood, the business of the day is done between 8 A. M. and 6 P. M., with some indications that the people have lunch between 11.30 and 1 o'clock.

A similar comparison of traffic load curves of other cities will be of interest. In Philadelphia, for example, we find the heavy traffic between 9 A. M. and 5 P. M., with lunch between 1 and 1.30.

In Boston the traffic shows a work day from 9 A. M. to 5 P. M., with time for luncheon in different offices varying from one and a half to two hours between 12 and 2 o'clock.

New York telephone users seem to take life even more serenely than those of Philadelphia or Boston, and we find the work day beginning as late as 9.30 in the morning and ending at about 4.30 in the afternoon, with two hours for lunch between 12 and 2 o'clock.

Telephone traffic varies with the seasons as well as with the time of day. The Canal office district of the Chicago Exchange shows a fluctuation of 50 per cent. between summer and winter traffic. This is caused by the vast lumber interests of the district, which practically close down during the winter months. There is a heavy rush of traffic in April and May, followed by a 40 per cent. reduction in traffic during July and August. In the fall business increases to a maximum in September. This is followed by a 50 per cent. reduction in traffic, culminating in January. A change in the character of the traffic from Canal district, however, has been noticed within recent years, and the wide variation of traffic with the seasons is less marked.

The traffic of all offices slumps decidedly during the summer months. There is a reduction of perhaps 30 per cent. during July and August, the vacation period.

The volume of traffic of a telephone exchange is also an infallible index of general business conditions. This is shown by the fact that during 1894, 1895 and 1896 there was very slight increase in traffic. With the return of prosperity, however, the traffic has increased by leaps and bounds, until now it will approximate four times as heavy as during 1895 and 1896. In passing it will be of interest to note that for 10 hours per day the traffic of Chicago Exchange ranges above the average hourly traffic figured on a 24-hour basis. For the other 14 hours per day the traffic is much lower than the average hourly traffic.

The average traffic for the maximum hour is about 2½ times the average traffic of the day, and perhaps 200 or 300 times the traffic of the hour of minimum traffic. The percentage and ratios of traffic given herein take no account of rushes of traffic for short intervals due possibly to the news of a prize fight, a fire, a panic or a football game. These and the tremendous rushes of traffic always preceding or following every important holiday, make a severe test of the resources of the operating plant.

The traffic of Saturday forenoon is always the heaviest of the week, and is taken as a basis for the adjustment of operators' loads and the loads on trunk lines. The adjustment of the operator's load must be made with a view to handling the traffic well during the busiest hour of the day. Experience has shown that approximately ⅛ of the business of the entire 24 hours must be handled during the busiest hour.

"A System of Selective Signaling for Telephone Lines" was described by Mr. W. W. Dean, engineer of the Kellogg Switchboard & Supply Company. This is a new four-party line system, the theory of which was discussed by Prof. Carl Kinsley, of the University of Chicago, while some of the actual operating features were considered by Mr. K. B. Miller.

In a short discussion which followed Mr. J. G. Wray called attention to the advantage of having a system with grounded wires, as it affords protection against lightning discharges and other currents which might accidentally be discharged into the system.

For the purpose of arousing interest among the members, so that a large delegation representing the Chicago membership, more especially so as the newly-elected president of the Institute, Mr. Bion J. Arnold, is a Chicago man, the chair was empowered to appoint a committee of three members, this committee also to provide transportation facilities for those attending the Institute meeting at Niagara Falls in July.

Western Union and Pennsylvania Railroad.

The differences between the Western Union Telegraph Company and the Pennsylvania Railroad over the removal of the former's lines from the railroad company's right of way last week assumed a violent form.

In last week's issue reference was made to the decision of the Pittsburg United States Circuit Court of Appeals to the effect that the Pennsylvania Railroad Company had a legal right to remove the wires and poles of the telegraph company located along its right of way. Counsel for the Western Union Company asked for a delay, as steps were being taken for an immediate appeal to the United States Supreme Court in the New Jersey case, but Judge Buffington, of the Pittsburg Court, said every opportunity had been given to prepare for the decree and further delay was unreasonable. Immediately after the court's decision the railroad company (on Thursday) began the work of chopping down the poles, and wrought havoc to the telegraph company's lines along the main line of the railroad between Philadelphia and Pittsburg and on the road between Camden and Atlantic City in New Jersey. More than one thousand men took part in the work of destruction and in a short time the wires and poles covered the ground for a distance of many miles. Lines were also chopped down along the Cumberland Valley road from Chambersburg to Harrisburg, and all the poles and wires attached were thrown into the fields. Along the main line Lewiston was isolated from the rest of the world as far as the Western Union Telegraph service was concerned.

It is stated that the Western Union had prepared for such a move on the part of the railroad company by completing its independent system and that there was no serious interruption to its business. According to the newspaper accounts, 1,500 miles of telegraph line and 15,000 miles of wire were chopped down, the total value of the property being placed at $750,000.

Announcement was made by ex-Judge Dillon, counsel for the Western Union interests, that the matter would be carried to the United States Supreme Court. Mr. Esterbrook, general solicitor of the Western Union Telegraph Company, said that he did not think that the United States Supreme Court would tolerate the action of the Pennsylvania Railroad or uphold the lower courts. President Clowry, of the Western Union, states that the reports of the damage done are greatly exaggerated, and that the company's service was not crippled; that it is going on as usual, and is being handled without delay.

A dispatch from Pittsburg stated that the cutting of the wires by the railroad company compelled the Baltimore & Ohio Railroad Company to run its trains temporarily by telephone. This was due to the fact that some of the Baltimore & Ohio wires were on the same poles with the Western Union wires in the neighborhood of Pittsburg. The telegraph company arranged to reach points where its wires did not go by telegraphing to the nearest station, and telephoning the rest of the way. An agreement to this end, it is stated, was made with the American Telephone & Telegraph Company.

At the last writing President Clowry, of the Western Union Company, makes the announcement that the company is able to transmit messages to all points reached before the Pennsylvania Railroad Company began to cut the wires and poles along its lines. There has been no serious interruption of the service at any time, he said, as the Western Union had been for months stringing wires over independent lines. Special care had been taken to protect the leased wire system against any interference. He stated that the cutting of wires had been wholly confined to the State of Pennsylvania, and that the lines within the State of New Jersey were protected by an order obtained from Judge Kirkpatrick at Newark. "At present," he said, "we are sending messages to every point hitherto touched by us, and the receivers at all of our offices have instructions to refuse no messages."

It will be noted above that President Clowry denies that any of the company's property in New Jersey was interfered with, notwithstanding the dispatches referred to in the early part of this account to the effect that the lines on the Atlantic City road had been chopped down.

The following statement is made by Mr. Charles M. Schaeffer, superintendent of telegraph of the Pennsylvania Railroad:

"The Western Union Telegraph Company, under its contract with the Pennsylvania Railroad Company, bound itself upon six months' notice after the termination of the contract to remove its poles and wires from the property of the railroad company, and upon their failure to do so the contract provided that the Pennsylvania Railroad Company had the right to remove the poles and wires at the expense of the telegraph company.

"Further, that the Pennsylvania Railroad Company, in order to save the telegraph company the expense and loss incident to the removal of the poles and wires, had offered to purchase the lines at a fair valuation, but that the Western Union Telegraph Company had evidently preferred to allow the Pennsylvania Railroad Company to tear down and remove them at its expense.

"The Pennsylvania Railroad Company having entered into a contract with the Postal Telegraph Company to provide it with facilities on its lines, was compelled to proceed to remove the poles and wires of the Western Union Telegraph Company, in order to put themselves in a position to carry out their agreement with the Postal Telegraph Company, as the right of way occupied by the Western Union Telegraph Company was necessary for that purpose."

Programme of A. I. E. E. Niagara Meeting.

Following is the programme, so far as has been determined to date, of the Niagara meeting of the American Institute of Electrical Engineers. The papers named will be read and discussed at morning sessions:

MONDAY, JUNE 29, INSTITUTE AND PRESIDENT'S DAY.

1. President's Address.
2. Institute Branch Meetings, their Organization, Development and Influence, by Calvin W. Rice.
3. The Energy Transformations in the Synchronous Converter, by W. S. Franklin.
4. Commercial Alternator Design, by W. L. Waters.

Afternoon.—Visits to local points of interest. No pre-arranged programme.

Evening.—An exhibition of the Hewitt converter and the mercury vapor lamp, by P. H. Thomas.

TUESDAY, JUNE 30, ELECTRICAL DAY (RAILWAY PAPERS).

1. High-Speed Electric Railway Problems, by A. H. Armstrong.
2. Storage Battery Industrial Locomotives, by Frank L. Sessions.
3. Predetermination in Railway Work, F. W. Carter.
4. Car Run Tests, by W. E. Goldsborough and P. E. Fansler.
5. Some Recommendations Concerning Electrical and Mechanical Specifications for Trolley Line Insulators, by Samuel Sheldon and J. D. Keiley.
6. The Storage Battery in Sub-Stations, by W. E. Goldsborough and P. E. Fansler.

Afternoon.—Technical tour of inspection of electrochemical and other electrical installations operated by Niagara Falls power, and the power houses of the Niagara Falls Power Company. Reception by Niagara Falls Power Company on terrace of power house No. 2.

Evening.—Dance under the auspices of local committee, at Cataract House.

WEDNESDAY, JULY 1, NIAGARA DAY (POWER TRANSMISSION PAPERS).

1. On the Testing of Electrical Apparatus for Dielectric Strength, by P. H. Thomas.
2. Choice Frequency for Very Long Lines, by P. M. Lincoln.
3. Method of Entering Buildings with High-Tension Wires, by C. E. Skinner.
4. Y or ∠ Connection of Transformers, by F. O. Blackwell.

Afternoon.—Trolley trips to Niagara Gorge, Fort Niagara, Brock's Monument, Chippewa. Technical visits to following plants: Niagara Falls, Hydraulic Power & Manufacturing Company, Canadian Niagara Power Company, Natural Food Company.

Evening.—Entertainment, Cataract House, under auspices Local Committee and General Committee.

THURSDAY, JULY 2, EXCURSION DAY (MISCELLANEOUS PAPERS).

1. The Factors which Affect the Energy Losses in Armature Cores, by J. Walter Esterline and Clarence E. Reid.
2. Central Station Economies, by W. E. Goldsborough and P. E. Fansler.
3. The Electrical Equipment of a Gold Dredge, by Ralph L. Montagu.
4. The International Electrical Congress of 1904, by Elihu Thomson.

5. The Legalized Standard of Electromotive Force, by H. S. Carhart.
6. Symbols and Nomenclature, by Carl Hering.
7. A Universal Telegraphic Code, by G. O. Squier.
8. The Magnetic Units, by A. E. Kennelly.

Afternoon.—Technical excursions to Olcott Beach, St. Catharine's, Lockport, Tonawanda Sub-Station.

Evening.—Illumination of Gorge Route.

FRIDAY, JULY 3, BUFFALO DAY.

Joint meeting with the Society for the Promotion of Engineering Education.

Papers will be presented by the following members of the Institute: W. S. Franklin, J. G. White, E. H. Mullin, B. Gherardi, Jr., L. A. Osborne and T. J. Johnston.

Afternoon.—Technical trips to Buffalo, Buffalo General Electric Company, Buffalo Terminal House.

Commercialism in Universities.

A conference was held in Chicago, on May 8 and 9 to discuss the relation of the college to the professional school. It was called by President James, of Northwestern University, and about 100 representative educators, including over forty presidents, of colleges and universities, assembled to consider what changes should be made in college courses to enable these time-honored institutions to hold their useful place in our educational system, and not be set aside in favor of institutions offering the shorter combined courses leading to practice of the professions and mechanical arts. So the discussion was guided by the propositions in the following questions:

"Has the college a field peculiar to itself, not covered by the technical school or by the demands of preparation for the professional school?"

"Is it desirable that the college course should be reduced in time from four to three or even two years and correspondingly in amount of work?"

"What subjects in the typical college course can be accepted by the professional school as qualifying in part for the professional degree so as to shorten the time required for graduation in the professional school?"

"If reduction is allowed should it be by (*a*) acceptance of credits in the college of liberal arts for work done in the professional school, or (*b*) by acceptance in professional school for work done in the college of liberal arts, or (*c*) by combining these plans?"

"The relation of the technical school to the college."

Four technical schools as such were represented at this conference —Rose Polytechnic Institute, Terre Haute, by President C. Mees; Armour Institute of Technology, Chicago, by President Frank W. Gunsaulus; Lewis Institute, Chicago, by Director George N. Carman, and the Massachusetts Institute of Technology, by Dr. Harry W. Tyler. Naturally the discussion of the conference was not a little in the line of explanation and defense of the traditional four years' college course, being a course designed to humanize and broaden the youth, preparing him to reason when he should take up the specialized work of the professional schools, and to be fit for public service should he end all institutional instruction when his college gives him its bachelor's degree. But whatever the theory of the bachelor's degree, and the honorable work for civilization done by two centuries of American college graduates, short cuts to a professional degree are increasing in number, and hence the anxiety of the small colleges and professional schools to forecast the future and by alliance and adjustment secure their own perpetuation with profit and honor.

The conference adopted no platform, but it arranged for a meeting next year, and, what is more, for a national college association. It directed President James, of Northwestern University; President Merrill, of Colgate University, and President, King, of Oberlin College, to appoint a commission of fifteen who should call a similar conference in May, 1904. provide a programme, and report a plan of membership and organization. In the above-quoted list of topics discussed at this conference may be seen a manner of approach to the problem of concession and reciprocity in courses by which both colleges and universities may find it possible to get together—to reach affiliation as Prof. Monroe Smith, of Columbia. in an able discussion on the interchange of credit, said he hoped would result instead of subordination.

Two notable addresses at this conference were by President Frank W. Gunsaulus, of Armour Institute, perhaps Chicago's most eloquent clergyman, and by Dr. Harry W. Tyler, of the Massachusetts Institute of Technology. The former was an appeal to resist the commercialism of the age so far as to refuse to turn out from our technical schools machines in place of men. The latter was a broad study of the relation of the school of technology to general education. With tribute to what Director Carman, of the Lewis Institute, and what the Massachusetts Institute of Technology were trying to do in way of making men as well as engineers, Dr. Gunsaulus in part said:

"If you would know the brutal wave of commercialism beating in fullest power stand in an institute of technology. When for years you have withstood that assault, your high ideals questioned, you are ready to say to that brutal wave, 'Thus far shalt thou go and no farther.' I thank Dr. Tyler and the Massachusetts Institute of Technology for the determinative force in the mind of Mr. Armour, that great man of pork, beef, sides and wheat, whereby he came to the conclusion that the American youth must take time enough to prepare for a career of manhood. The question of questions is whether we shall supply these vast industrial instrumentalities with youth to be consumed, or whether we shall keep and train and make our boys powerful for civilization. Schools of ample endowment have enormous responsibility. The work of Lewis Institute is one of conservatism for the Mississippi Valley. Only the strong schools can be conservative. For ten years Armour Institute has been getting ready. The voices of fathers cry, 'Here is my boy; graduate him quick.' The voice of the callow, soft and vealy youth, with absolutely no self-control, says, 'Graduate me quick.' Hustling has come to be a positive disease. God save us from strenuosity in education. Twenty-five years hence, when we get our poise, we are going to ask some awful questions with regard to the positive ferocity with which we are seeking for students in some of our schools, and with regard to the criminal velocity with which we are pushing them out into life. Schools of technology must give the culture of soul and brain; the whole man is our man. We can't afford to cut off the top in instruction; rather let us broaden the bottom. Let all point toward manhood; intellectual method is better than information."

Dr. Tyler, in his elaborate paper, made the point that "The school of technology has the right and duty to make its requirements of general education such that the aggregate value and efficiency of its graduates shall be a maximum, diminished neither on the one hand by too narrow training of a great number of men, nor, on the other, by the undue restriction of numbers in consequence of a standard too broad or too high. The professional school may accept responsibility for general as well as for professional education, and, requiring literary as well as scientific subjects for admission, may undertake more or less successfully to combine certain fundamental elements of general education; for example, English, history and economics, with its own professional instruction. The main difficulty of this plan is that of time. Or, the professional school planning its courses for graduates of secondary schools, may at the same time make provision for college graduates to enter with advanced standing, in such a manner that their total period of education may not be unduly prolonged.

Electrical Annunciator Drop Litigation.

Judge Wing, sitting in the United States Circuit Court of the Northern District of Ohio, handed down a decision on May 26 in a case involving the Warner annunciator drop, the patent on which he declared invalid through lack of novelty in view of the prior art. The patent (477,616) was granted June 21, 1892, on an application filed June 17, 1889. Following is one of the claims:

"The combination with a coil or helix, of a soft iron shield surrounding the same, the armature at the rear of the core of the helix, and the armature lever extending forward through a slot or opening in the plate, and a drop with which the lever is adapted to be engaged when the drop is lifted, and to be disengaged therefrom when the armature is attracted."

The parties to the litigation were the Western Electric Company, complainant, and the North Electric Company, Cleveland, defendant.

Recent Electrochemical Developments.

By Clinton Paul Townsend

PRODUCTION OF SODIUM CHROMATE.

Heinrich Specketer, of Griesheim-on-the-Main, Germany, assignor to Chemische Fabrik Griesheim Electron, produces sodium chromate and caustic soda as principally products by electrolyzing sodium sulphate in a cell provided with a diaphragm, employing an anode of ferrochromium. The reaction is controlled by the addition to the anode compartment of caustic lime in quantity sufficient to combine with the chromic acid formed at the anode and to precipitate the dissolved iron as hydroxide. Calcium chromate exists in the anode solution only as an intermediate product, reacting at once with the sodium sulphate of the electrolyte to yield sodium chromate and calcium sulphate. At the beginning of the operation the anode compartment contains a 25 per cent. solution of sodium sulphate and the proportion of calcium hydrate above indicated; in the cathode compartment is a saturated solution of sodium sulphate. A current of 1½-2 amp. per square decimeter at 2½-3 volts is continued until the concentration of chromic acid in the anode compartment reaches 100 grammes per litre, when the operation is interrupted, the precipitated calcium sulphate and ferric hydroxide separated by filtration from the anode liquor, and the latter concentrated to crystallize the sodium chromate. The cathode lye, in which a proportionate quantity of caustic soda has accumulated, is likewise concentrated to separate the residual sodium sulphate which may then be returned to the cell.

CARBORUNDUM AND ALUMINA.

The combination of two or more processes in electrometallurgy in such manner as to yield their distinct products or a modified product, has long been a favorite project, and reference was made to a series of such proposals in the issue of this journal of December 27, 1902. The most recent effort in this line is found in a patent issued to Dr. F. C. Weber, of Chicago, the aim in this case being to produce carborundum from aluminum silicate and carbon, with the simultaneous production of alumina of such purity as will warrant its use for the separation of the metal. The proposed method is extremely simple in outline, consisting in calcining a suitable hydrous aluminum silicate, such as kaolin or fire clay, and thereafter mixing the same with its due proportion of carbon and subjecting it to sufficient heat to produce the carbides of silicon and aluminum.

The specification gives no data from which it is possible to conclude whether this step of the process occurs in a clear-cut and definite manner; that is to say, whether the sole solid products of the reaction are carborundum and aluminum carbide, and whether the impurities present are of such kind or in such proportions as to interfere with the technical success of the method and the commercial value of the products. This is, of course, the point upon which the value of the method turns, and it is precisely upon this point that the specification fails to supply the required information.

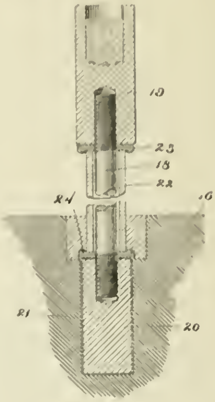
Given a pure mixture of silicon carbide and aluminum carbide and the separation is easy, for the former is unaffected by water, whereas the latter is decomposed, yielding methane and aluminum hydroxide. According to the patented method this hydroxide is washed away from the carborundum, dried and calcined, and utilized in the usual fluoride baths for the separation of aluminum.

ANODE CONNECTOR.

The accompanying figure illustrates a connector applied by Mr. Hugh K. Moore to gas carbon anodes for use in sodium chloride solutions. Mr. Moore has found such electrodes to be porous to a degree which interferes seriously with the sustained efficiency of the cell, the difficulty arising largely from their absorption of the brine, and the consequent corrosion of the metal terminal; furthermore, the salt tends to separate at the surface of junction of the metal and the carbon, increasing the potential fall and heat development at this surface, the latter acting to accelerate the separation of salt until the efficiency of the connection is lost.

The carbon anode, 16, is drilled for the reception of a copper plug, 20, into which the anode rod, 18, is screwed; between the copper and the carbon is a sheath or bushing, 21, of platinum or other metal unaffected by chlorine. The anode rod, 18, is surrounded by a tube, 22, of glass, sealed above and below by rubber packing rings, 23, 24, which may be compressed by screwing down the mercury cup or terminal, 19. The coefficient of expansion of platinum being intermediate between those of copper and carbon, and its position being also intermediate, it is apparent that the rise of temperature of the cell in operation serves to increase the effectiveness of the contact.

A somewhat similar connector was patented abroad in 1896 to Siemens Bros. According to their construction the carbon was drilled, the socket lined with platinum, and an alloy of bismuth, lead and tin, possessing the property of expanding upon cooling, was cast in the whole, this plug of alloy serving to force the platinum into close contact with the carbon and affording a means of connection to the current leads.



ANODE CONNECTOR.

The efficiency of these connectors cannot be questioned. Even graphitized anodes have a certain porosity, and unless means are adopted for preventing access of the brine to the connector the use of platinum as a sheath for the latter would seem to be necessary. It appears, however, that the simpler expedient of immersing the ends of the carbons in boiling paraffine has proven in practice to answer every requirement in preventing access of the electrolyte or its corrosive products to the metal. (Compare *Transactions* American Electrochemical Society, Vol. 1, page 62.)

New Telephone Patents.

In the Patent Office issue of a week or two ago there appeared a selective telephone system patent which was temporarily overlooked. This patent is sufficiently broad in its scope to be of considerable interest to those following the selective signal question, and a few words concerning it may not be amiss at this time. The patent in question is No. 726,476 of the issue of April 28, 1903, which was granted to John S. Stone, of Cambridge, Mass., and assigned to the American Bell Company. This patent covers broadly the use of what the inventor terms "sonorous" circuits as signal current generating devices. The system considered is of that type wherein the selective feature depends upon the frequency of the signalling current, the signal-receiving apparatus at each station being included in a circuit tuned to or resonating with a particular frequency only. The "sonorous" circuits have corresponding characteristics, but contain a source of current. When the current or potential is suddenly altered the sonorous circuit by virtue of the inductance and capacity included in it, sets up a wave of the characteristic frequency. By proper tuning this frequency may, of course, be that to which any one of the resonating circuits responds. Further, if two or more of the sonorous circuits are simultaneously disturbed, the composite wave resulting on the main line will be separated into its components by the resonating circuits, and several stations may therefore be called at once, if so desired.

The patent issue of May 12th is very remarkable from a telephone standpoint, as it contains fifteen patents relating to that art. Of these eleven were considered in our last week's issue. Of the remainder one of the more interesting is that of J. J. O'Connell, covering a telephone cable terminal or pot-head splice. Every one knows the difficulty of efficiently and cheaply terminating a paper-insulated lead-covered cable. A few years has seen the costly cable head largely superseded by the true pot-head splice, this being a splice between the paper-covered wire and rubber-covered wire, the whole enclosed in an enlargement of the cable sheath and impregnated with a water-proof adhesive compound. This, too, is expensive. Of late iron cable boxes to which the cable sheath is soldered and which can be filled with compound have been tried quite successfully. Such boxes have contained terminals to which the distributing wires must be led in.

Mr. O'Connell combines the pot-head and iron box principles, his terminal being shown in Fig. 1. As may be seen, an iron pipe is first passed over the cable core from which the lead covering has been removed, and it is then driven down tightly over the end of the sheath. Then the core rubber-covered wires are spliced just outside the pipe and these latter are bent down along the side of the pipe and distributed about the periphery of it, as evenly as possible. Tape is applied at the base of the pipe and to the wires to bind the whole together. The tape is then continued around the last layer of rubber wires until an outer pipe may just be forced over it. This outer pipe is next filled with adhesive compound binding, thus hermetically sealing the splice. Besides the question of cost, another advantage is derived from this arrangement of parts. This is the impeding effect of the half turn of each wire about the inner iron pipe, which effect assists the lightning arresters materially in keeping discharges out of the cable.

A new telephone switchboard lamp has been patented by A. D. Whipple, his patent being assigned to the Kellogg Company. This lamp is of the tubular form with the terminals cemented to the side of the lamp so as to register properly with the lamp jack. The usual wood block for securing the rearward extension of the terminals, present in most such lamps, is not here used. In this lamp the securing of the terminals is accomplished by providing a cap of lava for these extensions and filling it with a suitable cement. The terminal extensions are bent toward each other and are transversely curved. The cement thus engages them and adheres to the lamp and cap, binders securing the parts together strongly.

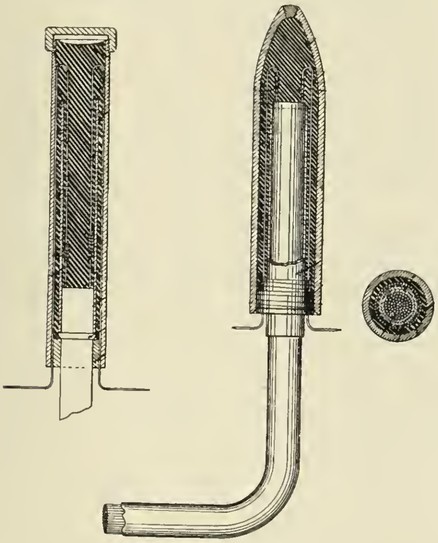


FIG. 1.—O'CONNELL CABLE TERMINAL.

"Electrical Protective Device" is the title of a patent of the May 12 issue, granted to E. B. Ellicott, of Chicago. As this device is in the nature of a circuit-breaker, and may be readily reset, it seems to have considerable merit for subscribers' station use. It is shown in section in Fig. 2, from which figure the operation will be nearly self-evident. The main line is carried through the rod to the coil frame and thence through the coil. The rod is normally latched against the force of the spring. When an excessive current occurs, the adjustably weighted armature being attracted, strikes the point of the rod and, raising it, allows it to fly away from the frame contact. The armature at the same time closes the spring contact above it and grounds the line, if this be desired. Resetting involves merely pushing the rod back home.

The last patent of the May 12 issue is that for a "Telephone Special Directory," which is in total a sheet of metal so apertured that it may be clamped against the transmitter face by the mouthpiece and carrying a ruled cord to serve for a directory of numbers and names frequently called.

Coming now to the issue of May 19, we have for first consideration an interesting form of self-releasing switch for intercommunicating systems. With such systems trouble has always been experienced, due to users leaving the switch set in positions other than the normal, and many devices more or less successful have been designed to obviate this difficulty. The present one is shown in Fig. 3. The line contacts are arranged in a vertical row, and are closed as desired by the wheel on the receiver hook. This latter slides upon the rod freely in an upward direction and freely downwardly as long as the receiver is on the hook. When the receiver is off the hook, the downward motion is arrested by a spring clamp. Thus the return of the receiver returns the switch, while the setting of the switch is accomplished by raising the hook manually until a pointer attached thereto points to the desired number, all numbers being stamped upon the box cover in a vertical row.

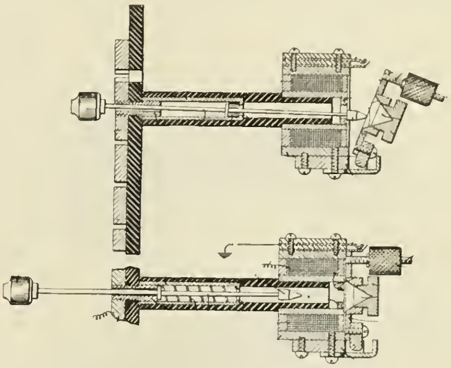


FIG. 2.—ELLICOTT PROTECTIVE DEVICE.

Mr. George E. Wheeler has two of the patents of this issue to his credit, one describing a receiver and the other a transmitter. The receiver is designed with convenience of repair primarily in view. A sectional view of it is shown in the upper part of Fig. 4. This shows the case and magnetic portion constructed entirely independently and held together by the clamping of the cap. The pole pieces, supporting cup, magnet and insulating spacer are all held together by the same screws. The coils have a metallic strip connecting them which serves not only as a support, but also as a connection between the inside ends of the windings. These are thus kept concealed and are unlikely to break off. The outside ends tap stiff terminals secured to the spacer block, to which terminals the cords may be lead in. Mr. Wheeler's transmitter, which is also shown in Fig. 4, is of very novel construction. The carbon electrodes are both stationary, one, 14, being secured directly to the button and the other, 13, being secured to it, though insulated from it by the sheet, 15. Within the button carbon granules are placed

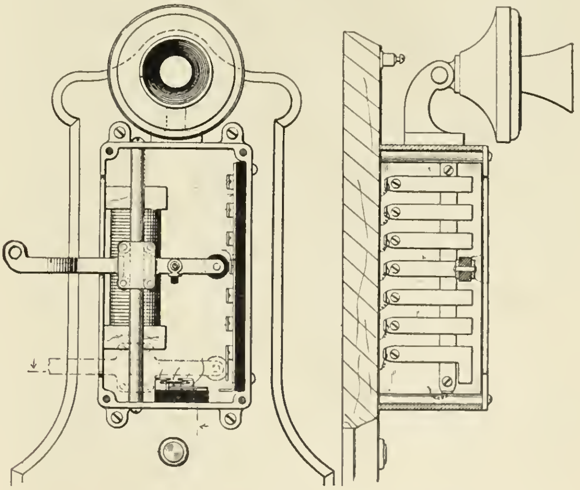


FIG. 3.—YURGAE TELEPHONE SWITCH.

and through it an agitator passes longitudinally This agitator has no electrical connection, but acts mechanically, and may be of any cross section and fluted or tapered to better act upon the granules. One end of the agitator bears against the diaphragm while the other engages a variable tension spring. Many modifications are illustrated in the patent, one of these in which the electrodes are circular and vertically mounted being worthy of special note. In this case the agitator is a wire screen and within each mesh and between the vertical opposing faces of the electrode there is placed a rather large single granule. This gives a transmitter akin to the multiple microphonic type of foreign practice

A messenger strand support forms the subject of a fourth patent; this is the joint invention of Messrs. H. F. Neslage and H. H. Watson, both of St. Louis. It is their object to provide a pole attachment which shall not only securely hold the strand, but which shall in addition form a guide to carry the cable hanger hooks over the support and thereby avoid the necessity of having a man at each pole. The support is in two parts, one the support proper and the second a cap which screws down over the strand. This latter has rounded edges and a rounded top, which rises slowly from nothing at its ends to a height in the middle sufficient to carry the hanger hooks clear of the strand support. That the device will not be very successful in its present form, at least for many types of hanger, the experience of others has shown. To be most successful, the extremity of the guide must pass partly across the strand, its ends lying in a plane considerably below the top of the strand. By this means the guide is brought well beneath the hanger hook before the weight of the cable is transferred from the strand to the guide.

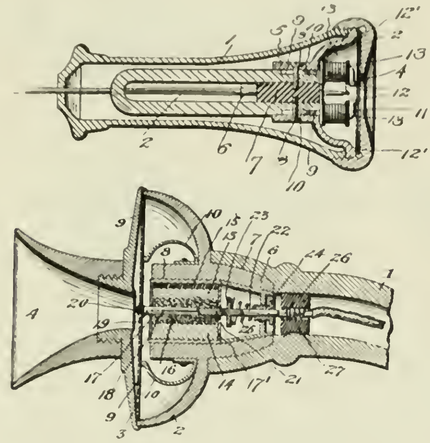


FIG. 4.—WHEELER TELEPHONE RECEIVER.

It is not very often nowadays that one sees new apparatus designed for series party line working. A system based upon such working is, however, the subject of a patent granted to E. Understock, of Kansas. As the field for such apparatus is rather limited, it suffices to say that the chief novelty embraces the obtaining of secrecy by causing any interloper to interrupt an existing conversation entirely and thereby give warning of his presence upon the line.

Municipal Plant Lighting for New York City.

Mr. R. F. Monroe, Commissioner of Water Supply, Gas and Electricity, has again advised Mayor Low, of New York City, to reject all public bids for lighting for 1903. He makes this recommendation after an investigation of the problem in which he retained Dr. Cary T. Hutchinson as consulting engineer. In his letter to the Mayor, Mr. Monroe says:

"Dr. Hutchinson has prepared an estimate of the cost of constructing and operating an electric light plant to supply ten thousand arc lamps, and to light all public buildings by electricity in the two boroughs above mentioned, and he has added a supplemental estimate for a plant to furnish such public building lighting and to supply five thousand arc lamps. This supplemental estimate is for comparison with the service of rented lights now installed.

"The present service, though actually somewhat less than five thousand 2,000-cp lamps, should grow to those figures by the end of the year, and therefore the number given is properly taken for a basis of comparison

"In my report submitted to your board on March 13, 1903, I gave the average price paid by other American cities for 2,000-cp arc lamps as $88.00 per lamp per year Dr Hutchinson's estimate shows that if New York erects and operates a municipal plant of ten thousand lamps, a 2,000-cp arc lamp can be produced for $69.40 per annum. This price includes interest charges and 8 per cent. depreciation—a larger percentage than is actually necessary.

"The estimate submitted, while limited to Manhattan and the Bronx, sufficiently demonstrates what can be accomplished by the erection of a municipal electric lighting plant for all the boroughs, and taken with the data as to the cost of electric lighting in other cities submitted March 13, 1903, shows conclusively that the prices bid for arc lamps for 1903 are too high. Those prices are as follows:

"Manhattan and the Bronx, $140 per lamp per year for nominal 2,000-cp arc lamps. Brooklyn, $124.50 per lamp per year for nominal 1,200-cp arc lamps. Richmond, $125 per lamp per year for nominal 1,200-cp arc lamp. Queens, $124.10 per lamp per year for nominal 2,000-cp arc lamps.

Meeting of the New York Electrical Society.

The New York Electrical Society held its 235th meeting on May 20th, in the lecture-room of the American Institute, 19 West Twentieth Street, on which occasion a lecture was given by Mr. William J. Hammer, on "Phenomena of Radio-Active Substances, Radium, Polonium, Actinium and Thorium," which was preceded by a consideration of phosphorescence and phosphorescent substances. Mr. Hammer also, by special request, referred to a recent visit to the Finsen Institute, at Copenhagen, Denmark, describing the system employed in the treatment of disease by the ultra-violet rays, and illustrating his remarks by many interesting lantern slides.

He showed some lantern slides representing the practical applications of selenium, during which he exhibited apparatus employing selenium in connection with wireless telephony, etc. A cannon was also fired over the heads of the audience by merely waving the lecturer's hand between an acetylene flame and a selenium cell, the cell varying its resistance sufficiently to operate a relay and battery, which in turn fired a cannon. The lecturer also showed a large number of lantern slides illustrating the various phenomena in connection with phosphorescence and radio-activity, exhibiting a very extensive collection of phosphorescent substances. Many of these were caused to glow in the dark by being stimulated in various ways, such as by burning magnesium wire, by heat, by friction, by ultra-violet light, by discharging electricity through vacuum tubes, by cathode rays, by oxidation or slow combustion, etc. Practical applications of phosphorescence were illustrated by switches, socket taps, signs, etc., painted with various phosphorescent substances. Certain phosphorescent substances exhibited, showed practically all of the colors of the spectrum presenting a beautiful appearance in the dark.

The principal subject of the lecture was that of Radio-Activity. The lecturer threw upon the screen various illustrations of experiments of his own and of others, showing the X-ray and cathode ray characteristics of radium rays, their wonderful penetrative effects, etc., and he gave a lengthy dissertation upon the physiological effects presented by radium, their chemical effects, their ionization of the air, discharging of negatively electrified bodies, their destruction of microbic life, and various other phenomena. Mr. Hammer exhibited a 3-pound cannon ball or shell, in the center of which he had placed a few decigrams of radium, which radiographed the image of the shell upon a photograph negative after an exposure of seven days.

At the close of the lecture some interesting remarks were made by President Sheldon, supplementing the lecture of the evening.

The following ticket was nominated for the season 1903-'04: For president, J. J. Carty; for vice-presidents, N. I. Donshea (for re-election), Hobart D. Betts (for re-election), W. S. Barstow (for re-election), Douglass Burnett, F. C. Bates, H. C. Townsend; for secretary, George H. Guy; for treasurer, Henry A. Sinclair.

In the report of the Nomination Committee, which was read to the meeting, it was stated that the committee, prior to its nominating meeting, had received a letter from President Samuel Sheldon, stating that he heartily agreed with the rule now so generally adopted and favored by a large majority in the society, to limit the term of the president to one year, and accordingly he should decline a nomination for a second year.

Chicago Convention of the National Electric Light Association.

(*By Telegraph.*)

THE twenty-sixth convention of the National Electric Light Association opened in Chicago on Tuesday morning with nearly five hundred members and guests registered. The session was called to order promptly and opened with the presentation of resolutions that had been passed by the Chicago City Council, welcoming the Association, and the reading of letters from Edison, Brush, Thomson and others, expressing regret at inability to be present. President Ferguson then delivered his address, which was referred to a special committee for action concerning important recommendations made. The report of the Committee on Progress was next read and accepted without discussion.

The report by Chairman W. M. Anthony, of the Committee on Office Methods and Accounting gave rise to a most lively and interesting discussion in which Messrs. Doherty, Insull, Ryan, Newman, Holmes, Scovill, Bemis, Carlton, Bean, Smith and many others took part. Mr. Insull pointed out that a proper system of central station accounting has a beneficial effect on the standing and the value of securities. He said that in the last year he had bought ten lighting properties, not one of which had a decent system of bookkeeping; the result was that some of the properties were acquired below their real value. An amusing discussion took place between Mr. Scovill and Prof. Bemis as to erroneous ideas propagated by theorists as to the low cost of current. Mr. Scovill said that such ideas did harm to the industry. Prof. Bean disclaimed any such intention and called Mr. Bean and others sharply to account for statements which opposed his views. The discussion also took up the matters of deposits on meters, the use of prepayment meters and weekly instead of monthly payments. Mr. Anthony urged that stations must be ready to meet all tastes and conditions like a lunch counter. Messrs. Williams and Gilchrist referred to the difficulty of obtaining a satisfactory prepayment meter and to the complications which its use involves. Mr. Gilchrist said that Chicago had a great number in use with satisfactory results. Mr. Peck testified to the excellent results from the use of the bookkeeping system recommended by Mr. Anthony. At the close of the discussion, the convention was invited to visit the new Edison turbine station on the following day.

The afternoon session was largely attended and opened with the reading by Mr. Hosmer of a paper by Mr. Charles L. Edgar, of Boston, on the "Advantages derived from the use of one system of generation and transmission of electrical energy from all power stations in one locality." Mr. Junkersfeld pointed out that the policy in Chicago was similar to that carried out in Boston. Mr. John W. Lieb discussed questions relating to reliability of operation, touched on double busses and said that a storage battery equipment is essential in a central station. Mr. A. Bement then read his paper on "Boiler and Furnace Efficiencies." In the discussion Mr. W. L. Abbott dwelt upon the importance of securing efficiency in the boiler room, and pointed out that since boilers in central stations are only worked at their full capacity for short periods, their average efficiency is higher than the efficiency at full power. The paper was also discussed by Messrs. Lieb, King and Dow. Mr. John S. Peck then read a paper entitled "Standard Ratios for Transformers," which was discussed by Messrs. Moody, Wagner, Garland, Lieb, Carlton, Hewitt, Gille, Wirt and Lewis. Next came a paper by Mr. J. Henry Hallberg, of Cincinnati, on the "Application of Four-Ampere Series Enclosed Alternating Arc Lamps for Street Lighting," which gave rise to an interesting discussion participated in actively by Messrs. Ryan, Bertrand, Wirt, Williams, Lieb and Bean, the latter treating the subject in a humorous but none the less practical manner Owing to the absence of Prof. Elihu Thomson, who was detained owing to a serious illness in his family, Mr. Ryan, of the General Electric Company, read the paper by Prof. Thomson, which was discussed by Messrs. Ryan, Wirt, Lieb and Bean. The afternoon session closed after a rejoinder by Mr. Hallberg to the discussion of his paper.

A group photograph of the attendants, numbering four or five hundred, was then taken outside the Art Institute. The first day's proceedings may be regarded as a great success. The meeting hall was uncomfortably warm, but there were always from one hundred to two hundred and fifty in the audience, and the proceedings were most interesting. By the close of the day almost six hundred names were registered, being a record for the association for a first day's attendance. President Ferguson made an excellent presiding officer, his attitude being firm, quiet and judicious. The programme of hospitalities offered by the Chicago Edison and others was most excellent, and was admirably carried out under the direction of Mr. James Wolff.

Under the experienced management of Mr. C. O. Baker, Jr., Master of Transportation, a special train was organized over the New York Central and the Michigan Central Railroads to run through from New York City to Chicago. It left about 1.15 on Sunday afternoon and arrived at 12.45 p. m. on Monday. But for an accident to the locomotive, even this high speed would have been beaten by an hour. But as it was the three-score members and friends were delighted not alone with the speed of the run, and the weather that attended it, but with the constant attention and courtesy shown by the officials of the two systems. Those who went off in detached squads from the East "missed it." At the end of the pleasant trip, just before reaching Chicago, a muster was called in the smoking car and hearty resolutions of appreciation of the good treatment received were noted unanimously. Whether the convention special is a thing of the past or not, as to crowds, it is certain that this one will hold its own with any in the past for fun and quiet good fellowship. On arrival, a large party of Chicagoans, headed by Past President Wilmerding, were at the depot with coaches to take everybody to their destined hotels.

A most enjoyable and enthusiastic reception was given on Monday evening by the electrical interests represented in Chicago, to the delegates, members and ladies attending the convention. It took place in the parlors of the Auditorium and was attended by several hundred people. Guests were received by President and Mrs. Ferguson and other members of the Entertainment Committee, and to enumerate the well-known representatives of electric light and power, in manufacturing and central station work, would fill a page. Music was given during the evening by an excellent band, and refreshments were served in the south parlor. This large room had been very tastefully decorated with the Elblight system, streamers of colored lamps and smilax, etc., hanging from the ceiling and walls, while spirals of lamps were also grouped on the tables. The sight was heartily applauded by all. After the collation, dancing began and was kept up until a late hour.

The Entertainment Committee comprised: James Wolff, chairman; J. W. Buell, B. E. Sunny, A. L. Tucker, Homer E. Niesz, W. W. Lowd and W. R. Pinckard.

The Reception Committee included the following well-known Chicagoans: B. E. Sunny, chairman; Samuel Insull, Edward B. Ellicott, Frank L. Perry, C. D. Crandall, Truman P. Gaylord, B. J. Arnold, Thomas I. Stacy, H. R. Hixson, F. E. Donohue, R. C. P. Holmes, F. B. Badt, G. H. Atkin, Francis Raymond, J. R. Wiley, A. D. Lundy, C. E. Gregory, George C. Bailey, F. W. Kohler, W. M. Smith, George B. Foster, M. B. Austin, W. S. Goll, C. H. Wilmerding.

PRESIDENTIAL ADDRESS.

In opening President Ferguson referred to the great increase in the membership of the Association, having advanced in one year more than 22 per cent., until now the active and associate membership list numbers 532 members, 452 of whom are active, and 80 associate, besides 20 honorary members.

The President of the Association, he said, should not be burdened by detail, but the office should be that of chief executive, whose duties consist in enlarging the scope and value of the Association's work and conserving the interests of its members by directing the forces at his command, rather than that of historian. The work of review should be done by one whose daily thought and activity are along the lines of watching the development of the art. Following this idea, he had appointed a "Progress Editor," who has covered in a very exhaustive and elaborate report the development of electricity in its application to light and power.

In addition to the standing committees already in existence at the last convention, there have been appointed during the year reporters on five special subjects, all of great importance to the members of the Association. These reporters have been actively engaged gathering information and suggestions from all the members, which they have assorted, sifted and compiled, and from which they have drawn certain conclusions which will be submitted to you as recommendations in the form of carefully prepared reports. The reports of these special committees are not merely perfunctory reports, but represent months of special and continuous thought, and will prove as valuable and interesting as the papers which have been prepared especially for the convention.

The "Question Box" has been made a special department, and an editor appointed to handle it. It has grown to such proportions it was deemed advisable to have the questions and answers printed completely for distribution at the convention, and if found desirable it will be discussed at one session of the meeting.

At the last convention there was considerable discussion on the subject of the relation between manufacturers and central station companies, and through the president taking up with the manufacturers' individual cases as they arose, it has been found that all the manufacturers are willing to co-operate to all reasonable extent. Much success has been met in handling several cases of unfair competition, and in no instance where the president's assistance was requested has he failed in protecting the interests of the member companies. Early in the year there was one notable case, where a member had obtained a franchise and city contract for lighting. After considerable effort the real basis of the opposition was traced, and by using the influence of the Association and its members, the manufacturers were induced to discontinue negotiations for the sale of machinery and the financial houses to reconsider their proposed support, resulting in a complete abandonment of the proposition, and leaving the field clear to the original company. The value of the Association to this member company in this one case would more than pay its dues for one hundred years.

The Committee on Standard Rules for Electrical Construction and Operation has been called upon for unusually active work in connection with the National Electrical Code. Certain changes in the rules for overhead construction had been proposed by a committee of the National Underwriters' Electrical Association, and were under consideration by a committee representing the American Institute of Electrical Engineers. Feeling that some of the proposed changes in the rules were impracticable, objectionable and unfair to the member companies of this Association, the president communicated with the president of the American Institute of Electrical Engineers, and urged postponement of favorable action on these changes until they might be considered by the National Electric Light Association. The request was granted, and the N. E. L. A. Committee on Standard Rules for Electrical Construction and Operation was invited to attend the future joint meetings of the Committees of the National Underwriters' Electrical Association and of the American Institute of Electrical Engineers. Two meetings were held in Boston, one in February and one in March, at both of which the committee and president of the Association were in attendance and took an active part. The committee took the position that no changes could be made in these rules without a meeting of the conference, consisting of representatives of all associations interested in the subject. This position, after considerable argument, was sustained, and as a result of the efforts of the committee of the Association, assisted by the committee from the American Institute of Electrical Engineers, the underwriters removed many of the objectionable features in the proposed changes of the rules.

The re-establishment of a conference—after an inactivity of five years or more—to finally settle all questions of rules of the National Electrical Code, is of prime importance to the central station companies of the country, and it will prevent the establishment of rules by the underwriters which might seriously injure the electrical interests of the country and retard the development of the industry.

The necessity for closer relations with other associations of kindred character was shown by the joint work of the Committees of the National Electric Light Association, and the Association of Edison Illuminating Companies, in the matter of the National Electrical Code. The American Institute of Electrical Engineers, whose membership is made up largely of purely technical men, may lay down some rules, or the National Bureau of Standards may adopt some standards of measurement which, while they may appear good from a purely scientific standpoint, may be exceedingly bad from a business standpoint of the members of this Association.

Some of the members of the Association are also members of the Association of Edison Illuminating Companies, and the various State gas and electric light associations throughout the country and the officers and engineers of the member companies are members of the American Institute of Electrical Engineers, and of the American Society of Mechanical Engineers, and other similar societies; consequently if the influence which it is possible for them to wield is brought to bear on any given subject affecting them, and under consideration by other bodies, there is no doubt that serious injury to the interests of the member companies of this Association may thereby be prevented. He recommended, therefore, the appointment of a small committee of forceful men to watch the movements of other kindred bodies and engineering societies, to confer with them from time to time, and to promote a closer relationship with them so their officials may not be antagonistic to the members of this Association.

Taking up the subject of the steam turbine, President Ferguson said that there is probably no piece of apparatus in the construction of the central station at the present time, the results of which are awaited with such keen interest by central station managers. When we stop to consider that two manufacturers of steam turbines in this country have taken orders in twelve months for approximately 540,000 hp capacity, one may reealize what an important factor it may ultimately become in the central station business. It seems wise, therefore, that a committee of three good mechanical engineers should be appointed to follow the development of the steam turbine during the coming year and report the results at the next convention.

There is a growing demand for electric power in factories, and it is important to central station companies that this business should be obtained for their service. Statistics showing the useful and economical application of electricity in factories, together with costs at various rates per kilowatt-hour, are not readily obtainable, and the appointment of a committee of three men from different sections of the country was recommended to gather statistics on "Purchased Electric Power in Factories," and report at the next convention, or sooner, if found feasible.

President Ferguson said that in choosing the papers for this convention, he had tried to touch upon each branch of the central station business treating of some phase of production, by-products, distribution, customers' apparatus, engineering and testing and management. It has been his intention to avoid confining the papers and reports entirely to purely technical subjects, and to treat with considerable liberality questions which might properly be classed under the management of the central station. Many of the subjects to be presented are entirely new to the Association, and have never been discussed before in its conventions.

In conclusion, President Ferguson thanked the gentlemen who had so kindly contributed papers, the editors and reporters of the various committees whose names appear on the programme, and the members of other active committees, who by their valued support have helped him to serve the interests of the members. He complimented the industrious and ever-watchful assistant secretary of the Association, who so ably handles the routine work, and expressed his appreciation of the aid of the electrical press.

REPORT OF THE COMMITTEE ON PROGRESS.

As chairman of the Committee on Progress, appointed for the first time this year, Mr. T. C. Martin presented a report of 69 pages, which, besides an introduction, included such topics as gas and electricity; incandescent gas lighting; the statistical growth of the art; comparisons with abroad; the storage battery equipment; high-tension overhead transmission; new types of arc lamp; high-tension underground transmission; motors and electric drive; advances in electric heating; improvements in fuses; vacuum tube lighting methods of charging for current development of Nernst lighting; osmium incandescent lamps; the diffusion of light from arc lamps; a street electrolier competition; central station chemical work; the Cooper Hewitt static converter; cheaper production of current, including steam turbine data, and state laboratories. The report abounds in figures. As to its discussion of topics, the following as to electric heating will be of interest:

In discussing the subject of electric heating with central station men, the remark is still often heard that the cost of purchase and operation places it beyond the category of large sources of income; and the private customer also very often abstains from the use of such apparatus because of the fear that it will cost too much. There is a third party in interest, the manufacturer of such apparatus, who is fighting all the time for a lower kilowatt-hour price; and it is obvious that the lower the cost of current the greater will be the public patronage extended to any and every class of electrical service and appliance. I can well remember that cost of current was the burden of complaint in the early days of the motor, but to-day every intelligent manager is aiming to increase his motor load, and with concessions to the consumer that are doing much to build up that class of business. In the meantime, many a manager is having electric heat appliances put on his circuits without knowing much about it, so that the public often finds it convenient to pay for temporary heat the price of light. Paradoxical as it may sound, the crying demand is for heat in summer, which largely goes unsatisfied, and will remain a want until the electrical inventor and manager have solved the problems in a manner that will enable a woman to cook electrically as easily as she now throws a shawl over her shoulders, or permit a man to warm up his office as promptly as he can don a light overcoat.

At Somerville, Mass., recently, the central-station manager, in reconstructing, cut off circuits in resident sections a street at a time, from day to day, when light would not be required. His first experience was that he got five complaints from one street. The people had no current—and they must have it—because they could not use their flatirons. Yet the manager had not sold a single flatiron at that time and did not have the means of knowing that any were thus being operated. Mr. James I. Ayer, our worthy past president, now manager of the Simplex Electric Heating Company, informs me that he, also, knew of no such use specifically in Somerville. In this case we have an example of what must be going on all over the country, for Mr. Ayer states that they have made and sold over 60,000 flatirons, of which, in New York alone, we have, by the way, some 5,000. What is true of flatirons must be true of other appliances, for Mr. Ayer tells me that last year alone they disposed of about 1,000 chafing dishes; and I think it stands to reason that a great many of these must be operated on central-station circuits. Perhaps, as I have intimated, we are beginning to do more collectively than, as individual stations, we imagine to be the case. Seeking for information in this respect, I have learned from Mr. Ayer that their customers' index carries about 10,000 names, about 20 to 25 per cent. of which represent factories, hospitals and public institutions

It may still seem to some central station men that this is "picayune" business, but heating is apt to run up into the consumption of large volumes of current; and there is a growing inquiry for special work and equipments through central stations. In one instance, the recent supply of a 15-kw heater for an oil tank enabled the central station to get the motor business also by being able to take care of the other want. Mr. Ayer states that they have installations of as many as 50 electric glue pots operated on central-station current; and the number of such pots is already "way up" in the thousands. In this respect also, Mr. Max Loewenthal, engineer of the Prometheus Electric Company, informs me of three cases within the month of April where the settlement of important industrial heating questions enabled the stations to secure large contracts for current.

All this is encouraging, but I am free to confess my present dissatisfaction with the slowness of development in the domestic field as compared with gains in the industrial. If we assume hypothetical cases, it would seem that a great deal more could be done even now. Under a sliding scale of prices, whatever current is consumed for heating, cooking or laundry purposes, counts toward reducing the price for all the current used. It is easy to see that this tends at once toward economy. In fact, it is possible, if one takes an extreme case, almost to save money by adding an electric kitchen to the household. Let us assume that a flat contained 16 electric lamps, and that their total consumption was estimated at 800 watts an hour. Now let us also suppose that they actually consumed 47 kw a month, which would be just within the two-hour-a-day limit, and still subject them to the charge of 15 cents a kw. The monthly bill would be $7.05. Now, assume that an electric kitchen has been added which uses 3,300 watts a day. This would be 99 kw a month. If paid for at 15 cents a kw, the kitchen alone would cost $14.84 and the whole bill for current would be $21.89 for the month. As a matter of act, however, the total consumption of current would have amounted to 146 kw, or more than six times the hourly capacity of the lighting installation, and the whole bill would be at the rate of five cents a kw. The total charge would then be $7.30, or a cost of 25 cents only a month for the cooking. Unless there is something very much amiss with this calculation beyond my power of detection, such figures involve a revolution in domestic economy that we must come to sooner or later.

In respect to the advance of the Nernst lamp, the following figures are given:

I am sure that few new departures in the lighting art have been watched with more interest than the introduction of the Nernst lamp, the general elements and features of which are now so well known to members as to need no comment. At the worst, we have in this lamp a valuable addition to our resources in subduing the whole domain of lighting; at the best, we have a device which has apparently advantages over some earlier methods in certain respects, and which rounds out the central station efficiency. In view of the criticism leveled at the lamp from some quarters as to its economy, I have been surprised at its rapid advance, for there could be no more eloquent testimony as to its meeting a want than the fact that it has already, within little more than a year, been adopted by upwards of 1,000 central stations and isolated plants in this country.

The adoption by central stations of Nernst lamps is gradually being pursued in the same manner as with the incandescent lamp; that is, on the free-renewal system. The general result stated by Mr. Dunham, of Hartford, Conn., who has 4,000 Nernst lamps, is that he can produce the same illumination at a general cost of less than one-half that of incandescent lamps, everything considered, on account of the lesser consumption of energy necessary with the same central station equipment. Some of the larger installations for street lighting are at Hartford, Conn.; Unionville, Conn.; Rouse's Point, N. Y.; Annville and Sewickley, Pa.; Lincoln, Neb.; Madison, Wis., and Salt Lake City, Utah. In some cases it is the six-glower lamp that is being used for this purpose, comparing in energy and light with the ordinary 5.5-amp. enclosed-arc lamp. In other cases, it is the three-glower and quite often the single-glower is used. The latter is especially well adapted, as it gives a candle-power of 50 with less than 100 watts' consumption.

Another installation is on the college grounds at the city of Mechanicsburg, Pa., which is operated by the Cumberland Light, Heat and Power Company. The lamp is being extensively used in shops and factories, halls, lobbies, office buildings and the like, such as the Riter-Conley Manufacturing Company, Leetsdale, Pa.; the Lunkenheimer Company, Cincinnati; the various shops of the Westinghouse interests; viz.: Air Brake, Electric & Foundry; the Wellman-Seaver-Morgan Engineering Company; the Deering Division of the International Harvester Company; Deere & Co., Moline, Ill.; Williams, White & Co.; the Atlas Tack Company, Fair Haven, Mass., and Swift & Co., Fort Worth, Texas. It is quite extensively used in the yards of Armour & Co., Swift & Co., and the Union Stock Yards at Chicago.

For office work and drafting it is being found specially well adapted on account of the uniformity of quality and the absolute steadiness of light. The drafting rooms of the Union Station of the Pennsylvania Railroad, at Pittsburg, are completely equipped with Nernst lamps. The Farmers' Bank Building in the same city, which is the third largest structure of its kind in America, has two or three thousand lamps, and this plant has been illustrated and described in the technical press. The John Hartness Brown Department Store in Cleveland, Ohio, which is the latest big store in that line, will be entirely equipped with Nernst lamps. Among special installations, there might be mentioned those of Barnum & Bailey and Ringling Brothers' circus, where a special and unique traveling plant has been devised for the illumination of the vast marquee or arena tent in which performances are given.

Mr. Calvin W. Rice, second vice-president of the Nernst Lamp Company, states that when compared with the carbon incandescent lamp the same light-giving power can replace clusters of incandescent lamps, and including the cost of maintenance, trimming, energy, etc., it can effect a saving of from 30 to 50 per cent. Of course, the question is a different one when we come to consider the demand for the smaller unit incandescent lamp of ordinary 16 cp.

REPORT ON OFFICE METHODS OF ACCOUNTING.

A most interesting and valuable report was presented by Mr. W. M. Anthony, comptroller of the Chicago Edison Company, on "Office Methods and Accounting," at the Tuesday morning session. It took the shape of two handsome pamphlets "printed and prepared for private circulation only." One of these contained the text of the report; the other embraced in fac-simile a number of the tables, forms, blanks, loose sheets, etc., used by the Chicago Edison system in the transaction of its enormous business. The textual report was also admirably illustrated by a number of half-tone cuts, of which one showed the interior of the accounting department of the Chicago Edison and Commonwealth Companies, and the separate application of the addressograph comptometer, arithmometer, bookkeeping typewriter, perforating receipt stamp, etc. Mr. Anthony remarked in the course of his report that: "The art of operating accounting consists in giving an air of distinction to insignificant but very important things in their inception; locking the door of knowledge before the horse of responsibility is gone"; and he then proceeded to discuss suggestions and devices brought to notice by members of the Association, but drew largely upon his own store of ripe experience. The chief topics thus taken up were "receipts and disbursements"; the "reading of meters"; "billing of current" and "use of customers' ledgers." Mr. Anthony discussed in detail and with excellent elucidation the points connected with loose sheet and card systems for receipts, the latter "card" method as applied to companies with about 1,000 customers. He remarked: "Some of the chief objections raised against the card system are its first cost, and the fact that the cards are liable to get lost or destroyed to cover up theft. But the experiences of the larger number of small companies shows that they have never lost a card, and they think that the value of the system is well worth its cost." Mr. Anthony then discussed minutely such topics as credits and collections, disbursements, purchases and invoices, accounts payable and voucher system. In regard to the necessity of conforming accounting details to the requirements of executive and operating officers, if feasible, Mr. Anthony said: "The bookkeeper who will 'fall off his perch' once in a while and take a peek at things as they are, through the eyes of the operating official will have his eyes opened to his own prospective advantage. This, perhaps, is a little digression, but it is wise to stir the animals up now and then, as it is depressing to stand on one leg too long." In conclusion, Mr. Anthony submitted a form of voucher record or register of disbursements, because it exemplified the widest scope of business activity, covering lighting, street railway, gas, express, heating, water power, etc.

BOILER AND FURNACE EFFICIENCIES.

Mr. A. Bement read a paper with this title, in which he gave the results of tests on two types of boilers, a single boiler of one type being tested and three boilers of a second type, one of the latter, however, having changes introduced making it practically a third type. The boilers had a standard rating of 400, 434 and 480 hp respectively, and were of the water tube type. The tests were so made as to separate the boiler and furnace efficiencies, the former term referring to the amount of heat abstracted by the boiler water surfaces from the gases. The paper is illustrated with a large number of curves, and contains tables giving the dimensions of the boilers and the data of tests.

To determine the boiler efficiencies the initial temperatures of the gases were taken at various points in the course of the gases to the flue. In one case 72 per cent. of the drop of temperature was shown to have occurred in the furnace and in the passage of the gases between the tubes of the boilers. In a comparative test between one boiler of each type, the efficiencies of the combined boilers and furnace were found to be 57.83 per cent. and 59.12 per cent. respectively, and the efficiencies of the boiler alone, 77.69 per cent. and 70.12 per cent. respectively. The paper discusses at length the bearing of all the data obtained, and shows how by certain changes the efficiency of one of the boilers was greatly increased.

STANDARD TRANSFORMER VOLTAGES.

In a paper with the above title, Mr. John S. Peck presented a plea for the adoption of standard transformer voltages. The employment of standard voltages means, he said, that the user shares in the advantages gained by the manufacturer, and the possession of transformers which may be used interchangeably on different parts of his circuits is an advantage easily appreciated. It means to him the necessity of carrying in stock fewer spare parts and the possibility of obtaining such parts much more quickly than when special ones are required. It means the ability to shift apparatus from one part of his system to another, and in general a great increase in the flexibility of a vital part of his equipment.

The Westinghouse Company has adopted for standards the voltages recommended by the A. I. E. E., with such additions as had been frequently demanded in commercial work. For varying these voltages over the desired range, the plan of bringing out taps from the winding was adopted. A table gives the voltages adopted as standard, as well as the variations which may be obtained. In all cases a value of 5 per cent. below normal, and two values, one 5 per cent. and one 10 per cent., above normal may be obtained. There is thus obtainable from any transformer, a total range of 15 per cent., which is found ample for almost every condition of service.

Where this series-multiple connection is demanded, the plan has been adopted of bringing out a tap from each half of the winding, so that 5 per cent. of the total winding is included between each tap and the outside terminal. With this arrangement the multiple connection gives a voltage 10 per cent. in excess of the normal, and the series connection, two voltages, one 5 per cent. and the other 10 per cent. in excess of the normal. Where the three two-phase connection is to be provided, each additional voltage means a large increase in the number of taps brought out, and therefore complication of terminal block. Where this connection is required, the transformer is provided with taps for increasing the normal voltage by 10 per cent. To standardize low-tension voltages, the same plan was adopted as for the high tension; that is, certain nominal values were selected and taps brought out for a suitable variation. For example, for a nominal voltage of 2,000, two taps are brought out so that the following voltages may be obtained: 2,200, 2,100, 2,000, 1,900. In many cases, however, low tension winding must be arranged for series-multiple connection, so that two secondary voltages may be obtained—for example, 200 and 400 volts. For this condition, the same arrangement as was described for the high tension is adopted, namely, a 10 per cent. tap is brought out from each half of the winding. For the 200-400 volt combination, the following values may be obtained: 300, 220, 400, 420, 440. For rotary converters, the voltage required varies with the number of phases of the rotary, and with the direct-current voltage which it supplies. With transformers for this service, an alternating-current voltage is selected which will give the required direct-current voltage. This is considered the normal, and taps are brought out to give values approximately 5 per cent. higher and 5 per cent. and 10 per cent. lower than normal.

FOUR-AMPERE SERIES ALTERNATING CURRENT, ENCLOSED ARC LAMPS FOR STREET LIGHTING.

In a paper with the title "The Application of Four-Ampere Series Alternating, Enclosed Arc Lamps for City Lighting," Mr. J. Henry Hallberg sketched the history of street lighting, and then gave an account of the system employed in Cincinnati. In that city the council specified four-ampere alternating current, enclosed arc lamps for the streets, alleys and suburbs. The paper includes numerous illustrations of the manner in which the lamps are installed, and gives an account of the generating station, where switching and regulating apparatus for 100,000 lamps and 90 automatic constant-current, 60-light transformers are installed. The entire system is operated from a 4,500-volt, 60-cycle, 3-phase generator. Four thousand five hundred arc lamps are in circuit. The paper discusses the subjects of carbon life, trimming, globes, underground cables, power factor, etc.

The conclusions of the author, based on his experience with the installation during the past year are as follows:

First, the open-base inner globe is safer and more economical than the closed-base globe. Second, the large metal reflector is not necessary on four-ampere series alternating-current lamps hung only 12 or 15 feet above the street, but a small enamel reflector immediately above the arc is beneficial. Third, the initial or natural power factor of a four-ampere series alternating-current system should not be depended upon to be greater than 75 per cent., varying between 70 and 75 per cent. Fourth, the 75-per cent. power factor applies to ordinary overhead circuits. When the current is supplied underground in lead-covered cables, the capacity of such cables introduces leading currents, hence the operating power factor of the underground circuits at Cincinnati is maintained above 90 per cent. Fifth, the efficiency can be maintained above 91 per cent. and the regulation still be perfect. Sixth, four amperes is the lowest practical limit at which successful alternating-current arc lighting can be practised. Seventh, half-inch diameter carbon is the most practical size to use in a four-ampere alternating-current lamp. Eighth, notwithstanding the large size of the carbon (considering the low-energy arc), the regulation of the system is perfect, and there are no objectionable shadows from the carbons. Ninth, it requires only eight trimmers to take care of 4,500 lamps. Tenth, the outages or lamps requiring starting in the underground district are less than one-fourth of one per cent., and in the overhead district the outages average one per cent.

CURRENT NEWS AND NOTES.

FERRARIS STATUE.—A statue to the late Prof. Galileo Ferraris was unveiled at Turin, Italy, May 17.

THE MANILA CABLE.—A dispatch from Manila, dated May 25, states that the cable steamship *Anglia* anchored the Manila end of the Pacific cable on the beach on that day and started to pay it out to Guam, the next station.

LECTURE ON RADIUM.—Mr. William J. Hammer gave a lecture on "Radium and Radio-Active Substances" at the thirty-fourth annual meeting of the New Jersey State Microscopical Society, held in the Ballantine Gymnasium, Rutgers College, New Brunswick, N. J., Monday evening, May 25.

INDEPENDENT TELEPHONE CONVENTION.—The annual convention of the National Independent Telephone Association is to be held, as announced by us last week, on June 24 and 25, at Chicago. Mr. J. B. Ware, of Buffalo, the secretary, informs us that an interesting programme is in preparation, which will soon be ready for publication, and which exceed any previous one in importance to the art and industry.

NATIONAL ELECTRICAL CODE.—The 1903 edition of the National Electrical Code, which has just been issued, contains 107 pages, an increase of 27 pages since 1901. No notice is given of the new matter added nor any indication of changes. It would appear very desirable that this information should be contained in some prefatory pages, in order that the contractor might know, without a close reading of the entire text, whether new requirements bear on his methods of installation.

MARCONI IN DRAMA.—According to a London dispatch, Mrs. Langtry, the actress, proposes to produce a drama in which the Marconi wireless telegraph system will form an important part. The information was given out in the wireless telegraph paper printed on board of the American Line steamer *Philadelphia* on her last trip from New York to Southampton. The climax of the proposed play will be a scene on an ocean liner, on which the villainy of the villain and the heroism of the hero will be established by wireless telegraph messages from Nantucket.

LIGHT FROM WASTE.—So successful have been the experiments of Commissioner Woodbury of the New York Street Cleaning Department in using street refuse for fuel, that he has decided to establish plants for the production of electric power. He will manufacture "briquettes" from the refuse by using a bituminous flux. He announced last week that from the 800,000 cubic yards of refuse yearly disposed of by the city, power can be generated each day capable of lighting 7,272 lamps of 2,000 cp. "There will be no more dumping at sea," said the Commissioner. "Hereafter the city will use all refuse for fuel. The city can sell power and make money, instead of selling the refuse. I have put in an order for flux to make the briquettes. We have already a plant or crematory running in West Forty-seventh Street and I intend to ask the Board of Estimate to let me erect another." Major Woodbury said it would be possible to supply fuel to the proposed city lighting plant.

LETTER TO THE EDITORS.

The Mechanical Cause of Gravitation.

To the Editors of Electrical World and Engineer:

Sirs:—I quite agree with your correspondent, Mr. Townsend Wolcott, that *under the conditions he has described*, the helicoidal motion of the water particles is more or less an illusion; and the illusion is apt to be explained in the way he explains it. That is one of the reasons which has tended to switch off scientists from a true scientific investigation, because such an explanation is in accordance with the accepted theory.

But if Mr. Wolcott or any reader will use the apparatus I have described in the issue of May 16th, and instead of using water, will use compressed air of sufficient pressure to project a two-inch lead ball from the rotating nozzle with a longitudinal velocity of at least 100 ft. per second, they will not only see, but can also photograph the elliptical orbit produced.

Or, if any readers have the facilities necessary to enable the experiment to be carried out vertically upwards in an empty elevator shaft 12 ft. square, and 150 ft. high, where calico screens can be stretched across the shaft at each floor, I shall be very pleased to assist them with the experiment whilst I am in the city. As I am only here on a visit, and have no acquaintances who have the facilities, I hope some of your truth-loving readers will take this matter up.

It is fifteen years since I carried out the experiments at my ranch in California, and since that have in my spare time been trying to find a scientific explanation, and trying to trace out the application of the new laws of motion into realms of natural philosophy, which when the facts are known and accepted, will produce the most profound revolution in dynamical science the world has ever known.

And now I wish others to know the truth as I have found it, because it will not only save scientists the unutterable anguish of feeling that they are powerless under the present system of being able to explain natural phenomena, as their intuition tells them it ought to be explained. But it will also lead to many commercial inventions, by establishing true mechanical causes in place of uniform antecedents or illusions. From over twenty years' study of this subject, I am prepared to prove the following four propositions:

First Proposition.—That Galileo was mistaken by his projectile experiments in formulating the parabolic law of falling bodies, and in establishing the principle of the independent superposition of longitudinal and transverse momenta. Because he imagined that a body such as a stone when raised from the ground and let go, actually falls back to the ground; whereas the falling is only an illusion, and I will prove by experiment that it is only an illusion, and that the true cause is a resultant motion of the earth, spinning on its axis whilst describing a helicoidal trajectory in space. The body only obeys Newton's first law of motion, not his law of attraction, which is a fallacy so far as the *cause* of the motion is concerned.

Second Proposition.—I will prove experimentally, and by physical and mathematical reasoning, that Newton was likewise mistaken in his supposed proof of the parallelogram of forces. And I will prove that a curve, not a diagonal straight line, is the true resultant when two momenta are compounded transversely; and I will likewise prove that there is no force lost in the composition. And that proof will supply mankind with the long-lost key to the enigma of the universe.

Third Proposition.—I will also prove that Newton's second law of motion is wrong in two of the three cases given by him in the "Principia," and paraphrased by Kelvin and Tait in their great classic, when dealing with that law.

Fourth Proposition.—That Euler was mistaken in a similar way when he formulated his celebrated doctrine of the "Independence of translation and rotation."

But I wish to deal with one error at a time, and the first one is that of orbital motion, shown by the rotating nozzle and one ball. I wish to have that fact confirmed by some of your readers. That experiment will not only show how gravity is produced mechanically, without the attraction of matter; but it will show that the motion cannot be explained by the laws of motion now being taught at the universities. I have requested the leading scientists at the principal Eastern universities to check my experiments as the demonstration proceeds, but as some have tried to throw ridicule on the subject, I have been forced to appeal to a wider range of scientists, through the wide circulation of your valuable journal, with the earnest hope of receiving the recognition necessary to settle this matter definitely. I shall be glad to reply to any letters on the subject addressed to me, at 99 John Street, New York, care Institute of Mining Engineers.

New York. Robert Stevenson.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Power Factor of Three-Phase Motors for any Wave Form.—Dina.—A mathematical article. The difference of the e.m.f. curve of a three-phase motor, from a pure sine wave, is generally small, as in it the 3rd, 9th, etc., overtones are missing, while in the current curve the other harmonics are dampened by self-induction. Nevertheless, it is not proper to assume from the first that the error due to the assumption of pure sine curves for the e.m.f. and current waves, is negligible in practice. He investigates the dependence of the power factor of a three-phase motor upon the wave form and arrives at the result which is approximately true, that the value of the power factor, as found by the tangent formula, is greater than the true value by as many per cent. as the effective value of the voltage curve is greater than the effective value of the fundamental wave.—*Zeit. f. Elek.*, May 7.

REFERENCES.

Induction Motors with Commutator Armatures.—Alexander and Fleischmann.—The first part of an article in which the authors give a theory of induction motors with direct-current armatures provided with a commutator, such as the Heyland motor. The purpose of the article is to explain the action of such motors by developing their known properties from a new point of view.—*Zeit. f. Elek.*, May 10.

Motor-Starting Switches.—Broadbent.—Critical notes on some remarks in a recent paper by Bate on motor starting switches.—Lond. *Elec. Rev.*, May 8.

POWER.

Electric Power in Mines.—Schneider.—An article on electric installations in various mines in Germany. In Westphalia there are several mines with electric plants up to 1,000 hp. In a new mine in Silesia a power plant of 5,600 hp will be installed, consisting of eight three-phase generating sets, each of 700 hp. Some researches are mentioned on the utilization of blast furnace gases in gas engines. The engines have been greatly improved during the past years; difficulties due to the non-uniform composition of the blast furnace gases, their impurities and their relatively small caloric value, have been partly overcome; and there is no doubt that there is a great future for the blast furnace gas engine. Many coal mines are in an even better position than blast furnace works, because they have a gas which is more suitable for gas engine operation than the blast furnace gas. The coke ovens, even when by-products are obtained, give a gas volume which is greater than that required for heating the furnaces. The quantity of this surplus gas varies between 11 and 40 per cent., and therefore averages 25 per cent. "The caloric value of the gases also varies between 3,500 to 4,500 calories, and therefore averages 4,000 calories." If these numbers are assumed as a basis, a battery of 50 furnaces gives a surplus of 520 cubic metres of gas per hour, which when burned under boilers give about 300 hp, but when used in gas engines about 655 hp. In the coal mine region of Westphalia about 100,000 hp are thus available. Several such plants are now installed in Germany.—*Zeit. f. Elektrochemie*, April 16.

Power Transmission in Greece.—An illustrated description of the first three-phase transmission plant in Greece. Numerous waters are collected and discharged through a tunnel in the mountains; between the tunnel exit and the level of the lake there is an average fall of between 8 and 9 metres, and there the power house has been erected. There are two turbine-driven, 130-kw, 5,000-hp, three-phase generators and the current is transmitted over a 13-km line to the pumping station which consumes the main part of the power. It contains two 80-hp induction motors, direct-coupled to two centrifugal pumps. It is intended to furthermore use the electric power for the agricultural development of the load, and incidentally for the lighting of offices and driving small machines.—Lond. *Elec. Rev.*, May 8.

Mersey Railway.—An article, illustrated by maps, on the "electrification" of the Mersey Railway. The contractors were the British Westinghouse Company, who carried on the conversion successfully without interruption of the regular steam service, which was no easy task, considering that the trains were carrying about 10,000,000 passengers per year. Weeks before the new line was opened, the electric trains were running between the scheduled steam trains, in order to put the whole system to a test under working conditions. The electric service was definitely introduced on May 2. A technical description is promised for a later issue.—Lond. *Elec.*, May 8.

Noiseless Railway Crossings.—A description of an experiment being tried in St. Louis, in which wooden blocks are used for the crossings of the rails. In one pattern a wearing plate of steel is laid on the wooden block; this is the plan which it is thought will be most desirable, and is illustrated in the engraving.—*St. R'y Jour.*, May 9.

New Emergency Line Wagon.—A description of a wagon which was built for one of the Massachusetts roads. In summer it is used as an emergency wagon and in winter as a snow plow. The tower is raised by a windlass; inside the car is a reel large enough to hold 1 mile of trolley wire. The car has a portable pneumatic crane, which can operate from either side of the car, for lifting in and out heavy appliances.—*St. R'y Jour.*, May 9.

REFERENCES.

Cars for the Yerkes Underground Railways.—The first shipment of electric cars for the Metropolitan District Railway Company, which is now operated by steam, in London, has been received. This line will use a double metallic circuit, the third rail being about 16 in. outside of the wheel rail and 3 in. above it; the return rail is in the center of the track, 1½ in. above the wheel rail. Each train will be made up of seven cars, three of which are motor cars and four trailers. The cars will be heated by electricity.—*St. R'y Jour.*, May 9.

Du Bois.—An article on improvements in the Du Bois Traction System. This town has a population of 12,500 and the company operates both the railway and the lighting systems. The company has 11 cars, 100 arc lamps, 6,500 incandescent lamps and several stationary motors.—*St. R'y Jour.*, May 9.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Distribution Losses and Resonance Effects.—The conclusions of a detailed account of the discussion of the paper by Constable and Fawsett on distribution losses in electric supply systems and of Field's paper on a study of the phenomenon of resonance in electric circuits by the aid of oscillograms; also an editorial summary of the principal results of this extended discussion. There exists now a fairly definite idea what is the order of magnitude of the dielectric hysteresis loss plus eddy-current loss in a modern cable; in the vast majority of cases it is not serious enough to impair greatly the efficiency of a supply system. Should at any time an engineer want to lay a ten-mile, 10,000-volt, three-phase cable merely for supplying electrical energy to a town with a maximum demand of 300 kw and a load factor of 12 per cent., there will be serious losses in the high-tension main if it is of the ordinary type; but such a case would be very unusual. Cable manufacturers should, however, investigate more closely the dielectric hysteresis and eddy-current losses in their cables. From the discussion of Field's paper the conclusion is drawn that proper main charging appliances are a necessity, and an auxiliary discharger in the guise of a lightning protector is not to be despised. Sparks advises not to "run up" on the mains by increasing the speed of the alternator, but to do so by running the alternator up to the standard frequency before switching on, and to raise the voltage by increasing the excitation.—*Lond. Elec.*, May 8.

ELECTRO-PHYSICS AND MAGNETISM.

A Penetrating Radiation from the Earth's Surface.—RUTHERFORD AND COOKE.—A Phys. Soc'y paper referring to an observation of Rutherford that the radiations from the naturally radioaction bodies and also the excited radiations, include some rays of an extremely penetrating character, which are able to pass through great thicknesses of matter. Since the excited activity obtained from the atmosphere is very similar in character to the excited radiations from thorium and radium, it was thought possible that some penetrating rays might be given off from the surface of the earth and walls and rooms on which excited activity from the air is distributed. This view was confirmed by experiments in which he found that about 30 per cent. of the ionization inside a closed vessel is due to an external radiation of great penetrating power. This radiation appears to come equally from all directions and is probably due to excited activity from the surface of the room in which the observations were made.—*Phys. Rev.*, March.

Electric Conductivity of Atmospheric Air.—MCLENNAN AND BURTON.—An account of some experiments on the electric conductivity of atmospheric air. From experiments of previous investigators it seems probable that the earth's surface, and possibly, too, the materials used in the construction of the apparatus used for such experiments, are sources of emanation. The authors have made a series of observations upon atmospheric air confined in air-tight vessels of different metals. The result of the investigations showed that the conductivity of the enclosed air depends very largely upon the material of which the receiver was made, and the effects observed would seem to indicate that all metals in varying degree are the sources of a marked though feeble radioaction emanation.—*Phys. Rev.*, March.

Lagrange's Equations and Electric Currents.—DAY.—A note presented to the Am. Phys. Soc., on the problem taken up by Maxwell, of applying Lagrange's equations of motion to the phenomena of electric currents. In treating this problem Maxwell found that the question arises whether a wire would experience a sudden impulse in the direction of its length, when a current was suddenly started or suddenly stopped in the wire; he stated that no evidence of the existence of such a term has ever been discovered. The present author shows that starting from the same basis, one may ask another question, namely whether a wire would experience an impulsive torque when a current was suddenly started or stopped in it. He made an experiment in this direction, but could not find that such an effect exists.—*Phys. Rev.*, March.

Coherer.—TAYLOR.—An account of a long series of experiments with the coherer in which he reaches the following conclusions: The coherer may give either of two distinct types of curves, depending upon the applied voltage, the amount of ballasting resistance, the strength of the current, the amount of oxidation of the contacts, and the influence of electrical disturbances. When in a condition to give one of these typical curves, the coherer is most sensitive, and will show either positive or negative coherer action to very nearly the same degree. The coherer is easily sensitive to changes of contact distance of the order of a ten-millionth of an inch, as well as to electrical and mechanical disturbances of exceedingly small magnitude. The order of distance to which the coherer is quite sensitive, shows that the single-contact coherer really has no practical existence; what has been called a single-contact coherer is in reality a coherer of many contacts. On account of the variable potential, and consequent variable electrostatic attraction, it is not likely that the distance and voltage curves represent very closely the true relations between those two quantities. Still, these curves show considerable similarity, and in accordance with the assumption of many parallel pairs of contact elements, they show a variable rate of increase of voltage with distance, the curve getting steeper as the contacts are pulled apart, and fewer contacts come into play. The theory of the coherer is far from complete and there is no theory which satisfactorily explains all the different phases of coherer action. The author explains many of the coherer phenomena on the basis of the assumption of parallel elements of contact surface.—*Phys. Rev.*, April.

Hysteresis.—GUYE AND HERZFELD.—An account of an investigation made to determine whether the hysteresis loss per cycle depends on the frequency; the result is negative, the loss being found to be constant up to a frequency of 1,200 cycles per second.—*Comptes Rendus*, April 20.

Magnetic Effect of Electric Convection.—CREMIEU AND PENDER.—An account of the final results of a joint investigation made by the two authors, who had formerly arrived at opposite results in independent researches. The present result is in favor of Maxwell's theory and the probable error which caused Cremieu's previous negative results, is shown.—*Comptes Rendus*, April 20.

REFERENCES.

Pressure Due to Radiation.—NICHOLS AND HULL.—An abstract of an Amer. Phy. Soc'y paper in which they give an account of more recent and more accurate measurements of radiation pressure in comparison with measurements of radiant energy. The results are in agreement with the Maxwell-Bartols theory to within about 1 per cent. A demonstration of the effect of radiation pressure upon the torsion balance used in the experiments, was made before the society. —*Phys. Rev.*, March.

Magnetic Moment.—BECK.—A description of some experiments on the effects of certain mechanical changes upon the magnetic moment of a bar magnet. The effects of bending, twisting and concussion are discussed and the results are given in tables and diagrams. —*Phys. Rev.*, April.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemistry in the United States.—HABER.—The first part of a report to the German Bunsen Society for Applied Chemistry on the industrial development of electrochemistry in this country and on the methods of teaching electrochemistry in our universities. He points out the differences in the industrial development in the European countries where the old type of culture exists and in a new country like the United States. In the former an increase of wealth of the nation depends upon larger refinement of engineering skill and upon progress of scientific knowledge; it is a development "in depth" rather than "in breadth." The latter is the characteristic feature of the new country which applies to the achievements of the older countries to the utilization of undeveloped wealth. He believes that the period of the general influence of Germany on the chemical industrial development in the United States has now about passed, and the branches of inorganic chemistry in the United States have become or are becoming independent. Metallurgy has long become independent, and in the size of plants, the development of machinery and the output of metals, it has generally surpassed Europe. The American manufacturer does not consider research work as a necessary supplement to the regular operation of his plant, while the German manufacturer generally employs a certain number of chemists who do research work, the results of which are not felt by immediate improvement of the income of the factory, but only by possible results, hoped for in the future. He discusses at length the study of electrochemistry and of physical chemistry in American universities, and gives a general comparison of American and German universities; the student entering a university in the United States has had by far less scientific education than in Germany. On the other hand, in American boys a certain technical intuitive power is developed to a remarkable and much greater degree than in German boys; in this respect the workshops in high schools, manual training schools, and universities, have an important influence. From the German point of view, the education in chemistry in American universities appears "superficial and practical." From the American point of view, the education in chemistry in German universities appears "thorough and impractical." He emphasizes the importance of physical chemistry to the inorganic chemist; as it is not a special branch of chemistry, it presents the only general method by which the chemist should think. He then discusses the industrial development of electrochemistry in the United States. California is not yet "ripe" for electrochemical industries, although there are good prospects for electrolytic copper refining in the northern part of the State and for the electrolytic mining of tin from scrap tin in the southern part; as the price of zinc is high, the precipitation of gold from cyanide solutions by means of the electric current also appears promising. It would be wrong to assume that the enormous developoment of the industries and engineering in general in the United States has been due to water power developments; the increase of steam power has been much greater since 1870 than the development of water power. Concerning the cost of generating electrical energy by steam power, he states among other things that the cost of the electric horse-power hour, produced by steam power, is about 1 to 1.25 cent for a greatly varying load curve and discontinuous operation, but that for absolutely continuous operation with uniform load the cost is much smaller, and may be as low as 0.25 cent per horse-power hour. Canada is even richer than the United States in water powers which can be cheaply developed. He gives data concerning the amount of power used by the different electrochemical concerns in Niagara. He thinks that for the power used in the two plants of the Pittsburg Reduction Company, 15,500 hp is nearer the truth than 10,500, as given by Dr. J. W. Richards; the company itself declines to give the exact figure. He gives descriptions of the processes used by the Union Carbide Company and the Pittsburg Reduction Company, at Niagara; the manufacture of ferro-chronium by the Wilson Aluminum Company, in Kanawha Falls, W. Va., the manufacture of silicon copper by the Cowles Electric Smelting & Aluminum Company in Lockport; and the Acker process in operation at Niagara. The success of the Acker process is said to be technically perhaps the most unexpected; the voltage is higher than in other process, but the current efficiency is better than in any other known process for alkali and chlorine. The durability of the apparatus is said to be fully satisfactory, and if this be found to be the case in the future, the process would have all chances of becoming the standard one on account of its simplicity and elegance if there was not the high power consumption. In any case the success is to be considered as a remarkable technical achievement.—*Zeit. f. Elektrochemie*, April 16, 30.

Action of Hydrochloric Acid in Various Solvents upon Metals.—PATTEN.—A paper in which he first refers to the opinion, often expressed that there cannot be any chemical action except between ions, and that the presence of water or moisture is an essential condition for enabling a chemical action to go on. Kahlenberg, however, has shown that the oleates of copper, nickel and cobalt dissolve in benzine to form non-conducting solutions and that dry hydrochloric acid gas precipitates instantly the chlorides of these metals; he also found similar and analagous reaction. To further study the action of chemicals upon each other in solutions in which the conduction of electricity is extremely slight, the present author has dissolved gaseous hydrochloric acid in various solvents and brought the resulting solutions into contact with a number of metals and carbonates. From this it appears that the presence of water is not a necessity in order that chemicals may react upon each other; a chemical system need not conduct electricity electrolytically in order that chemical action takes place. There is an interesting appendix to this paper, referring to a statement of Remsen that he had been unable to get hydrogen by acting upon dry zinc with hydrogen chloride dissolved in dry benzine; this is in contradiction with Kahlenberg's results: the present author shows that Remsen's failure was due to the fact that moisture was not excluded in his experiments. Kahlenberg's results are confirmed.—*Jour. Phys. Chem.*, March.

Electrolysis of Water.—WHITNEY.—A paper referring to the recent investigation of Bigelow on the continual electrolysis of water at voltages below the decomposition value. He thinks that a strict application of the Nernst formula for e.m.f. of polarization would explain all the phenomena observed and described by him without the necessity of introducing any new corpuscular hypothesis. Whenever a very small e.m.f. is applied, too small for visible electrolysis, there immediately occurs at least such an amount of real electrolysis as is capable of changing the poles into electrodes whose characteristic e.m.f. is equal and opposite to the impressed e.m.f. The earliest experiments on polarization point to this as a fact. In the case of an aqueous solution, the gases when dissolved in the electrolyte are capable of depolarizing the electrodes, especially the hydrogen; the oxygen electrode and a current at very low voltage seems a necessary result, which should depend largely on diffusion and convection, as the actually studied current evidently does. The quantity factor of the electrical energy necessary to decompose the water is the constant of Faraday's law, but the intensity factor by which this must be multiplied to give the energy necessary, is the e.m.f. of polarization. This, in accord with the Helmholtz Nernst conceptions, is a function of the concentration at the active electrodes. He claims that Bigelow's experiments support this view.—*Jour. Phys. Chem.*, March.

The Disintegration of the Anode.—WOHLWILL.—A very long paper on the phenomena of the disintegration of the anode. The formation of the anode slime in electrolytic refining is mainly due to the non-uniform composition of the anode, but even when an absolutely pure and uniform copper anode is used in pure sulphuric acid, there is a formation of a fine red powder on the anode, which he claims must be a precipitate from the electrolyte. He gives a long list of facts which support his theory.—*Zeit. f. Elektrochemie*, April 23.

REFERENCES

Electrolytic Oxidation of Aromatic Compounds.—SEBOR.—An account of some experiments in which he investigated the conditions under which aromatic compounds can be oxidized electrolytically. A high current density should be used, but the current is nevertheless small.—*Zeit. f. Elektrochemie*, April 30.

The Dissociation Constant and Identity and Purity of Organic Compounds.—SCUDDER.—An account of a long investigation of the reliability of the dissociation constant as a means of determining the identity and purity of organic compounds. He concludes that it is a moderately reliable aid to identification, but its use is limited.—*Jour. Phys. Chem.*, April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Damped Ballistic Galvanometer.—STEWART.—A paper in which the author states that the theory of the ballistic galvanometer as usually presented assumes either that there is over damping or that it is small. Consequently there is a general impression that a well-damped ballistic galvanometer cannot be used to measure or to compare quantities of electricity; yet it has been shown experimentally that such a galvanometer can be used; when used in determinations of magnetic induction no appreciable errors have been detected. The author gives a mathematical theory of the damped ballistic galvanometer and shows that the throw in a galvanometer whose motion is aperiodic, is directly proportional to the quantity of electricity, and, therefore, conforms to the general rule of undamped ballistic galvanometers. This result is obtained under the assumption that the damping force is directly proportional to the velocity; if the damping is due to induced currents, no matter where, this is strictly true; in the case of air damping it is approximately true. He also assumes that the force of restitution is proportional to the angular deflection. This for the movable needle type is true only for small deflections, but for the d'Arsonval galvanometer, it is not so restricted. He shows that in an aperiodic d'Arsonval galvanometer the throw is approximately independent of the moment of torsion of the suspension strips. This is of some practical importance, as it often happens that in low-resistance galvanometers of this type, the suspension strips have as great and sometimes greater resistance than the coil itself. When this galvanometer is intended for ballistic work with an earth inductor or in electromagnetic experiments when the damping is necessarily great, the galvanometer being used on closed circuit, a considerable gain may be had by not making the strips so small. In a well-damped galvanometer the principal agent in overcoming the velocity imparted to the needle and thus limiting the throw, is not the earth's field or the torsion of the suspension, but the damping. The author concludes that in all the determinations of magnetization curves and hysteresis loops by the ballistic method, a great deal of time may be saved by using as the ballistic galvanometer an ammeter without its shunt or a voltmeter without its series resistance.—*Phys. Rev.*, March.

Use of Meters.—An abstract of the report of a committee, appointed by the Professional Syndicate of Electric Stations, on the use of meters in the systems of French central stations. The report gives a summary of the replies receive to inquiries sent to the different central stations. For direct current, motor meters are universally used. The meters are tested at different intervals by the different stations, these intervals varying between one month and two years; in some stations they are tested only upon a complaint of a customer. The replies received concerning starting and exactness were rather uniform; they indicate that a meter starts at about one-fiftieth of its normal power and that the accuracy is about one-twentieth of this power. The use of the O. K. (O'Keenan) meter is less general than that of the Thomson meter; but the former seems to be considered to be more sensitive. Concerning alternating-current meters, less replies were received. The following types are in use: Batault, Blathy, Japy and that of the Creil Company. The meters are said to register the wattless current at a power factor above 0.6 to 0.8; some are said to be exact for a power factor of 0.3. They are practically independent of the variations of e.m.f., and of the wave form. Nothing is said on the influence of the frequency.—*L'Ind. Elec.*, April 25.

Measuring Very Low Resistances.—Rennie.—A communication in which he comments on a method recently described and in use in the German Reichsanstalt for comparing very low resistances, and which he thinks is too complicated. He is of the opinion that a more promising method for this important class of measurement will be found on the lines of the differential galvanometer method. The present form of the Cranley arrangement has shown itself amply capable of giving results to 1 in 10,000, while an accuracy of 1 in 1,000 is easily obtained. It is, therefore, thought that it is in the direction indicated by the differential galvanometer that progress is to be sought.—Lond. *Elec.*, May 1.

REFERENCES.

Electric Micrometer.—Shaw.—A detailed illustrated description of an electric micrometer for laboratory use. It reads in units of 0.001 mm or 1 micron, the error being, under favorable conditions, not more than ½ micron. The scale is very long, the range being from 1 to 40,000 microns or more. The applicability of the instrument to various measurements is described.—*Phys. Rev.*, March.

Telegraphy, Telephony and Signals.

Wireless Telegraphy at the Sea Coast.—Sharman.—A communication in which he points out that there is at the present time a large and very useful field for the immediate application of wireless signalling over moderate distances for the prevention of wrecks along the seacoast. He remarks that the "effective range" of a wireless telegraphy station varies from time to time even when the utmost care is taken to eliminate all instrumental irregularities; apparently it depends upon certain obscure atmospheric conditions. While the Morse alphabet is useful in all signalling operations, he prefers another system for the purpose of preventing wrecks; he proposes to install the apparatus on a dangerous island or headland; some simple combination of impulses is taken to serve as a code abbreviation for the name of the danger point, for instance by the letter *i*, represented by two dots; these are transmitted automatically at the commencement of every minute by the action of a cam operated by clockwork; automatically the transmitter is connected first to a vertical wire of great length, representing transmission over a zone of five miles, then to a shorter air wire, representing transmission over a zone of three miles, and then to a still shorter air wire, for transmission over only one mile. When a ship is within five miles near the danger point, it receives the letter *i*, once at the commencement of a minute, while it receives it twice or three times, when at a distance of three miles or one mile respectively. In this system the dot combination (or letter) indicates the name of the danger point, and the number of times this combination is received at the commencement of each minute, indicates the approximate distance from the ship to the danger point. The manner in which the character of the signals change as the ship continues her course, serve to show whether she is going towards or away from the danger point.—Lond. *Elec.*, May 8.

REFERENCE.

Wireless Telegraphy and the Army.—Prasch.—An illustrated article on the applications of wireless telegraphy to the uses of the army.—*Zeit. f. Elek.*, May 3.

Miscellaneous.

Separation of Metals by Electrostatic Means.—Negresno.—A description of an experiment in which he connects a horizontal metallic disc to the positive pole of a Wimshurst machine, and the plate from which it was cut, to the negative pole. If a mixture of sand and finely divided metal is dusted upon them the sand is deposited chiefly upon the disc and the metal on the other plate. The method may be useful in the separation of metals from their ores, and also in the separation of two mixed metals; in a mixture of powdered brass and copper, for instance, the brass is repelled and deposited on the upper disc.—*Comptes Rendus*, April 20; abstracted in Lond. *Elec.*, May 8.

American Physical Society.—The minutes of all meetings of this society and abstracts of the papers read before it will hereafter be published in the *Phys. Rev.*; the publication of the bulletin of the society has been discontinued. An account of the Washington meeting held December 31, 1902, and January 1, 1903, is given in *Phys. Rev.*, March.

REFERENCE.

Engineering Education.—Dalby.—A paper read before the British Inst. Mech. Eng. on the education of engineers in America, Germany and Switzerland.—Lond. *Elec.*, May 1.

Biographical.—Benjamin.—An account, with portrait, of the life and work of Alexander Graham Bell.—*Sc. Am.*, May 2.

New Books.

Finances of Gas and Electricity Manufacturing Enterprises. By W. D. Marks, Philadelphia, Pa. 125 pp. Price, $1.

The author of this very entertaining and instructive little volume is well known as an engineer and central station manager. He has drawn largely upon his own experience, but has chosen to present some of the data in a rather unusual controversial form, which, to say the least, compels attention. The aim of the book is to show how much ought to be charged by a plant for gas and electricity to make the enterprise profitable, and this question opens up many others relative to the design of the plant and features of operation. Not only is data given with regard to one large city, but Prof. Marks discusses small lighting and railway enterprises from the standpoint of a searching analysis of all the conditions involved, and illuminates his subject very effectively. Even those who may not agree with his processes of reasoning can learn a good deal from his general and searching treatment of the subject. We are glad to note his insistence on a full allowance for depreciation, and may also signalize as worthy of study his remarks on meters and his commendation of hot water or exhaust steam auxiliary business. The dollar spent by any central station man for this pithy little book is well invested.

Annual Report of the Board of Regents of the Smithsonian Institute, 1901. Washington: Government Printing Office. 782 pages, illustrated.

The most interesting section of the Smithsonian Annual Report for the year ending June 30, 1901, is an account of the history to date of the Smithsonian Inistitution, accompanied by a number of well-engraved portraits. The reading of this, however, gives rise to a doubt if the purpose of the founder, "the increase and diffusion of knowledge," has been so served as to exert any considerable influence in advancing knowledge. At the time when the policy of the Institution was fixed it might have appeared that great good could be accomplished by the publication of original memoirs and their free distribution to important libraries throughout the world; in the giving of popular lectures in Washington, their publication and distribution to libraries and individuals; in the stimulation of scientific work by providing apparatus, and by making grants of money to worthy investigators; and in the co-operation with government departments in advancing work useful to the general government.

At the present day, however, it would seem that any aid that may be given by the Smithsonian Institution to any of these objects has become superfluous. Original contributions to knowledge can now be made through channels which lead to more immediate and wider publicity among those directly interested than through the occasional memoirs of the Smithsonian Institution—an advantage that cannot be balanced by the free gift of the latter publications. We are not aware of any popular lectures that have been given in Washington which have had an iota of the influence, for example, of those given before the Royal Institution of London and similar bodies. The magnificent equipment of modern universities, and, above all, the splendid Carnegie grant, furnish facilities for original investigation that minimize the function of the Institution, and the government scientific departments as now organized could doubtless be efficiently conducted without aid from the Institution.

In looking over the list of publications of the Smithsonian Institute during the year ending June 30, 1901, we find only a reference to a "Smithsonian Contribution to Knowledge," namely, a memoir on experiments on ionized air by Dr. Carl Barus, which is stated to be in the hands of the printer. In the "Miscellaneous Collections" there are noted a Bibliography of Chemistry, a paper by Langley and Very, entitled, "The Cheapest Form of Light"; a list of observatories, and two volumes comprising documents relative to the origin and history of the Smithsonian Institute, containing altogether 1083 pages. The other publications, aside from official reports, are reprints of articles from Smithsonian Annual Reports, the articles themselves being in almost every case belated reprints from other sources; and finally a number of publications of government departments issued under supervision of the Smithsonian Institution.

The present annual volume comprises, aside from the report of the secretary, about 600 pages, containing about three score articles which, with very few exceptions, are reprints of articles that appeared in 1901. Among these are a number on physical subjects, as follows: A reprint of a Royal Institution paper by Prof. Poynting, entitled, "Recent Studies in Gravitation"; a reprint from the *Phylosophical Magazine* of a paper by Lord Kelvin on "Ether and Gravitation through Infinite Space"; a reprint from the *Popular Science Monthly* of an article by Prof. J. J. Thomson, entitled, "On Bodies Smaller than Atoms"; a reprint from the *Revue des Deux Mondes* of an article by A. Dastre, entitled, "The New Radiations: Cathode Rays and Röntgen Rays"; a reprint from the *Proceedings* of the Royal Institution of a paper by Marconi on "Wireless Telegraphy"; a reprint from *Everybody's Magazine* of the article by Prof. W. A. Anthony on "Transatlantic Telephoning"; a reprint from the *Transactions* of the American Institute of Electrical Engineers of the paper by Mr. W. J. Hammer on the "Telephonograph"; a reprint from the *Popular Science Monthly* of a paper by Prof. Glazebrook on "The Aims of the National Physical Laboratory of Great Britain"; a reprint of a paper read by Walter Hough before one of the 1900 Paris congresses, entitled, "The Development of Illumination"; a paper read by Prof. S. P. Langley read before the Philosophical Society of Washington, entitled, "The Laws of Nature"; and an address, reprinted from a Johns Hopkins University *Circular*, by Prof. Mendenhall in commemoration of Prof. Henry A. Rowland.

As with scarcely an exception the papers above mentioned, as well as most others in the Annual dealing with other branches of science, received wide publicity at the time of their delivery in publications much more accessible than the Smithsonian Annual, to reprint them in the latter two or more years later appears to involve a waste of effort.

How to Become a Competent Motorman. By Virgil B. Livermore and James Williams. New York: D. Van Nostrand Company. 232 pages, illustrated. Price, $1.00.

This is one of the practical volumes and deals with the electric street car motor in much the same fashion that the numerous catechisms on the locomotive deal with that form of prime mover. In many respects, to use a trite expression, the book fills "a long-felt want," for there is very little literature that the would-be motorman can obtain as a guide to the practice of his art. To meet this deficiency, the prominent electric railway companies are establishing schools for the training of motormen, and while it is impossible for any written presentation to compare with ocular and practical instruction, this little volume forms a handy memorandum, will supplement demonstrations, and become a valuable pocket companion.

The book is divided into a series of sections that hardly have the continuity of chapters. These sections deal with the various methods of street car control, and minutely describe the operation of the controllers and other pieces of apparatus for manipulating electric cars. This portion occupies about one-third of the volume. Then comes a very exhaustive and complete set of rules concisely setting forth the best method of procedure under all of the emergencies of which the authors can conceive.

Finally, the volume gives diagrams showing the circuits and paths of current, through all the best forms of controllers, under all circumstances. The book then concludes with a catechistic set of questions and answers relating to the operation of electric cars. The fact that the authors are practical men, who have written from a standpoint of the front platform, lends authority to the work.

BOOKS RECEIVED.

La Traction Electrique: Tramways, Locomotives et Metropolitains Electriques. Par Paul Dupuy. Paris: C. Naud. 495 pages, 264 ill. Price, 12 francs.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. General meeting, Niagara Falls, June 29, July 3. Programme printed elsewhere in this issue.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association. F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. ext meeting, Atlantic City, N. J., September 2, 3 and 4, 1903.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

National Electric Light Association. Secretary, James B. Cahoon, 136 Liberty Street, New York.

New York Electrical Society. Secretary, G. H. Guy, 104 Liberty Street, New York.

Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association. Secretary, E. W. Pichardt, Huntingburg, Ind.

Weston Employees' Club.

On the evening of May 22 the Weston Electrical Instrument Company tendered an inauguration reception to the Weston Employees' Club, the occasion being the formal opening of the new club rooms at the company's plant at Waverly Park, Newark, N. J. There were about 1,000 gentlemen and ladies present, and the affair was marked with cordiality and good-fellowship throughout.

The evening's entertainment consisted of some excellent instrumental and vocal music followed by a dance which lasted well into the early hours of Saturday. An elaborate banquet was served at midnight. Towards the end of the musical programme Mr. Edward Weston, president of the company, made an address in which he dwelt upon the importance of establishing closer relations and a better understanding between officers and employees of industrial concerns. "Very often," he said, "the employers and employees are at odds because no effort is made by either to understand the other. With a view to bringing these two interests of his company into closer contact and thus promote harmonious relations between them, the Weston Company had encouraged and aided the employees in forming and establishing this club. He explained, however, that it was not wise for the manufacturer to go outside of his business to take up matters belonging to the worker. This fact led to the adoption of a plan whereby the administration of the affairs of the club would be entirely in the hands of the members themselves, the company providing the rooms and retaining only its building rights.

Mr. A. O. Benecke, chief electrician of the company, in behalf of the employees, thanked Mr. Weston for his interest in their behalf and assured him that the feeling was reciprocated. In closing his remarks, he presented Mr. Weston with a massive silver loving cup as a token of the esteem with which he is held by the employees.

Mr. Weston found it difficult to control his emotions when he arose to receive the gift. After expressing his thanks, he gave an interesting account of the company's development from its beginning to the present time, and concluded by paying a compliment to the skill of American engineers and workmen in successfully solving the many difficulties encountered in the development of the company's products, which are now used in every civilized country on the face of the globe.

For club purposes the company has provided two entire floors of a large four-story brick building. The floors are 200 ft. long x 38 ft. wide, and are completely furnished and equipped for their special uses. The dining room has a seating capacity for 300 persons, when it is proposed to furnish meals to the employee-members at just sufficient profit over actual cost to keep the club running.

The dining room on the occasion of the reception contained three long rows of tables, running its entire length, with a break here and there. Along the center of each row of tables was laid an Elblight lamp, with vari-colored lamps, and at the breaks in the long tables the strips were carried over the gaps in the form of an arch, sufficiently high to permit a person to pass under. When the current was turned on the effect was very pretty. This hall, as well as the reception and dancing hall, was decorated with festoons of Elblight streamers and profusely draped with flags and banners. The electrical decorations of the side rooms, which were temporarily utilized as part of the banquet hall, were particularly effective. In the center of the tables were large bouquets of artificial flowers studded with electric lights which gave a warm glow to the surroundings.

One of the features of the club's quarters is the bathing pool, said to be the largest indoor bath in the country. It is 150 ft. long and about 15 ft. wide. It is fitted up in the most approved manner.

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Ferro-Manganese Plant in Canada.

A bill has been agreed to by the Legislature of New Brunswick to incorporate the Electro-Manganese Company, with a capital of $1,500,000, and power to increase this capital to $10,000,000. The incorporators are Barton E. Kingman, New York; Fred. C. Sayles and Robert S. Sayles, Providence, R. I.; Harry McLaughlin, New York, and Mattew W. Lodge, of Moncton, N. B. They propose to reduce wad, or bog ores, which abound in the Province of New Brunswick, and from these ores obtain ferro-manganese and spiegeleisen, with the ultimate idea of establishing a steel plant. They have a process of reducing the ores by electricity, and claim that for the first time it has been found this can be done on a commercial basis, but a great water power and a large electric plant are required. For this purpose, therefore, they wish to be granted by the government the use of the immense water power at the Grand Falls, on the St. John River, where they will erect a big plant. The company, it is stated, has concluded arrangements for establishing at Shawinigan Falls, Que., works for the production, on a large scale, of ferro-manganese. The contract calls for the delivery to the company by the Shawinigan Water & Power Company, of electrical power to the amount of 5,000 hp. The necessary plant will be installed at once, and to facilitate the operations of the company during the construction of permanent works, a temporary arrangement has been made with the Shawinigan Carbide Company, to operate in a part of the latter company's buildings. This will allow the Manganese Company to begin production in July next. The initial installation will employ 1,200 hp. and the output will be sold to manufacturers of steel, both in Canada and the United States.

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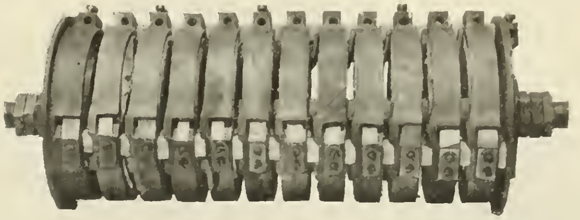
Ventilated Cell Diverter.

The "Ventilated Cell Diverters" manufactured by the Westinghouse Electric & Manufacturing Company are designed to express the latest and best ideas in this form of electrical apparatus, answering the demands for capacity, insulation, durability and economy of cost, while maintaining good mechanical design and features. The individual cells are separated, permitting a free circulation of air around each cell, and may easily be renewed if injured or worn out. Solid insulating blocks are placed between the cells, and solid insulating washers under the nuts at the ends of the columns. The end of the resistance strip is brought out through a slot in the cell casting and connected to a boss by means of a washer and two screws, giving the contact great permanency and rendering it unaffected by long exposure to severe climatic conditions. The whole apparatus is both compact and durable, arranged in several units for convenience in mounting, and adapted for all kinds of outdoor service, no material of either a hygroscopic or a combustible nature being used in the construction.



VENTILATED CELL DIVERTER.

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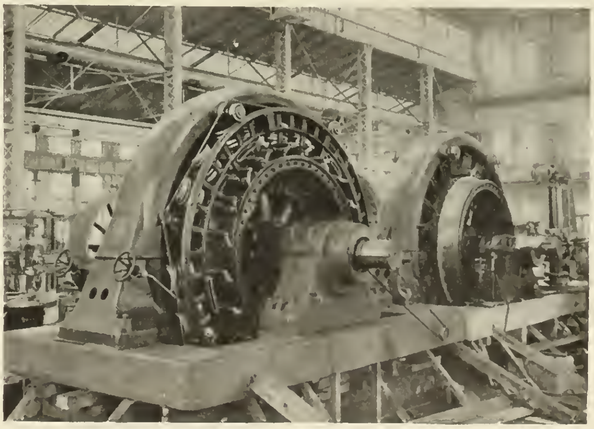
Bullock Generators for Massena.

The accompanying illustration shows two 2,250-kw direct-current generators now being built by the Bullock Electric Manufacturing Company for the Pittsburg Reduction Company and are to be installed at Massena, N. Y. Four machines of this size and type are being made for this company. They have double commutators and are to be driven by water wheels. They will operate at 140 r.p.m. and develop 500 volts. In the tests made, the machines were speeded up to 280 revolutions and at this speed the commutators had a peripheral speed of 7,500 ft. per minute. Notwithstanding this severe test, no faults were developed.



GENERATOR FOR MASSENA.

A New Telephone Receiver.

The Holtzer Cabot Electric Company, of Boston, Mass., is placing upon the market a new telephone receiver, views of the parts of which are shown in Fig. 1 The shell is made in two parts, the body of the shell and the cap. Following the latest practice, binding posts have been discarded The terminals are entirely enclosed inside the shell, making a perfect electrical connection and doing away with the danger of the user receiving a shock, while the cord, which is in all cases supplied with the receiver, is given a substantial hitch about the yoke of the magnet in such a way that no strain can come on the connections. Thus the life of the cord is greatly extended, while the work of renewing the cord is very slight

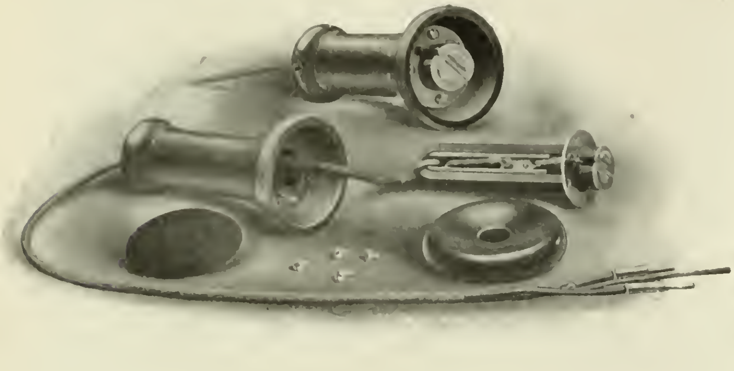
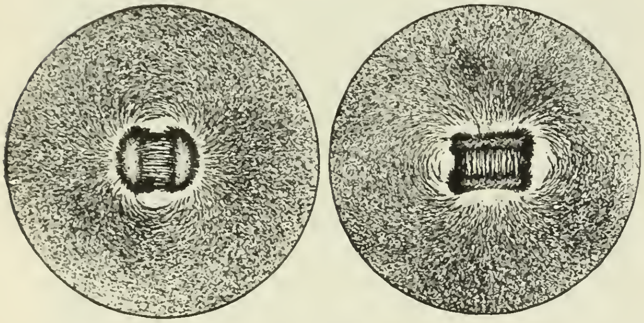


FIG. 1.—RECEIVER DISSEMBLED.

The permanent magnets are of a special grade of magnet steel while the pole pieces are of the softest Norway iron. It will be observed that the construction is bipolar. The pole pieces being semi-circular in section, give a more efficient distribution of the magnetic lines than is possible in a receiver in which the section of the pole pieces is rectangular. This point is well brought out in Figs. 2 and 3. These diagrams were made by covering thin diaphragms with iron filings and holding them over the poles of the magnets. By gently tapping the diaphragm the iron filings were caused to arrange themselves in position showing the direction and intensity of the magnetic lines in the region of the pole pieces. Fig. 3 shows the arrangement of the distribution in a field in which the pole pieces are rectangular and Fig. 2 in which they are semi-circular.

The adjustment feature has been omitted entirely and the receivers are permanently adjusted before leaving the factory. This is claimed a distinct advance in receiver construction; only one adjustment is necessary and this should be made by the manufacturers.



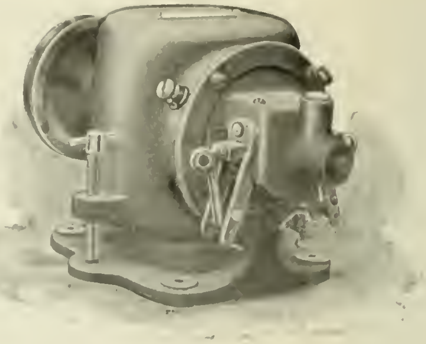
FIGS. 2 AND 3.—MAGNETC SPECTRA.

The magnets are wound with silk-covered magnet wire, and corrosion is prevented by nickel plating all exposed parts. In connection with the unusually strong magnet a heavy diaphragm is used, making an extremely sensitive instrument and one that will respond perfectly through a wide range of conditions of transmission. These instruments are carefully standardized and are made with tools, jigs, etc., so that all parts are interchangeable. The receiver is made with either pure hard rubber or composition shell.

Gas Engine Igniting Apparatus.

The accompanying illustration shows a new form of gas engine igniter, which it is claimed to posses a great many advantages over other forms, among them being the use of a device for tightening the belt by means of which the dynamo can be rocked in either direction or held rigidly in position. This consists essentially of a cradle casting in which the dynamo is suspended and two thumb screws which enable the dynamo to be rocked in either direction to tighten or loosen the belt as the case may be. It will be noticed that the brush holders are readily accessible and may be removed from the dynamo by simply pulling out the brush holder fingers. It is not necessary to remove any screws in so doing.

The dynamo proper is entirely enclosed and is both water and dust-proof. There is no joint in the magnetic circuit, the entire machine being cast in one piece with the exception of the front bearing, which is removable. The commutator is of copper insulated with mica. The brushes are of carbon of rectangular cross section, and may be slipped into the holders from the outside by pulling back the brush-holder fingers. Access to the commutator is had through a small opening directly above it which is closed by means of a brass cover plate. The speed of this igniter is 1,200 r.p.m. This igniter is being put on the market by the Carlisle & Finch Company, Cincinnati, Ohio.



GAS ENGINE IGNITER.

Extensive Electrical Equipment for North German Lloyd Docks.

Considerable electrical equipment is now being installed in the new North German Lloyd docks at Hoboken, N. J. Ten electric hoisting engines are already in use on one section of the docks just completed and twenty more are to be used on the other two sections now under construction. The hoists just installed consist of four double-drum outfits of 40-hp capacity each, operated by General Electric motors. They are to be used for handling coal. Six 27-hp single-drum double-winch machines, also operated by General Electric motors, are also in use for handling cargo. The hoists were built by the Lidgerwood Manufacturing Company. Each machine is protected by a circuit-breaker located on the machine and also by an additional switch located on the ceiling. All operate at 500 volts. This is the most extensive electrically-driven hoisting equipment so far installed in American docks.

Ten electric elevators for passenger and baggage use are also being put in. They will be driven by 25-hp motors built by the General Electric Company. The elevator contract was secured by the Otis Elevator Company.

For the purpose of lighting the docks, 500 6½-amp. arc lamps and 500 incandescents of 16 cp are to be used. The lamps will be supplied by the United Electric Company of New Jersey, which at present furnishes energy for lighting and operating the machinery on the docks. The wiring contract has been allotted to E. A. Brennan & Co., Hoboken.

Ultimately the North German Lloyd Company intends to build its own plant for generating current for dock work. The capacity of the plant will be about 1,000 hp. W. F. Whittemore, 1 Newark Street, Hoboken, N. J., is consulting engineer for the North German Lloyd Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a good demand for money and a fairly liberal supply, the closing rates being 3½ a 4 per cent. for 60 to 90 days, and 4 a 5 per cent. for four to eight months. On the stock market there was a slump of prices in the middle of the week, due to fears of trouble to speculative interests arising from the manipulation of cotton and the severe breaks in Canadian stocks. This was, however, followed by a rally and renewed strength. The market did not fail to notice the further reduction in iron prices and the continuance of unsettled conditions in the labor situation. Among the industrials, the United States Steel securities took the lead and there was more or less liquidation in both common and preferred on the further decline of iron prices and the fact that the bond issue plan has proved to be a qualified success, only $150,000,000 of preferred stock, including the $80,000,000 to be supplied by the syndicate, having been tendered for exchange. Amalgamated Copper was steady in the face of the decline of the general market, but was not prominent in the trading. Tractions were weak and closed at the lowest figures, Brooklyn Rapid Transit losing 1½ points net, and Metropolitan ⅝, the closing quotations being 62½ and 129 respectively. General Electric dropped to 182½ but recovered, closing at 183¾, this being a net loss of 1½ points. Westinghouse rights sold between 7⅛ and 7, the latter being the closing quotation. Western Union was weak and dropped from 84¼ to 83, which was the closing price, being a net loss of 1½ points. American District Telegraph lost 3 points, closing at 30. The following are the closing quotations of May 26:

NEW YORK.

	May 19.	May 26		May 19.	May 26
American Tel. & Cable	78	75	General Electric	185¼	183⅛
American Tel. & Tel	154	153	Hudson River Tel	..	..
American Dist. Tel	30	29	Metropolitan St. Ry	130	129¾
Brooklyn Rapid Transit	64¼	61⅝	N. E. Elec. Veh. Trns	..	.
Commercial Cable	..	.	N. Y. & N. J. Tel	..	. .
Electric Boat	20	20	N. Y. E. V. T. Co	7	6¼
Electric Boat pfd	40	39	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1¼	1¼	Western Union Tel	84	82¾
Electric Vehicle	9	8½	Westinghouse com	196	190
Electric Vehicle pfd	15	13½	Westinghouse pfd	196	190

BOSTON.

	May 19.	May 26		May 19.	May 26
American Tel. & Tel	154½	154¼	Western Tel. & Tel. pfd	95	95
Cumberland Telephone	..	..	Mexican Telephone	1⅞	1¾
Edison Elec. Illum	..	..	New England Telephone	137*	136*
General Electric	..	.	Westinghouse	97	94
Western Tel. & Tel	19	17⅛	Westinghouse pfd	98	94

PHILADELPHIA.

	May 19.	May 26		May 19.	May 26
American Railways	..	..	Phila. Traction	96¾	96½
Elec. Storage Battery	74*	74*	Phila. Electric	6½	6¾
Elec. Storage Battery pfd	74*	74*	Pa. Electric Vehicle	..	..
Elec. Co. of America	8¼	8¾	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	May 19	May 26		May 19.	May 26
Central Union Tel	..	..	National Carbon pfd	95	95
Chicago Edison	..	..	Northwest Elev. com	..	..
Chicago City Ry	205	200½	Union Traction	4½	3½
Chicago Tel. Co	..	..	Union Traction pfd	32	32½
National Carbon	24	23¾			

*Asked.

UNITED GAS IMPROVEMENT RUMORS.—The *Philadelphia Press* says of the rumored retirement of Mr. P. A. B. Widener from the United Gas Improvement Company: "Mr. Widener's retirement will mean another step toward the wide separation of the famous Widener-Elkins-Dolan syndicate, which is unquestionably the richest and most powerful aggregation of street railway men in America or the whole world. For years this coterie of millionaires has dominated the traction systems in Philadelphia, New York, Chicago, Pittsburg and Washington. It has for years been the ambition of Mr. Widener to have all the gas, electric lighting and street railway business of Philadelphia consolidated in one huge corporation. John M. Mack, who secured the rapid transit franchises, and who was largely interested in the electric light plants here, also favored that gigantic project. But Thomas Dolan opposed it most effectually. That caused some disagreement. Mr. Dolan refused to go on the rapid transit board. Widener and Mack then retired as directors from the Philadelphia Electric Company, and as Dolan's friends control United Gas Improvement, Widener's proposed retirement from the board of that company is a natural sequel to the campaign of differences. Dolan, Morgan and Bodine have gone ahead with gas and street railway enterprises all over this country. They own upward of forty corporations through the United Gas Improvement Company, which is regarded as a most successfully managed concern. Mr. Dolan prefers to keep this vast system of gas, electric and railway plans separate from other alliances."

JERSEY LIGHTING AND TROLLEY MERGER.—Official announcement is made that 86 per cent. of the entire outstanding stock of the five companies in the new $25,000,000 Public Service Corporation of New Jersey has been deposited in favor of the plan. The plan was declared operative a fortnight ago, and former Attorney-General McCarter, of New Jersey, who resigned to become president of the Public Service Corporation, is now ready to assume charge. The first act of the new company will be to issue $10,000,000 of stock for cash at par. It will reserve $15,000,000 for future requirements, to be issued at par and expended for betterments and extensions. This big consolidation of transportation and lighting companies in Passaic, Hudson, Bergen and Essex counties has as subsidiary companies the North Jersey City Street Ry. Co., Jersey City, Hoboken and Paterson Street Railway; Orange and Passaic Valley Railway; Elizabeth, Plainfield and Central Railroad Company, and the United Electric Company of New Jersey. For all these it will issue certificates aggregating $20,200,000. Negotiations are now pending for the leasing of the Essex and Hudson County Gas Company, Paterson and Passaic Gas and Electric Company, South Jersey Gas, Electric and Traction Company.

WESTINGHOUSE PROSPERITY.—It is noted from Pittsburg as a proof of the excellent future of electrical manufacturing that the business of the Westinghouse Electric & Manufacturing Company for last month was 160 per cent. greater than the company's business during April, 1902. With the $7,200,000 increased capital that the company will have from the sale of the $4,500,000 of stock to be issued at $80 there will be ample provision for a future continuance of the remarkable growth of the company's business shown by April's increase of 160 per cent. In investment circles there is a growing expectation that the electric company will follow the Westinghouse Air Brake Company's policy of the payment of extra dividends in addition to the 10 per cent. dividend basis already thought to have been decided upon. For some years the Air Brake dividends have been 2½ per cent. quarterly regularly and 3½ per cent. extra. The prediction, credited to Mr. Westinghouse, that electric will cross air brake is regarded as affording support for the expectation of extra dividends on electric before the year is out.

A DEAL BY THE UNITED GAS IMPROVEMENT.—Advices from Philadelphia state that the United Gas Improvement Company is engaged upon a deal involving the leasing of the American Light & Traction Company of New York with $40,000,000 capital. Negotiations have reached a point where auditors representing the gas company are examining the books of the other concern, and it will be upon the result of the examination that the terms of the lease will be negotiated. The question of terms has only been discussed informally, but it is understood that the controlling interests of the Light & Traction Company are willing to lease their property for an annual rental of 6 per cent. upon the entire capital. The Light & Traction Company, which was incorporated at Trenton on April 6, 1901, is a corporation similar to the United Gas Improvement Company, its object being to acquire control of other gas, electric and street railway companies, and to operate gas, electric light and power plants and street railways. While Philadelphia is not represented in the Board of Directors, a large amount of stock is held there.

KANSAS CITY CONSOLIDATION.—The conclusion of the transaction by which the recently formed $25,000,000 Kansas City Railway and Light Company takes over certain Kansas City properties was announced in Wall Street recently by the Equitable Trust Company, the depositary under the plan. The properties taken over were the Metropolitan Street Railway Company, of Kansas City, and the Kansas City Electric Light Company. The agreement provided for the exchange of 100 shares of the Metropolitan company for 100 of the preferred and 60 of the common of the new company, and 100 shares of the Kansas City Electric Light Company for 80 shares of preferred and 100 of common of the new company's stock. Under this, 32,140 shares of the railway and 18,414 shares of the electric light company stock have been deposited and exchanged. Interests connected with the transaction are understood to include the Armours, Blair & Co., and Kuhn, Loeb & Co.

CHICAGO TELEPHONE STOCK INCREASE.—The directors of the Chicago Telephone Company at a meeting on May 20 voted to issue $2,000,000 additional stock, which will raise the total outstanding to nearly $15,000,000, the full amount authorized. The new shares are to be offered at par to stockholders of record June 5. One-half of the amount must be paid in by July 1, and the remainder by October 1, and the company will allow interest at the rate of 5 per cent. on prepayments. This new issue will permit each stockholder to take one share for every six that stand in his name June 15. The proceeds of the new issue will be used in the extensions and improvements of the company's business in Chicago and the nearby cities in which it operates.

NEW WESTINGHOUSE STOCK.—With regard to the new issue of Westinghouse stock, a Pittsburg banker is quoted as follows: "At the price announced for the new Westinghouse Electric second assenting stock, $4,500,000 of which is to be issued at $80 per share, in the ratio of one new share for each four old ones, the rights on the basis of 105 would be worth but 6¼ per share. Buying the new stock at $80 would make the price of electric seconds to present holders on the basis of all their holdings, an even $100 per share. On the proposed 10 per cent. basis the stock is just a 5 per cent. payer, with the added attractiveness of the official statement of the directors that the company is earning over 20 per cent. on its outstanding capital."

RAILWAY CONSOLIDATION IN CLEVELAND.—The Cleveland Electric Railway Company, commonly called the "Big Consolidated," and the Cleveland City Railway, known as the "Little Consolidated," have agreed upon terms of consolidation. Both properties are to be taken over by a new company. The Big Consolidated has 136 miles of track and an authorized capital of $13,000,000 and the Little Consolidated 84 miles of track, with a capital of $9,000,000, of which $8,000,000 has been issued. The new company will probably be capitalized at $30,000,000. Senator Hanna will be the chairman of the Board of Directors. One of the immediate advantages of the consolidation will be the issuing of general transfers.

INDEPENDENT TELEPHONY.—Cleveland advices state that the stockholders of the Cuyahoga Telephone Company, one of the Everett-Moore syndicate properties, have voted to reduce the capital stock from $3,000,000 to $1,500,000 and to issue $1,500,000 preferred stock, the proceeds of which are to be used for extensions and improvements. From Canada it is stated that the thirty-million-dollar Merchants' Telephone Company will no longer confine itself to Montreal, but will establish connections through the Dominion in opposition to the Bell Company.

CONSOLIDATION IN COLUMBUS, OHIO.—The Columbus Railway & Light Company has been incorporated with $5,000,000 capital stock by W. P. Huntingston, R. S. Warner, Emil Keiswater, E. R. Sharp and F. W. Prentiss. The company will lease the properties of the Columbus Railway Company and the Columbus Edison Company, guaranteeing stipulated dividends on the stock of the two companies. It is generally believed that the Columbus Gas Light & Heating Company will be leased under a similar arrangement.

BOSTON LIGHTING DEAL.—The Edison Electric Illuminating Company has purchased the electric light and power plants and business heretofore conducted by A. W. Perry under the name of the Church Green Electric Company, which has supplied light and power to customers in the shoe and leather district. The negotiations were conducted by Whitcomb, Wead & Co.

ELECTRIC STORAGE BATTERY.—Application has been made to the Stock Exchange to list $15,795,700 common stock of the Electric Storage Battery Company.

Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing the general conditions the mercantile agencies note that while underlying conditions have improved as a whole, there is still room for betterment in weather, crop and labor matters. Retail trade has been stimulated by summer weather, but wholesale business halts pending further developments affecting fall trade. Collections have improved in a number of large cities. Railway earnings are as good as ever reported, the gross receipts for the first half of May indicating 14 per cent. increase over the same month last year, while the net returns for March show a significant increase of 16 per cent. on the corresponding increase in gross. The warmer weather has led to an almost magical change in reports from the South, and the cotton and corn crop there are coming on well with an unquestionable increase in the total acreage. Spring wheat reports are almost uniformly favorable and a bright prospect for fall trade exists in the Northwest. The labor situation is still a very mixed one and aggression by the men is being met by union among the employers. In the building trade at New York there is no improvement and the tie-up is quite general. Iron is drooping, largely because buyers are holding off on future purchases. Stocks do not accumulate, and consumers are insistent for deliveries on old orders. Steel is firm at the West, but resales of foreign steel at Eastern markets lead to an easier feeling in the market for billets. Finished products are in good demand. One of the less favorable situated trades is lumber, which shows the effect of building trade labor troubles. The copper market has been very quiet and a midsummer dullness prevailed throughout the week. Both producers and consumers continue to assume a waiting attitude, especially in view of the uncertainty of the labor situation. The ruling quotations are 14½ a 14¾c. for Lake; 14⅜ a 14½c. for electrolytic in ingots, cakes and wire bars; 14⅛ a 14¼c. in cathodes, and 14c. for casting stock. The United Metals Selling Company was reported on Friday to have advanced its prices to 15½c. for Lake and 15⅜c. for electrolytic copper. The business failures for the week ending May 21, as reported by *Bradstreet's*, numbered 155, against 182 the week previous, and 152 the corresponding week last year.

ALLIS CHALMERS ENGINE SALES for April are shown partially in this list: City of Ely, Ely, Minn., one 14 and 28 x 36 cross-compound Reynolds Corliss engine; Mr. Charles Pope, Chicago, two 12 x 36 and 18 x 36 horizontal Reynolds Corliss engines; National Tube Company, McKeesport, Pa., three 46 and 86, 84 and 84 x 60 vertical steeple cross compound furnace blowing engines; Carnegie Steel Company, Pittsburg, Pa., two pairs 44 and 84, 84 and 84 x 60 vertical standard disconnected compound blowing engines; National Steel Company, Pittsburg, Pa., two 50 and 96, 96 and 96 x 60 vertical steeple cross compound furnace blowing engines; Morowebb Cotton Mill Company, Dallas, N. C., one 20 x 42 horizontal Reynolds Corliss engine; Smeeth's Copper & Bronze Company, Chicago, Ill., one 14 and 28 x 24 vertical cross-compound condensing direct-coupled engine; Wheeling Steel & Iron Company, Wheeling, W. Va., one 44 and 84 x 60 vertical standard blowing engine; Construction Company of America, New York City, two 20 and 40 x 42 horizontal cross-compound Reynolds Corliss engines; Grand Rapids Veneer Works, Grand Rapids, Mich., one 32 x 48 horizontal Reynolds Corliss engine; Munising Paper Company, Limited, Munising, Mich., two 20 x 36 horizontal Reynolds Corliss engines; American Steel & Wire Company, Shoenberger Works, Pittsburg, Pa., one 46 and 84 x 60 vertical standard long crosshead Bessemer blowing engine; one 80 and 84 x 60 vertical standard low-pressure furnace blowing engine; C. A. McDonald, Chicago, one 16 x 36 girder frame engine; Thomas A. Anderson & Co., Lancaster, Ohio, one 10 x 36 Reynolds Corliss engine; James M. Arnold, Chicago, one 16 x 36 Reynolds Corliss engine; El Oro Mining & Railway Company, Mexico, one 20 and 40 x 42 tandem-compound Reynolds Corliss engine; Harbison-Walker Company, Pittsburg, Pa., one 22 x 48 girder frame Reynolds Corliss engine; Valley Oil Mills, Memphis, Tenn., one 18 x 36 girder frame Reynolds Corliss engine; Wheeling Steel & Iron Company, Wheeling, W. Va., one 44 and 84 x 60 vertical standard blowing engine; Cunningham, Becheheimer Supply Company, Norborne, Mo., one 12 x 36 girder frame Reynolds Corliss engine; Larson & Greenough, Mullan, Idaho, one 10 x 30 girder frame Reynolds Corliss engine, and several other large orders are also noted.

WESTINGHOUSE ENGINE ORDERS.—Westinghouse, Church, Kerr & Co., Maritime Building, Bridge Street, New York, has taken a contract for a 400-hp compound engine for direct connection to a 300-kw generator for the American Waltham Watch Company's shops at Waltham, Mass. The outfit will be used for both lighting and power purposes. A 50-hp junior engine, direct-connected to a 30-kw generator, has been ordered for installation in the Binghamton (N. Y.) municipal lighting plant. Two 85-hp, three-cylinder gas engines direct-connected to 50-kw generators have been requisitioned for installation in the Pittsburg department store of Joseph Horne. The engines are to operate on natural gas. The outfits are intended to furnish power for lighting purposes. Among the foreign contracts received within the last few days by the Westinghouse interests is one for two 75-hp automatic engines and one of 25-hp capacity for the Mexican Petroleum Company, at El Bano, Mexico. These engines will be belted to generators.

MACHINE TOOLS, ETC., FOR TOKYO STREET RAILWAY SHOPS.—The Tokyo Shigai Tetsudo, which is now building an electric traction system in Tokyo, Japan, has placed contracts through the Japanese house of Okura & Co., New York offices, Bowling Green Building, 11 Broadway, for several American machine tools, etc., for installation in the machine shops of the road. The tools will be operated electrically. Twenty-one labor-saving devices have been requisitioned for. Manning, Maxwell & Moore, 85 Liberty Street, New York, were allotted the contract for lathes, which will be built by the W. F. & J. Barnes Company, of Rockford, Ill. The Morse Twist Drill & Machine Company, New Bedford, Mass., has also taken an order for its specialties. The Niles-Bement-Pond Company, 136 Liberty Street, New York, has taken a shaper order. The General Electric Company got a motor order.

BALL ENGINE ORDERS.—The Emery Estate, of Cincinnati, Ohio, has placed an order with the Ball Engine Company, Erie, Pa., for two 200-hp tandem compound, self-oiling engines, arranged for direct connection to Westinghouse generator, to be used in the Mercantile Library Building. The Douglas Electric Company, Douglas, Wyoming, has purchased two 80-hp direct-connected engines from the Ball Engine Company. The Belvidere Hotel, Baltimore, Md., will have a large electric plant, consisting of three engines of 600 hp direct-connected to Crocker-Wheeler generators, the Ball Engine Company, Erie, Pa., supplying the engines, which will be of the self-oiling type. The Kentucky Wagon Company, Louisville, Ky., has placed an order with the Ball Engine Company, for a 150-hp self-oiling engine arranged for direct connection to a James Clark, Jr., & Co., generator.

WESTINGHOUSE EQUIPMENT FOR CORDOBA.—Segura, Braniff & Co., of Orizaba, Mexico, who are the contractors for lighting that city, and have a complete plant there and a large water power in the vicinity of the city, have secured a contract for the furnishing of Cordoba with electric light. The initial installation will be 50 arc lamps and 1,000 incandescents. The Mexican firm has also undertaken to supply all the electric power that may be required for Cordoba. The plant at Orizaba, from which transmission will be made to Cordoba, is of Westinghouse build, the contract for which equipment was taken by G. & O. Braniff & Co., of Mexico City, who represent the Westinghouse interests in the southern republic. The new Cordoba plant will also be equipped with Westinghouse machinery. The distance between Orizaba and Cordoba is sixteen miles.

SOUTH AMERICAN ELECTRICAL TRADE.—A dispatch from Berlin, Germany, which has been given considerable publicity, says: C. A. Coffin, of the General Electric Company, and Mr. W. G. Clark, of the British Thomson-Houston Company, are here discussing with the Allgemeine Electricitäts Company, the largest electrical works on the continent, the basis of a non-competitive agreement. Herr Rathenau, director-general of the Allgemeine Company, it is understood, announced that the Allegemeine would not surrender its individuality, but he said he was willing to treat for geographical spheres of interest on the lines of the Atlantic shipping agreement. Messrs. Coffin, Clark, Rathenau and Louis Magee, manager of the Union Company, have had daily conferences, which are likely to result in the General Electric taking Latin America in return for certain unnamed considerations.

BELL TELEPHONE OUTPUT.—The American Telegraph and Telephone Company instrument statement for month ended April 30 and since December 20 compares with previous years as follows:

	1903.	1902.	1901.
Gross output	104,429	108,242	72,396
Returned	43,491	37,587	33,177
Net output	60,938	70,655	39,219
Since Dec. 20:			
Gross output	410,390	387,795	288,505
Returned	160,137	152,085	122,604
Net output	250,253	235,710	165,901
Total outstanding	3,400,573	2,761,720	2,118,717

MEAD CONVEYING MACHINERY ORDERS.—John A. Mead & Co., New York offices Bowling Green Building, has secured a contract for a coal and ash-handling plant for installation in the Omaha & Council Bluffs Railway power station. The capacity of the machinery will be 45 tons per hour. A contract has also been received from the Union Traction Company, of Indiana for coal and ash-handling machinery for its power station at Anderson. The Ingersoll-Sergeant Drill Company's new plant at Phillipsburg, N. J., which is to be electrically equipped, will be installed with Mead coal and ash-handling machinery.

ENGINES FOR NEW A. S. & W. PLANT.—The American Steel & Wire Company has just let a contract for engines to be installed in its new shops at Worcester, Mass. The contract calls for four duplex engines of 325-hp capacity each. The award was made to the American Engine Company, builders of the American Ball engine at Bound Brook, N. J., whose New York offices under the management of Mr. E. S. Boyer, are in the White Building, Liberty Street. These engines will be direct-connected to generators not yet contracted for. The equipment is to be utilized for general power purposes.

INTERNATIONAL PUMP.—The International Steam Pump Company is making extensive improvements on its various plants from the proceeds of the sale last January of $2,500,000 debentures, viz.: At Harrison, N. J., it is erecting the largest machine shop in the world, said to be as long as the Brooklyn Bridge. It will be completed in a year or so, and represents a cost of about $1,500,000. At Buffalo, on the Snow Steam Works, additions are being made to cost $500,000. At Cambridge, Mass., on the Blake Manufacturing Company plant, $300,000 is being spent, and $100,000 for a foundry at the Laidlaw, Dun, Gordon & Co. works, Cincinnati.

NERNST STREET LIGHTING.—Another Wisconsin city has recently decided to light its streets by the Nernst lamp, and for this purpose the city of Oshkosh has recently purchased a supply of these lights through Julius Andrae & Sons Company, of Milwaukee, which is the local agent for the Nernst Lamp Company. The Sewickley Electric Light Company has also just entered an additional order for 20 six-glower Nernst lamps, to be used in extending the street lighting system of the town of Sewickley, Pa., which is said to be already one of the most complete in the country.

AMERICAN BALL ENGINE ORDERS.—The American Engine Company, through its New York offices in the White Building, has just secured a contract for a 11-in. x 19-in. x 14-in. duplex compound engine for direct connection to a 100-kw Crocker-Wheeler generator, which will be used for both light and power in the Brooklyn plant of the Tuttle & Bailey Manufacturing Company. The Sohmer Building, 170 Fifth Avenue, New York, is to be equipped with a 100-hp American Ball engine, direct-connected to a 60-kw generator of General Electric manufacture.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has recently sold to the Union City, Winchester & Muncie Traction Company two alternating-current generators which will be used in connection with an extension this latter company is building to the Dayton & Northern division of its line, now operating between Dayton and Greenville, Ohio. When the new extension is completed, through electric cars will be operated from Dayton, Ohio, to Muncie, Indiana.

HARVEY HUBBELL pull clusters have been installed in the State, War and Navy Annex Building, Pennsylvania Avenue and Seventeenth Street, Washington. They have also been put lately into the Carnegie Library, Norwalk, Conn. Harvey Hubbell, Bridgeport, Conn., reports that these clusters are rapidly taking the place of the old style chandelier in stores, offices, etc., on account of the economy in current, wiring, etc., besides the gain in appearance.

MEXICAN HYDRAULIC PLANT.—An hydraulic plant is to be constructed on the Tunal River at a point about four miles distant from the City of Durango, Mexico, for the purpose of generating power for transmission to that city. Mr. Stahlknecht, of Durango, is primarily interested in the syndicate which will build the plant. The initial capacity will be 800 hp. A dam costing about $50,000 will have to be constructed.

ALBERGER CONDENSERS FOR YALE & TOWNE PLANT.—The Alberger Condenser Company, New York, received a contract for high vacuum condensers which are intended to take care of two 500-kw Westinghouse turbines, one of which is already installed in the Stamford (Conn.) plant of the Yale & Towne Manufacturing Company.

EQUIPMENT FOR SPANISH ARSENAL.—The Westinghouse interests have secured a substantial contract for further electrical equipment for the Trubia Arsenal, which turns out the big guns for the Spanish army and navy. The plant is to be considerably extended. The Niles-Bement-Pond Company is also reported to have been awarded a contract for big gun lathes.

THE JENNEY ELECTRIC MANUFACTURING COMPANY.—It is reported from Indianapolis that a syndicate of Indianapolis and Cleveland capitalists have obtained control of the Jenney Electric Manufacturing Company. It will at once expend $150,000 in new buildings and extend the plant. The capital stock has been increased from $80,000 to $450,000.

ALLIS-CHALMERS COMPANY.—The constant menace of labor upon the Allis-Chalmers Company has resulted in the closing down of its plants on the west side of Chicago and the company has withdrawn its plan to expend nearly $1,000,000 on the plants. It is estimated that fully 90 per cent. of the expenditures would have represented labor.

TELEPHONE EQUIPMENT FOR MEXICO.—The purchase of considerable telephone equipment, etc., by the Chihuahua Telephone Company will be necessary, as that concern is to extend the telephone system from the city of Chihuahua to the principal villages located in the State of Chihuahua, Mexico.

THE SHELBY ELECTRIC COMPANY, of Shelby, Ohio, has contracted for a large brick building to be finished by July 15. It will be constructed as a wing of the present plant and will double the capacity, showing a pleasing demand for its product of Shelby lamps.

EQUIPMENT FOR JAPANESE MINES.—The Mitsui Mining Company, Japan, which is controlled by Mitsui & Company, whose New York offices are at 445 Broome Street, will shortly let contracts for considerable American electric equipment, including cranes.

LIGHTING EQUIPMENT FOR MERIDA, YUCATAN.—Felipe G. Canton, whose offices are in the Columbia Building, 29 Broadway, New York, has secured a contract for an electric lighting equipment to be shipped to Merida, the capital of Yucatan.

EQUIPMENT WANTED FOR MEXICAN MINE.—Pedro Alvardo, of Parral, Mexico, is about to let contracts for the electrical equipment of his Palmillo mine.

General News.

THE TELEPHONE.

ST. HELENA, CAL.—The Chiles Valley Improvement Company will construct and operate a telephone line from St. Helena to the Valley.

SANTA MONICA, CAL.—W. L. Porterville, interested in a home telephone company at Long Beach, has applied for a franchise in Santa Monica, to install a $15,000 plant.

SANTA BARBARA, CAL.—The Board of Supervisors has granted a franchise to the United States Long Distance Telephone Company to operate lines throughout Santa Barbara County. An application is now before the City Council for a franchise inside the city limits of Santa Barbara.

WILMINGTON, DEL.—The Citizens' Telephone Company, of New York, with a capital of $50,000, has been incorporated here.

RUSHVILLE, ILL.—The Rushville Telephone Company has been incorporated, with a capital stock of $5,000, and the incorporators are L. A. Jarman, A. F. Rodewald and David G. Glass.

CAMARGO, ILL.—The Home Telephone Company, of Douglas County, has been incorporated with a capital of $4,600. Eugene Rice, G. C. Jeffers and G. C. Wiseman are the incorporators.

GRAYMONT, ILL.—The Graymont Telephone Company and the Friendship Telephone Company, both of this place, have been incorporated, each with a capital stock of $2,500. Mr. L. B. Snyder is interested in both companies.

AUSTIN, ILL.—Determined not to take a dare from his companions, Douglas Drysdale, a ten-year-old boy, climbed a telephone pole and hung by his hands from a telephone wire. His weight pulled the wire down until it came in contact with a trolley wire. The boy was killed instantly by the current and dropped lifeless to the ground.

EVANSVILLE, IND.—Twelve miles of copper wire have been stolen from the Cumberland Telephone Company. The wire was taken down from the poles of the company by men who are installing the new plant.

WARSAW, IND.—The Commercial Telephone Company of this city has increased its capital stock from $30,000 to $50,000. The company contemplates making improvements and extensions.

PLAINFIELD, IND.—The Plainfield and Danville telephone companies have consolidated to be known as the Consolidated Telephone Company, with Dr. Amos Carter, of Plainfield, president. The company will make improvements and extensions and put in a modern switchboard at Danville.

INDIANAPOLIS, IND.—The following new telephone companies filed articles of incorporation recently: The Farmers' White Line Telephone Company, of Mt. Comfort, capital stock $15,000. David Keller, I. W. Wright and others are directors. The McCarty Bell Telephone Company, capital stock $10,000. The principal office will be in Brimfield. W. A. McCarty, C. W. Bliss and others are directors. The Eckhart Telephone Company; J. E. Eckhart and F. M. White are directors. The Orestis Telephone Company; capital stock $7,000. Andrew F. Greenlee and John N. Potter, of Alexandria, are directors. The Oakalla Telephone Company; capital stock $2,000. John F. Johnson and Frank I. Torr are directors. The Range Line Telephone Company, of Hancock County; capital stock $1,600. James H. Binford and Rob't W. Brooks are directors.

ESTHERVILLE, IA.—The Kossuth Telephone Company will build a line westward from Armstrong through this city to Spirit Lake.

ONAWA, IA.—The Onawa & Monona Telephone Company, with a capital stock of $100,000, has been incorporated by Fred Marquis, J. W. Huff, G. W. McMullan, S. B. Martin and C. H. Huntington.

DALLAS CENTRE, IA.—The Farmers' Mutual Telephone Company, of Dallas Centre, has been incorporated, with a capital stock of $20,000, by H. M. Schamel, Will Sehmen, G. F. Rinehart, A. J. Wise, D. G. Hobb, Clyde E. Brenton, O. A. Repars and J. H. Royer.

BALTIMORE, MD.—The South Maryland Telephone Company, under the auspices of the Maryland Development Company, is being formed here.

BALTIMORE, MD.—The Municipal Subway Commission has granted a permit to the Chesapeake & Potomac Telephone Company to construct conduits of its own along North Avenue.

SAULT STE MARIE, MICH.—Frank P. Sullivan and others have applied for a franchise for an independent exchange here. There is considerable indignation against the Michigan Telephone Company (Bell) which has recently raised its rates.

LUDINGTON, MICH.—The Ludington-Scottsville Rural Telephone Company has been organized with $30,000 capital stock. Connection will be made with the lines of the Michigan (Bell) Telephone Company affording long distance service.

MAGNOLIA, MINN.—The Enterprise Telephone Company will build a line from Lismore to Kenneth.

CLEARWATER, MINN.—The Clearwater Telephone Company has been incorporated with a capital stock of $10,000. The officers are: President, G. P. Boutell; vice-president, W. F. Shattuck; secretary, W. Frantzen; treasurer, C. D. Whitmore; manager, J. H. Whitney.

KEARNEY, NEB.—The Buffalo County Telephone Company has been organized with Peter F. Wink as president and J. A. Walters, vice-president.

TRENTON, N. J.—The National District Telephone Company, with a capital stock of $100,000, has been incorporated by S. W. Slayer, Jas. H. Reid, B. A. Judd and R. W. Beard.

GRAND FORKS, N. D.—C. C. Gowran, of this city, has been granted a franchise for a local telephone exchange. Mr. Gowran represents the Twin City Telephone Company.

ALLIANCE, OHIO.—The Central Union Telephone Company is preparing to erect a new exchange here.

KENTON, OHIO.—The Kenton Telephone Company has secured new quarters and will enlarge its switchboard.

YELLOW SPRINGS, OHIO.—The Miami Telephone Company has secured a franchise and will install an exchange at once.

NEWARK, OHIO.—Judge H. M. Critchfield has obtained a franchise to build an independent telephone exchange at Hebron.

OXFORD, OHIO.—The Oxford Telephone Company has secured a franchise to build a number of toll lines throughout Oxford County.

GALION, OHIO.—The new system of the Galion Telephone Company has been completed and the exchange has been opened for business.

ASHLAND, OHIO.—C. W. Garver, of Ashland, has submitted a proposition to the town to install an electric fire alarm and police patrol system.

MARYSVILLE, OHIO.—The Marysville Telephone Company has been incorporated with $50,000 capital stock. George E. Whitney and others are interested.

FLUSHING, OHIO.—The Flushing Telephone Company, of Belmont County, has increased its capital stock from $10,000 to $25,000 and will make needed extensions.

NEY, OHIO.—The Ney Telephone Company, capital $10,000, has been incorporated by O. Welker, Ed. Myers, P. M. Lehman, W. F. Gollen and A. P. Yeagley.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company is securing estimates on the cost of installing a new multiple central energy switchboard. The company contemplates giving party line service.

RAVENNA, OHIO.—The Portage County Telephone Company is preparing to string considerable cable. The company is also planning to build a toll line to Parkman to connect with the new exchange there.

FREMONT, OHIO.—The Fremont Telephone Company is preparing to install a new switchboard which will cost $15,000. The company has 900 telephones in operation and its business is growing very rapidly.

SALEM, OHIO.—The Columbiana County Telephone Company is preparing to make extensive improvements and will carry out its plans as soon as the money authorized by the Federal Telephone Company is secured.

CLEVELAND, OHIO.—Officials of the Cuyahoga and United States Telephone companies announce that the deferred interest on bonds will be paid July 1. It is claimed that the properties mentioned are now in good shape and will be able to take care of the bond interest in the future.

TOLEDO, OHIO.—The Toledo Home Telephone Company has voted to expend $75,000 in improvements. The company now has over 7,000 telephones in use with orders for many more, and it will be necessary to install a large amount of new conduit and overhead lines besides enlarging the switchboard.

CLEVELAND, OHIO.—The United States Telephone Company (long distance) has issued the following statement for the first quarter of 1903. Gross earnings, $88,722; operating expenses, $51,728; net earnings, $36,743; surplus for stock, $11,937. The company is building about 100 miles of additional long distance line in Ohio.

OTTAWA, OHIO.—A considerable portion of the stock of the Ottawa Home Telephone Company has recently changed hands. New officers have been elected as follows: J. V. Duncan, president; W. H. Johnson, vice-president; A. F. Schoch, treasurer, and Wm. Colwell, secretary. The company is planning to make improvements.

CLEVELAND, OHIO.—It is reported that the Federal Telephone Company will buy back the interest in the Columbus Citizens' Telephone Company, which was sold to Columbus parties at the time of the Everett-Moore embarrassment. The company retained an option under which it could buy back the stock at the selling figure plus interest, less dividends, any time previous to July 1, 1903.

CLEVELAND, OHIO.—The Federal Telephone Company is working its way out of its difficulties. A large number of small creditors have accepted a proposition to take cash on a basis of 50 cents on the dollar and a considerable amount of the indebtedness has been cleared up in this way. It is understood that a number of the largest creditors have agreed to a longer extension of time allowing matters to stand as at present until the properties are more thoroughly developed. It is probable that a new holding company will be organized to take over the assets of the present company.

SUMTER, S. C.—The Sumter Telephone Company has increased its capital stock from $2,000 to $10,000.

SHERMAN, TEX.—The Grayson County Telephone Company of this city has increased its capital stock from $170,000 to $340,000.

SALT LAKE CITY, UTAH.—The Utah Home Independent Telephone Company has purchased from the city for $48,000 the property on the corner of First, South and State Streets on which it will erect a three-story fire-proof stone, brick and steel building.

STUART, VA.—The Hillsville & Stuart Telephone Company has been organized to build a line between the two places named touching intermediate points. Construction work has already commenced. Among those interested are Capt. T. J. Banks, of Carroll, T. T. Clark and S. C. Scott.

SPOKANE, WASH.—The International Telephone Company of America, with headquarters at Washington, D. C., has applied to the council for a franchise to operate a telephone system, telephones to the number of 5,000 to be put in free and no party lines to be used.

BLOOMER, WIS.—The Bloomer Telephone Company has increased its capital stock from $8,000 to $15,000.

OSCEOLA, WIS.—The Minnesota Mutual Telegraph & Telephone Company will establish an exchange in this place. This will give Osceola three telephone systems.

SPRING GREEN, WIS.—The West Spring Green Telephone Company, of Spring Green, has been incorporated with a capital stock of $494, by George H. Peck, J. W. Reyman and Samuel Huntley.

ELECTRIC LIGHT AND POWER.

DEMOPOLIS, ALA.—The Demopolis Electric Light & Power Company, F. B. Clement, president, has $10,000 capital and operates a Westinghouse system, with 44 arc and 3,300 incandescent lights.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company, W. C. Lemert, president, operates 50 miles of circuit, with 225 arc lights and 15,000 incandescents, 50 motors at 5 to 15 cents per kw-hour, and 16 cars.

HARRISON, ARK.—The Harrison Electric Light & Ice Company will shortly merge with the Arkansas Traction Company, capital $500,000, bonds $500,000.

PINE BLUFF, ARK.—The Citizens Light & Transit Company was organized in 1901, with $300,000 capital, $100,000 bonds. Geo. O. Martin is superintendent. It operates 200 arc lights, 20 motors at 10 cents per kw-hour and 10 cars. Summer cars and trailers are needed, and an electrical supply business would do well.

SANTA CRUZ, CAL.—The City of Santa Cruz municipal plant furnishes 84 arc lamps.

CORONA, CAL.—Reports from this place are to the effect that there is a good opening for all improvements as there are none now.

SAN BERNARDINO, CAL.—The San Bernardino Gas & Electric Company has $500,000 capital; 220 arc lamps and 4,500 incandescents. It runs 45 motors at four cents per unit.

SAN LEANDRO, CAL.—The Suburban Electric Light Company has $500,000 capital, and operates a long distance transmission plant. There are 150 arc and 15,000 incandescent lights; motors of 500-hp from 3½ to 6 cents per kw-hour, and heating irons.

ONTARIO, CAL.—The Ontario Power Company, organized in 1901, has $500,000 capital stock, $380,000 bonds; L. S. Dyer is president. It runs about 40 motors at two cents to nine cents, according to consumption and supplies 4,000 16-cp incandescent lights. All power not in local use is sold to the Pacific Light & Power Company, of Los Angeles.

OXNARD, CAL.—The electric light department of the Colonia Improvement Company has five enclosed arcs and 2,782 incandescent lamps. An electric railway to haul freight to the ocean front and domestic produce is needed. Mr. Thurston, superintendent, informs us that another independent corporation exists called the Oxnard Suburban Electric Company, which furnishes light for ranch houses and barns.

WESTPORT, CONN.—Following are the rates of the Westport Electric Light Company for incandescent service: For stores, mills, etc., six nights from "early candle light" until 12 o'clock, $1 per month; six nights from early candle light until 11 o'clock, and until 12 o'clock Saturdays, 85 cents per month, for 3 lights or less. Churches, public halls, etc., 25 cents per kw-hour. At this rate a 16-cp lamp costs 1¼ cents per hour, and is equivalent to coal gas at $1.85 per 1000 feet. Meter rates for stores, mills and residences 20 cents per kw-hour for 2250 watt hours or less, which is equivalent to 45 hours use per month for each 16-cp lamp or equivalent. The rate for service exceeding the above limit is 12½ cents per kw-hour.

JACKSONVILLE, FLA., has a municipal plant which furnishes 265 arc lights and runs 40 motors at 7 cents to 4 cents per kw-hour.

PORT TAMPA, FLA.—The Electric Light & Water station is the property of the A. C. L. R. R. There are 17 enclosed arcs and 900 incandescent lights, also two motors of 150-hp.

HOGANSVILLE, GA.—The M. K. Wood plant operates 20 arc lamps and 300 incandescents.

NEWNAN, GA.—The Newnan Light & Power Company, organized in 1901, has $20,000 capital stock, 31 2,000-cp arc lights and 2,000 16-cp incandescents.

MONTEZUMA, GA.—The Montezuma Mfg. Co. bought out the Oglethorpe & Montezuma Light & Power Company, and it is now operated in connection with the first-named. The company is about to install 25 arc lights and operates 600 incandescents.

SHEFFIELD, GA.—The Sheffield Company formed in 1903 with $500,000 capital. Mr. H. Parsons is president. It is doing great work in developing the resources of the place, in building an electric railway, a lighting system and water works in Tuscumbia, Florence and this city. The power station is at Sheffield.

GRANGEVILLE, IDAHO.—The Grangeville Electric Light & Power Company is in the market for a complete outfit of water wheel and electrical apparatus for a new plant.

ST. ANTHONY, IDAHO.—The St. Anthony Water & Light Company was formed in 1903, with a capital of $50,000; W. Vanderveer is superintendent. It operates six 1,200-cp arc lights and 630 16-cp incandescents.

MOSCOW, IDAHO.—The Moscow Electric Light & Power Company contemplates extending its lines to Pullman, Wash., nine miles; to supply 1,000 lights to that place at 10,000 volts and will need transformers and other supplies.

TAMAROA, ILL.—It has been voted to construct an electric light plant by private ownership.

AUBURN, ILL.—The Auburn Electric Light Company operates 23 arc lights and 1,500 incandescents.

NORMAL, ILL.—The electric light plant at this place was seriously damaged by an explosion recently.

ROCKFORD, ILL.—The capital stock of the Central Heat & Power Company has been increased from $50,000 to $100,000.

EARLVILLE, ILL.—The electric plant supplies twenty-five arc lights and 1,800 incandescents. J. T. Wilson is the proprietor.

CANTON, ILL.—The People's Gas & Electric Light Company has increased the number of its incandescent lights to 3,000, mostly of 16-cp.

PEKIN, ILL.—The Pekin Electric Light Company has decided to enlarge its plant. A 300-hp boiler and a 350-hp engine will be installed.

ONEIDA, ILL.—The Oneida Light & Power Company has just been extending its lines. It operates three arcs and 1,300 incandescent lights.

AMBOY, ILL.—The Amboy Light & Power Company, S. H. Wallace, superintendent, operates 25 2,000-cp arcs and 1,100 incandescents. It also runs fan motors. New arc lamps are required.

BLANDINSVILLE, ILL.—The Blandinsville Roller Mill & Light Plant is the property of W. P. Wright. It supplies eight arc lamps and 450 incandescents. Mr. R. L. Moore, chief engineer, notes the need of a 100-hp boiler.

ALPHA, ILL.—The Alpha Electric Light & Power Company operates two arcs and 1,200 incandescent lights. It requires a 125 to 150-hp Corliss engine and 100-hp boiler. An electric railway of 40 miles would be very successful.

ELMWOOD, ILL.—The Elmwood Electric Light Company has $30,000 capital stock and is owned and managed by E. L. Brown. It operates 15 miles of arc circuit with 100 lamps and 12 miles of incandescent circuit, with 3,500 lights.

EVANSTON, ILL.—Northwestern University has leased for a term of ninety-nine years to the Evanston Electric Illuminating Company, all the ground comprised in the block bounded by Benson Avenue and Church, Clark and Maple Streets.

CENTRALIA, ILL.—The Merchants' Co-operative Lighting Company, of Centralia, has been incorporated, with a capital of $5,000, to furnish electric light, heat and power. Incorporators: Wm. B. Smith, O. V. Parkinson and Wm. Benjamin.

FREEPORT, ILL.—The Freeport Railway, Light & Power Company, organized in 1903 with $350,000 stock and $350,000 bonds. It operates a Westinghouse system, with 50 miles of circuit, 100 arc lights of 2,000-cp and 8,000 incandescents. The company also runs 25 motors and five cars.

MOORESVILLE, IND.—S. J. Bolton light plant desires to buy a second-hand direct current dynamo of 600 or 800 lights capacity.

ANDERSON, IND.—The Alexandria Light & Power Company has secured the contract for lighting the city for ten years at $80 per light per year.

ELKHART, IND.—The City Council has granted a franchise to the National Manufacturing Company for an electric light, heat and power plant. Walter Brown is president.

GREENSBURG, IND.—A ten-year franchise has been granted the Greensburg Electric Company by the City Council, to take effect April 1, 1904. The price is $69 per light on an all-night schedule.

MORGANTOWN, IND. Mr. C. Teeters, proprietor of the electric light plant, wants to change the generator for a larger one to put in 300 more lights.

BLAIRSTOWN, IA. The Blairstown electric light plant is to be sold. It pays $100 per month over expenses.

ALTA, IA.—The committee on light of the City Council has under consideration plans for enlarging the electric light plant.

ELDORA, IA.—The Eldora Electric Light Company has two miles of mains for steam heating and finds it very successful. It has 27 2,000-cp arc lights and 4,200 incandescents.

REINBECK, IA.—The question of constructing an electric light plant is under consideration. Whether the city will build the plant or let a franchise to private parties is yet undecided.

ASHLAND, KY.—The contract for lighting the streets with electricity has been awarded to the Ashland Electric Light & Power Company at $51 per lamp per year on a ten-year contract.

KENNEBUNK, ME.—The municipal electric light plant was destroyed by fire recently.

HOULTON, ME.—Geo. Ingram is reported interested in the construction of an electric light plant.

MADISON, ME. The Village Council has instructed the electrical commissioner to procure plans, estimates and bids for the establishment of an electric plant on Sandy River.

HYATTSVILLE, MD.—The citizens have voted to grant the Northern Electric Lighting Company, of New York, N. Y., a franchise to construct an electric light plant in Hyattsville.

OTIS, MASS.—The Selectmen have awarded the contract for lighting the streets for one year to Leominster Electric Light & Power Company at $72 per year, for arc lights to burn till 1 a. m.; for all night arc lights, $110 and for 65 incandescent lights, $16 each.

DURANGO, MEX.—P. E. Stahlnecht, of Durango, writes that it is proposed to develop the power of Tunal River; probable cost of work, $700,000. He will be ready to receive bids for the electric plant in about six months.

CALUMET, MICH.—The Calumet Light, Heat & Power Company has been organized by P. P. Roehm, John Burder and A. W. Kerr to conduct a central heating plant in connection with its electric plant; capital, $80,000.

VULCAN, MICH. The Wisconsin State Assembly has passed a bill permitting the construction of a dam on Menominee River, near Vulcan. The power of Sturgeon Falls will be utilized and electric power generated to be used in operating mines in the vicinity of Norway and Vulcan.

SOUTH STILLWATER, MINN.—Electric light and water bonds amounting to $23,000 are reported sold.

PELICAN RAPIDS, MINN.—The council is reported to have voted to issue bonds for an electric light plant.

CALEDONIA, MINN.—J. Kenny, village recorder, writes that bids are wanted for an electric light plant; probable cost, $8,000. S. G. Reque, Westby, Wis., is the engineer.

JACKSON, MISS.—Bids are now being received by the Capitol Light & Power Company for furnishing three boilers, engines, dynamos, wire and supplies for the new electric light plant; boilers are to be 150-hp each, of

Scotch marine type, with corrugated furnaces, for a steam pressure of [illegible] lbs per sq. in. Bids call for both simple and compound engines. For further information apply to Kirkpatrick & Johnson, engineers.

HACKETTSTOWN, N. J.—The Electric Light Company is stated to have secured the contract for 116 25-cp lights for one year at $1,700 per year.

NEWARK, N. J.—The Block Light Company, of Colorado, capital $50,000, has been incorporated at Newark by William H. Washington, Frederick H. Porter, William M. Shaw, Charles A. Murphy and Pelmon A. Balcom.

FAYETTEVILLE, N. C.—The citizens have voted to issue bonds for water works and an electric light plant.

HENDERSON, N. C.—The contract for lighting the town for a period of 10 years has been awarded to the Henderson Lighting & Power Company for $2,700 per year.

URBANA, OHIO.—The Urbana Electric Light & Power Company has applied for a new franchise in Urbana.

ATHENS, OHIO.—It is stated that bids are wanted by W. B. Golden, Village Clerk, for $15,000 electric light bonds.

PUT IN BAY ISLAND, OHIO.—The council has granted an electric lighting franchise to R. K. Ramsay, of Sandusky, who will erect a plant.

COLUMBUS, OHIO.—The Erner Hopkins Company, of Columbus, is stated to have secured the contract for furnishing wire, pole line and sundries for the municipal electric light plant for $18,183.

DAYTON, OHIO.—Engineer C. P. Folsom of Dayton announces that preliminary work is now being done for the development of power on Cumberland River for electrical purposes; the probable cost of work is $2,000,000.

OBERLIN, OHIO.—The plant of the Oberlin Gas & Electric Light Company has been sold to a syndicate of local capitalists. The company has just secured a new franchise from the council. A. E. Hay, of Elyria, will manage the plant.

CLEVELAND, OHIO.—An Eastern syndicate is figuring on establishing an electric lighting plant on the south side with a view of supplying that portion of the city. It is proposed to erect the plant near the new coke ovens of the Cleveland Furnace Company and to utilize the gas from the ovens.

DEFIANCE, OHIO.—A company has been organized at Defiance with $200,000 capital stock to utilize the water power in the Auglaize River near Defiance. An electric power plant will be established at once and the company will endeavor to induce manufacturing establishments to locate in the town.

CLEVELAND, OHIO.—The new city administration will take immediate steps for the establishing of a municipal lighting plant. An ordinance for an issue of $200,000 electric light bonds has already been presented to the council. Preliminary plans for the proposed station have been submitted by Charles E. Phelps, of Baltimore. It is proposed to utilize a part of the old water works station for the generating plant. It is calculated that the required outfit would cost about $375,750, and it is claimed that city lamps could be supplied at $55 per year instead of $75 per year as at present.

OKLAHOMA, OKLA.—The Oklahoma Gas & Electric Company, organized in 1902. The president is A. H. Branch. It operates 116 city and 156 commercial arcs. It also furnishes motor power at 5 cents per kw-hour and power for street railway. The capital is $300,000 and it is bonded for $300,000.

SANGER, ORE.—Surveys and plans are being prepared for the construction of an electric power and light plant; probable cost of plant, $60,000. J. K. Romig, of the Sanger Gold Mining Company, is interested.

HOMESTEAD, PA.—The Mifflin Light & Power Company is about to petition for a franchise in Homestead.

MONTOURSVILLE, PA.—The Borough Council has accepted the proposition of the Montoursville Electric Company to furnish 53 lights at 25-cp each, contract to go into effect July 1.

LEBANON, PA.—Bids will be received until June 1 by I. L. Beckley, City Clerk, for lighting the streets with electricity. There will be required about 135 open or closed arc lights, and not less than 50 incandescent lights, to burn from twilight to dawn. The bids are to be for a period of 1, 5 and 10 years.

GAFFNEY, S. C.—Ladshaw & Ladshaw, Spartanburg, S. C., are preparing plans for a 10,000-hp water power development on Broad River, 11 or 12 miles from this place, estimated to cost $500,000.

AUSTIN, TEX.—The Governor has approved the bill appropriating $155,000 with which to install a water, light and power plant for the State institutions located in Austin.

SOURLAKE, TEX.—The Light & Power Company, of Sourlake, has been incorporated, capital $10,000. Incorporators: D. O. Lively, T. J. Douglas and T. W. Freeman.

VERNAL, UTAH.—E. W. Davis writes in regard to the electric plant for Vernal Light & Power Company that the company is not yet organized. The work will cost about $35,000, and bids for the work will probably be received about July 15.

RICHMOND, VA.—Samuel Cohn has petitioned the Council for a franchise to construct and operate an electric light plant.

WYTHEVILLE, VA.—The Town Council has offered for sale an electric light franchise for Wytheville; also the old plant owned by the town. Bids for both to be opened June 5.

ELLENSBURG, WASH.—The city contemplates improving its municipal light plant, either by increasing its present steam plant, or by constructing a water power, diverting water from Yakima River. A. McL. Hawks, of Tacoma, has been selected to advise upon the project. Geo. Sales is City Clerk.

LANCASTER, WIS.—John Schreiner and others, of Lancaster, have purchased the local electric light plant, and propose changing the present system from a direct to alternating current.

THE ELECTRIC RAILWAY.

DANBURY, CONN.—The Danbury and Harlem Traction Company will increase its capital stock and issue bonds to construct a trolley from this place seventeen miles to Golden's Bridge, N. Y.

WALLINGFORD, CONN.—The Wallingford Tramway Company has been incorporated in Connecticut with a capital of $500,000, to build a trolley line, which is said will be the completing link in a through line from New York City to Boston.

HARTFORD, CONN.—The Woodbury & Seymour Street Railway Company has been chartered to build an electric railway in Woodbury, Southbury, Oxford and Seymour. The company is capitalized at $400,000. The incorporators are Floyd F. Hitchcock and Levi E. Curtis, of Woodbury; Christian Strobel, of Waterbury, and Frederick L. Everil, of Branford.

CHICAGO, ILL.—The Lake Street Elevated Railway Company is having plans made for a new transformer station at Lombard Avenue and Lake Street, to cost approximately $75,000.

MONMOUTH, ILL.—Articles of incorporation has been filed by the Illinois Union Railway Traction Company, with capital stock $500,000. The incorporators and first board of directors are P. E. Elting, of Macomb, Ill.; W. H. Beaver, of Abingdon, Ill.; John W. Andrews, of New York, and W. W. McCullough, W. B. Young and S. S. Hallam, of Monmouth.

MICHIGAN CITY, IND.—The Chicago & South Shore Railway Company has increased its capital stock from $300,000 to $1,000,000. The company will expend the $700,000 in extending its line, which connects Michigan City and LaPorte, east to South Bend.

COLUMBIA, KY.—The Columbia Interurban Railway Company has been organized here, with $15,000 capital stock subscribed. The officers of the company are Prof. W. K. Azbill, president; Capt. W. W. Bradshaw, vice-president; C. S. Harris, secretary; Judge J. W. Jones, treasurer.

LOUISVILLE, KY.—The Louisville Suburban Electric Railway Company is reported to have awarded the contracts for constructing the proposed interurban line from Louisville to Mount Washington to A. L. Rick Company, of Cincinnati. The work will be done under the supervision of the Tennis Construction Company, of Cincinnati.

NEW ORLEANS, LA.—H. H. Pearson, Jr., has been re-elected president of the New Orleans Railway Company, W. W. Miller, of New York, has been chosen first vice-president, and Colonel Joseph H. DeGrange, of New Orleans, second vice-president.

CONWAY, MASS.—The Legislature has a bill before it to authorize the Conway Street Railway Company to buy the property of the Conway Electric Light & Power Company. The bill will probably pass.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company is securing options on land between Worcester and Leominster, over which it proposes to build a second line to Leominster, by way of West Boyleston and Sterling.

WORCESTER, MASS.—The Worcester & Connecticut Eastern Street Railway Company will absorb the Thompson Tramway Company, the People's Tramway Company and the Danielson & Norwich Street Railway Company, all of which operate in the eastern part of Connecticut. The roads have been controlled by the same interests for some months. The company is granted two years in which to build extensions to unite the roads.

NASHUA, N. H.—The Hudson, Litchfield & Goffs Falls Electric Railway, which is to connect this city and Manchester, has organized as follows: Isaac N. Center, of Manchester, president; Arthur S. Campbell, of Manchester, vice-president; John J. Baker, of Hudson, treasurer. The directors were instructed to proceed immediately with the construction of the road.

ATLANTIC CITY, N. J.—The Central Passenger Railway Company has been incorporated, with a capital stock of $40,000, to build an electric railway here. William McLaughlin, Louis Kuehule, Francis B. Quigley and John A. Jeffries, of Atlantic City, are interested.

ALAMAGORDO, N. M.—Alamagordo Street Railway Company has been organized with $50,000 capital stock, to build and operate a street railway and electric light system. Arthur P. Jordan, William Hodge and Thaddeus H. Llayford, of Alamagordo, are interested.

JAMESTOWN, N. Y.—It is stated that the Jamestown, Chautauqua & Lake Erie Railroad, which runs from Jamestown to Westfield, is to be converted into an electric railway.

NEWBURGH, N. Y.—The Orange County Traction Company is considering the advisability of extending its lines from Walden to Montgomery.

LITTLE FALLS, N. Y.—It is stated that J. M. Farley, of White Plains, is forming a company to build an electric railway from Johnstown to Little Falls. A survey of the line has already been made.

PENN YAN, N. Y.—Lake Keuka and East Side Railroad Company, of Penn Yan, has been incorporated to operate an electric road, thirteen miles long, from Penn Yan to Keuka. The capital is $130,000. Directors: J. C. Harris, New York; M. F. Sheppard, Penn Yan, and D. E. Hoover, Keuka.

TOLEDO, OHIO.—The People's Rapid Transit Company has increased its capital stock to $500,000.

ELYRIA, OHIO.—The Elyria, LaGrange & Southern Traction Company, recently organized to build a line from Elyria to LaGrange, has elected these officers: Wm. Heldmeyer, president; J. M. Starr, vice-president; F. H. Foster, treasurer; H. Wilcox, secretary.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Railway Company has awarded a contract to the Westinghouse Company for its electrical equipment and with the Erie City Iron Works Company for engines and boilers. A temporary power house will be built at Genoa.

PORTSMOUTH, OHIO. In addition to building a suburban line to Hanging Rock, the Portsmouth Street Railway & Light Company is planning to make important extensions to its system in Portsmouth. The company will built its new power house at Millbrook Park near Yorktown.

COLUMBUS, OHIO.—The Toledo & Chicago Construction Company has heen incorporated, with $10,000 capital stock, by J. R. Seagrave, A. R. Seagrave, U. G. Denman, J. H. Ainsworth and W. F. Courtad. This is the company which will have charge of the construction of the Toledo-Chicago Interurban Railway. Its offices are in Toledo.

READING, PA.—The Metropolitan Electric Company will install a storage battery plant to take care of the heavy travel on its lines during the summer. The plant will include 264 cells.

PHILADELPHIA, PA.—Dallett & Co., of this city, have received the contract for furnishing the electrical equipment for the new cars of the Allentown & Reading Traction Company.

SPARTA, TENN.—It is reported that capitalists are interested in a proposed electric railway from Sparta to Cookeville. A fine water power at Burgess Falls is being examined with a view to its development for power.

BENNINGTON, VT.—At the last session of the Vermont Legislature a charter was granted to the Bennington & North Adams Street Railway Company. The capital stock of the new company is $150,000, with authority to increase. George F. Graves, of Bennington, president of the First National Bank, is interested.

MORGANTOWN, W. VA.—The Morgantown, Fairmont & Cheat River Street Railway Company has been chartered. It is capitalized at $750,000, and the incorporators are Davis Elkins, Jos. H. McDermott, Frank K. Brett, Clarence B. Dille and Thomas R. Dille. About 20 miles of road will be constructed.

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC RECORDING & SIGNAL COMPANY, of Kenton County, has been incorporated in Kentucky with a capital stock of $5,000.

THE PARRY ELECTRIC COMPANY, with a capital of $1,000,000, has been incorporated in Ohio to build an electric railway from Lexington, Ohio, to Zanesville.

THE ONONDAGA AUTOMOBILE COMPANY, of Syracuse, N. Y., has been incorporated; capital, $150,000. Directors: G. L. Gridley, G. E. DeLong, and J. S. Palmer, Syracuse.

THE W. H. GOUGH ELECTRIC COMPANY, of Syracuse, N. Y., has been incorporated with a capital of $40,000. Directors: W. H. Gough, David Cronin and W. G. Holbrook, of Syracuse.

THE ORANGE AUTOMOBILE EXCHANGE AND MANUFACTURING COMPANY, Newark, N. J., has been incorporated, capital $50,000. Incorporators: George J. Althen, B. A. Durham and R. Arthur Heller.

BARTZ, WYGANT & BROWN, Hornellsville, N. Y., have been incorporated to make electric motors and appliances, capital $60,000. Directors: Frank Bartz, Frederick A. Wygant and Alfred E. Brown, Hornellsville.

THE MARQUETTE ELECTRIC COMPANY has been organized at Augusta, Me., to manufacture electrical machinery. The capital stock is $100,000 and the officers are: President, F. L. Dutton; treasurer, E. F. Whittum.

THE URBAN CONSTRUCTION COMPANY, of Deerfield, Wis., has been incorporated to build gas and electric lighting plants. The capital stock is $10,000 and the incorporators are H. B. Fargo, Gilman Peterson and Charles E. Pierce.

THE METROPOLITAN ENGINEERING COMPANY, of New York, has been incorporated to deal in electrical advertising devices; capital, $30,000. Directors: Frederick W. Jesser and Alexander H. Laidlaw, Brooklyn; Maitland E. Elliott, of Manhattan.

THE KARAS ELECTRIC COMPANY has been incorporated at Chicago, Ill., with a capital stock of $10,000 for the purpose of manufacturing electrical, mechanical and chemical specialties. The incorporators are Leland C. Summers, Bertrand S. Summers and Joseph Karas.

THE AMERICAN STEEL & ELECTRIC COMPANY has been incorporated under the laws of New Jersey, with a capital stock of $125,000 to engage in the manufacture of electrical supplies. The incorporators are Bertil Von Philip, Harry L. Ogden and J. M. Thorn.

THE ON-LEE BURNER MANUFACTURING COMPANY has been incorporated in New York City to manufacture arc and incandescent illuminating lamps and supplies. Capital $5,000. Directors: Wm. H. Batterson, Jersey City, and Leon Pistner and Max Bernstein, of New York.

THE INDIANAPOLIS ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., has incorporated to carry on an electrical manufacturing business and to furnish motive power and apparatus.. The capital stock is $10,000. Henry E. Kattman, Ansel Fatout and C. E. Morgan are directors.

THE DUQUESNE MOTOR CAR COMPANY has been incorporated at Buffalo, N. Y., for the purpose of manufacturing, selling, leasing and otherwise dealing in automobiles and automobile parts. The capital stock is $50,000 and the directors are Harry Howe, Harry G. Johnson, L. Ray Pelletier, John Fraser and John B. Uster.

THE NATIONAL CHEMICAL POWER COMPANY has been organized at Prescott, Ariz. Among other objects, it will engage in the generation of electricity for power and lighting purposes by means of a chemical process. The capitalization is $25,000,000. The incorporators are John H. Carruthers, Otto Koehler and Oscar Bergstrom.

THE J. L. MOTT COMPANY has been incorporated under the laws of New Jersey, with a capital of $3,000,000, to manufacture and deal in plumbing, steam fitting and electric fixtures. Incorporators, who are identified with the Jordan L. Mott Iron Company, of New York, which is about to establish a large manufacturing concern in Trenton, are Jordan L. Mott, Jordan L. Mott, Jr., John Reid, Augustus Mott, and Knox Goebel, of New York, and O. O. Bowman, of Trenton.

OBITUARY.

MR. J. F. STAUFFER. Brief note was made in our columns recently of the death of Mr. John Forney Stauffer, the president of the Geo. C. Towle Manufacturing Company, of Lancaster, Pa. Mr. Stauffer was born in Penn township, Pa., on Aug. 6, 1845, and was the son of Benjamin Miller Stauffer and Sophia (Forney) Stauffer who was a cousin of John W. Forney, the founder of the Philadelphia *Press.* Mr. Stauffer's ancestors came from Switzerland about 1790. He was married to Clara S. Fondersmith, whose great-great grandfather was Ludwig von der Schmidt, a descendant of the house of Hesse-Darmstadt, who was a manufacturer of guns in Germany for the government and came to Lancaster County in 1749; and his son John manufactured guns for the war of 1812. The deceased had two sons, Charles F., a prominent contractor of Lancaster and B. Grant, secretary and treasurer of the Geo. C. Towle Mfg. Co. Mt. Stauffer, previous to going into the electrical business, was a contractor for railroads, water works, etc., and many of the engineering feats of eastern Pennsylvania were accomplished by his ability. At his death he was president of the Geo. C. Towle Mfg. Company and the American Spring Water Company and a member of several social organizations. The business of the Geo. C. Towle Mfg. Company will be continued by the same general management.

PERSONAL.

MR. A. ANDERSON has been appointed general manager of the Albany Electric Illuminating Company, of Albany, N. Y.

MR. W. S. ACCLES, European manager of the Niles-Bement-Pond interests, left for Europe May 27 on the American liner *New York*, after some weeks' sojourn on this side.

MR. E. O. EDSON has become secretary and treasurer of the Bendit Mercantile Engineering Company, 714 Wainwright Building, St. Louis. Mr. F. C. Laufketter has retired to assume the presidency of the Victor Manufacturing Company of St. Louis. The Bendit concern represents a valuable line of mechanical and engineering specialties.

LT.-COL. CUBILLO, principal of the Spanish government arsenal at Trubia, sailed for Europe May 27 on the American liner *New York*, after several weeks' visit on this side. The Trubia arsenal is already equipped with considerable Yankee electrical machinery and machine tools and Col. Cubillo during his Yankee electrical machinery and machine tools and Col. Cubillo during his present trip has placed orders for further equipment, some particulars of which appear elsewhere in this issue. Shortly after his return to Spain it is anticipated that further substantial contracts will be sent to various American manufacturers of machinery, etc.

Mr. W. E. PARK, manager of the Johannesburg offices of Fraser & Chalmers, Limited, of London, will arrive in the States shortly for the purpose of placing substantial contracts. Fraser & Chalmers, Limited, acquired the British and Colonial manufacturing and selling rights of Fraser & Chalmers, of Chicago prior to that concern entering the Allis-Chalmers Company. Among the American firms represented by the Fraser & Chalmers people in South Africa are the Rand Drill Company; the Wheeler Condenser & Engineering Company; the Sullivan Machinery Company; the Knowles end of the International Steam Pump Company; the Jones & Laughlin Steel Company; the Chapman Valve Manufacturing Company and the Robins Conveying Belt Company. They also look after the South African business of the British firm of Dick, Kerr & Company.

PRESIDENT JOHN I. SABIN, of the Pacific States Telephone & Telegraph Company, recently returned to San Francisco from Chicago where he managed the affairs of the Bell companies for two years during which there was a great increase in the business of the lines in and around Chicago. Louis Glass, the vice-president and general manager of the Pacific system, is still traveling in the Orient, and Mr. Sabin will at once take active steps to improve the service throughout the coast as well as in San Francisco. The exchange facilities in that city will be increased from the present capacity of 45,000 to 100,000 subscribers' stations. San Francisco had on May 1, 40,287 subscribers and the entire coast system 164,540. This shows quite a rapid increase. The company has taken off its solicitors and ceased to advertise, pending the proposed extensions of the system in San Francisco. There is only one city on the Coast, and probably in the United States, that has more telephones in proportion to the population than San Francisco, that is Bakersfield, Cal., where is is 1 to 20. The great number of oil wells is largely responsible for this, as there is a telephone at every pump in the oil districts. The projected independent telephone companies in San Francisco and Oakland are not being heard from at present, although the persons promoting the enterprises had good financial backing it is said. Mr. Sabin is quoted as saying that he does not fear competition in the long run.

MR. FRANK L. MIDDLETON, who, for the past three years has been prominently identified with the sales and correspondence departments of the Stromberg-Carlson Telephone Manufacturing Company has resigned from that company to accept a similar position as manager of the sales department with the International Telephone Manufacturing Company. Mr. Middleton has had a broad and practical experience in the telephone field, having twenty years ago, while a boy, started in as night operator and later as inspector by the Central Union (Bell) Telephone Company, at Elkhart, Indiana. He soon rose to the position of manager of that exchange and remained with this company for a period of about eight years. At the opening of the independent field, he took up this line of work in the organizing of the Elkhart (independent) Telephone Company, which put in one of the first independent exchanges in the country. After the completion of this plant, he assumed the management of the Merchant's Mutual Telephone Company, of Michigan City, Indiana. He later resigned to assist in the organization and take charge of the construction of the independent exchange at Waco, Texas, which is considered one of the largest and best built exchanges in the Southwest. At the completion of this plant, Mr. Middleton resigned the management of this company to enter the manufacturing field in the offices of the company from which he has just resigned. The International Company, being now well established in the manufacture of a complete line of central energy and generator-call telephones, together with switchboard systems for any size exchange, including all the most modern conveniences and embodying in the construction of the parts many new features that are of importance to the durability as well as the efficiency of a telephone plant, will enable Mr. Middleton to continue to serve his many friends in the business.

Trade Notes.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY has removed its Chicago office to a suite of rooms on the twelfth floor of the Marquette Building.

ARNHOLD, KARBERG & CO., of China, have removed their offices from 50 Wall Street to more commodious quarters at the Battery Park Building, State Street, New York City.

THE SHELBY ELECTRIC COMPANY, of Shelby, Ohio, has broken ground for an addition 30x100 feet and two stories high. This will about double the capacity of the plant.

FILTERS FOR STEEL CORPORATION.—Two large Cross oil filters were recently ordered from the Burt Mfg. Co., Akron, Ohio, by the U. S. Steel Corporation, making 114 now in use in its different mills.

THE ELBLIGHT COMPANY OF AMERICA has called attention to the fact that its system and fittings are specifically included in the list of approved fittings for decorative lighting by the National Board of Fire Underwriters in the 1903 National Code.

REMOVAL.—The A. G. Schoonmaker Company will, on or about June 1, move its offices and warerooms to 29 West Street, New York. The company will have at its new quarters increased facilities for handling its business and more commodious and convenient warerooms.

MASHINTER ELECTRIC CO., of Buffalo, N. Y., has moved its place of business from 12 Perry Street, in that city, to 62 Niagara Street, where it will carry a full line of electrical supplies, and will be fully equipped there for every class of electrical construction, armature winding and repair work.

THE WARD-LEONARD ELECTRIC COMPANY, Bronxville, N. Y., manufacturers of rheostats and circuit breakers, reports a large number of orders from the New England states for its DK type circuit breakers for use in automobile stations. On account of its special features and extremely low cost the breaker is very popular.

THE ECK DYNAMO & MOTOR WORKS, Belleville, N. J., are kept busy filling the constantly increasing orders for their well known dynamos and motors of various sizes. The present demand for their new universal fan motors shows the interest this newest production in fan motors has created. It is a highly ingenious mechanism.

THE LUNKENHEIMER COMPANY, Cincinnati, reports that on account of the unprecedented demand for its superior line of brass and iron steam specialties, it has been compelled to increase its foundry output 50 per cent. Machine tools of the most improved type are being installed in various departments as fast as they can be obtained.

THE AMERICAN BALL BEARING COMPANY, Cleveland, Ohio, manufacturer of ball bearings for automobiles and other purposes finds itself cramped for space and has purchased a six-acre site on the West Side near the Lake Shore & Michigan Southern tracks where it will erect a three-story factory. Considerable new machinery will be installed and all of it will be electrically driven. A power plant consisting of a 250-hp cross compound engine direct-connected to a 150-kw alternating current generator will be installed, as well as a number of independent motors.

THE UNIVERSITY OF WISCONSIN, at Madison, Wis., has recently removed the arc lamps from the gymnasium, and substituted eighteen six-glower Nernst lamps, making a considerable gain in both the quantity and quality of the illumination. Other educational institutions throughout the country are also adopting the Nernst lamp, notably the State Normal School, of Westfield, Mass., which has lately installed 75 single-glower Nernst lamps.

MASURITE COMPANY.—The Masurite Explosive Company announces the removal of its offices from 50 Broadway, New York City, to its manufacturing plant at Masury, Ohio. This will enable the executive and managing departments to be in closer touch with the manufacturing end of the business and the company feels that it will thus be in a position to give better care to the interests of its patrons. The company's post office address is Sharon, Pa.

THE NEW TELEPHONE WIRE now being sold by the Electric Appliance Company, Chicago, is of the celebrated "O. K." manufacture. It is a two conductor, glazed braid, made with trace thread in one conductor, then twisted. It is carried in Chicago in black, maroon and nut brown colors, No. 18 B. & S. copper. This insulation does not rot or deteriorate and if we may believe the Appliance Company, is cheaper than many rubber wires of greatly inferior quality.

THE UNITED ENGINEERING & FOUNDRY COMPANY, of Pittsburg, installed last year a complete heating and ventilating equipment in the roll shop of the Lincoln foundry department. The apparatus, which was furnished by the B. F. Sturtevant Company, consists of a steel-plate exhauster direct-connected to a horizontal, side-crank engine. The exhauster draws air from out of doors through a large steam heater built up in sections of one-inch pipe, one of the sections receiving the exhaust from the fan engine.

TELEPHONE CONTRACTS.—The De Veau Telephone Manufacturing Company, 27 Rose Street, New York, announces that it has just closed a contract for a complete telephone system for the Willard Hotel in Washington; also for a camplete telephone plant for Luna Park, Coney Island. It has also received a large order for telephones from the New York Central Railroad Company. The De Veau Company is just about to ship a complete telephone plant to Alaska.

AN ART SOUVENIR.—The Swedish-American Telephone Company, of West Jackson Boulevard, Chicago, has combined art and science most skillfully and effectively in its new catalogue, which will be mailed upon request. The book is one of the most artistic ever undertaken in the telephone field and is certain of an enthusiastic reception wherever introduced. The cover, paper, stock, illustrations, border designs, printing, etc., are all perfect in their way. Every telephone man will want the "Art Souvenir," and can get one.

PROVED BELTING.—A half century's constant use in thousands of the leading factories of the United States has proved the worth of "Royal Worcester" belts. The Graton & Knight Manufacturing Company is to be congratulated on the reputation that its belting has secured by its honest work all through this long period of time, and any manufacturer who desires to secure the best of belting will do well to write for prices and facts about "Royal Worcester." Inquiries are invited and full data will be furnished promptly.

THE BENJAMIN ELECTRIC MFG. COMPANY, of Chicago, exhibited its wireless clusters and electrical specialties at the Auditorium Hotel, Chicago, the present week, during the convention of the National Electric Light Association. Many interesting features were shown. On account of the rapidly increasing demand for its products the Benjamin Company found it necessary to establish its office and factory in larger quarters, and therefore moved to its present location, 141 South Clinton Street, where with increased facilities, it will bo able to supply the demand for its goods.

LATEST DEVELOPMENTS IN TELEPHONY is the title of a bulletin just issued by the International Telephone Manufacturing Company, of Chicago. It gives illustrations of the company's full line of apparatus for large and small public and private central energy and generator-call telephone plants, with a clear description of the many improvements embodied in the construction of the various parts. The pamphlet is artistically arranged and will interest all who are engaged in the telephone operating and constructing field.

THE DALE COMPANY, manufacturer of electric fixtures and other electrical specialties, is now located in its handsome new building at 9th Avenue, 13th and Hudson Streets, New York, where no expense has been spared to make it the model plant of its kind in this country. New machinery of the latest type has been added and the new show rooms are splendidly appointed. Mr. J. H. Dale has recently acquired all of the outstanding shares in the Dale Company and now owns exclusively all the stock. Mr. O. J. Bryan, sales manager, will shortly make an extended trip to the West in the interests of the company.

BANNER ELECTRIC COMPANY.—The stockholders of the Banner Electric Company held their annual meeting recently and elected these officers: President, J. Evans Lippincott; vice-president, Thomas Carr; treasurer, O. U. Cassady; superintendent, F. C. Kirchner; secretary and general manager, N. L. Norris. The above with R. T. Hamilton, C. S. Cook are directors. The affairs of the company were reported in a very prosperous condition and the output of the plant has been increased materially in the past year. There was a substantial earning on the capital invested, but the directors decided to allow this to remain in the treasury for future developments.

THE CALCULAGRAPH CO., New York, recently changed its quarters to a more commodious location at 15 Maiden Lane, where it has been for some little time past. From its new offices the view is superb; and its floor space is also increased. It has recently issued a partial list of purchasers and users of instruments, which looks like a miniature telephone directory. The use of the calculagraph in telephone work has shown wonderful results. According to a statement made by Mr. Henry Abbott, president of the company, 16 instruments sold to one telephone company earned in one month $1,126.20, this sum being for toll charges on excess minutes that had previously been unrecorded.

THE F. BISSELL COMPANY, Toledo, Ohio, since moving into its new building, No. 226-230 Huron Street, reports an overwhelming amount of business; its trade in switchboards, time switches and other specialties being especially heavy. It carries in stock a complete line of telephone and electric light supplies and ships orders promptly. The Northern Electrical Manufacturing Company's line of motors and dynamos has recently been added to the list and sales on this line are also heavy. The Cleveland office, No. 709 New England Building, is in charge of Mr. A. B. Mann, who looks after machinery business in that locality. The company will be glad to send copies of its excellent catalogues to any address.

HART & COMPANY, of Chicago, makers of the Red Cross lubricant for commutators, are finding a very gratifying demand for this new commutator lubricating stick, which now has the endorsement of over 15,000 electricians and engineers. Full sized sticks are five inches long and 7/8 inch in diameter. A trial is all that is asked. This company is also furnishing the Langleben brush. This is a carbon brush, which contains a sufficient percentage of graphite to make it self-lubricating and soft enough to secure a good contact on the commutator at all times. It is especially adapted to use of stationary motors and generators. Besides the carbon brush, this company carries a stock of superior bronze woven wire brushes.

MAGNET STEEL.—The use of high grade permanent magnet steel is constantly increasing, and A. C. Leslie & Co., Merchants Bank Building, Montreal, Canada, report that they are finding a large demand for "Remy" brand of imported steel, for which they are agents. They state that this brand has been adopted by nearly all the leading manufacturers of electrical instruments in the United States, as well as by a number of telephone companies and other classes of electrical concerns requiring magnet steel. The "Remy" brand is produced in Germany from pure Swedish stock, the makers having had a specialty in this for more than a generation. They are indeed said to be the largest producers of finished magnets from which fact they derive a practical experience that is most valuable to them in checking the quality of their steel. In addition to importing this steel on special order, the firm of A. C. Leslie & Co. has arranged to carry a certain quantity in stock at New York.

TELEPHONE CATALOGUE.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., and Chicago, Ill., has just issued a very handsome and artistic bulletin entitled, "Interurban Telephones." The catalogue contains descriptions and illustrations of telephone and switchboard apparatus for railway and interurban lines. Views are given showing the practical use of the instruments on such railways. As has already been noted in these columns, the Detroit United Railway Company uses the telephone system of despatching. A description of this system is also included in the bulletin, together with various views of telephone booths along the line, and the switchboard at headquarters. An excellent half-tone view represents one type of the instrument in use on the line of the Trenton & New Brunswick Railway Company. All of the illustrations in this catalogue are of the highest class and are very complete in detail and clearness. Altogether the bulletin is one of the most finished and attractive ever issued on this particular branch of the subject. Two fine views of the company's factories at Chicago and Rochester are given, and the front cover is a work of art. This company's apparatus has been especially designed to meet the most exacting requirements of perfect communication at all times between the various departments of railway companies, requiring reliability and efficient service.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 12, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

726,476. ELECTRICAL DISTRIBUTION AND SELECTIVE DISTRIBUTION; John Stone Stone, of Cambridge, Mass. App. filed April 4, 1894. (See page 928.)

727,764. ELECTRICAL PROTECTIVE DEVICE; Edward B. Ellicott, of Chicago, Ill. App. filed Dec. 17, 1901. (See page 928.)

727,829. CABLE-TERMINAL; Joseph J. O'Connell, of Chicago, Ill. App. filed Oct. 13, 1902. (See page 928.)

727,880. TELEPHONE SPECIAL DIRECTORY; Lewis M. Bannan, of San Francisco, Cal. App. filed April 3, 1902. (See page 928.)

728,060. SWITCHBOARD INCANDESCENT LAMP; Allen D. Whipple, of Chicago, Ill. App. filed Jan. 27, 1902. (See page 928.)

728,195. SECTIONAL COVER FOR BOXES; Thomas H. Brady, New Britain, Conn. App. filed Jan. 12, 1903. A fuse box having a sectional cover, any number of the sections of which can be removed at the same time.

728,202. STORAGE BATTERY; Alfred W. Charlton, Toronto, Can. App. filed Oct. 6, 1902. A rectangular lead tube containing a lead core having four wings in contact with the four corners of the tube.

728,210. ELECTROLYTIC ARC-LIGHT; William T. Dean, of Chicago, Ill. App. filed November 15, 1901. (See Current News and Notes.)

728,222. BRUSH HOLDER; Henry Geisenhoner, Schenectady, N. Y. App. filed Dec. 19, 1900. Details.

728,231. LAMINATED LEVER SWITCH; Edward M. Hewlett and Charles C. Badeau, Schenectady, N. Y. App. filed Dec. 16, 1898. The blade which enters between the jaws of the terminals also carries laminated bridging contracts which rub against the outer faces of the terminals.

728,242. LIGHTING DEVICE FOR INCANDESCENT GAS BURNERS; James Keith and George Keith, London, Eng. App. filed Aug. 19, 1902. Details.

728,243. WIRELESS TELEGRAPHY; James F. King, New York, N. Y. App. filed Feb. 5, 1902. Automatic apparatus for rendering the transmitting devices inoperative at such times as the receiving apparatus is in operation.

728,254. FACSIMILE TELEGRAPH; Hans Liebreich and John C. Francis, Detroit, Mich. App. filed June 14, 1900. Transmitting points and receiving points are mounted to rotate about an axis and are connected by a single main line; high tension currents are used for writing purposes and low tension current for synchronizing purposes.

728,256. BRUSH FOR DYNAMO ELECTRIC MACHINES; Walter D. Litchfield, Schenectady, N. Y. App. filed Nov. 23, 1900. Each brush is made up of a number of carbon blocks overlapping each other.

728,259. SYSTEM OF ELECTRICAL DISTRIBUTION; Alexander D. Lunt, of Schenectady, N. Y. App. filed Nov. 30, 1900. (See Current News and Notes.)

728,273. BRUSH HOLDER; Edgar W. Mix, Paris, France. App. filed March 22, 1900. Details.

728,274. ELECTROLYTIC CELL; Hugh K. Moore, Lynn. Mass. App. filed Aug. 29, 1901. The connections with the anode are made of disimilar metal and so joined that their different coefficients of expansion under heat will cause the joints to maintain firm electrical contact.

728,278. TELEPHONE-WIRE HANGER; Herman F. Neslage and Harry H. Watson, of St. Louis, Mo. App. filed July 14, 1902. (See page 928.)

728,292. ELECTRIC ELEVATOR; Frank B. Rae, Chicago, Ill. App. filed Nov. 16, 1895. A brake circuit is operated from the car independently of the motor circuit.

728,293. CIRCUIT BREAKER; Robert H. Read, Schenectady, N. Y. App. filed July 27, 1901. Means for locally generating fluid pressure by which an insulating fluid may be forced across the arc when the circuit is opened.

728,299. SYSTEM OF ELECTRICAL DISTRIBUTION; Edwin W. Rice, Jr., of Schenectady, N. Y. App. filed Jan. 2, 1901. (See Current News and Notes.)

728,300. ELECTRIC REGULATOR; Edwin W. Rice, Jr., of Schenectady, N. Y. App. filed Nov. 5, 1902. (See Current News and Notes.)

728,301. MOTOR BRACKET FOR PRINTING PRESSES; Frank E. Rich, Chicago, Ill. App. filed July 2, 1902. Details of construction.

728,313. TROLLEY; George E. Smith, Exeter, N. H. App. filed April 5, 1902. A small wheel is mounted in a frame normally pressed upwards by a spring. A trolley finder first directs the wire to the small wheel after which the spring on the trolley arm forces the main wheel into place.

728,321. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles P. Steinmetz, of Schenectady, N. Y. App. filed Jan. 2, 1901. (See Current News and Notes.)

728,322. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles P. Steinmetz, of Schenectady, N. Y. App. filed Jan. 2, 1901. (See Current News and Notes.)

728,324. THIRD RAIL ELECTRIC RAILWAY; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed July 5, 1902. A third-rail guard consisting of a roof plate and a rod beneath the rail, the latter supported in the insulators and serving as a foot-guard.

728,325. SYSTEM OF ELECTRICAL DISTRIBUTION; Charles W. Stone, of Schenectady, N. Y. App. filed Oct. 23, 1901. (See Current News and Notes.)

728,342. TELEPHONE-RECEIVER; George E. Wheeler, of Burlington, Ia. App. filed June 19, 1902. (See page 928.)

728,343. MAGNETO GENERATOR; George E. Wheeler, Burlington, Iowa. App. filed June 19, 1902. Details of a laminated core for the armature.

728,344. TELEPHONE-RECEIVER; George E. Wheeler, of Burlington, Ia. App. filed July 31, 1902. (See page 928.)

728,350. TELEPHONY; Robert H. Yurgae, of Milwaukee, Wis. App. filed Nov. 24, 1902. (See page 928.)

728,357. ILLUMINATOR FOR SURVEYING INSTRUMENTS; Carl M. Bernegau, Hoboken, N. J. App. filed March 20, 1902. A tubular handle carrying a small lamp, reflector and lens at its extremity.

728,372. POLE CHANGER; John Crawford, Denver, Colo. App. filed April 26, 1902. The construction involves a barrel switch in combination with fixed contacts.

728,381. STORAGE BATTERY; Mary Emme, New York, N. Y. App. filed March 11, 1902. The electrodes are placed in the earth which is then saturated with a suitable electrolyte.

728,440. PURIFYING APPARATUS; Pierre J. Boucher, Cleveland, Ohio. App. filed Oct. 16, 1902. Method of mounting electrode plates in a tank in which liquids are electrically treated.

728,442. ELECTRIC INSULATOR; Edward J. Burke, Olyphant, Pa. App. filed May 22, 1902. A conical split plug between the parts of which the wire is clamped, is driven into a V-shaped cross-passage in the head of the insulator.

728,523. CIRCUIT BREAKER FOR HOISTS; Samuel S. Wales, Munhall, Pa. App. filed Feb. 19, 1903. An actuating connection is arranged between the main circuit breaker and a switch in a safety circuit.

728,528. PROCESS OF TREATING KAOLIN FOR THE PRODUCTION OF CARBORUNDUM AND ALUMINA; Frederick C. Weber, Chicago, Ill. App. filed Nov. 3, 1902. Consists in forming silicon carbid and aluminum carbide from kaolin, then subjecting the product to the action of water forming methane and aluminum hydrate and then separating by washing the hydrate from the chrystalline carborundum.

728,537. DEVICE FOR ACTUATING AND CONTROLLING ELECTRIC MOTORS; Otto C. Britsch, Maspeth, N. Y. App. filed Nov. 28, 1902. The starting switch and brake of a sewing machine motor are operated from a treadle.

728,540. MOTOR CONTROL SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed Jan. 6, 1902. Apparatus for rendering it impossible to improperly operate the motor controlling switch in a multiple unit system.

728,544. ELECTRIC SIGNALING DEVICE; George E. Clark, Northampton, Mass. App. filed Aug. 16, 1902. Details.

728,546. MAXIMUM DEMAND INDICATOR; Frank P. Cox, Lynn, Mass. App. filed March 2, 1899. In a maximum demand instrument for three wire systems, an arrangement consisting of a tube, expansible fluid therein acting as an indicator, a coil included in circuit with each of the outside mains for heating the fluid, the two coils acting simultaneously and with an effect corresponding to the current flowing.

728,564. ELECTRIC RESISTANCE STRUCTURE; Henry Geisenhoner and Tycho Van Aller, Schenectady, N. Y. App. filed Nov. 10, 1900. A fur-mace in which a free circulation of the heated air among the coils is obtained so that the interior chamber may receive the full benefit of all the heating coils.

728,56[illegible]. BRUSH HOLDER; Henry Geisenhoner, Schenectady, N. Y. App. filed Dec. 20, 1900. Details.

728,567. APPARATUS FOR APPLYING TERMINAL WIRES TO ELECTRIC LAMP GLOWERS; Joseph M. Gulentz, Pittsburg, Pa. App. filed April 10, 1902. Apparatus whereby the ends of the terminal wires may be forced into the ends of the glower blank when the latter is in a soft condition.

728,568. METHOD OF APPLYING TERMINAL WIRES TO ELECTRIC LAMP GLOWERS; Joseph M. Gulentz, Pittsburg, Pa. App. filed April 15, 1902. Covers the method carried out by the preceding apparatus.

728,570. REGULATOR FOR ALTERNATING SERIES ARC LIGHT SYSTEMS; Josef H. Hallberg, New York, N. Y. App. filed Sept. 30, 1902. A fixed transformer and a movable reactance coil have their cores formed from the same body of iron.

728,575. TRANSFORMER; George H. Hill and Sydney G. Brown, Montreal, Canada. App. filed June 7, 1902. A medical apparatus comprising a cautery, a light and a shocking coil, each having their own leads and means, including a safety cut out, for connecting all of the coils to the source of energy.

728,579. SYSTEM OF DYNAMO ELECTRIC MACHINES; Frank H. Jeannin, Schenectady, N. Y. App. filed Oct. 28, 1901. Sources of electromotive force in series with each other, a consumption circuit in a lead extending between two of said courses and a regulating circuit connected to one terminal of the consumption circuit and to another lead extending said sources.

728,581. TRACTION SYSTEM; Ernst L. K. F. Kahlenberg, Charlottenburg, Berlin, Germany. App. filed Feb. 27, 1899. An induction motor having a resistance of predetermined value permanently included in circuit with its armature, is provided with means for increasing the pressure of the source of current supply when the car requires more than the normal amount of torque to propel the same.

728,648. ELECTRIC LAMP; Alexander J. Wurts, Pittsburg, Pa. App. filed June 19, 1902. It is stated that grooves formed in the frame surfaces adjacent to the glower, break up or prevent continuity of the deposit of platinum black on said surfaces and therefore prevents short circuits.

728,649. COLLECTOR FOR USE ON ELECTRICALLY PROPELLED OR LIGHTED VEHICLES; Benjamin H. Dodell, London, Eng. App. filed May 16, 1902. A magnet mounted on the car has pole pieces carrying spring supported fingers which are normally withdrawn from the roadway, but when presented to an iron button in the roadway, are pulled downward into contact to establish electrical connection between the button and car.

728,667. STORAGE BATTERY; John C. Brocksmith, Chicago, Ill. App. filed Jan. 14, 1902. Details.

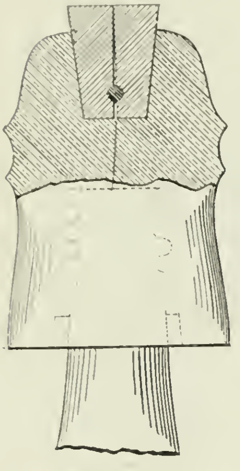
728,752. ELECTRICAL DISTRIBUTION; Samuel L. Naphtaly, Edward C. Jones and Frank H. Varney, San Francisco, Cal. App. filed Sept. 16, 1901. Transformers are automatically cut into and out of circuit according to the load.

728,766. WINDING FOR ELECTRICAL MACHINES AND APPLIANCES; Raymond Rouge, Paris, France. App. filed Oct. 10, 1902. The peculiar details of this winding can best be obtained from the patent itself.

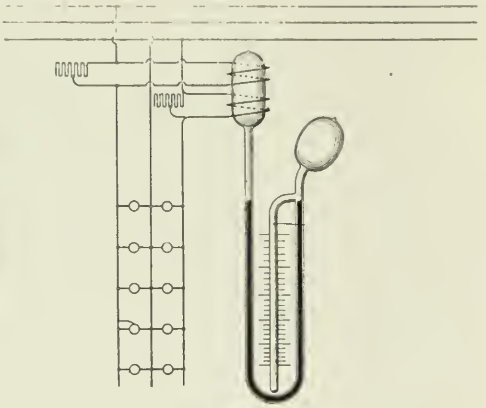
728,778. PRODUCTION OF CHROMIUM COMPOUNDS AND ALKALIES; Heinrich Specketer, Griesheim on the Main, Germany. App. filed July 1, 1901. The process consists in electrolyzing solutions of the salts of the alkalies with an anode containing chromium while preventing the mixing of the anode and cathode electrolyte and adding to the anode electrolyte a neutralizing agent.

728,780. CONDENSER; Charles F. Splitdorf, New York, N. Y. App. filed Aug. 4, 1902. A stack of layers of alternate foil and dielectric material is rolled up in such a manner that the inner ends of the foil are all in contact while their outer ends are all exposed, so that terminals can be respectively connected with them, the inner terminal consisting of a post around which the roll is formed and the outer terminal consisting of a binding wire for the roll.

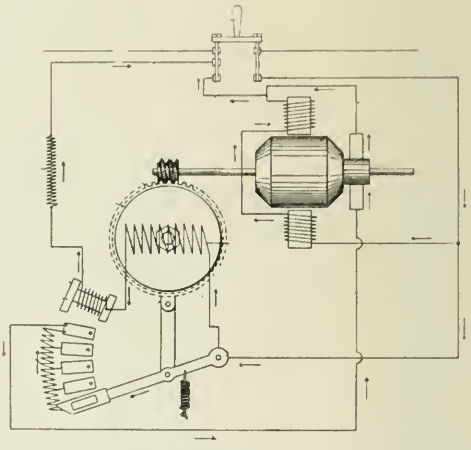
728,785. TELEPHONE SYSTEM; Ernest Umdenstock, of Reading, Kan. App. filed April 21, 1902. (See page 928.)



728,442.—Electric Insulator.



728,546.—Maximum Demand Indicator.



728,814.—Device for Automatically Cutting Out Starting Resistances of Electric Motors.

728,590. LOCK FOR CONTROLLER HANDLES; John B. Linn, Schenectady, N. Y. App. filed Jan. 29, 1901. An inspector boards the car at boundary points between city and suburban districts and fixes the limits of movement of the controller handle so that the motorman cannot run faster than is permitted in each district.

728,596. EQUALIZING BRUSH HOLDER; Edwin J. Murphey, Lynn, Mass. App. filed Oct. 4, 1901. The support for the brushes is permitted to move when the relative pressure of the brushes upon the commutator varies.

728,611. SYSTEM OF MOTOR CONTROL; William B. Potter, Schenectady, N. Y. App. filed Jan. 24, 1901. In a pneumatic system, a device for causing a quick movement of a valve consisting of a solenoid whose core strikes a hammer blow upon the valve.

728,612. MEANS FOR COMPENSATING TEMPERATURE CHANGES IN ELECTRICAL MEASURING INSTRUMENTS; William H. Pratt, Lynn, Mass. App. filed Dec. 12, 1902. A thermo-electric couple having the joints exposed to the same temperature conditions as the shunt joints and connected with the instrument terminals so as to provide an opposing thermo-electromotive force.

728,614. CURRENT COLLECTOR; Edward D. Priest, Schenectady, N. Y. App. filed Dec. 2, 1901. A number of collecting rings and spacing rings between them are clamped together and against an end flange by means of one pressure collar.

728,632. CONTACT-BREAKER; Charles F. Splitdorf, of New York, N. Y. App. filed September 19, 1902. (See Current News and Notes.)

728,647. HEATER CUTOUT FOR ELECTRIC LAMPS; Alexander J. Wurts, Pittsburg, Pa. App. filed July 7, 1900. The solenoid core which operates the cutout, is connected to the cutout bar in such manner that it is tilted in the core space to rest against the walls thereof and prevent its noisy vibration when the lamp is operated by alternating currents.

728,789. ELECTRIC HEADLIGHT LAMP; Harlan P. Wellman, Ashland, Ky. App. filed Jan. 3, 1903. Details.

728,797. CIRCUIT BREAKER OR SWITCH FOR HIGH POTENTIALS; Edward M. Hewlett, Schenectady, N. Y. App. filed Feb. 11, 1899. The terminals are located in a narrow tube and are separated with a sudden and extended movement.

728,805. INSULATOR; Fred M. Locke, Victor, N. Y. App. filed Jan. 29, 1902. The insulator has an upper surface in the form of a flattened cone around which there is a gutter to carry off moisture.

728,812. RECTIFIER; William Stanley, Pittsfield, Mass. App. filed March 10, 1897. Details of construction.

728,814. DEVICE FOR AUTOMATICALLY CUTTING OUT STARTING RESISTANCES OF ELECTRIC MOTORS; George H. Whittingham, New York, N. Y. App. filed July 8, 1902. A magnetic clutch is interposed between the armature shaft and the rheostat lever; when the resistance is all out, the clutch releases and thereafter runs free.

728,817. STARTING ALTERNATING CURRENT MACHINES; Jonathan E. Woodbridge, Schenectady, N. Y. App. filed Oct. 11, 1901. Means for reducing the normal electromotive force before impressing the same upon the machine in starting.

728,820. CIRCUIT MAKING AND BREAKING DEVICE; Alexander J. Wurts, Pittsburg, Pa. App. filed April 17, 1901. Details.

728,821. HEATER CUT OUT FOR ELECTRIC LAMPS; Alexander J. Wurts, Pittsburg, Pa. App. filed March 14, 1901. Details.

12,113. RAILWAY SIGNAL; Jonathan D. Price, Aurora, Ill. App. filed April 23, 1901. A system in which the track rails are utilized as a part of the circuit for operating signals located on the train.

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CONTENTS.

Editorial 953
Telephone Convention 956
Wireless Telegraph and the Cable 956
Edison at the St. Louis Exposition 956
Transatlantic Wireless Work 956
Hydro-Electric Development of the French Broad River, N. C. By Charles E. Waddell 957
Ashtabula Telephone Exchange 959
Some Educational Points. By H. S. Knowlton 960
Canadian Power Development at Niagara Falls. By Arthur B. Weeks 961
Edison in Wireless Telegraph 961
Telephones in a Lighting and Traction System 962
American Institute of Electrical Engineers 963
Twenty-sixth Convention of the National Electric Light Association 964
New York Electrical Society 975
Canadian Electrical Society 975
Current News and Notes 975
Letters to the Editors:
  The Use of Differentially-Wound Telephone Receivers in Electrical Measurements. By H. Ho. 977
  Commutation of Alternators. By M. Latour 977
Digest of Current Electrical Literature 977
New Books 981
English Turbo-Generators 982
Steam Turbine Plant of the Manchester Corporation, England 983
Wireless Telegraph Earnings 983
3,000-kw Generating Units for the London Metropolitan Central Station System 984
Electric Steering Gear on an English Yacht 985
Two-kw Dynamo 986
Stirrup for Arc Lamp Suspension 986
Exhibits at the National Electric Light Convention 987
Electric Vehicles in Boston District 992
The New Claypool Hotel in Indianapolis 992
News of the Week 993

National Electric Light Convention.

Supplementing the report given in these pages last week, of the first day's proceedings of the National Electric Light Association meeting in Chicago, we now devote several pages of the present issue to the work of the convention during the rest of the week. It is almost needless to repeat our comments upon the great success which has attended this latest visit of the body to Chicago. Whatever dead wood there was in the Association—and undoubtedly some had accumulated—it has evidently all been cut away, for never in the history of the Association was there a larger or more enthusiastic gathering, or one at which a larger amount of useful work was accomplished. The most gratifying aspect of the situation is that while the big companies remain in membership, and naturally supply the incumbents of the presidency, large numbers of the smaller companies are coming in, occupying the other offices, attending the meetings, giving a distinct stamp to the proceedings, and deriving a large amount of good from what is done. Indeed, it must be obvious to any one who studies the conditions of things that the best hopes of the Association lie not so much in holding together the few larger companies which do a considerable portion of the electric light and power business, but in enlisting the sympathy and active support of the smaller companies throughout the country. If we take fifteen or twenty of the largest companies, it will be found that they are systems presenting a remarkable sameness in the questions that arise in regard to them, and that these problems are more or less specifically limited to this score of corporations. On the other hand, the three thousand relatively small companies, also doing in the aggregate a large proportion of the production and distribution of current, present a greater variety of aspects and difficulties for consideration, and it is evident that further increase in membership of any magnitude must be looked for among them. The Association does well, therefore, not merely to place representatives of the minor companies among its officers, but to put upon its programme papers and discussions directly affecting their interests. Indeed, it might be said that the Question Box, and the new Committee on Progress, have both been developed with special reference to the wants of the smaller companies whose activity and welfare are stimulated by a study of the advances being made in the art, and by an interchange of practice and experience in regard to the newer problems that arise.

The growth in membership during the past year is, indeed, one of the most hopeful features connected with the work of the Association. It thus gets into touch with a larger area, and becomes more a representative body with the right to express opinions with greater validity when it addresses public sentiment. But, while encouraged by this rapid growth of the past year, the officers ought not to rest, but to push their propaganda, so that instead of claiming five hundred members they can point proudly to at least a thousand. Even then they will have but thirty per cent. of the possible; but that will be a good proportion, and while enhancing the influence and reputation of the Association will give it the resources wherewith to take up the work which it has not yet attempted, but which the industry is entitled to expect of it. Some of this newer work was indicated in the presidential address of Mr. Ferguson, and it is easy to suggest other lines. As to the new president, Mr. Edgar, it can only be said that, like his talented predecessor, Mr. Ferguson, he is eminently qualified to fill the chair, and that both, like Mr.

Doherty, are remarkable representatives of the younger element in the electric light profession. When we remember how hostile and antagonistic the Edison contingent was at one time toward the National Electric Light Association, it is a sign of the best augury thus to find Edison men welcomed to the ranks of the Association and given also its highest place of honor.

We have sometimes heard cynical and skeptical people wonder what good conventions are, but we are sure that not one who attended the meeting last week in Chicago will have ventured to raise such a doubt, or even to entertain it. The crowded attendance at each of the business sessions was a most happy indication of the deep interest taken by the central station men in the vital questions affecting their prosperity; and altogether the bearing and behavior of this vast concourse of nearly a thousand people was the best possible evidence of the dying out of the old spirit of junket, and the broadening and deepening of the ideals that must govern the future of an industry now making so good an impress upon the social life of the United States.

LOST CURRENT.

We hope that many a station manager will take to heart the curious facts brought out in Mr. Van Ness's convention paper. The sins of the early alternating-current systems in the matter of lost energy are well known, and from all appearances the case even now is none too good. In the good old times when everybody used 50-volt lamps and at least one transformer for every customer, it was a wonder that enough current to keep the station out of bankruptcy was ever sold, and unless our memory plays us false it frequently was not. We should really like to see an authentic record of the lost current in some of these old-time plants. Certainly, in some cases, the energy actually paid for by the consumers was no more than twenty-five or thirty per cent. of the total generated. But who knows how much lower it may have fallen? To pass from these prehistoric times to the present, Mr. Van Ness cites one circuit in operation until very recently in which the sales were only 48.5 per cent. of the energy, and it is safe to say that there are scores of instances quite as bad. In this particular circuit most of the waste was very easily accounted for, and was found in the transformer core losses as usual. The resistance losses were small, the meter losses were insignificant, and the energy unaccounted for was practically none; that is, it was well within the range of experimental errors. A comparison of this circuit with another from the same table affords some startling facts. The house-to-house transformer system, although having the advantage of some commercial work, showed only 2.4 kilowatts of load connected, and 0.6 kilowatt of maximum demand per transformer connected. The average capacity of the transformers was 1.1 kilowatt, and under the circumstances it is small wonder that nearly half the output went to settle the core loss account. Such a circuit seems hopelessly out of date.

The modern three-wire circuit with which it was compared showed the advantages of a secondary main system in the most striking fashion. The connected load was 31 kilowatts, and the maximum demand 5.4 kilowatts per transformer of 9 kilowatts average capacity. Still, with all this improvement the percentage of energy sold was only 71.2. More than half of the loss was due to core loss in the transformers, and over 5 per cent. of the total energy was wasted in the meters. Both these items seem needlessly large. It certainly appears to be wasteful metering that uses up *seven per cent.* of the energy sold, and it is certain, as Mr. Van Ness shows in the figures from another circuit, that this figure can be reduced by careful engineering to less than one per cent. But the core loss is still with us and there seems small prospect that it can be greatly reduced by direct improvements in the transformers. It can, however, be very greatly reduced by skill in arranging the system, and nothing is more clearly shown in Mr. Van Ness's paper than the effect of attention to detail upon station economy. If an electric manufacturing company brought out a transformer with less than a quarter the usual core loss, the racket would be heard around the world, yet here before us is a case where just this result was reached by *finesse* in arranging a feeder circuit. The need of skilled supervision of details is obvious.

ARCS OF LOW AMPERAGE.

Street lighting seems just now to be that branch of central station work which is subject to the most rapid and striking change. The old arc machine held the field undisturbed for a long time, but when the change began it progressed with most astonishing rapidity. Mr. Hallberg's paper on some of the recent work in Cincinnati displays the trend of recent practice admirably. There is no doubt that the tendency to use more and smaller lights is a growing one, and that in the main the movement is in the right direction. There obviously comes a point in subdivision at which it ceases to be advisable, and it is always an interesting matter to determine this point, which, of course, varies with different illuminants. We must confess to some doubts as to the wisdom of working series alternating enclosed arcs with a current as low as four amperes. It would be very interesting to know the mean spherical candle-power and the distribution curve from Mr. Hallberg's lamps, without which the comparison with other illuminants loses much of its force. The old "2,000-candle-power" open arc gave a vile distribution of light and generally flickered abominably, but it did give very strong illumination at a good luminous efficiency, and it gave white light. It seems to us that most of the practical gain in the modern arcs, from the standpoint of the public, comes from the very great increase in steadiness, and the absence of an abnormally bright zone near the lamp. The low-ampere alternating arcs give a light which is not yet satisfactory, and we cannot avoid the impression that they may represent only a temporary phase in street illumination, unless the color difficulty can be permanently overcome. The system of constant-current transformers seems to work admirably and the increase in plant efficiency over the older arc systems is very marked. And yet it seems like a makeshift to generate and transform the energy in the same building. It is, indeed, a pity that the constant-current transformers cannot be distributed as other transformers are. Such distribution is, indeed, practiced now and then, but the general opinion of station managers seems to be against it.

The whole business of street lighting seems to be in a transitional stage, and one constantly wonders what will be the outcome. We would like to see a careful comparison between the various systems of electric street lighting, based not on distribution and operating expenses alone, but on the watts per mean candle-foot at the areas to be illuminated. Something is certainly to be hoped from the new illuminants now being pushed into use. It would be interesting, for example, to get authentic figures from Nernst lamps used on the streets and from the mercury arcs as well. The latter arc is, it is true, most weird in color, but not more so than the low alternating-current arcs, and being capable of use with clear shades on account of their lower intrinsic brilliancy, should give a pretty good result in efficiency. Then, too, there are some modified arcs yet to hear from, and altogether the outlook is varied. It is a far easier task to devise a light for the street than for the house on account of the less severe requirements as to intensity, color and steadiness, but there is plenty of room for improvements still. But even so, it is a large gain from the sputtering, clattering, glaring arcs of the early eighties to the enclosed arc used on our streets to-day.

The Heyland Motor and Generator.

Much has been said and written during the past year concerning the possibilities of the Heyland improved induction motor, but the first reliable tests of this machine published in America appear in Prof. Adams' paper read at the last meeting of the American Institute of Electrical Engineers. As most of our readers are aware, the Heyland motor is an improvement upon the ordinary polyphase induction motor, and is designed to get rid of the relatively powerful wattless or magnetizing primary current of the machine. A commutator, with or without a special winding, is mounted on the rotor secondary of the machine, and polyphase currents, either from taps in the primary star winding or from a compensator connected to the primary terminals, are supplied to the stationary brushes. With suitable adjustment of the brushes and of the voltages applied to them, the power factor of the motor while running can be brought up to nearly unity, or one hundred per cent. The particular Heyland motor tested by Prof. Adams was a 10-hp, 6-pole, 60-cycle, three-phase machine constructed in this country.

When an induction motor is operated at synchronous speed, or the speed which the rotor very nearly attains when unloaded, the current supplied to the motor at primary terminals is an appreciable fraction of the full-load current, whereas the current supplied to a direct-current motor unloaded is a much smaller fraction of the full-load current. This induction motor current at light load is mainly a magnetizing current, serving to develop the rotating magnetic field of the machine and corresponding to what is called the exciting current, or leakage current, of a transformer on open secondary circuit. The exciting current of an ordinary transformer with closed magnetic circuit is a very small fraction of the full-load current, so that the wattless component of current in a transformer is of little practical importance. But the magnetic circuit of an induction motor cannot be closed, since the mechanical clearance between stator and rotor necessarily introduces two air-gaps in series. Consequently, the magnetizing current and the wattless component of the current under ordinary load is of considerable practical importance. In the motor tested by Prof. Adams, without the use of the commutator currents, i. e., in the condition of the ordinary induction motor, the current at full load was 14 amperes per line, and at no load 6 amperes per line, or nearly 43 per cent. of the full load current. The power factor of the current at no load was 20 per cent., and at full load 86 per cent. When the commutator was brought into action, the full-load current per line was reduced to about 12¼ amperes, and the no-load current to about 2 amperes, or to about 16 per cent. of the full-load current, while the corresponding power factors at full load and no load were about 99 per cent. and 65 per cent., respectively.

The preceding figures seem to present the salient advantages of the Heyland motor. The result may be summed up by stating that the current supplied to the motor from the mains and central station can be materially reduced during the full-speed running of the motor, but without sensible change of the input or efficiency. The reduction in current at no load may be about 66 per cent., and at full load about 12 per cent. For average running conditions under variable loads, the average current reduction might be, say, 20 per cent., since induction motors are not usually operated at relatively small loads. The basis of the method adopted in the Heyland motor is that when polyphase currents are admitted to a motor winding through fixed points, the rotating magnetic flux thereby set up, cuts the loops in the winding and generates a relatively large reactive voltage; whereas, if the same currents are admitted to the winding through properly adjusted brushes on a commutator, and the brushes are revolved backwards at synchronous speed, the rotating magnetic field will be pulled back by the brushes at the same speed at which it advances with respect to them, so that the field will be stationary in space and in the winding, thereby cutting no loops and generating no reactive e.m.f. Similarly, if the armature be rotated at synchronism with the brushes at rest, the field will not rotate in space, as before, but will still be at rest with respect to the reactive e.m.f. A comparatively small alternating voltage applied in this manner through properly disposed brushes will, therefore, produce a relatively powerful working current in the motor winding, having only the ohmic resistance to overcome, and may produce the same rotating magnetic field as a displaced or wattless component of current at the greatly increased pressure necessary to overcome the reactance of the winding.

The Heyland motor may then be stated at its best, when it is regarded as receiving its exciting current from a local commutator exciter, only the energy of this excitation being supplied from the mains, while the wattless component of primary current is thus in large measure suppressed. This undoubtedly enables one objection against the induction motor to be removed. The other principal objection, namely, feeble starting torque per ampere, remains practically unaltered. An induction motor in which the field exciting current was absolutely zero under all conditions would still have a large reactance in the secondary winding at starting, a corresponding large secondary phase displacement of current, and a feeble torque per ampere of secondary current. A relatively large primary current strength would still be required to develop full load torque in the motor. Consequently, the advantage of the Heyland device would be less apparent with induction motors that were frequently stopped and started, than with motors that ran continuously near full speed. In the latter case the current saved in each motor might, perhaps, be 20 per cent. In the former case it might not amount to 10 per cent. The Heyland device does not appreciably improve the condition of the motor at starting. The question then rises whether the reduction in line current effected by the Heyland method of field excitation is worth introducing the extra complication of the commutator and brushes. The saving in line current is mainly an advantage to the central station manager. The bills for watt-hours consumed presented to the consumer would be about the same whether the Heyland device were used or not. The only reduction in expense to the consumer would be by the indirect advantage of such reduction in copper and generator plant as might enable the central station to lessen the cost and selling price of production. On the other hand, a commutator induction motor is necessarily a more expensive motor than the exciting commutatorless machine. Theoretically, it might be possible to use a larger clearance between stator and rotor in the Heyland motor, and thus reduce the cost of manufacture by eliminating some of the refinements in construction; but it seems doubtful whether such an attempt could succeed in paying for the commutator and brushes.

A considerable portion of this interesting paper is devoted to the consideration of the Heyland machine converted into a generator being driven by power with negative slip, or above synchronism. The machine under test maintained its terminal voltage nearly constant up to full non-inductive load output, running self-excited by its commutator. This is a valuable achievement for the Heyland machine, since such generators are asynchronous, and can be thrown together in parallel without difficulty. But even here there are difficulties to be overcome in order to compete with existing generators under commercial conditions. Prof. Adams' paper is a most valuable contribution to a subject which has been much agitated, and which needed just such careful experimental data to be compiled and published, in order to arrive at an adequate conclusion.

Independent Telephone Convention.

Mr. J. B. Ware, the secretary of the Independent Telephone Association of the United States, writes us as follows: "Nearly all on the programme have accepted the invitation to participate in our convention so that the changes hereafter will be very slight. Every indication at present is that the programme will be exceedingly interesting and profitable one to those in attendance, and that the local committee comprising the leading manufacturers have prepared an entertainment which will be enjoyed by all who are in attendance. We see no reason why the attendance should not be large and the meeting one of our most successful ones. Perhaps special interest will center around the report of the patent litigation committee which so ably and successfully looked after the interests of the independent companies in the famous Berliner and Carty patent suits."

A local committee, with Mr. J. G. Ihnsen as chairman, has already been formed in Chicago and is working to make the convention a great success. The preliminary programme is as follows: June 24, 2 P. M.—Address of welcome by Hon. Carter H. Harrison, Mayor of Chicago, response by Hon. S. P. Sheerin, of Indianapolis, Ind.; annual address of President James M. Thomas; roll call of States, ten minute reports; "Advantages of Association," by Hon. C. E. Hull, of Salem, Ill., president Interstate Telephone Association; "The Telephone and the Technical School," J. C. Kelsey, professor of telephony, Purdue University, Lafayette, Ind.; "Modern Exchange Construction," W. H. Johnson, general superintendent Frontier Telephone Company, Buffalo, N. Y.; "Independent Telephone Development in the South," by C. E. Stinson, president Memphis Telephone Company, Memphis, Tenn.; "Western Telephone Development," J. S. Bellamy, Knoxville, Iowa. 6 P. M., concert in Auditorium Hotel. 8 P. M., special train to San Souci Park; programme of entertainment there to be given later. June 25, 10 A. M.—Patent Litigation Committee report, Hon. Hugh Dougherty, of Bluffton, Ind., chairman; "Telephone Discipline," by C. E. Tarte, general manager Citizens' Telephone Company, Grand Rapids, Mich.; "Eastern Telephone Development," F. A. Demarest, general superintendent Interstate Telephone & Telegraph Company, Trenton, N. J.; "Present and Future," Frank L. Beam, Columbus, Ohio; General business; election of officers.

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Wireless Telegraphy and the Cable.

From time to time, the effect of wireless telegraphy on submarine cable interests has been discussed in these pages, and it is now interesting to note the latest comments on the subject. At the half-yearly meeting of the Eastern Extension, Australasia, and China Telegraph Company, Sir J. Wolfe-Barry, said that the shareholders were aware that the agreements entered into with certain of the Australian States when the company undertook to lay the Cape-Australian cable provided for a graduated reduction of tariff down to 2s. 6d. a word, if a certain standard revenue were maintained. Unfortunately, it was not maintained during the past year, and therefore it was impossible to reduce the tariff from 3s. to 2s. 6d., as the directors had hoped, on January 1 last. Irresponsible critics were very fond of saying that, if the rates were only reduced, the traffic would so largely increase that the revenue would not be diminished; but experience showed that these views were not borne out by the facts, and that tariff reductions took a very long time to recoup themselves. The following figures would illustrate the point: On January 1, 1901, the company reduced the Australian tariff from 4s. to 3s. 6d. a word, and the number of words transmitted during 1901 was only 1,912,000, as compared with 1,866,000 in 1900; and on January 1, 1902, they further reduced the tariff to 3s., and carried 1,963,000 words during 1902. These figures showed that the work was practically stationary, notwithstanding a reduction of 25 per cent. in the tariff.

Since he last addressed the shareholders many sensational statements had appeared in the press in regard to wireless developments. Nothing had, however, happened, and nothing had come to his knowledge to alter the opinion he had from time to time expressed—that wireless communication was much more likely to be a valuable adjunct to submarine cable companies than to become a competitor with them. This view was evidently held in Germany, France, Holland, the United States and elsewhere, to judge by the extensive projects emanating from those countries for new cables in all parts of the world, some being now actually manufactured for connecting their possessions in the Far East. As he said at a former meeting, it would be rash for any one to put a limit on what might happen in the future, but, judging from what they knew in the present, he saw no likelihood of wireless telegraphy competing with cables for long-distance business, and he thought that that opinion was held very widely. He did not want to be regarded in any way as a hostile critic of wireless telegraphy. He still held that within its limits it would be not only useful to the public, to the navies of the world, and to the shipping community, but that it would also be useful to the company, who, in fact, had already found it to be so within distances of thirty or forty miles.

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Edison at the St. Louis Exposition.

President Francis, of the St. Louis Exposition, has received the following autograph letter from Thomas A. Edison, who has accepted the appointment of honorary chief consulting electrician of the Exposition:

Orange, N. J., May 18, 1903.

David R. Francis, President St. Louis Exposition:

Dear Sir:—I beg to acknowledge receipt of your favor of April 22, informing me of the great honor done me in appointing me honorary chief consulting electrician of the Universal Exposition, commemorating the acquisition of the Louisiana Territory.

In thanking you for this honor, and accepting it, I cannot but note with pleasure your reference to the fact that the Exposition year falls on the twenty-fifth anniversary of my perfection and introduction of the incandescent lamp. This recognition of work in the field of electrical invention is very gratifying to me, especially as it comes in association with your magnificent demonstration to the world of what has been done in all branches of industry in the States comprised within the original territory—a region where, as a young telegrapher, I spent many arduous years before moving East.

Permit me to commend your judgment in allotting at the Exposition a fine large building exclusively for electricity, and to express the fervent hope that it will be filled to overflowing with the latest examples of apparatus for light, heat and power and the communication of intelligence.

It will not only be my duty to take part in exhibiting such of my newer inventions as your colleagues may deem worthy of acceptance, but I hope to see from abroad, in rivalry with American advances, the results due to European leaders in the art to which I have given my life, because of my belief in it as one of the noblest agencies ever rendered available for human welfare and benefit.

With the best wishes for the brilliant success of the Exposition and pledging my own assistance as it may be required, I have the honor to remain, Mr. President, very truly yours,

Thomas A. Edison.

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Transatlantic Wireless Work.

A dispatch from Halifax says: "The Marconi station at Table Head, C. B., is in perfect order for the transmission of messages. The delay in establishing a wireless service between England and America has been entirely due to the station at Poldhu, which is being re-equipped with machinery similar to that at Table Head, and within a few days messages will probably again flash across the Atlantic and the first long-distance wireless service on a commercial basis be established.

"This statement was made by W. D. Deeks, of New York, who is interested in both the Canadian and the American Marconi Companies, and who is on his way from Table Head. Continuing, Mr. Deeks said: 'The present difficulty with us is of a purely mechanical character. But R. N. Vivian, who is in charge of the Table Head station, expects to receive word any day that Poldhu is ready to receive and transmit messages.

"'On Saturday a wireless station was opened in Chicago, and another in Milwaukee, and communication has been established between the two places. In Canada an overland station will be established at Vancouver and others at Port Arthur, the western terminus of the Canadian Northern, and probably at Halifax.'"

Hydro-Electric Development of the French Broad River, N. C.

By CHARLES E. WADDELL.

THE rapid strides made in the last decade in alternating-current work, and the steady increase of voltage and capacity of units render the description of a 2,250-kw, 6,600-volt plant a matter belonging to the commonplace, and meriting publicity merely because it indicates the steadily increasing confidence on the part of capitalists in electrical investments.

Near Asheville, North Carolina, the Weaver Power Company are now at work developing a hydroelectric plant on the French Broad River. The French Broad rises in the Pisgah forests of the Biltmore estate, and pursues a northwesterly course through the State into Tennessee. The fall from the source to Asheville is slight, but becomes marked some five miles north of the city. The first of the rapids possesses a fall of 13 ft. in a lineal distance of 2,500, and it is here that the Weaver Company have located their plant.

The scheme of development is: 1. The building of a dam across the river. 2. The construction of a canal 3,000 ft. in length. 3. The erection of a power house and equipment.

At the head of the rapids there projects across the river a ledge of granite, running at an angle of 15° with the river, and lying with the fissures and seams facing up-stream. This was selected as the site for the dam as affording an admirable foundation and anchorage. The dam, which is being built of blue granite, is 11 ft. high, 12 ft. wide at the base, 5 ft. wide at the top, and 532 ft. long, and is laid in cement. The purpose of the dam is merely to raise the head, no storage of water being contemplated. According to statistics prepared by the United States Geological Survey, the lowest flow on record is 96,000 cubic ft. per minute, and this amount is more than sufficient to operate the plant.

There will be no super-elevation of head to provide against rise in the river from freshets, for as 6 ft. is the greatest height attained by the water in any past flood, and as the head is 24 ft., it is estimated that the wheels will be capable of giving their rated output at normal speed with this amount of back water.

The canal is 3,000 ft. long, 60 ft. wide at the bottom, 100 ft. wide at the top, and is excavated down to solid rock. The mountain forms the east bank, and a wall had to be built on the river side. From the intake gates at the dam to a point some 2,000 ft. below this wall consists of an earth embankment 38 ft. wide at the base, 12 ft. wide at the top, and lined on the inside with a stone wall 2 ft. thick, laid in cement.

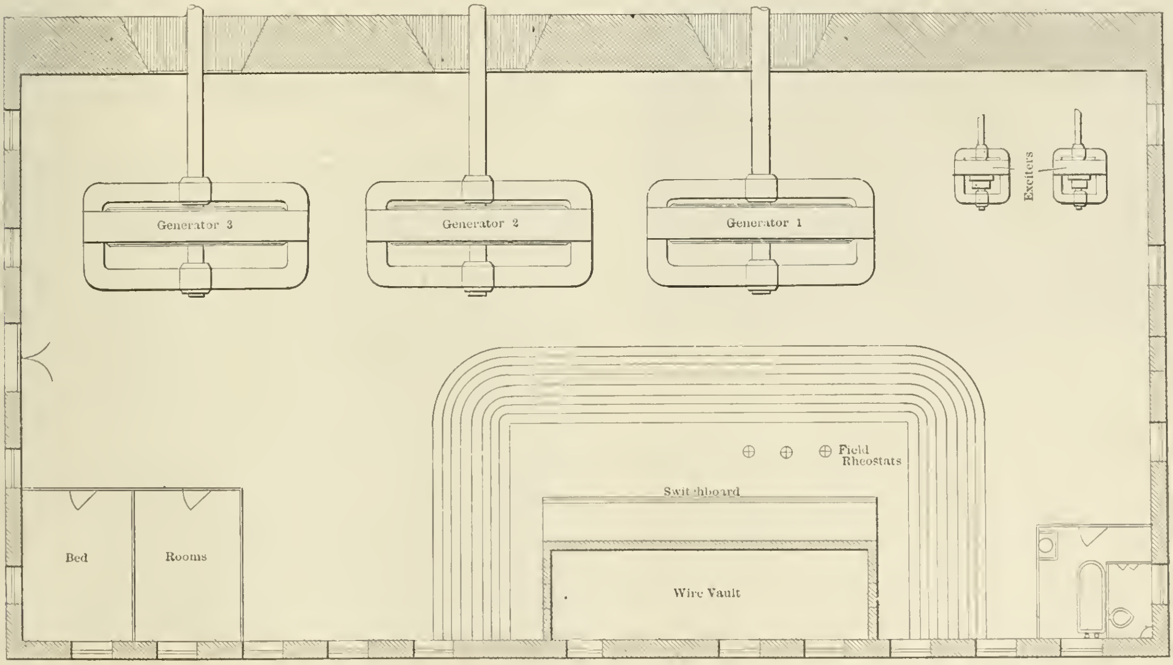


FIG. 1.—PLAN OF POWER HOUSE, WEAVER POWER PLANT.

Along the river side willows, aspens and kindred trees are planted, the object being to prevent wash or damage from driftwood in times of floods. The last thousand feet of the wall averages 20 ft. in height, 14 ft. thick at the base, 4 ft. at the top, is built of masonry, and affords together with the dam a total rollway of 1,500 ft.

The power house is located at the end of the canal, the bulkheads of the canal being the power house wall. It measures 50 x 90 ft., and rests on stone arches that span the tailrace. The building will be of brick with a slate roof supported on wood trusses. There will be a 15-ton traveling crane operated by hand.

FIG. 2.—VIEW NEAR POWER HOUSE.

The water power plant will be located in an open flume, and each unit will be composed of one 54-in. and two 51-in. Hercules turbines direct-connected to a 750-kw generator. There are to be three of these units, which taken with the excitation plant, constitutes the full equipment. Two 21-in. Hercules wheels each connected to a 56.25-kw dynamo, form the exciter plant. The dynamos are direct-current, 125-volt, compound-wound, and operate at 270 r.p.m. The exciters are not provided with governors. Each machine has capacity sufficient to excite all three generators. The water wheel shafts extend through cast-iron heads, set in the power house wall, and couple to their respective generators by means of flange couplings.

Each unit is provided with a governor, and the governor is so arranged that the unit may be started or stopped by means of a push button located on the generator panel of the switchboard. This device will be especially convenient for synchronizing.

The generators are of Westinghouse make, are 6,600-volt, 60-cycle, revolving field type, and are designed to operate at a speed of 120 r p m. The switchboard is located on a balcony 4 ft 8 in above the power house floor, and will be easily accessible, as steps are provided on three sides.

The board stands in front of a wire vault (a section of which is shown in the figure), which measures 8 ft. wide x 13 ft. high, and extends 30 odd ft., the entire length of the switchboard. In it are located the high tension bus-bars, transformers, lightning arresters, choke coils, oil switches, etc., and as all generator cables and transmission lines terminate herein, no circuit to the switchboard operates at a potential exceeding 125 volts. Motion to the oil switches is imparted by the levers running under the floor. The arrangement of the connections of the machines and board as shown in the figure was designed to secure extreme flexibility. There are two sets of high-tension bus-bars, and two oil switches on each generator and feeder. All or any generator may be operated on either set of busses, and all or any feeder may be connected to either set.

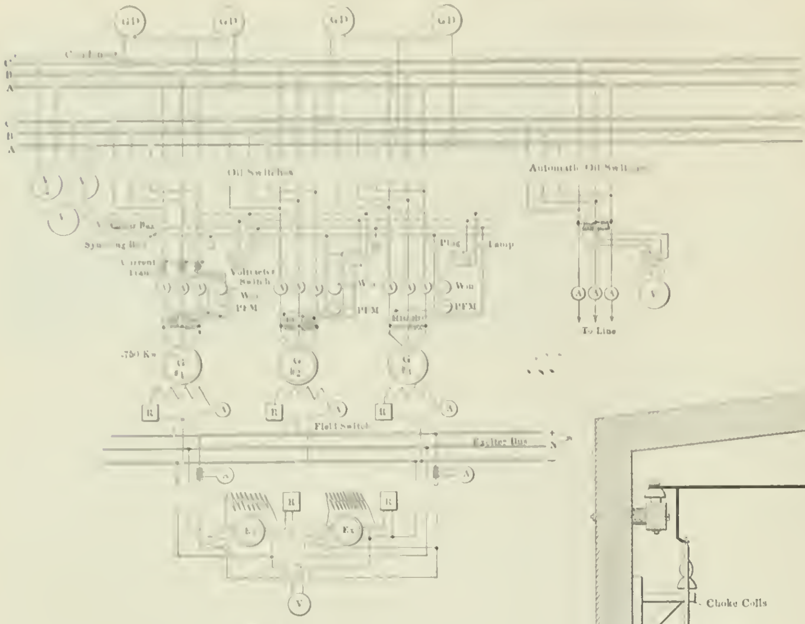


FIG. 3.—DIAGRAM OF CONNECTIONS.

As an example of the flexibility of the system, an inductive load could be switched on one set of bus-bars and one or two generators thrown in to operate it; the remaining generators or generator operating a non-inductive load on the other set of busses. The switches interlock in order to prevent the two sets of bus-bars from being thrown in parallel.

The switchboard consists of four types of panels. Each is made of blue Vermont marble, and equipped with Westinghouse instruments. The types are: (1) Exiter panel, (2) generator panel, (3) power feeder panel and (4) light feeder panel.

The exciter panel contains a voltmeter, two ammeters, switches and instruments of the kind that are usually found on a board of its class. It provides for the operation of the exciters individually or in parallel. The generator panels each contain two oil switches, three ammeters, a power factor indicator, a polyphase wattmeter, and a field ammeter. The field rheostats and switches are mounted on pedestals in front of the generator panels. The power panels contain a voltmeter, an ammeter and two automatic oil switches These switches operate by means of a relay, and open under an overload on any phase.

The light feeder panels differ from the power feeder panels in that there are three ammeters instead of one. This will indicate the state of the balance on the circuits. In addition to the foregoing instruments there are two electrostatic ground detectors for each set of bus-bars, and three voltmeters, two connected to the sets of bus-bars, and the other to the plug switches on the generator panels, to be used in paralleling.

It is hoped that work will have progressed sufficiently to be able to furnish current to the mills and other industries in and around Asheville by the first of September of this year.

Ohio Engineers.

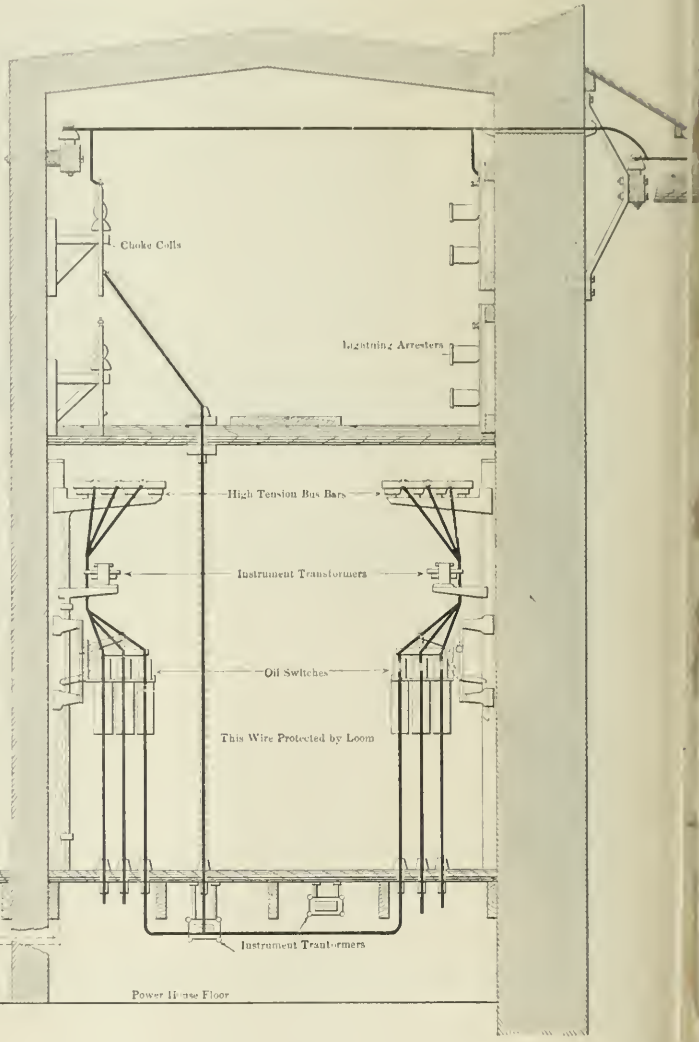


FIG. 4.—SECTION OF VAULT WITH WIRING DETAILS.

The Ohio Society of Mechanical, Electrical and Steam Engineers held its first annual meeting in Cleveland, May 23. Officers of the association are E. E. Miller, Canton, president; R. G. Ingleson, Cleveland, vice-president; John McConnaughy, Warren, second vice-president; R. H. Probert, Akron, treasurer, and C. J. Miller, Canton, secretary.

Ashtabula Telephone Exchange.

THE Ashtabula, Ohio, telephone exchange has recently been re-equipped with modern apparatus, which places it among the finest exchanges in the State. The Ashtabula Telephone Company was organized in 1896, and the growth has been so rapid that the exchange is to-day several times larger than was first considered possible. After having outgrown several switchboards, as well as the outside construction, a complete new equipment has just been installed for the central office.

The switchboard, which is shown in Fig. 1, is of the lamp signal, common battery, multiple type, and has a capacity for 1,800 lines, with at present 1,000 local common battery lines connected. A separate position on the board is equipped for magneto-rural lines, which class of service the Ashtabula Telephone Company has been recently been taking on. As will be noticed in the photograph, the first, or annex position, is reserved for the necessary multiple jacks; the second, or magneto position, generally known as "B" position, is equipped with 50 magneto drops, for taking care of the rural lines. The operation at this position has within her reach the multiple of every line on the entire switchboard. This position is equipped with party-line signalling apparatus, so that the operator can selectively signal any of the subscribers on her section.

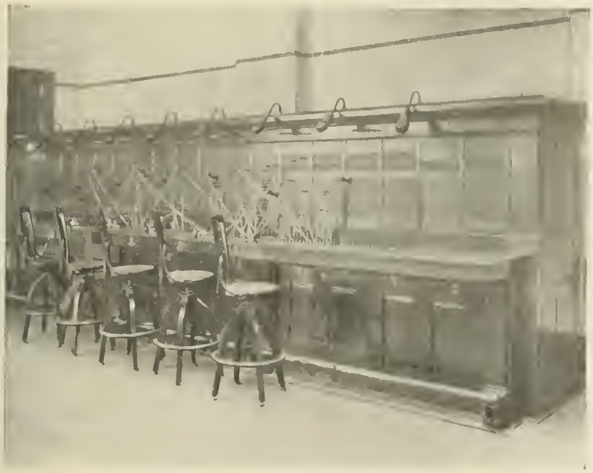


FIG. 1.—GENERAL VIEW OF SWITCHBOARD.

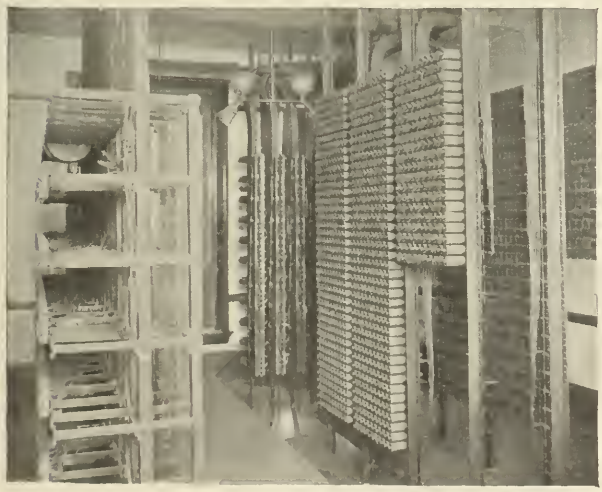


FIG. 2.—TERMINAL ROOM.

The third position on the board, known as the "switching" or second "B" position, is equipped with a duplicate of all toll drops, as well as with the necessary trunks for handling the toll traffic during the day time. At night the toll service is switched from the separate toll board to the switching position on the main board, so that the night force can handle the entire traffic of the exchange at one point. The switching position is also equipped with busy back signals, so that any subscriber's line temporarily in use can be easily reserved and held for any long-distance work that may be required.

The next five positions, known as "A" positions, and equipped with local lines, are arranged with 200 line equipments to the operator. This has been considered an unusual number of lines for one operator to handle, but the experience at Ashtabula has demonstrated that 200 lines can safely be handled by expert operators and give first-class service. While the service per line on this exchange is above the average for its size, a three-second service is maintained.

Each of the "A" positions is equipped with the necessary cord equipment, including party line keys and with supervisory signals for each cord pair, so that the operator can at all times tell automatically whether a subscriber has answered a call, whether either one has finished, and whether either one is demanding a subsequent call. In addition to this she can selectively signal any party line subscriber with whom she has occasion to connect. This makes this board particularly attractive for work in exchanges of the character mentioned.

The switchboard is finished in golden oak and mounted upon a substantial iron rack, all work being put into it in such a way that additions can be made without any changes in the wiring.

The chief operator's desk, which is not shown here, is equipped with all the necessary listening taps and apparatus for the chief operator in handling the force working under her. In addition to this her desk is equipped with observation lines, so that any lines needing special attention can be covered.

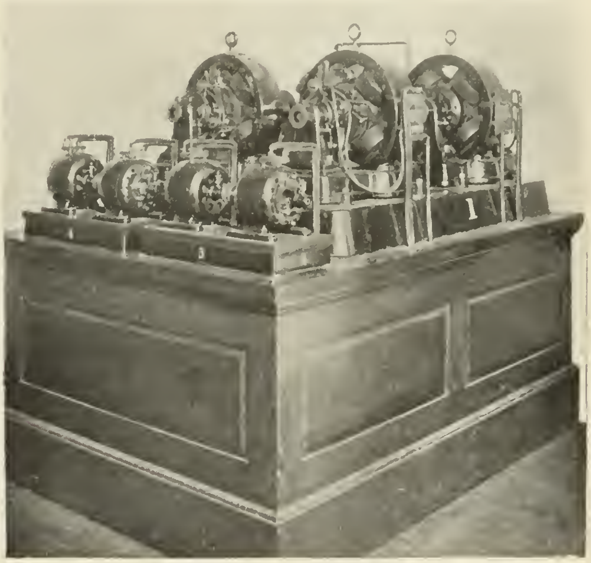


FIG. 3.—GENERATOR PLANT.

Fig. 2 shows what to many telephone men is the most interesting part of the exchange—the terminal room. Here are located the main and intermediate distributing boards as well as the relay racks. To the line side of the main distributing rack are brought all of the outside cables, while on the switchboard side are located the protectors. The intermediate distributing board is also of the open iron rack construction and of the latest design. The relay racks on the right of the cut are strong and substantial, and the relays are so mounted that all parts are accessible. It will be noted that all relays are enclosed in individual dust-proof cases. In this room is also located the wire chief's desk, equipped with meters, switches, plugs, keys and all other paraphernalia necessary to enable him to test any of the lines in use in the exchange.

A most important part of common battery, central office equipment is the power plant. The power switchboard consists of three panels of Tennessee marble, mounted in a substantial iron rack, the panels being equipped with all fuses, switches, circuit-breakers and meters, nothing but the Weston meters being used. The work in the rear of the power board is substantial and heavy and could take care of the currents required if the exchange were several times its present size.

The entire power plant is in duplicate. The generators (Fig. 3) are mounted upon a pedestal which is filled with sand, thus doing away with the noise and vibration often incident to telephone power plants. The charging machines are of the Holtzer Cabot make, and are designed to work from the various power plants available at this center. These machines are in duplicate, so that in the event of a break down of one power circuit, the other is available. The ringing machines were manufactured by the same company, one being equipped to work off of the power circuit and the other off of the batteries. It will be noticed that each individual machine bears its number, which corresponds to the switches, etc.

Fig. 4 shows the storage batteries, which are in duplicate, mounted upon angle iron racks of substantial construction. They are the chloride type, and each set is of ample capacity to handle the exchange for 24 hours when running to its full capacity. The wiring to the cells is such that an individual test at the power board can be made of each cell, or each set of batteries can be tested simultaneously. The power wiring is put in in such a way that there can be no charging induction. The storage batteries are set in a separate room.

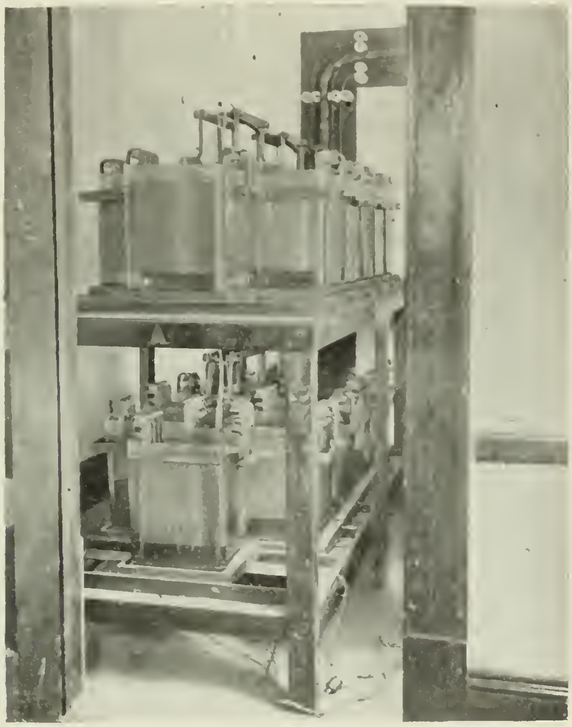


FIG. 4.—STORAGE BATTERIES.

The toll board, which is situated in a separate room, is connected by a complete automatic trunking system in such a way that the signals between the toll board and the main board are automatic; the toll operator having complete supervision over all toll calls.

The Ashtabula company has a branch exchange located at Ashtabula Harbor, the board being for 300 lines, on which are handled a great many party lines. This board is connected to the main exchange by several coming and outgoing trunks having automatic signals, all trunks terminating on the second "B" or "switching" position. This gives a complete supervision of all trunk connections by the switching operator.

The Ashtabula Telephone Company erected its own building, investigation proving this to be the most advisable course. The exchange is provided with workship, inspector's room, stock room, operator's retiring room, and everything necessary for the handling of the business. There are, in addition to this, the general office, director's room, as well as the counting office. The North Electric Company, of Cleveland, Ohio, supplied the central office equipment.

Some Educational Points.

By H. S. Knowlton.

THE rise of the technical graduate in the business world and the remarkable increase in his responsibilities which has manifested itself in the last decade are among the most interesting developments of the period. Considering the results of the training offered by the engineering schools, one is led to believe that much additional progress may be made in bringing the college world and active professional life into closer relationship than now obtains.

There can be no doubt that both professional school and business life occupy spheres of activity which are peculiarly their own, and nothing is farther from the intentions of the writer than to decry that thorough groundwork of essential theory which should constitute the basis of every engineer's training. It is certain, however, that the usual four years' course of the technical school or college can in many instances be made of more lasting practical value, even at the cost of eliminating certain antiquated methods of instruction.

One of the most common obstacles to the attainment of a maximum educational efficiency is the exclusive absorption of the instructing staff in their own individually chosen special fields of labor. The importance of emphasizing the relations of the component parts of the curriculum is too often lost to sight, in the anxiety of the instructor lest he fail to secure a maximum amount of work from the student in some particular study, which is the former's hobby. Thus, in the mathematical courses, we believe that the principles of that beautiful science can be quite as well illustrated by examples drawn from engineering practice as by fossilized problems in regard to the distance an intelligent horse will walk in unwinding a taut rope from a hitching post, or the ultimate destination of a theoretical fox pursued by a pack of hounds in full cry over a parabolic path. In the electrical course, for instance, there is ample room for the exercise of mathematical ability in the prospective development of the equation of the railway motor curve, and the problems of the determination of the area of engine indicator cards are quite as likely to appeal to the interest of the proper minded embryonic mechanical engineer as the probability of drawing two red balls out of a possible five from a green bag in a theoretical raffle.

As far as possible, illustrations of principles studied in the various subjects taken up should be drawn from modern engineering and business as actually carried on in daily life. In mechanics, the railroad of to-day furnishes an almost inexhaustible supply of interesting and live problems. The tractive power of locomotives, train resistance, strength of bridges, carrying capacities of cars, relations between speeds, roadbed and track, consumption of fuel and intricacies of interlocking plants are but suggestions of the fascinating mechanical questions which compel the enthusiasm of the interested student. Similarly the electrical engineer student who has not mistaken his calling can be roused to a high pitch of working energy by giving him problems based upon the practice of neighboring electric railways, power transmsision, lighting, telephone and telegraph interests.

The importance of frequent visits to industrial plants in the vicinity of the professional school cannot readily be overstated. As practice in training observation and bringing the students in touch with applied theory it ranks high in method. Even if the cost of such visits be the lessening of laboratory and machine shop practice by a few hours each fortnight, it is well worth while to make the trips, and the special processes and appliances noted should frequently form the subjects of future discussions in the classes instead of, as is often the case, being allowed to pass before the student's eye like a rapid panorama.

Lectures by prominent business and professional men afford excellent opportunity for students to come in contact with the essence of expert practical experience and advice. It is difficult to compress into a single sentence the broadening personal influence which the presence of a distinguished practicing specialist upon a professional school lecture platform imparts, but it is safe to say that no feature of the student's technical training is more powerful in promoting liberal mindedness. Hours spent with leaders in the professions are high privileges, and remain fixed in influence as the years go by. To neglect opportunities in this direction is to make a serious mistake, and to run in danger of intellectual narrowness of the most provincial degree.

Economics for engineering students can be made a thoroughly interesting and profitable study if the industrial life of the present day be turned to account. Questions of organization, finance, statistics, labor and management can be analyzed at practically first hand in these days of accessible information. Many a technical graduate does not know the difference between a contract and a requisition when he receives his degree, and cannot distinguish between a share of preferred stock and a bond. With enormous aggregations of capital like the United States steel Corporation and the Atlantic ship combine to study, and with financial documents like the Pennsylvania Railroad's Annual Report to analyze, it is difficult to realize how the applications of economics in modern business can fail to add interest and progressive ideas to the briefest course in industrial science. The present stormy scenes between labor and capital, the controlling of markets, fluctuations in prices of securities, governmental suits against 'holding corporations," and the widespread applications of insurance, open up an inexpressibly broad field of reading, which bears directly upon the occupation of the would-be engineer.

Finally, one cannot but urge the ever-increasing advantage of making the utmost possible use of the professional journals. Discussions in class of their contents has been found most helpful by those who have tried it, and the satisfaction of keeping in touch with installations and methods of latest value, is great. Through the medium of the technical press many interesting and important tests, discoveries, and laboratory experiences can be made available for the world's use, with advantages to every participant in the bringing to light of new combinations of mind and matter, and in the same manner the academic atmosphere of the technical school can be freshened and invigorated by the contact with the commercial world which the technical journal brings about through its editorials, descriptions of progressive installations and general news. The experiences of both business, world and educational life can thus be interchanged, to their mutual advantage.

Canadian Power Development at Niagara Falls.

By Arthur B. Weeks.

The work of power development on the Canadian side of the Niagara River is being rapidly advanced. The Ontario Power Company has drills at work at the edge of the cliff in front of the forebay. A ledge of rock overhanging the site of the power house is to be removed, and work on the course of the penstocks will also be carried on from this point.

Several small tunnels to be used for heavy blasts are being bored into the foot of the cliff near the site of the power house. Work has also been begun on this site, nothing having been done during the winter because of the accumulations of ice.

The removal of the reef of rock lying across the head of the Ontario Company's canal has been begun by the Niagara Construction Company, which has also erected a large number of buildings to be used as storehouses, etc. The intakes of the Ontario and Toronto Companies are side by side. Work is being carried on here with difficulty, because of the encroaching of the rapids on the cofferdams; yet considerable rock is being removed.

The old suspension bridge, erected in 1879, across the mouth of the channel at Dufferin Islands is being torn down, to make room for the works.

At the wheelpit of the Canadian Niagara Company, preparations for alteration are everywhere apparent. The present pit has already been sunk to nearly the required depth, and part of the machinery used in excavating is being removed. The extension of the wheelpit will soon be begun. The site is being cleared of mountains of stone for the power house, and several buildings and railway tracks will be moved. The extension is to be in a line directly south of the present excavation. Stone for the forebay is now arriving and being lowered into the excavation.

Gangs of men have been increasing steadily in numbers, and many hundreds more will soon be engaged. The debris of countless decades is being cleared away from in front of the portal of the Canadian Niagara Company's tunnel, which is now being completed. Though the water is being held back by an enormous cofferdam, so much runs in from spray and springs that three large pumps are kept in constant operation, and can scarcely hold the water under control. The shaft of the new scenic tunnel at Table Rock, which is to replace the one demolished by the work of power development, has been already sunk to a depth of nearly 40 ft.

Altogether, the Canadian bank of the Niagara above the Horseshoe fall presents a most unusual scene of bustle and activity, almost rivaling the rush and ceaseless industry of the rapids themselves.

Edison in Wireless Telegraph.

It is announced that Mr. T. A. Edison has been appointed to the board of technical engineers of the Marconi Wireless Telegraph Company of America, and has permanently identified himself with the company by the acquirement of an interest therein as a stockholder. It is officially announced at the office of the Marconi Company that the company has acquired Mr. Edison's patents. The principal Edison patent, in its claims, covers the field of wireless telegraphy by inductive means. While modern wireless telegraphy is based upon Hertzian wave transmission and not on induction, the Edison patents are stated to be considered important additions to the patents owned by the Marconi Company, which include also the inventions of Prof. M. I. Pupin, who, it is stated, is also a member of the company's technical corps.

Edison's first patent on wireless telegraphy, secured by the Marconi Company, is dated December 29, 1891, and in it he declares:

"I have discovered a new and useful improvement in means of transmitting signals electrically, having elevated induction plates or devices. I have discovered that if sufficient elevation be obtained to overcome the curvature of the earth's surface and to reduce to a minimum the earth's absorption, electric telegraphing or signaling between distant points can be carried on by induction without the use of wires connecting such distant points. This discovery is especially applicable to telegraphing across bodies of water, thus avoiding the use of submarine cables, or for communicating between vessels at sea, or between vessels at sea and points on land; but it is also applicable to electric communication between distant points on land, it being necessary, however, on land, to increase the elevation in order to reduce to a minimum the induction-absorbing effect of houses, trees and elevations in the land itself. At sea, from an elevation of 100 ft., I can communicate electrically a great distance, and since this elevation, or one sufficiently high, can be had by utilizing the masts of ships, signals can be sent and received between ships separated a considerable distance, and by repeating the signals from ship to ship, communication can be established between points at any distance apart or across the largest seas, or even oceans. The collision of ships in fogs can be prevented by this character of signaling by the use of which, also, the safety of a ship in approaching a dangerous coast in foggy weather can be assured. In communicating between points on land, poles of great height can be used, or captive balloons. At these elevated points, whether upon the masts of ships, upon poles or balloons, condensing surfaces of metal or other conductor of electricity are located. Each condensing surface is connected with the earth by an electrical conducting wire. On land this earth connection would be one of the usual character in telegraphy. At sea, the wire would run to one or more metal plates on the bottom of the vessel where the earth connection would be made with the water."

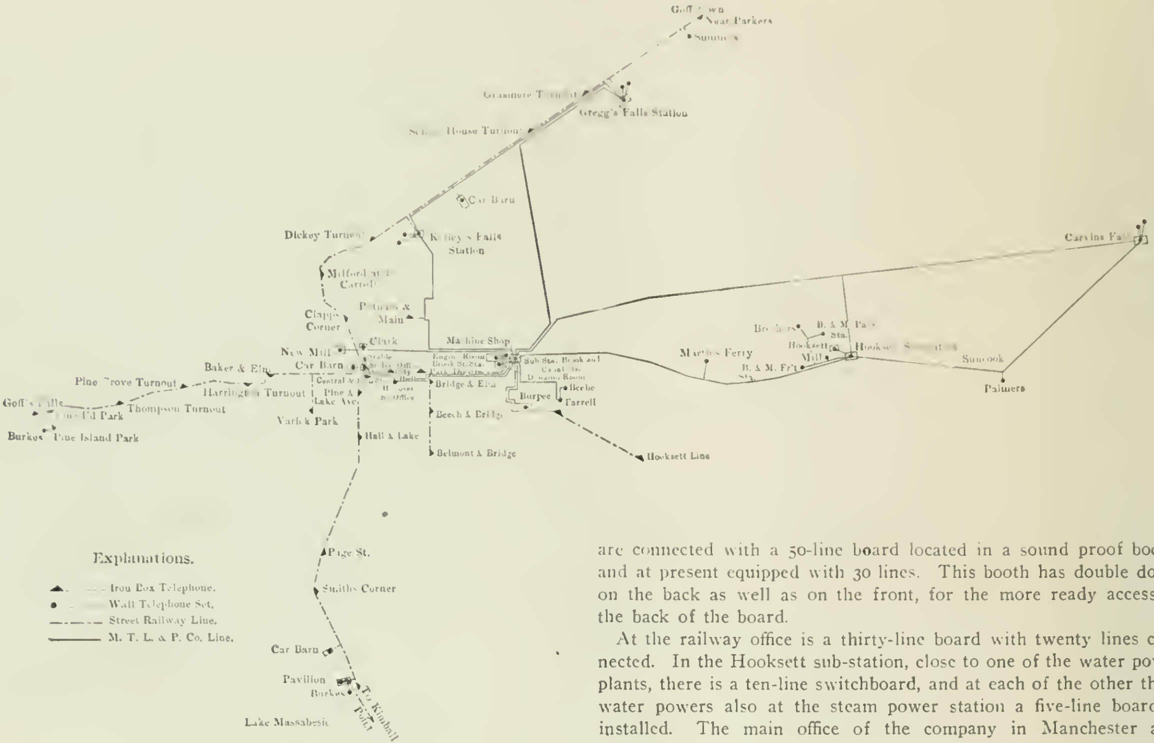
Fire Protection Engineering.

Armour Institute of Technology, Chicago, has instituted a four years' course in fire protection engineering, leading to the degree of bachelor of science. The course will be inaugurated September 21, 1903, under the direction of Prof. Fitzhugh Taylor, formerly an engineer of the Underwriters' Laboratories. The requirements for admission are identical with those for the mechanical, electrical, civil and chemical engineering courses. Advanced students will be given due credit for work done in other engineering courses of the College of Engineering of Armour Institute of Technology or of other colleges. A special feature of the course will be a series of lectures by prominent insurance officials, architects and contractors, upon the practical features of their work. The technical laboratory work of the ceurse will be given at the Underwriters Laboratories, Chicago, under the direction of experts connected with the laboratories.

Telephones in a Lighting and Traction System.

MANCHESTER, New Hampshire, is the center of a lighting and traction system that includes five generating stations, two sub stations, 33 miles of high-voltage transmission lines and 36 miles of electric railway track. These equipments are scattered over a territory covering a radius of about 14 miles, using the city as a center, and are all controlled from the main office there.

Centralized management of these widely separated properties depends in no small degree for its complete success on the extensive use of telephones. To render the telephone system most effective it must be devoted exclusively to business of the electric lighting and railway interests, and it has, therefore, been constructed entirely by the Manchester Traction, Light & Power Company, the owner of these plants. As the telephone system stands, immediate communication may be had between the main office of the company and either of the generating stations, sub-stations, car barns, or pole telephones along the railway tracks.



Map of Telephone System of Manchester Traction, Light & Power Company.

Centralized control in the operation of this system is especially necessary because the four water power stations and one steam power station, all widely separated, must work in multiple on loads made up of arc and incandescent lighting, stationary motors and electric cars. No one station being able to carry the entire load, the number of generators operating at any time in any one station must be regulated according to the number in use at the other stations. As far as possible, it is desirable that each particular generator and its transmission line be devoted exclusively to either electric railway or general electrical supply, and this furnishes additional reason for prompt communication throughout the entire system.

The general plan of operation is to have all of the five generating plants feed into the sub-stations at Manchester, and from this sub-station energy is sent out for the several classes of service. At intervals along the suburban railway lines there must be telephones, so that persons in charge of cars can communicate with the railway office. Finally, the residences of employees are connected with the telephone system.

Equipment of the telephone system includes 75 miles of circuits, one fifty circuit, one thirty circuit, one ten circuit and five five circuit switchboards. The 75 miles of telephone circuit are all double, thus using 150 miles of wire, and the circuits are attached to pole lines that also support the transmission or distribution lines or railway feeders, as the case requires. All of the telephone lines are of No 12 galvanized iron wire, brand "Extra B B," of Washburn & Moen make. Telephone circuits to Kelley's Falls, Gregg's Falls, Hooksett and Garvin's Falls, the four outlying water power plants, follow the pole lines that carry high-voltage transmission wires. Telephone circuits on these poles are strung some feet below the transmission lines.

All of the telephone circuits that run directly to generating stations center at the Manchester sub-station. All of the telephone circuits that follow electric railway lines center at the railway office in Manchester. Independent telephone circuits connect the railway office and the Manchester sub-station, also these two with the main office of the company there. At this sub-station the telephone lines are connected with a 50-line board located in a sound proof booth, and at present equipped with 30 lines. This booth has double doors on the back as well as on the front, for the more ready access to the back of the board.

At the railway office is a thirty-line board with twenty lines connected. In the Hooksett sub-station, close to one of the water power plants, there is a ten-line switchboard, and at each of the other three water powers also at the steam power station a five-line board is installed. The main office of the company in Manchester also contains a five-line board. In the Manchester sub-station are two magneto generators, each belted to one of two motor-driven blower sets there, which latter maintain a pressure for the air blast transformers.

One of these magnetos is always in operation and furnishes current for bell ringing. At the other stations hand magnetos are employed for a similar purpose. Each telephone set is equipped with 1,000-ohm bridging bells and each transmitter is operated by two cells of dry battery. The five and ten-line switchboards were designed by Mr. J. Brodie Smith, general manager of the company, and are so arranged that one or two pairs of lines may be connected without the use of switchboard cords. The telephones and switchboards were manufactured by the Couch & Seeley Co. All of the switchboards and instruments are provided with D. & W double-pole telephone protectors, which have 2,000-volt, 3-amp. enclosed fuses for the line and 0.3-amp. sneak current-breakers. At the Manchester sub-station and the railway office these protectors are mounted in weather-proof boxes outside of the buildings, and the lines are led in through cables. Two cables are there used and each of them contains wires enough to connect with all of the lines that come into the sub-station. In this way, should one cable be disabled the other may be at once connected up. As may be seen from the map, it is possible to reach each generating station from either the Manchester sub-station or the main business office of the company by two independent telephone lines.

American Institute of Electrical Engineers.

At the annual meeting of the American Institute of Electrical Engineers, a general account of which appeared in our issue of May 23, three papers were read, all dealing with alternating-current subjects. Prof. Comfort A. Adams, of Harvard University, presented a lengthy paper giving the theory of the Heyland machine as a motor and generator, and including descriptions of tests made on such a machine at Harvard. The paper opens with a brief resumé of the principles of the predecessors of the Heyland type of motor, including those of Gorges, Le Blanc and Blondel. After a description of the Heyland motor, the paper develops the subject under the heads of reactance of exciting winding; description of machine tested and theory of operation; general conditions of tests; results of tests; the Heyland machine as a generator, and compound excitation. Numerous curves are given obtained from tests of the machine experimented with. Owing to the character and length of the paper—which occupies 49 pages of the Transactions—it is impracticable to give a satisfactory abstract of its contents.

Mr. B. A. Behrend presented a paper entitled, "The Experimental Basis for the Theory of the Regulation of Alternators," which was prepared upon request to aid the Institute Committee on Standardization to draw up rules for a redetermination of voltage regulation, the present rules being by no means in accordance with fact and observation. The paper contains a number of regulation curves of different alternators, and includes some general remarks on the value of the short-circuit characteristic in the design of electric generators. In summing up, Mr. Behrend says it has been demonstrated that the application of the ampere-turn method, as proposed by the Institute rules, leads to entirely wrong results. It gives rise to machines of inferior design and large leakage, that appear in regulation not only equal to, but even better than, machines of careful and superior design. In a word, the method is not scientific and not in accordance with fact and observation. The ampere-turn method, while very simple, is inherently wrong, and it should, therefore, not be used, even if it is impossible to substitute an equally simple rule for it. The desire to have such a simple rule should not tempt us to adopt one that is false.

The third paper, in the absence of the author, Mr. A. S. Garfield, was read in abstract by Mr. Gano S. Dunn, the title being "The Compounding of Self-Excited Alternating-Current Generators for Variation in Light and Power Factor." The paper gives a description of the characteristics of a polyphase revolving-field generator provided with a single closed-circuit field winding and commutator. The effects of shifting the brushes at various inductive and non-inductive loads are represented graphically. The data on which the paper is based was placed at the disposal of Mr. Garfield by Mr. Marius Latour, who has developed this type of machinery.

In the discussion Mr. Behrend called attention to one or two matters which he had not had an opportunity to take up in the paper. One is the great importance of providing for regulation in a specification. Consulting engineers occasionally specify and demand a regulation of 5 per cent. on a 100 per cent. power factor, and a regulation of 12 per cent. on an 80 per cent. power factor, and an increase of excitation of 10 per cent. between voltage at no load and voltage at 80 per cent. power factor. Such a requirement is impossible. One object of his paper was to point out a method by which one can convince him as to what conditions are possible to obtain. Furthermore, the specification of the regulation itself is an important factor in the operation of generators, for with a regulation of 5 per cent., there will be cross-currents between machines which, if not particularly troublesome, will be a disagreeable feature. There is no need for such regulation under ordinary conditions. It is injurious, because you have to pay for it, and because you have to regulate anyhow, and it does not make any difference whether you regulate within 5 per cent. or 7 per cent. It increases coal consumption and makes operation poorer. Prof. Adams corroborated what Mr. Behrend said in regard to the ordinary methods for the calculation of alternator regulation. He has made tests on a few large machines, and the results are entirely corroborative of Mr. Behrend's results, that the e.m.f. method gives, almost invariably, results which are too poor, and that the e.m.f. method gives too good a regulation; that in machines of inductive type, with armature leakage, reactance plays a larger part than the armature reaction. The e.m.f. method fits more nearly the machine with least reaction and most reactance, because it is entirely e.m.f. drop, part armature reaction and part armature reactance. In the machine with most armature reaction and least armature reactance—cases of the ordinary low frequency, revolving field alternator of to-day—the other method will fit more closely; but in either case it is very hard really to get accurate results over any wide range.

Mr. William L. Waters said that by far the best method in guaranteeing the regulation of an alternator is to guarantee it for a low power factor. The quantity to be measured is much larger than for a guarantee on unity power factor; and by running a test with two machines as described by Mr. Behrend, one running as a synchronous motor and the other as a generator, and then adjusting the excitations, one can easily get a direct reading for the regulation, even on very large units.

As regards the advisability of having the regulation guaranteed for low power factor, even in the case of running rotary-converters, he gave an incident that came to his notice of a station having several 800-kw, 3-phase alternators, running rotary-converter sub-stations, in which a break-down one day occurred on the high-tension leads of the alternators causing a temporary shut-down of the plant. Then, when the alternators were again run up the rotaries had to be started from the alternating-current side. As soon as the voltage showed up again in the sub-stations, all the sub-stations threw on their rotaries at the same time, and the consequence was an immense lagging current cutting the volts right down and the rotaries refused to start. The attendants seeing this cut out their rotaries and the volts rose again. This went on two or three times and in the end it was about three-quarters of an hour before the sub-stations got started properly. These alternators had a regulation guaranteed of 7½ per cent. on unity power factor. The alternators would satisfy this guarantee if tested by the Institute rules, but their behavior on low power factors can be imagined from the above incident.

Mr. Waters considered that neither of Mr. Behrend's two empirical methods for determining regulation are accurate, and that every designer has to modify these empirical methods in order to obtain satisfactory results on his own individual machines. Some years ago he did some work on the method of obtaining the regulation of the alternator by splitting the effect into armature reaction and self-induction, and in measuring the self-induction of the armatures of some thousands of alternators, with different relative positions of the armature and field, he found this value to vary very considerably according as the relative position of the armature and magnets was changed, and in some machines of very small air-gap the variation was of the order of six or eight to one. These measurements, of course, did not actually represent the condition of things under load, but they give some idea of what variation may be expected. The short-circuit method of determining the compounding on a direct-current machine is very old and was used with fair success on the old smooth-core armature machines, but in modern slotted armature machines, with highly saturated teeth, the distortion of the field on account of armature reaction, makes a large increase in ampere-turns necessary on full load to overcome the decreased permeability of the iron due to this distortion; and so, though this method may give fairly good results in a machine in which the teeth density is not over 125,000, it will be very inaccurate on machines with highly saturated teeth, say machines with teeth worked at 150,000. The compounding ampere-turns necessary in this latter case would probably be double that given by the short-circuit method.

Mr. Behrend, in reply, said that Mr. Waters had pointed out one of the principal weaknesses of his paper. He pointed out that the arbitrary application of a cap diagram to the determination of the regulation at different power factors. That is perfectly true. We are in a sea of arbitrariness. In determining the conditions under which machines have to operate, and in determining the exact dimensions of machines, we continually flounder in a maze of assumptions more or less arbitrary. He pointed that out in his paper, and has pointed it out invariably in his papers on the induction motor, and in papers on other matters connected with electrical engineering. Electrical engineering is an art and not a science. As you cannot teach any one to make a good picture if he has not the natural aptitude, so you cannot teach a man how to design a motor. This must be left to the engineer's ability, and it is a question of judgment in designing. If this falls in the hands of an unskillful man, the result will be like the knife in the hands of a bungling surgeon, and results will never be satisfactory if implements are put in the hands of those who do not know how to use them.

Twenty-Sixth Convention of the National Electric Light Association.

THE twenty sixth, annual convention of the National Electric Light Association was held at the Auditorium Hotel, Chicago, from May 26-29, inclusive, and in our issue of last week several pages were devoted to the exercises and papers of Tuesday, the first day. The later proceedings are treated in the present issue Mr Louis A. Ferguson made an admirable president, and his year of office has been the most successful in the history of the Association; while the convention itself was one of the very best. An attendance of over 900 would be enough to make it remarkable, but the papers and discussions were also far beyond the ordinary and each session was crowded.

At the close of the convention, in executive session an amendment to the Constitution and By-Laws was adopted, making the dues of associate members twenty dollars. This simply corrected an oversight in omitting the dues of associate members from the amendment adopted at the Cincinnati convention.

The report of the Committee on Nominations was presented and the following-named gentlemen were elected as officers for the ensuing year: President, Charles L. Edgar, Boston; first vice-president, S. B. Livermore, Winona, Minn.; second vice-president, J. W. Lieb, Jr., New York.

Members of Executive Committee for three years: Louis A. Ferguson, Chicago; Harry Bottomley, Fall River, Mass.; Alex Dow, Detroit.

President-elect Edgar was escorted to the chair and thanked the Association, and said: "I recognize that it is an honor to be made president of this Association. It was my good fortune to be vice-president in 1890. It is impossible to describe the difference between the meeting of the Association in 1890, at Cape May, and 1903, in Chicago. I recognize I have a hard row to hoe. Each president naturally desires to make his meeting somewhat better than the previous one; and I know you will all admit I will probably not make the meeting next year anywhere equal in interest and importance to that through which we have just passed. I do not know that I can say a word more to emphasize it than that the success of this meeting is due to Mr. Ferguson. We all feel it, and we hope he appreciates the fact, that we know he as president has done more to promote the interests of the National Electric Light Association than any previous president."

On motion of Mr. Scovil, a vote of thanks was passed to the retiring president, Mr. Ferguson, which was gracefully acknowledged.

The report of the treasurer was presented, and showed the following financial transactions during the year:

Receipts, including balance, 1902	$17,091.52
Disbursements	8,439.55
Balance	$8,651.97

In connection with the report of the Committee on Standard Rules for Electrical Installation, the following resolution was passed:

Resolved, That a vote of thanks be tendered the Committee for its diplomatic and effective efforts to secure a reasonable and practical set of rules;

That the Association expresses its appreciation of the importance of co-operation with the National Board of Fire Underwriters in work where mutual interests are involved, and that it recognizes the value of the results obtained since there has been such co-operation;

That a set of the rules and the report of the committee be printed and sent to each active member of this Association, and that action on said committee report be deferred until the next regular meeting of the Association;

That any change in the personnel of the committee for the coming year be referred to the incoming president for such action as he may deem desirable.

On motion of Mr. Scovil the following resolution was passed:

Resolved, That the proper officers of this Association suggest to the National Underwriters' Association that they would consider it a compliment if they can see their way clear to include the cost of their electrical inspection in their rates.

On motion, the action taken at the Cincinnati convention fixing the place for the 1904 convention at St. Louis was reconsidered, and the matter of the time and place for the 1904 convention was left with the Executive Committee. Boston was subsequently selected.

On motion, it was voted to hold a special meeting in St. Louis in September, 1904, in conjunction with allied organizations.

On motion of Mr. J. G. White, of New York, the thanks of the Association were given to the electrical interests of Chicago, particularly the officials of the Chicago Edison Company, for the information, assistance and attention given and rendered to the delegates to the convention, and the secretary was also instructed to send a copy of this resolution to the chairman of the Entertainment Committee, Mr. J. Wolff.

The convention then adjourned.

LOST AND UNACCOUNTED-FOR CURRENT.

Mr. L. G. Van Ness, in a paper with the above title, classifies the losses in current distribution as follows: Alternating current: Transformer iron loss, resistance loss, meter shunt loss, unaccounted-for current loss. Direct current: Resistance loss, meter shunt loss, unaccounted-for current. Means for the determination of these various losses are given.

The following table shows the output and losses for an average winter day for 5 feeders which have received considerable attention in the way of design. One of the peculiarities of the data are that in feeder 4 the meter shunt loss amounts to more than the transformer loss. This is due to the fact that the feeder supplies a residence section by a carefully designed three-wire network. The conditions here were such that the transformer capacity could be so installed that very little more than the demand for the feeder was necessary in order to give proper regulation.

Table 2 shows the loss and unaccounted-for current in the case of a certain station. It will be noted that the transformer loss remains throughout the same. As a result of this analysis, it is stated that losses will be cut something like 10,000 kw-hours per month in a short time. As a result of the analysis the resistance loss has already been decreased with very little expenditure, and the unaccounted-for current loss reduced about 45 per cent. in three months. It is not expected, however, that the meter shunt loss will be reduced.

TABLE I.

		Trans. Iron Loss.		Resistance Loss.		Meter Shunt Loss.		Output.
	Voltage.	Watt-hrs.	Per cent.	Watt-hrs.	Per cent.	Watt-hrs.	Per cent.	Watt-hrs.
1 ..	1,000	28,488	6.76	23,923	5.68	14,916	3.54	421,000
2 ..	1,000	19,752	3.78	25,086	1.98	19,092	3.65	522,400
3 ..	1,000	28,680	9.56	17,026	5.60	23,316	7.77	300,000
4 ..	2,000	20,712	5.01	29,691	7.28	24,504	5.93	413,000
5 ..	2,000	42,576	8.55	28,867	5.79	18,720	3.76	477,600

TABLE II.

	Trans. Fe. Loss.		Resistance Loss.		Shunt Loss.		Unaccounted for.	
	Kw-hours.	Per cent.	Kw-hours.	Per cent.	Kw-hours.	Per cent.	Kw-hours.	Per cent.
January .	29,296	14.3	7,849	3.76	7,486	3.58	43,205	20.6
Febru'y .	26,163	14.5	6,588	3.66	6,625	3.68	36,096	20.1
March ..	28,153	16.9	4,377	2.62	7,121	4.28	23,958	14.4

SALT AS A BY-PRODUCT.

Mr. Alex Dow, in the paper with this title, advocated using exhaust steam by electric light plants to evaporate salt brine in districts where this cannot be obtained. One plan suggested is that the electric plant be worked condensing during the hours of heavy load and non-condensing during the other hours, the exhaust then going under the pans of the salt plant. He admitted that this arrangement would not be profitable where the load during part of the day was so light that live steam would have to be used under the pans; but if a continuous load can be obtained for the electric light plant, a continuous and profitable operation can be assured for the salt block.

By means of the combination, however, a sufficient inducement may probably be offered to power users that will result in a good load curve during the working hours of the day, and there is even a chance of working up to continuous twenty-four-hour operation.

FIRST AIDS AND APPLIANCES.

A paper by J. D. McGowan, M. D., gives information for use in the case of bodily accidents. The information covers preliminary treatment, treatment for bleeding, burns, wounds, fractures, the use of splints, the transportation of wounded and electric shocks. We give below the information for the treatment of a case of the latter:

Place the patient in a warm, quiet place; after dressing wounds, wrap him in warm material and apply heat to the whole body, using hot water bottles, water bags, hot bricks, blankets, flannels wrung out of hot water (no heat to head), hot drinks (coffee best), spirits of ammonia diluted with water, or small amount of whiskey. Susceptibility to shock depends upon the individual; women and children being less resistant than men. Diseases of heart and kidneys predispose to accident from electric shock. Do not lower the head of a person who has received electric shock. Artificial respiration should be kept up for hours. Massage of abdomen and left side over the heart. Heat to body as above.

It is somewhat remarkable in view of the very complete knowledge available for the treatment of electric shock, that a paper read before an electrical association should contain such a perfunctory treatment on the subject.

In reply to a query, Dr. McGowan said that in case of damage to the eyes from flash, the best thing is to drop in the eyes some sweet oil or castor oil, then a solution of boracic acid and to ease the pain a little cocaine. In reply to a question as to what to do in case a shock produces spasms, he said that the best thing was to put the man in a hot bath, keep him quiet and bathe him. If there is no place in which he may be bathed, some clothes may be placed in hot water and wrung out. Mr. C. M. Lewis, of Bellevue, Ohio, spoke of a case where a man had had his hands badly burned through electrical contact, and after three weeks' treatment by a physician the wound was healed but slightly. One of the men in the station then suggested the use of powdered bismuth, and after dressing his hands only once they improved and were entirely well in two weeks.

HALLBERG PAPER.

In the discussion of the paper by Mr. J. Henry Hallberg on 4-amp. lamps for street lighting, an abstract of which was printed last week, Mr. W. D'A. Ryan said there is no question that the 4-amp. lamp as compared with the 6-amp. lamp has advantages in distribution, the better distribution of the smaller unit more than compensating for the higher efficiency of the large unit. He considered, however, that an advantage can be gained by the use of a ⅜-in. carbon instead of a ½-in. carbon. In reply to a question, Mr. Hallberg said that no lamp in Cincinnati is allowed to remain out more than two hours. If a lamp is defective a new one in that time is put in its place. The Cincinnati system of lamp attendance is such that a lamp has never been out more than two hours. With 4,500 lamps in operation, there are from 25 to 40 trouble calls in a night. Mr. H. C. Wirt said that with small light units the cost of maintaining lamps is greater. One objection to the enclosed system is that the volts per lamp being greater, the street wiring has to be nearly duplicated as compared with a 45-volt lamp service. Mr. Hallberg said that in figuring the lamp efficiency at 70 per cent., he had not considered the general plant and cost and maintenance of cables. In Cincinnati rubber-covered underground cables are used, the voltages varying between 4,500 and 5,200, and there has as yet been no electrical break-down in the system or any appreciable depreciation. He said that the city pays $73 per lamp connected with the underground system, and $8 to $10 less for those connected with the overhead system. He considered that the closed-base inner globe introduces an element of danger, especially with high-tension arcs; for if the arc produces a flame the chances are ten to one that it will jump over to the frame and not only put the lamps out but ruin the lower part of the lamp. In Cincinnati it was decided that the open-base inner globe is preferable. In reply to an inquiry, he said that the Cincinnati system operates at exactly 4 amp. Mr. Hallberg agreed with Mr. Ryan that ⅜-in. carbons would be preferable with respect to securing a more fixed position for the arc, but when an alabaster inner globe is used the diffusive power of the globe is sufficient to counteract displacements of the arc. The lights are suspended from 12 to 20 ft. above ground, and since alabaster inner globes are used there is practically no shadow. The lamps are hung about 250 ft. apart. One benefit of the low-ampere lamp is that it can be hung lower and therefore a better illuminating effect obtained. The illuminating effect compares favorably with that from incandescent lamps. Mr. W. D'A. Ryan said that adopting as a standard of illumination .006 of a candle-foot, this illumination would be given by a 7.5-amp. alternating-current lamp, if two lamps are installed 490 ft. apart, or by a 4.5-amp. lamp if installed 335 ft. apart. For a given illumination, eleven 7.5 lamps would be required per mile, expending 5,180 watts, and fifteen 4.4-amp. lamps, expending 4,235 watts; or for more illumination between lamps and the same energy, there would be eighteen lamps against eleven. Mr. Wirt said that the number of lamps, number of transformers, circuits, etc., should be included in comparing low-ampere with high-ampere lamps. Mr. John W. Lieb said that in comparing lamps one should go beyond the mere question of illumination on the street and take into consideration also the general effectiveness of the illumination and its brilliancy. Mr. Ryan said that the illumination by reflection from buildings is an important consideration, and consequently in cities it is a question as to how low one can go with units and still derive advantage from distributing power, as compared with the higher efficiency of the larger unit. Mr. Wirt considered there is some distinctive advantage in large light units, and he doubted whether it is possible to get below 4.4 amp. Mr. Hallberg said that while the company now gets $146 for two 4-amp. lamps, he doubted if they could have gotten that amount for one lamp of double the illuminating power. The people prefer the smaller lamps close together rather than large lamps farther apart.

PECK PAPER.

In the discussion of Mr. Peck's paper, on transformer standardization, an abstract of which appeared last week, Mr. Moody, of the General Electric Company, said that his company during the past ten years, has manufactured some 18,000 different transformers, which means 5 to 6 new designs per day. He recommended that engineers should specify standard transformers, and particularly so in the case of new plants. He suggested that the American Institute of Electrical Engineers might be a powerful factor in achieving standardization of transformers, since there is little likelihood of different companies coming to an agreement among themselves as to desirable ratios. He considered that a range of 10 per cent. is usually sufficient in the case of standard taps in large transformers. With a 15 per cent. range he suggested there must be a corresponding increase in the number of turns and in the cross-section of the transformer windings. On the other hand, 5 per cent. taps are in most cases too rough for adjustment. In the case of smaller transformers for lighting, there seems to be less reason for adjustable rates, and it would appear that the feeder regulator rather than the transformer is what should be adjustable for the variable drop in different feeders. His company for some time has made a consideration proportion of smaller transformers with a 1 to 9 or a 1 to 18 ratio. This was not an attempt to allow for drop, but to give 110 volts or more for motors in plants having generators that would not admit of obtaining these voltages under full load. As 2,200-volt generators become more common, the 1 to 10 or 1 to 20 ratio will answer every purpose. Mr. Moody did not favor a permanent adjustment of ratios by taps except in large units, as an adjustment can be made for only one condition of load, and is therefore not a real remedy for variable drop. If such a tap is used to obtain a higher secondary voltage than normal instead of to allow for drop, it is objectionable for the reason that when in use the core loss is approximately 20 per cent. higher and copper loss 10 per cent. less than that for which the transformer was designed. When so much effort is made to obtain a higher "all day" efficiency, a good design should not be thus distorted when it increases the "all day" losses 20 per cent. He said that in a few years at least 80 per cent. of all transformers purchased will conform to some generally acknowledged standard of capacity and voltage.

Mr. Wagoner disapproved of compensating for line losses on small transformers by means of a tap on the primary to give a higher secondary voltage, as this during 20 or 21 hours per day would increase the core losses 18 to 20 per cent. Mr. Lieb said that the preceding remarks did not affect the desirability of having three or more taps on such transformers as are used to reduce primary voltage for a rotary converter, in which case it is extremely desirable to have at least 4 or more such taps. Mr. Hewitt agreed with Mr. Lieb and said that he had found a second tap of value in the case of long lines supplying both lighting and motor loads, through assisting in continuing a fairly constant voltage on the lighting end of the system. The tap is also desirable on the end of a long feeder carrying a constant current load, would eliminate the necessity of adding more copper to the line. Mr. W. G. Carlton said that the Chicago Edison Company has feeders varying in length from one to five miles, and he did not see how they could dispense with taps on the transformers when operating from a common bus. Mr. H. J. Gille, of St. Paul, said that he thought taps on rotary converters are desirable, but that it would also be desirable for manufacturers to connect up all transformers when they ship them, thereby obviating a source of trouble at the station. Mr. H. C. Wirt considered that the question separated itself into a discussion with respect to large transformers and to small transformers. He considered that to adopt a transformer ratio of 20 to 1 or 18 to 1, while it might be convenient for manufacturers, would not strike central station men favorably. An interchangeable ratio may be obtained by having an additional winding on the secondary, which will cause the core losses to remain unchanged, and also to a great extent the copper losses. This method is to the advantage of the central man, but not to the manufacturer. Mr. Peck said that the double ratio of 18 and 20 to 1 was an advantage to the manufacturer, because it spared him from carrying two kinds of transformers. Taps on transformers are an excellent thing and never go amiss, as there are constantly instances where they can be used to advantage, and where new winding would be required were they not present. Mr. Moody said that the use of two ratios in a single plant makes it impossible to obtain the right voltage at any one place under all conditions of load, and there is a temptation to make connections to a transformer tap rather than to correct the feeder to keep the drop at the proper amount. As to three secondary voltages, the additional cost of having three rather than two is not great on a transformer of any considerable size, and it is in these cases that it is really desirable to use the third ratio, since few small motors are wound for higher than 220 volts. On the smaller sizes where the cost of three voltages adds materially to the expense, there is little or no call for voltages higher than the normal.

BEMENT PAPER.

The discussion of the paper of Mr. Bement, giving the result of some boiler tests, an abstract of which was printed last week, was opened by Mr. W. L. Abbott, who dwelt upon the importance of the boiler room, which he is convinced is the beginning, if not the end, of the central station man's success and trouble. If all the heating surface of the boiler could always be brought into use, it could be worked at great capacity with the same efficiency than is ordinarily done. He gave an illustration with respect to a common tubular boiler, in which most of the gases of combustion pass through the upper row of tubes and very little through the lower rows. He advocated a proper distribution of the draft so that the gases would be made to travel through all the tubes equally, and the same remark applies to a water tube boiler. In referring to smoke production, he said that during the past winter the Chicago plant burned coal at the rate of three-quarters of a ton a minute without producing the slightest cloud of smoke above the stacks. There is no special care taken in firing to prevent smoke, but from the construction of the furnace it takes all the coal that can be fed to it and burns it completely. Referring to another case, where there was much smoke, he said the cause was that the gases came in contact with the cold boiler surfaces before the combustion was complete. Mr. John W. Lieb said that the conditions in many of the Eastern cities are such that the best results are not obtained from the use of soft coal, more steam being generated per dollar from anthracite coal. He said that in the New York Waterside station better results are obtained from burning No. 3 buckwheat coal with hand firing than from using soft coal with mechanical stokers. In New York at one time forced draft of 1½ in. to 2 in. of air pressure was used, giving rates of combustion of from 30 to 40 pounds of coal per square foot of grate; no unusual depreciation of the furnace or boilers resulted, and the efficiency obtained was such as to make it worth while to do a very considerable amount of forcing during the time of peak load. In reply to an inquiry, Mr. Bement said that where the air supply is large and cannot be controlled it is better to use more coal and make more fire, this obviating the loss from excessive air supply. Mr. Alex. Dow said that a furnace, to give the highest efficiency, must be designed for the kind of fuel that is to be burned in it. Different coals require different proportions of combustion chambers, and different handling on the grates. He approved highly of the use of the tiled furnace construction for the reason that it provides a hot, long and large combustion chamber for the free burning of soft coals, and gets off the cooling effect of the tubes. He considered that stokers can be recommended if the fuel which they use has a coking quality, but different types of stokers are required for different kinds of fuel. He said some stokers will not feed small buckwheat; there is a possibility of constructing a stoker which will burn any kind of fuel fed to it, but that such a flexibility would be obtained at a sacrifice of efficiency.

REPORT OF COMMITTEE ON DISTRICT HEATING.

Mr. John W. Glidden presented the report of the committee on district heating, which opens with the statement that there are about one hundred heating plants of this character in operation in the United States at the present time, possibly ten of which are live steam heating plants doing only heating; of the remainder, about two-thirds are exhaust steam plants and one-third hot water heating plants. A list of questions was mailed to all of the plants, from which fifty replies were received and the accompanying table shows some of the data compiled from the reports received.

No.	Investment in heating plant.	Heating revenue.	Price of coal.	Labor and fuel for heating.	Total coal.	Back pressure.	Net revenue percent. of investment.	Remarks.
1	$75,000	$26,000	$1.00	$12,000	$31,536	3-15	18.7	Day load.
2	4,800	2,000	2.40	......	......	0-0	...	Water-power.
3	12,000	3,200	1.75	......	......	2 5	...	No day load.
4	33,000	2,293	1.25	......	5,838	0-3	...	Day load.
5	67,738	26,449	1.58	20,916	27,594	3-20	8.2	Day load.
6	5,000	1,000	1.25	......	......	0-0	...	No day load.
7	40,000	Just std.	2.15	......	......	0-0	...	Day load.
8	15,000	6,500	1.70	3,000	8,148	0-0	23.3	Day load.
9	.....	43,000	...	14,800	......	5-18	...	Live St. only.
10	16,000	3,712	2.00	......	......	0-0	...	Day load.
11	66,159	15,843	...	13,282	7,185	...	4.0	Live St. only.
12	30,000	3,170	2.25	......	......	0-0	...	New plant.
13	......	......	5.00	......	......	...	...	Sore spot.
14	48,000	10,000	.90	......	......	2-5	...	Sore spot.
15	10,000	2,642	1.35	1,414	4,950	1-3	12.3	Day load.
16	6,000	1,906	2.10	......	3,509	1-5	...	No day load.

Note.—Isolated office buildings use 100 pounds good Illinois coal per square foot of radiation during seven months heating season.

The conclusions of the committee are that it finds no evidence that the business is generally profitable; that there is lack of information among heating managers, and a lack of enthusiasm for the business, and little separate accounting. There is a genuine demand from the public for the services, and if the central station does not occupy it directly it will be occupied by others. Central stations are the best to meet the demand, first, because of some available apparatus already installed; second, because they possess the technical knowledge; third, because they possess the organizations; and, fourth, for their own self-protection.

Mr. C. R. Maunsell said he could not endorse some of the statements in the paper referring to the heating business. He said that in his town the demand for steam heat greatly exceeds the capacity of the company, which has had very good returns in a financial way from its heating business. Mr. D. H. McGee, of Red Oak, Ill., suggested the appointment of a committee for obtaining further information concerning steam and hot water heating by testing actual plants. He operates a hot water plant, and said that within the past four years he has answered no less than 600 letters of inquiry from all over the country, and has had personal visits from managers from every State from Kentucky to Washington. He considered that it would be to an advantage if a fund were appropriated for testing a certain number of steam and hot water plants. Mr. W. Walbank, of Montreal, Can., gave the result of an investigation in Montreal of the steam heating question. The result arrived at was if coal could be gotten for nothing and attendance for nothing, the receipts would not pay the interest on the pipes alone. Mr. Maunsell said the reason for this showing was that the plant was to be one sending out live steam. Last winter, he said, his plant had a revenue of nearly $15,000, which was sufficient to pay all the coal bills of the plant for eight months and leave nearly 4 per cent. interest on the money; the operating costs of the steam heating were only about 30 per cent. of the gross revenue for heating. Bills are made out from meter readings. In six years' use there has been practically no trouble, no cost for repairs, and no deterioration has been noted. Mr. James E. Pyle, of Westchester, N. Y., gave an account of his experience in steam exhaust heating, which gave satisfactory results. He considered it just as necessary to sell heat by meter as to sell electric light by meter. Mr. H. J. Gille called attention to the fact that

Prof. Carpenter, of Cornell, has given in a book the results of many tests of steam and hot water heating. Mr. McGee thought it was desirable, nevertheless, to make a general investigation of all systems; he said that last year the income from the investment of his company in steam heating was 23 per cent.; 6 per cent. is figured for depreciation and 6 per cent. for interest. The district served is a strictly commercial one, and the station is situated in the heart of it with a large building every 22 feet. At present there are 1½ miles of mains and 50,000 feet of radiation. Mr. G. W. Bryan, of Atlanta, Ga., said that during the last steam heating season, his company, with 15,000 ft. of mains, supplied 200,000 sq. ft. of radiation, and while he does not think any money was made, nevertheless the steam heating business is of great service in keeping out isolated plants. In closing the discussion President Ferguson referred to the difficulty experienced in obtaining information from members on the subject, and said that it might be well to stop the investigation unless members of companies which were members of the Association and using the system, were willing to give information they possessed for the use generally of other members of the Association.

TACTFUL RELATIONS WITH CUSTOMERS.

Mr. John W. Ferguson, assistant to the contract agent of Chicago Edison Company, dwelt upon the desirability of keeping on good terms with customers. A question to-day seriously occupying the attention of the public—and one that, if not provided against by the just and tactful treatment of customers, will surely in the near future play an important part in our political life—is that of municipal ownership of public utilities. To meet this issue, the central station management should show by their methods in operating that the companies fully recognize the limitations as well as the privileges vested in their franchise rights. The responsible head of any company should, therefore, see to it that there are placed at the head of the various departments men who will realize the necessity of tactful treatment of those with whom they come in contact. From the office boy and the elevator conductor, through all the ramifications in the organization of a big company, up to the president, upon each and every one depends the reputation of the company and its popularity, or lack of it, with the public. He dwelt upon the misuse or careless use of the telephone, to which is due much of the ill feeling exhibited by the public toward public service corporations. The minor clerk or office boy often conceives an exaggerated idea of his own importance, which he displays when using the telephone; these should be schooled to answer calls with patience and politeness. Upon the contract agent, the inspector, the collector, the meter reader and the repair man devolves most closely the duty of maintaining friendly relations with customers. Mr. Ferguson advises that central station managers should be careful in their choice of men for these positions and particularly for that of agent.

Mr. Leon Scherck, of New Orleans, recalled an incident in his city where one of the smaller companies was threatened with a loss of one of its largest customers and also a law suit, simply owing to a remark of one of the telephone boys. He considered that the greatest care should be exercised in choosing the head of the soliciting department, and he thinks it almost necessary at the present day to put in charge of the contract department a man who has some knowledge of electrical engineering, though not necessarily an expert engineer. Mr. John F. Gilchrist coincided with Mr. Scherck on this point, and said that too often the men who are at the head of the business know but little of the details of the handling of their customers. Mr. Arthur Williams expressed his gratification that associations all over the country are now giving more attention to this question of "commercial engineering," which term has been adopted by the General Electric Company and one or two of the other large manufacturing companies. Mr. C. S. Rogers, of Youngstown, Ohio, emphasized the necessity of promptly investigating all claims and said it is too often the case that the superintendents, not being responsible for the collection of accounts, do not give prompt attention to the investigation and adjustment of complaints. Mr. C. L. Wakefield, of Dallas, Texas, thought that the contract department often makes a mistake in having too many words in the contract. The trouble could be avoided by making a contract as simple as possible, so long as the price and term of contract is stated. Mr. E. F. Phillips, of Detroit, said that it was the practice of his company to tell the customer the truth at all times, regardless of whether the customer was lost or retained; and to acknowledge that a meter was too fast when that was the case. Mr. C. M. Lewis, of Bellevue, Ohio, said that in a dispute concerning a meter reading, the customer would be asked to put in place a new 16-cp lamp, try it for several hours and then check the watts with the meter reading

RELATIONS WITH EMPLOYEES.

Mr. Arthur Williams presented a paper giving an account of the provision that had been made by some large corporations for the permanent welfare of their employees, and detailing at length the Brown system of discipline. The paper also discussed the matters of pension and relief funds. In conclusion, the result of the investigations recently made by the New York Edison Company concerning the organization of a relief association is given. The plan suggested is that each member shall pay three per cent. of his wages and in the event of accident or illness shall have half of his wages or salary, and in the event of his death his heirs shall be paid $350; that the company shall pay to all employees serving continuously for a period of twenty-five years an annual pension of one per cent. of the average salary or wages received during the preceding ten years. As in the case of the Pennsylvania Railroad Company, the intent is to place a limit upon the total expenditure of approximately $3.80 annually for each employee on the pay roll. The paper gives extracts of the opinion rendered on the subject by the attorneys of the New York Edison Company.

In reply to a query, Mr. Williams said that he has not found any objection on the part of men to the additional payments made to benefit funds, because they are entirely voluntary and the men get a great deal more than they take. He knows of no company which requires any employee to join a benefit organization. Pensions, however, are administered entirely by the employer and are given to each employee whether he belongs to a benefit organization or not. There is no necessary relation between the sick and insurance organization and the pension system.

DECORATIVE AND SIGN LIGHTING.

Mr. Arthur Williams submitted an elaborately illustrated pamphlet to illustrate the different kinds of decorative lighting. The pamphlet contains more than eighty excellently executed half-tone engravings, some of which are printed on toned background in order to bring out a light effect. The illustrations show some of the most noted achievements in recent years in this class of lighting. On a double page is artistically printed "A Ballad of the Signs of the Times," by Carolyn Wells, the sentiment of which is that "The signs of the times are electric signs." This handsome pamphlet will be of much value to central station men wishing to work up the decorative lighting part of their business.

THE YOUNG ENGINEER IN THE ELECTRIC PLANT.

Mr. Charles F. Scott, in a paper, presented a plea for a proper technical supervision and direction of central station properties. There is, he said, apt to be a false tendency to an economy which rates brains too cheaply and fails to advance the intelligent young man. He gave instances showing the effect of good and poor supervision and laid down the qualifications necessary to the engineer of a central station. Such a man needs not only to be a steam engineer, an electrical engineer, and an all-around electrician, but in many cases he may have to do with hydraulics and gas. The type of man for the central station is a man who has a good foundation and has the power to develop. The man who has a good active mind and a sound theoretical basis, with even a small measure of practical experience, is capable of dealing with new questions in an intelligent way. We will probably find if we examine the ranks of the successful central station engineers, that as a rule they are technically educated men who have had their first years of practical training in a manufacturing company. Mr. Scott believes it is a mistake for a graduate to take office work at once, for what he needs is practical work, with overalls and grease. The vast interests of, and enormous capital invested in, central stations are increasing at a rapid rate; more men are needed, more men will be needed and those connected with the central station interests should as companies or as individuals do all they can to promote the development of the best apparatus, the best methods and the best men.

In the discussion of Mr. Scott's paper, Mr. W. B. Jackson emphasized the point brought out as to necessity of broad knowledge on the part of the electrical engineer. As to the remark about the young engineer knowing what overalls, grease and dirt are, he thought it well to go one step further and bear in mind that the young engineer who allows the dirt to remain upon him is apt finally to drop back into the position of dynamo or engine tender. He has been impressed and pleased by the efforts of those training young engineers to teach them the necessity of being a man, a well rounded man, as well as simply an engineer. The fact that not so many years ago a man who knew a little of engineering and a little of electricity made an excellent man to take charge of an electrical plant, does not apply at the present day. Mr. John F. Gilchrist considered that the young man who wishes to make progress in the central station business should be careful to obtain a very broad grasp of the business, especially in the smaller companies. Engineering schools should give more prominence to the business end, to the contracting, accounting and investment ends, and the proper charging of investment cost as in comparison with operating cost, in order that they may be able to determine what the property is doing and whether it is doing all it should. Mr. James I. Ayer said the engineer's training has only been started when he leaves college, and to perfect himself in the practical side of his work requires four or five years in the mechanical part of the business, during which time he should disregard in a large measure the fact he had been trained as an engineer, and go to work as a mechanical man to learn his trade. He deprecated graduates going into the office, where many of them wish to start. Mr. John W. Lieb said that an electrical engineer should be one who has first been grounded and developed as a mechanical engineer, the electrical features subsequently being added. He considered that the electrical courses of to-day are apt to develop electricians rather than electrical engineers. The proper course would be one in mechanical engineering with incidentally some electrical work, and then a one year's course of specialization in electrical engineering studies. He dwelt upon the necessity of the young engineer being able to present his ideas in a clear, concise form, so as to convince his employers of the strength and cogency of the arguments which he offers. Prof. H. E. Clifford seconded the opinion of Mr. Lieb that the electrical engineer should have a sound mechanical engineer's foundation, and said that at the Massachusetts Institute of Technology such a foundation is given. He differed with Mr. Ayer concerning the desire of students to begin at the office end of electrical work. Prof. W. L. Robb said that many central station men expected perfection in the young graduate of twenty-one, whereas a young man fresh from technical school cannot be expected to give better service than is obtained in the hospital from a young graduate from the medical school. Broad-minded engineers cannot be obtained in young men of twenty-one or two. He thought that technical school graduates ought first to be engineers and later become electrical, mechanical or civil engineers. He thought there were too many kinds of engineers at present and that engineering is now divided into too many departments.

Mr. W. M. Anthony considered that one of the greatest handicaps to the young man going into the central station is the attitude of central station managers in withholding information from them, and entered a plea that young men entering into work after graduation should be given a better chance than what they are at present. Prof. Goldsborough said that while he agreed entirely that engineers should be broad men, unless sentiment develops which will allow more than two years' training of engineers, it would be impossible to give them the amount of special training that they need. It is impossible for any man at the present to fully digest all the knowledge pertaining to civil, mechanical and electrical engineering in four years. In his opinion, the young engineer of the future will have four years of general engineering training along all lines, then two years of specialized training.

OFFICIAL METHODS AND ACCOUNTING.

Mr. W. M. Anthony presented his report as chairman on this subject in the form of two handsome pamphlets. One of these is a large page pamphlet containing reproductions of twenty-six kinds of office forms, instructions for use of which are given in the second pamphlet, which also discusses generally the subject of central station accounting.

The discussion on Mr. Anthony's report was one of the features of the convention, both in extent and interest. Mr. Doherty disagreed with Mr. Anthony as to the advisability of meter readers being kept informed of previous readings. His practice was not only to keep this information from meter readers, but to rotate the readers among the different districts month by month. He considered that broad principles of accounting are yet to be learned by central station men, and he drew a distinction between intelligent accounting and mere bookkeeping: a bookkeeper means a copyist, and what is needed is a thinking man to do accounting. According to the system of bookkeeping of his companies, two days from the last meter reading the earnings of the company for the preceding month are known. Errors of meter readings and errors of bookkeepers are posted on a bulletin card in the bookkeeper's room. The errors of meter reading have been reduced from eight mistakes per 1,000 meters read, to one mistake per 2,500, which has been the average for the last month. Mr. Anthony disagreed with Mr. Doherty concerning the entries on meter cards, his experience being that the more employees know of the details of their work, the better off is the company, and that the more the meter readers know of the customers' readings, the more they are apt to ascertain anything peculiar about a meter and report to the meter department. In replying to a query, he stated that loose leaf ledgers are considered as legal evidence in courts of justice.

Mr. Samuel Insull spoke very strongly on the subject of proper accounting systems. He said that in his experience in dealing with small properties—and he deals as extensively with smaller properties as with large ones—he seldom found that those running the properties knew whether they were making or losing any money. He has found cases of electric lighting plants, the owners of which found they were losing money and got out of business, whereas if they had had a proper accounting system and proper methods, and knew where they stood from month to month, they would have found that they were making money. A proper system of accounting for the smaller companies would cause the electrical securities of these companies to stand higher, which would reflect favorably on the securities of larger companies. He said that last year he bought ten small central station properties, and in a number of cases he was enabled to buy at prices lower than the properties were really worth, for the reason that no proper system of accounting had been employed and the real value of the properties was not known.

In replying to a query, Mr. Anthony said that every official should be given the widest information, and that nothing should be held back, particularly as men are apt not to have any idea of the commercial value until that value is shown to them in dollars. Mr. W. S. Neuman considered that it was an advantage to the meter reader to have the previous reading of the meter. In reply to a question as to whether the storekeeper should be under the direction of the auditor of a company or the manager, Mr. Anthony said that the auditor should have direct charge of every department relating to showings of cost, receipts, interests or disbursements and general charge of every department as regards the obtaining of results. The storekeeper should come under the direct jurisdiction of the manager, for if he does not do his work the auditor is liable to call on the manager. He considered that all accounting should come in the accounting department proper, that the storekeeper should keep no accounts except with respect to quantities, and that the same was true of any employee or head of a department, as prices do not come within their category. The pay rolls in Chicago are kept in the same way, the number of hours on work, kinds of work, and places where done, being entered, the man who makes out the pay roll not being supposed to know the wages received by the men. In this way maximum efficiency is concentrated in each department where it belongs. Mechanical men should not be made storekeepers nor operating men bookkeepers.

Mr. F. E. Smith, of Somerville, Mass., said that in the case of his company, which had less than 500 customers, the meter reading was written on the customer's bill, and the bill collected at once if possible. If this could not be determined, the bill was left and a stub torn off, which was taken to the office from which to make the necessary entry there. Mr. J. F. Strickland, of Waxahachie, Texas, said that the average man connected with a small station should know only that part of the business that pertains to his personal responsibility. He should know this well, but not necessarily know the business of other men connected with the company. His company required a deposit to the full value of the meter installed.

Mr. Anthony did not consider it advisable to exact deposits for meters, and said that the less the deposit question is stirred up the better it is for a company. Where there is doubt, his company rents the meters weekly, as in that case a default would only be one week's bill. When asked why he did not use the prepayment meter instead of collecting bills weekly, he replied that it was because one had so many kinds of customers with different ideas to deal with. If customers can be obtained by the use of a prepayment meter, such a meter goes in; if the weekly system suits them the best they get that, being given their choice as at a lunch counter. His company had 30,000 customers and only $20,000 on deposit, and interest at 5 per cent. is paid on the deposits. Mr. E. F. Peck testified to the efficiency of Mr. Anthony's system as adopted at Schenectady, N. Y. Formerly he used to look forward to the showing at the end of a month with a great deal of anxiety, and now the end of a month is welcomed. Through the adoption of the system, the operating expenses have been decreased something like 8 per cent. Mr. Arthur Williams said that the New York Edison Company had not yet found any prepayment meter which gave entirely satisfactory results, but that it would welcome a reliable meter of this type. Mr. John F. Gilchrist, of Chicago, said that the Chicago Edison Company had from 225 to 250 prepayment meters in use. It was found that many people are unwilling to make a deposit, others are unwilling to agree to a minimum charge of one dollar a month, and to these the prepayment meter was offered. In a month or so the customer is generally found ready to make an arrangement on regular contract basis.

The discussion also took up the matters of addressing and computating devices and details of accounting organization. An enlivening incident was a tilt between Prof. Bemis and Messrs. Insull, Scovil and Bean. Mr. Scovil accused Prof. Bemis of misrepresenting the cost of producing electric current, and Mr. Bean, of St. Joseph, Mich., said that these misrepresentations had interfered with his business financially. Prof. Bemis, while disclaiming technical knowledge, said that he felt justified in writing as a statistician on central station matters; and so far as the misrepresentations to which Mr. Scovil referred were concerned, his remarks should have been directed at a report made to the City of Cleveland, which he had merely forwarded without endorsing the statements as to price which it contained.

ADVANTAGES TO BE DERIVED FROM CONSOLIDATION OF ELECTRICAL INTERESTS.

In opening his paper with the above title, Mr. Sydney Hosmer classified the advantages to be derived from any form of consolidation of manufacturing interests as follows: (1) The advantage of the lower capital investment, (2) lower cost of production, and (3) better service. To these should be added, in the case of the transmission of electrical energy, the advantage to be derived from an improved load factor, which is almost certain to result from a combination of different classes of business. This improvement of load factor, of course, affects the matter of capital invested and also cost of production, but it is an advantage which applies to electrical consolidations in addition to those which may apply to any other forms of consolidation. In all other cases where such consolidations have been effected, still another point has been gained, though it is not due to the mere combination. That is, small plants have an most every case been old and equipped with inefficient apparatus, while the consolidated plant has been of the most modern type and built under such conditions that the best engineering talent was available.

In the matter of invested capital, actual figures are hard to obtain. Taking the generating plant itself we know that plants of 15,000 to 20,000-kw capacity can be built for $90 a kw, while plants of approximately 500 kw run as high as $200 or over, due, of course, to the smaller units employed. Going above 30,000-kw capacity, the comparison would not continue to show such marked gain.

It is the almost universal practice to-day to run everything from one station, using sub-stations for the transformation necessary for the supply of local districts; this may be proper as far as it has gone, but a point will be reached where the cost of lines and sub-stations, with the liability to interruption in each, will not only justify, but demand a number of generating stations located with reference to the demand for current. The question of when this will be justified will depend entirely on coal and water facilities.

There is a limit to the amount of power it is desirable to put in one building. It has been demonstrated a number of times in our large stations that accidents can happen which will interrupt the entire plant. What this amount should be will depend largely on the character of service supplied. On the other hand, it should be as small as possible, so that any accident may affect as small a percentage of supply as possible; on the other hand, it must be large enough so that any possible demand for current can be met without difficulty. A plant supplying feeders of normal capacity of 700 or 800 kw could be divided into units of 10,000 or 15,000 kw without sacrificing any of the advantages of ample generating capacity, while a plant supplying feeders of 2,000 kw would have to be made in larger sections to give equal service.

In most cases it will be impossible to find a number of locations having good coaling and water facilities, so that a subdivided plant at one point may be preferable, but of course aside from coal and ash-handling machinery, there is no argument from the investment standpoint to justify putting all the plant at one place, while on the other hand, distribution investment might be very much reduced by a number of generating stations at different points, provided always, of course, coal and water can be obtained. The Boston Edison Company is now erecting a plant for an ultimate capacity of 50,000 or 60,000 kw; the situation there with reference to coaling and the shape of territory supplied is such that there is no choice but to locate the entire plant at one place. It is, however, the intention to absolutely divide that plant into at least three divisions, even cutting the bus-bars for the separate divisions. Of course arrangements will be made for connecting the bus-bars that they may be all supplied from one section at period of light load.

Turning now to the question of lower cost of production, we find in station cost alone a very marked gain, amounting to a difference of 500 or 600 per cent. between a plant of 500 kw and one of 20,000. In this respect, improvement should be found in consolidation, continuing almost in the same ratio no matter how large the plant may become. A subdivided plant may cost a little more to operate than one not subdivided, but the difference will scarcely be appreciable. This would be almost as true for a number of generating stations if they were properly interconnected.

In the distribution of the consolidated company there might be some small gain in expense, but it could not be a very marked one. This expense is a function of the number of subscribers, and miles of wire. In the consolidation, the miles of wire would certainly be increased for the same customers with consequent increase of expense of maintenance. If anything were gained here, it would probably be at the cost of increased investment; that is, the larger company would instal distribution plant perhaps better and in a more lasting way, but at greater cost.

In general expense and management, we could hardly expect much improvement, owing largely to the fact that responsibilities are largely increased and more complicated legal questions are brought in. Taxes would, of course, be decreased in such measure as we have saved investment.

Turning now to the quality of service, we find the small company almost invariably running without spare apparatus and the service liable to suffer if anything goes wrong. This is probably partly due to the fact that it is a greater burden for the small company to buy extra apparatus, but it is probably in a greater measure due to the character of management under which it is run. The management of the larger company has a greater appreciation of its responsibilities and realizes more thoroughly that development depends on reliability of service. This defect goes with the smaller company because it is smaller and the margin of profit is less, and less can be put into management, etc., and not as may be argued because the company is old-fashioned and poorly handled. Another defect which we find in most of the small companies and which is not due to the mere fact that they are small is the absence of modern methods and devices, owing to the fact that the plant usually is old and capital is not always available to take advantage of the newest developments.

The question of 24-hour service also comes in. In a 500-kw plant it costs as much to run one unit as it does the whole station in all except coal, as there are at most only two or three men to a watch, consequently, the long hours at very light load are an impossible burden. On the other hand, the cost in a large station varies in all things approximately with the number of units in use, and kilowatts produced at light load times bear same relation in cost to those produced on the peak. The difference in load factor between a small and large company comes in here also. A company supplying a great territory included a number of different classes of business—residences, amusements, factories and possibly street railways, so that the cost per kilowatt may be just as good at one part of the day as another. Also, one company taking the place of several does not necessarily get the sums of the peaks of the different stations as these may not coincide.

In the discussion of Mr. Hosmer's paper, Mr. Junkersfeld, in referring to Mr. Hosmer's opinion, that it is advisable to instal a number of smaller stations as opposed to one large station, said that the machinery in the present old stations operated during a few hours of a few months of the year is worth just as much to the central station as an equivalent capacity of machinery in a new station. Taking the situation in a large city, the more power electrically generated in one locality, the less will be the amount of unproductive investment to be carried, and the less amount of unproductive labor. As to the cost of sub-stations and distributing expenses, the transmission investment rarely runs higher than 6 per cent. of the total investment of the company, so that the location of the large station where the transmission voltage is high enough to be economical does not cut such a big figure. The low tension distribution network will be very near the same regardless of the number of generating stations, if these stations generate at a higher voltage and the current is distributed through sub-stations. At present the location of the station is very much more independent of the location of the load than formerly. As to the reliability of service in the large station, it means a much better class of machinery and better construction work than heretofore. Reliability, however, may be assured through the use of storage batteries, the subdivision of the station and proper control of the service. He considers that the tendency towards subdividing the station will increase. Mr. John W. Lieb, Jr., coincided with Mr. Junkersfeld as to the influence of unproductive labor and secondary cost in a multiplicity of small stations as against one large power plant. It is of extreme importance for the large central plant to be guarded with more than usual care against fire and interruptions of service. It is probably true that the best arrangement and relation of sub-stations to the large central plant has not yet been fully developed. Questions still open are whether single or two-bus operation is the better, the separation of switch gear, or a still further separation into practical single-unit operation to groups of sub-stations. It is probable, however, that supplying each sub-station through independent sets of feeders, following two courses, and having the central station arranged so as to secure two-bus operation, will supply a reasonable amount of safeguard without detracting too much from the economies to be obtained from multiple-bus operation. He referred to the extreme importance of an adequate storage battery equipment as a safeguard from short interruptions in service.

THE STEAM TURBINE.

Prof. W. L. Robb made some remarks from notes on the steam turbine, at the conclusion of which President Ferguson introduced Mr. W. L. R. Emmet as one who is entitled to great credit in bringing the Curtis turbine to its present state of development, and its application to electrical generation. Mr. Emmet said that in view of the prominence thus given to his name, he wished to refer to the great value of Mr. Curtis's work on the steam turbine. The work at Schenectady, which has not been his alone, has been in connection with the mechanical development of the turbine, and also in the development of the methods of making it economical and proportioning it, and this has resulted largely from the facilities there afforded for persistent experimenting. Mr. Curtis is the inventor of the turbine and his ideas have been very clear and distinct. Mr. Emmet then gave a sketch of the principles of the turbine as developed by Mr. Curtis and pointed out that in the Curtis turbine the water due to expansion is taken out in successive stages in more or less proportion, and does not take part in the subsequent expansions; consequently all the superheat that can be used is available and acts sufficiently without having to expend its energy in re-evaporating water. Experiments with the Curtis turbine have shown that the elimination of initial moisture or moisture at any stage by the addition of superheat is beneficial to the turbine, and the improvement in increased superheat is indefinite, being represented almost by a straight line. Hopes as to the future economy of turbines of this type are based to a great extent on the proper elimination of the moisture and the proper use of superheat.

He said that large turbines and small turbines were nearly equally efficient, but it is hoped that with the large machines there will eventually be great improvements in efficiency, for the reason that a certain amount of clearance is necessary for mechanical reasons, and that clearance can be made less proportionately as the turbine increases in size, while the leakage and dissipation from improper fittings will be relatively less, as well as friction and radiation losses. A turbine of 600-kw capacity showed an economy of 19 pounds of dry steam per kw-hour at full load, and only 1½ pounds greater at half load. Mr. Emmet said that in turbines the increase in economy has been about 1 per cent. for every 12 degrees of superheat. In a turbine of the Curtis type, the capacity is practically unlimited without any increased expenses, because by simply adding more nozzles, more power can be gotten out of the turbine. The economy would fall off somewhat with great overloads. Back pressure is rather more objectionable in the turbine than in the steam engine, and the turbine is relatively less advantageous in non-condensing than condensing. One of the great advantages of the turbine is in its ability to use high degrees of expansion, and when working non-condensing this advantage is lost. Up to the present time little or nothing has been done toward competing with the non-condensing engine, the details of commercial turbines being worked out on the condensing basis. In reply to a query Mr. Emmet said he thinks the gas engine has a future, but it is expensive to build and maintain and the same is true of its accessories. Turbines do nearly as well as the gas engines, and he thinks the latter will receive a great set back because of the development of the steam turbine.

Mr. Edward Yawger, of Pittsburg, Pa., said that the floor area at present actually used by turbines is about twice greater than is necessary. It has been suggested that the surface condenser should be made a part of the foundation of the turbine, but the objection to this is that it would necessitate the turbine manufacturer being also a manufacturer of the condenser, and it might possibly restrict accessibility to the condenser. Owing to the turbine occupying such a small space it can be set up on temporary foundations and thoroughly tested under load before shipment. In the Westinghouse shops the testing room contains foundations of a sufficient size to take 5,000-kw turbines, and there are also surface condensers of large capacity, pumps, an independent superheater, etc. It has been the practice so far of this company to thoroughly test every turbine, not only at full loads, but at smaller loads, down to ⅕. Up to the present some 500 such tests have been made on turbines.

Replying to a question, Mr. Emmet said that owing to the great expansive limit of the turbine, it is much more efficient at high vacuums than the steam engine. He said that in the smaller turbines the clearance is .03 of an inch and .05 of an inch in the largest turbines, which clearances are found to be ample. One of the objects in building the turbine in vertical position is to make it short, to simplify the bearings and render expansion of the metal unimportant. The pressure on the step bearing is governed by the size, it being 300 pounds per square inch in the smallest turbine and about 1,100 pounds in the largest machines. In reply to a question as to heating of the generator, he said that since the steam is expanded down to atmospheric pressure before entering the pressure shell, the temperature is only about 212°; and since there is vigorous ventilation in the rapid moving machine of this kind, no trouble has been experienced from the effects of heat.

RELATIVE ADVANTAGES OF ELECTRICAL AND MECHANICAL METHODS OF VARIABLE SPEED CONTROL FOR GENERAL POWER SERVICE.

Mr. William Cooper, in a paper on the above title, discusses the advantages of the several methods of obtaining variable speed control, and contrasts mechanical control by the use of cones, change gears, etc., with direct electric control, most of the advantages being in favor of the electric drive. The various systems of electric control are described, and it is pointed out that in installing a new manufacturing plant the two important considerations are as to what system will assist in yielding a maximum output from the machinery installed, and the comparative costs of the different methods installed. The following rules are given for determining the relative size of motors for constant horse-power application:

First—The total range of speed, using both variable voltage and field regulation, will be as the square of the range of voltages.

Second—Change of horse-power will be directly proportional to change of voltage on armature, field being constant.

Third—Change of horse-power by change of field strength will be inversely proportional to change in speed, voltage on armature remaining constant.

Fourth—Relative size of motor, as referred to the maximum speed, will be directly proportional to its speed variation when using variable voltages.

Fifth—The relative size of motor, as referred to the maximum speed, will be as the square of the speed variation when using field regulation.

Mr. A. W. Lloyd said that in Chicago the cost of driving machinery by gas engines is about the same as with electric motors, but the latter have greater advantages otherwise. The Chicago company takes out a great number of gas engines every year and replaces them with electric motors. He considered that from the central station standard, at the present time a motor will answer all purposes operating on two voltages with resistance in the field and perhaps also in the armature. He considered that the installation of small motors for groups of machines is more economical than the individual drive. Another objection to applying individual motors to old tools is that the tools are generally too light in construction. In the case of very large and heavy machines, however, the individual motor is preferable. Mr. H. M. Lyman, of Chicago, called attention to the advantages of the three-wire distribution and special motors over the four and five-wire systems and standard motors. The voltages of the three-wire system applied to the armature of a special motor permit a perfectly gradual one-to-four variation of speed. A two-to-one variation is ample for planers, slotters, milling cutters and many other tools. Lathes and boring mills require in extreme cases four-to-one variation of speed on a single job, while on different jobs a range as high as one to 12 or 16 may be required. As the cutting speed of the tool is pretty nearly constant, regardless of the rotative speed, the power taken by a machine is nearly constant for all motor speeds, and the motor must, therefore, be large enough to deliver full load at the lowest speed. It is better to have one of two changes of speed by gearing, than to furnish a motor capable of a full range of speed. The four or five-wire multiple-voltage system had signally failed in cases because the motors were not sufficiently large to furnish the power required when running at their lowest speed.

Mr. H. G. Gille said that in using a variable-speed motor on the three-wire system, unless the neutrals cared for the capacity of the outside feeders, there is likely to be trouble. Mr. Lloyd stated that in Chicago motors of a capacity as high as 15 hp were operated on the regular street system, and that recently a 30-hp motor was installed, but close to a sub-station. Mr. Cooper doubted if the five-wire motor system had failed in any individual case for the reason given, and added that the use of the system was largely increasing. Mr. Arthur Williams said that the experience in New York was that at present prices for electric current for power, there is no chance for the gas engine in competition with the electric motor. He cited an instance where a gas engine that was about to be installed would have cost $3,500 a year to operate, whereas electric current for the same service had cost only $2,700 per year. During the last several months the New York Edison Company has taken out an average of from six to eight gas plants a month. Mr. John W. Lieb considered that the experience of central stations was entirely at variance with the statement that the gas engine is a competitor of the electric motor. Mr. F. W. Borne, of Kenosha, believed that the matter of competition between the gas engine and the electric motor was not only a question of the cost of gas and price per kw-hour of electrical energy; that there were cases where customers would be willing to pay ten times more for electric power than for gas engine power. Mr. Williams stated that a gas engine cannot be run on 20 ft. of gas per hp-hour, and he knows of no test where they consumed less than 30 or 40 ft. of gas per hp-hour. Mr. C. W. Coiner, of Oneida, N. Y., said that in Oneida his company controlled both the gas and electric plants, and while they were selling gas for power purposes for $1.00 per thousand, and current for motor purposes from 10 cents down to 2 cents per hp-hour, yet the motor was almost invariably preferred for power as against the gas engine. Mr. H. T. Hartmann, of Philadelphia, related that in Canton, Ohio, where natural gas sells for 25 cents per thousand, which gas, moreover, is more efficient for use in gas engines than manufactured gas, his company has over 900 hp of electric motors connected in the town of 30,000 inhabitants. Customers find that the reliability of the electric service is more important to them than the cost. Mr. F. J. Pearson, of Chicago, considered that for driving machine shop tools and devices of that character in manufacturing plants, the two-voltage system has proven to be entirely satisfactory. He said that recently two gas engines were replaced with motors, and it was found that the item of labor in the case of the gas engines was 65 per cent. higher and the cost of oil and other materials 50 per cent. greater. Mr. F. E. Smith, of Somerville, Mass., gave examples where gas engine power was replaced by electric motors, and where a reduction in total expense of power followed; and in one case where the cost of electric power was considered greater, the customer was satisfied, owing to the better service. Mr. Harold Almert, of Oak Park, Ill., related that at a recent meeting of mechanical men in Chicago a conservative gas engine representative stated that he had ceased representing that gas engines needed no attention and that he would not now guarantee engines unless an attendant of superior intelligence to that of the ordinary steam engineer was put in charge of the plant.

FUNDAMENTALS IN PHOTOMETRY.

Prof. H. E. Clifford, of the Massachusetts Institute of Technology, delivered an address on "Some Fundamentals in Photometry." He urged the necessity of thoroughly calibrating the instruments and having due regard to the time element. He condemned the Lummer-Brodhun photometer, spoke well of the Kruss-Bunsen photometer, and said that the Jaly photometer gives results far too low. He recommended the Koenig spectro-photometer as a means for telling exactly whether a photometer is giving a true reading. He found that the Nernst lamp does not get down to its normal candle-power until a considerable time after current is turned on. Another point about the Nernst lamp is that it is particularly sensitive to change in voltage; a change of 5 volts on a 225-volt circuit for only a half a minute produces an effect such that the lamp does not recover its normal power for a period of 10 to 12 minutes after such fluctuation. He referred to an effect to be guarded against in the photometer as follows: If you have two lamps, one of a decided bluish tint and the other of a decided yellowish tint, and the two are compared, it will be found that the blue lamp has the advantage at greater distances from the photometer disk, and the yellow lamp the advantage at lesser distances, although they may be actually at mean distance of the same intensity. As a result it is necessary either to use a screen of the same color as the arc in arc light photometry, or else discard photometric measurements of the arc light as a means of rating. He recommended that arc lights should be rated by the illumination which they afforded.

In the discussion Prof. Mathews said that the Association Committee on Arc Light Photometry had taken into consideration in their measurements the color effect referred to by Prof. Clifford.

The only way to overcome the error due to that effect is to make the illumination of the disk quite low. Prof. Mathews said that during the year his committee had given attention to the Nernst lamp, the Welsbach mantel burner and the open gas flame. The watts per candle-power found for a single-glower Nernst lamp were 2.3; for a three-glower about the same, and 1.8 for a six-glower. The Nernst lamp has the advantage of an excellent quality of light, which is an important factor. In testing gas jets, the lights from a large number of tips were compared; though the different tips looked alike, the candle-power which they gave ran from 7 to 27 candles. In reply to a query, Prof. Clifford said that in the Nernst lamp, when the voltage is dropped by ten volts and held for one minute, and then restored to its normal value of 226 volts, the ratio of change in illumination was about 5.4 to 4.8, and the lamp does not return to its full voltage until after a period of about 10 minutes. In the case of a drop in voltage of 5 volts, the ratio became 5.1 to 2.7 and the lamp did not return to normal power for a period of 4½ minutes. Mr. N. W. Hanks said that if the pressure is dropped, the candle-power of the Nernst lamp will also drop; on raising the pressure again, the candle-power will not, of course, go up instantly to its full value, but for all practical purposes of general illumination this is a matter of little moment. Mr. Hanks said that Dr. Nernst has been using one of his glowers for standard work; the glower is operated free in the open air and brought into operation by means of an alcohol torch. The ballast is in series, and the candle-power is maintained constant by maintaining the current constant. The light he employed in photometry comes through a slit, which eliminates terminals. Mr. Arthur Williams said that in some tests with the osmium lamp, the voltage was increased from the normal voltage of 50 to 80 volts, with a corresponding increase of candle-power; after the voltage was restored to normal, however, the candle-power was only about 50 per cent. or normal, and it took some time for it to recover. Prof. Mathews said that in some tests the Nernst lamp, starting at 210 volts, ran to 230 volts, 220 being normal, with practically straight line relation. A change of 1 per cent. in the voltage made a change of 7 per cent. in candle-power. At 220 volts the candle-power was 27, and at 230 volts became 59. Much more uniform candle-power was obtained at constant current than at constant voltage.

Mr. Ryan said that when the Nernst lamp was first introduced the light was white, and it had a high efficiency but had a short life. The life has been improved, the efficiency has come down somewhat, and the color of the lamp to-day is nearly the same in quality as that of the incandescent lamp. Mr. Ryan considered that the open arc lamp with an opal globe gave a better light for the comparison of colors than the enclosed arc with a clear globe; a globe can, however, be selected for the enclosed lamp so that its light approximates to average daylight. The disadvantage of the open arc light in comparing colors, is the fatigue effect. Prof. Mathews suggested that matching colors should be done with the same light as that under which the colors will be used; for example, if a woman wishes to buy a dress to wear to a reception, she should choose the colors under light of the same character as will be used when she wears the dress. Prof. Jackson pointed out that, whereas arc lamps and incandescent lamps operated on low-frequency circuits give an unsatisfactory light, the Nernst lamp, on account of the large mass of its glowers, shows very little variation in illumination at a frequency as low as 25 periods per second, and he thought that the Nernst lamp may be worked satisfactorily at a frequency as low as 17.5 periods.

REPORT OF THE COMMITTEE ON THEFT OF CURRENT.

Mr. Robert L. Elliott, chairman, presented the report of the Committee on Theft of Current. The paper enumerates the classes who attempt to defraud a company, the various methods adopted by such persons to divert electricity to their own use, and the means and measures to be taken by the company to discover the act and punish the offenders, and means for prevention. Quite a number of States have adopted laws on the theft of current, and after an examination of these the committee recommends that the following points should be covered in any new law:

First—Fraudulently making any connection with any electrical conductor so as to supply electricity without the consent of the company or without its passing through a meter set by the company.

Second—Fraudulently preventing any meter from duly registering, or altering its index, or interfering in any manner with its proper action or just registration.

Third—Fraudulently diverting electricity in any other manner whatsoever so as to use or waste it, without the consent of the company or without its passing through a meter set by the company.

Fourth—Any one aiding or abetting or counselling the above acts to be equally guilty with the principals.

Fifth—A penalty of a fine not exceeding $500, or imprisonment not exceeding one year, or both. (In many States the penalty is less.)

Sixth—Proof that any of the above acts were done on the premises of the accused, or that he received the benefit of such electricity, shall be *prima facie* evidence of his guilt. The last-named provision is that contained in the laws of two of the States, namely, Michigan and Montana. Such a provision as this should, if possible, be incorporated in all laws, as by putting, in some measure, the burden of proof on the accused person, it simplifies matters in court in cases where there is no direct evidence of the act of tapping the wire or tampering with the meter.

THEFT OF CURRENT.

Mr. T. H. Bartlett, of Philadelphia, said that his company, in order to prevent theft of current, encased the service wires and cut-outs and all wires between the service and house cut-out in an iron box. The box and meter are mounted on a light angle frame about 3 or 4 in. from the wall, and the meter itself is set immediately over the box in such a manner that the wires pass directly into the bottom of the meter, thence to the back of the box and up a conduit into the house conduit or switch. His company had had considerable trouble through the dial glasses of meters being removed and the dials turned backward. Mr. John L. Gilchrist said he had been informed that in England convictions for theft of current had been obtained under the old English common law. Mr. Elliott added that in Germany convictions have been secured on the grounds that theft of current is larceny.

ATTENDANCE.

Below is given a list of the central station men in attendance at the Chicago convention of the National Electric Light Association, so far as could be ascertained from the registers and from observation. Several did not register. All told, over 900 persons were in attendance. Elsewhere in exhibit notes will be found the names of the supply and manufacturing houses represented, and a very full roster of those present in their behalf.

Aberdeen, Miss.—Aberdeen Electric Light Plant, J. F. Enderlin.

Albert Lea, Minn.—Albert Lea Light & Power Company, B. J. Shockley.

Albion, N. Y.—Albion Power Company, J. H. Rollins.

Allliance, O.—Alliance Gas & Electric Company, D. W. Low.

Alton, Ill.—Illinois Power & Light Company, H. M. Bamer.

Altoona, Pa.—Edison Company, E. B. Greene, superintendent.

Ann Arbor, Mich.—Washtenaw Light & Power Company, W. H. Emphill, Jr.

Antigo, Wis.—Antigo Electric Light Plant, W. L. Elliott.

Atlanta, Ga.—Georgia Railway & Electric Company, G. W. Brine,

Attleboro, Mass.—Attleboro Steam & Electric Company, E. J. N. Eley.

Battle Creek, Mich.—Citizens' Electric Company, V. D. Simons, C. A. La Ferer.

Beatrice, Neb.—Beatrice Electric Company, E. F. Schurig, E. J. Sullivan.

Bellevue, Ill.—Bellevue Light & Power Company, C. M. Lewis.

Beloit, Wis.—Beloit Electric Company, J. S. Allen.

Big Rapids, Mich.—W. E. Donley Electric Light & Power Company, W. E. Donley, W. J. Trott.

Bloomfield, Iowa.—City of Bloomfield E. L. Dept., P. H. Palmer.

Bloomington, Ill.—B. N. Railway, Electric & Heat Company, C. F. Snyder.

Boston, Mass.—Brookline Gas Light Company, G. E. Crosby.

Boston, Mass.—Edison Company of Boston, C. L. Edgar, S. Homer, W. H. Atkins, L. L. Elden.

Brooklyn, N. Y.—Brooklyn Electric Light Company, L. W. Greene.

Brodhead, Wis.—Brodhead Electric Light Company, G. M. Pierce.

Brooklyn, N. Y.—Edison Electric Illuminating Company of Brooklyn, J. W. Lieb, Jr.

Carlisle, Pa.—The Carlisle Gas & Water Company, C. E. Ramsey.

Cedar Rapids, Iowa.—Cedar Rapids Electric Light & Power Company, W. J. Greene.

Cincinnati, O.—Cincinnati Gas & Electric Company, J. E. Winn, H. C. Hutchison.

Cleveland, O.—Water Works, E. W. Bemis.

Cleveland, O.—Cleveland Electric Illuminating Company, M. E. Turner, S. Scovil, S. C. D. Johns.

Colorado Springs, Colo.—Colorado Springs Electric Company, G. B. Tripp.

Columbus, O.—The Columbus Edison Company, A. W. Field.

County of Shawano, Wis.—C. D. German.

Chicago, Ill.—Sanitary Dist. of Chicago, A. S. Ceane.

Chicago, Ill.—Wadeford Electric Company, C. A. Lundberg.

Chicago, Ill.—Oregon Electric Power Company, J. H. Gammans.

Chester, Ill.—The Chester Light, Water & Ice Company, J. D. Gerlach.

Chicago, Ill.—Commonwealth Electric Company, J. J. Schafer, E. D. Alexander, W. H. Pierce, F. C. Hebard, E. E. Schermerhorn, J. E. Combiths, W. M. Anthony, J. M. Radford, R. E. Thurston, A. C. Hanna, R. Johnston, J. G. Barrett, S. C. Platt, W. A. Wells, C. J. Eaton, F. E. Eaker.

Chicago, Ill.—Chicago Edison Company, S. Insull, L. A. Ferguson, W. M. Anthony, F. Sargent, W. E. Carlton, J. M. Sadler, W. L. Abbott, R. F. Schuchardt, J. F. Gilchrist, W. H. Fairclough, Jr., J. P. Barrett, Jr., H. A. Seymour, W. C. Berry, J. W. Ferguson, H. M. Hope, R. L. Elliott, G. A. Freeman, J. H. Goehot, G. H. Jones, P. F. Williams, O. R. Hogue, H. B. Gear, W. H. Ott, C. G. Y. King, F. L. Richardson, O. J. Bushnell, P. Junkersfeld, A. Dunkee, E. Schildhauer, D. B. Bronson, H. Jampolis, R. Ferguson, C. E. Partridge, W. H. Collins, M. E. Terbush, W. M. Ness, H. F. Frosch, C. Schwartz, D. W. Roper, E. N. Lake, M. B. Joyce, B. K. Howard, G. N. Eastman, E. D. Edkins, B. G. Jamieson, S. O. Radtke, W. G. Kelley, B. D. Buell, A. G. Gerlach, C. Klusman, G. B. Springer, G. W. Conover, E. Lunn, J. B. Weidgmant, J. E. Tills, G. R. Miles, J. Thulin, L. I. Porter, C. A. Keller, S. M. Bushnell, G. E. McKana, D. H. Howard, W. F. Sims, J. T. Doody, R. Schmettge, C. H. Ibsen, J. F. McGlensey, A. B. Case, P. S. Biegler, W. E. Chadsibadhy, W. H. Fairclough, H. P. Rushing, Dr. J. D. McGowan, H. C. Patterson, T. Wilson, R. E. Strohm, S. Gardner, W. Holloway, A. D. Gilmore, J. O'Brien, L. D. Allen, P. L. Clarke, C. L. Davidson, I. E. Brooke, E. J. Switzer, H. L. Gannett, W. Leiderer, C. C. Parer, G. W. Barlow, P. H. Bate, R. Mueller, I. J. Walsh, H. O. Fife.

Dallas, Tex.—Dallas Ice Factory Light & Power Company, C. L. Wakefield.

De Kalb, Ill.—De Kalb Sycamore Electric Company, J. W. Glidden.

Delavan, Wis.—Delavan Light & Fuel Company, G. C. Gum.

Denver, Colo.—Denver Gas & Electric Company, H. L. Doherty.

Derby, Conn.—Derby Gas Company, R. E. Wyant.

Des Moines, Iowa.—D. M. Edison Light Company, J. W. Turner.

Detroit, Mich.—Detroit Edison Company, W. F. White.

Detroit, Mich.—Public Lighting Commission, A. S. Hatch.

Detroit, Mich.—Peninsular Electric Light Company, E. F. Phillips, Alex. Dow.

Edwardsville, Ill.—Edwardsville Electric Light & Power Company, C. A. Vallette.

Eldora, Iowa.—Eldora Electric Light Company, W. S. Porter.

Elizabeth, N. J.—United Electric Company of New Jersey, E. H. Stevens.

Elmira, N. Y.—Elmira Water, Light & Railroad Company, H. M. Bengler.

Evanston, Ill.—Evanston Heating Company, J. R. Kimball.

Evanston, Ill.—North Shore Electric Company, G. H. Lukes.

Evanston, Ill.—Calumet Lighting Company, F. W. Insull.

Evanston, Ill.—Evanston Electric Illuminating Company, H. E. Marshall, F. J. Baker.

Evansville, Ind.—Evansville Gas & Electric Light Company, J. C. Gillette.

Eureka Springs, Ark.—Citizens' Electric Company, T. L. Hawley.

Fall River, Mass.—Fall River Electric Light Company, H. Bottomley.

Freeport, Ill.—Freeport Railroad, Light & Power Company, A. E. Walden.

Galion, O.—City Electric Light Plant, H. C. Dye.

Hartford, Conn.—Hartford Electric Light Company, R. W. Rollins.

Iowa City, Iowa.—Iowa City Electric Light Company, G. S. Carson.

Hoopeston, Ill.—Hoopeston Electric Light & Heating Company, C. J. Wakeman.

Houghton, Mich.—Houghton County Electric Street Company, J. J. Frey, J. T. Kester.

Jacksonville, Ill.—A. H. Kusler.

Jackson, Mich.—Jackson Light & Power Company, F. Mench.

Jamestown, N. Y.—Jamestown Light & Power Company, F. W. Bullock, superintendent.

Janesville, Wis.—Janesville Electric Company, P. H. Korst.

Jersey City, N. J.—United Electric Company of New Jersey, W. W. Titzell.

Johnstown, Pa.—Johnstown Light, Heat & Power Compnay, A. Weis.

Joliet, Ill.—Citizens' Light & Power Company, R. Roe.

Joplin, Mo.—South West Missouri Light Company, G. M. Myers, W. Parsons.

Junction City, Kan.—Kokomo Railway & Light Company, F. E. Tyler, T. C. McReynolds.

Kalamazoo, Mich.—Kalamazoo Valley Electric Company, H. C. Hoagland.

Kansas City, Mo.—Kansas City Electric Light Company, M. G. Campbell.

Kendallville, Ind.—City Electric Light Plant, F. E. Johnson.

Kenosha, Wis.—Kenosha Gas & Electric Company, F. W. Bowen.

Knox, Ind.—Knox Lake Light & Power Company, M. O. Bish.

La Porte, Ind.—La Porte Electric Company, J. H. Harding.

Lake Charles, La.—Lake Charles Ice, Light & Water Works Company, T. J. Bird.

Lambertville, N. J.—Hunterdon Electric Company, W. S. Neuman.

Lancaster, Wis.—Lancaster Electric Light Plant, G. P. Angus.

Lewiston, Pa.—Lewiston Electric Light Company, E. F. McCabe.

Lexington, O.—New Lexington Electric & Power Company, O. J. Smith.

Lima, O.—Lima Electric Railway & Light Company.

Lincoln, Neb.—Lincoln Gas & Electric Company, J. S. Dales.

London, Ont.—London Electric Company, C. B. Hunt.

Long Branch, N. J.—Consolidated Gas Company of New Jersey, L. E. Kerns.

Louisville, Ky.—Louisville Lighting Company, A. M. Worthington.

Lynchburg, Va.—Lynchburg Traction & Light Company, R. D. Apperson.

Lynchburg, Va.—Roanoke Railway & Electric Company, A. E. Anderson.

Lynn, Mass.—Lynn Gas & Electric Company, W. P. Hazeltine.

Madison, Wis.—Madison Gas & Electric Company, C. H. Williams.

Marion, Ind.—Marion Light & Heating Company, H. F. Reynolds.

Marlboro, Mass.—Marlboro Electric Company, H. E. Ryder.

Marquette, Mich.—Light & Power Company, C. Retallec.

Memphis, Tenn.—Memphis Consolidated Gas & Electric Company, F. G. Proutt.

Michigan City, Ind.—Lake Cities Electric Railway Company, A. A. Boyd, W. E. Wright.

Milwaukee, Wis.—N. W. Electrical Association, T. R. Mercein.

Mobile, Ala.—Mobile Light & Railroad Company, J. H. Wilson.

Moline, Ill.—Peoples' Power Company, F. W. Reimers.

Monmouth, Ill.—Edison Illuminating Company, R. Ferris.

Montpelier, O.—Municipal Plant, L. H. Gilbert.

Montreal, Can.—Lachine Rapids Hydraulic & Land Company, Limited, W. W. Walbank.

New Albany, Ind.—United Gas & Electric Company, R. W. Waite.

New Orleans, La.—New Orleans C. R. R. Light & Power Company; New Orleans Railway Company, L. H. Scherck.

New York City.—New York Edison Company, A. Williams.

New York, N. Y.—Dept. Water Supply, Gas & Electricity, F. E. Brown.

New York City.—The United Electric Light & Power Company, N. F. Brady.

Newark, N. J.—Public Service Company, J. J. Taffney.

Newark, N. J.—United Electric Corporation of New Jersey, A. H. Lynch.

Newton, Mass.—Newton & Watertown Gas Light Company, W. E. Holmes.

Niagara Falls, N. Y.—Niagara Falls Electric Light & Power Company, J. E. Montague.

Oak Park, Ill.—Cicero Light, Heat & Power Company, H. Almert.

Omaha, Neb.—New Omaha T. H. Company, K. A. McLaughlin.

Oneida, N. Y.—Madison County Gas & Electric Company, C. W. Koiner.

Pawtucket, R. I.—Pawtucket Electric Company, O. Smith, Jr., J. A. Welch.

Peoria, Ill.—Peoria Gas & Electric Company, R. S. Wallace.

Peru, Ill.—Municipal Plant, T. Weberling.

Philadelphia, Pa.—Philadelphia Electric Company, A. J. De Camp.

Philadelphia, Pa.—The Brush Electric Light Company, A. H. Manwaring, J. T. Hutchings, A. V. R. Coe, H. R. Kern, P. H. Bartlett, H. K. Mohr.

Pittsfield, Mass.—Pittsfield Electric Company, W. R. Gardener.

Plainfield, N. J.—Plainfield Gas & Electric Light Company, W. A. McClurg.

Port Clinton, O.—Port Clinton Electric Light & Power Company, C. H. Bish.

Port Huron, Mich.—D. J. Stephenson.

Port Huron, Mich.—Port Huron Light & Power Company, J. A. Davidson.

Port Washington, Wis.—The Wisconsin Chair Company, C. D. Leek, E. R. Kittredge.

Portland, Ore.—O. R. G. Company, A. B. Frame.

Portsmouth, O.—The Portsmouth Street Railroad & Light Company, J. H. Lange.

Quebec, Can.—Quebec Jacques Cartier Electric Company, J. E. Tanguay, G. A. Montgomery.

Quincy, Ill.—The Independent Light & Power Company, G. E. Mead, J. W. Cassidy.

Red Oak, Ill.—Red Oak Electric Company.—D. F. McGee.

Red Wing, Minn.—Red Wing Gas & Electric Company, W. F. Putnam.

Rhinelander, Wis.—Rhinelander Lighting Company, C. S. Wixson.

Rochester, N. Y.—Rochester Gas & Electric Company, G. A. Redman.

Rockford, Ill.—Rockford Edison Company, M. A. Beal, M. Heliger.

Saginaw, Mich.—Bartlett Illuminating Company, A. G. Moser.

San Antonio, Tex.—San Antonio Gas & Electric Company, G. H. Cushman, H. H. Scott.

Sandusky, O.—The Sandusky Gas & Electric Company, A. C. Blinn.

Schenectady, N. Y.—Schenectady Railway Company, E. Peck.

Sioux City, Iowa.—Sioux City Gas & Electric Company, C. C. Gattland.

Somerville, Mass.—Somerville Electric Light Company, F. E. Smith.

South Bend, Ind.—F. A. Bryan.

Springfield, Mo.—Gas & Electric Company, P. A. Bertrand.

Springfield, Ill.—Springfield Electric Light & Power Company, A. V. Schroder, C. E. Hay.

St. Joseph, Mich.—Benton Harbor & St. Joe Electric Railway & Light Company, W. W. Bean.

St. Louis, Mo.—The Laclede Power Company, E. V. Matlack.

St. Paul, Minn.—St. Paul Gas Light Company, H. J. Gille.

St. Paul, Minn.—Edison Electric Light & Power Company of St. Paul, A. P. Lathrop.

Streator, Ill.—Streator Gas & Light Company, A. K. Stiles.

Syracuse, N. Y.—Fulton Light, Heat & Power Company, G. W. Pilloce.

Taylorville, Ill.—Taylorville Electric Company, J. N. C. Shumway.

Terre Haute, Ind.—Terre Haute Electric Company, C. Mordock.

Tolono, Ill.—Tolono Light & Power Plant, A. L. Van Meter.

Topeka, Kan.—Edison Electric Illuminating Company, C. R. Maunsell, J. P. Griswold, A. H. Purdy.

Utica, N. Y.—Utica Gas & Electric Company, M. J. Brayton.

Vicksburg, Mass.—Vicksburg Railway & Light Company, F. H. Brooks.

Wabash, Ind.—The Wabash Electric Light Company, T. W. McNamee.

Warsaw, Ill.—Warsaw Electric Plant, E. B. Hillman.

Washington, D. C.—Potomac Electric Power Company, E. S. Barlow, H. W. Fuller.

Waterloo, Iowa.—Waterloo and Cedar Falls Gas & Electric Company, Austin Burt.

Watertown, Wis.—Watertown Electric Company, P. L. Utley.

Waupaca, Ill.—Waupaca Electric Light & Railway Company, J. P. Lord.

Wausau, Wis.—Wausau Electric Company, W. F. Collins.

Waxahachie, Tex.—Waxahachie Electric Light Company, J. F. Strickland.

West Chester, Pa.—Edison Electric Illuminating Company, J. E. Pyle.

Winona, Minn.—Winona Railway & Light Company, S. B. Livermore.

Woburn, Mass.—Woburn Light, Heat & Power Company, J. W. Cowles.

Worcester, Mass.—Worcester Electric Light Company, H. H. Fairbanks.

York, Pa.—Edison Electric Light Company, J. F. Dinsman.

Youngstown, O.—The Youngstown Consolidated Gas & Electric Company, S. C. Rogers.

CONVENTION NOTES.

PREST. C. L. EDGAR.

Mr. Charles L. Edgar, the new president of the National Electric Light Association, while still a young man, is one of the oldest and most experienced central station managers in the country. He was born near Princeton, N. J., in 1860, and graduated in 1882 from Rutgers College, where he afterwards took a post-graduate course in electricity. He received the degree of A. M. in 1885 and of E. E. in 1887. Shortly after leaving college he joined the Edison ranks, and by sheer merit soon became chief engineer of the old parent Edison company. He was then put in charge of the young system of the Edison Electric Illuminating Company of Boston, of whose remarkable growth a most interesting illustrated account was given in Electrical World and Engineer last year by Mr. E. W. Mansfield. The company to-day, under Mr. Edgar's able and vigorous presidency, is doing a business of over $3,000,000 a year, and it is now building another new station of 60,000-kw capacity in turbo-generators of the Curtis type. Meantime, under the Edgar regimé, the Boston Edison Company has acquired the big Brush system of Boston, and now it has also gathered under its wing a whole network of environing suburban electric light and power companies. The Boston development is one of the most interesting chapters in the earlier history of electric current generation and distribution in America.

Mr. Edison has long been an active member of the American Institute of Electrical Engineers and is now chairman of the successful Boston chapter. He has thrice been president of the Association of Edison Illuminating Companies, and is now president of the Massachusetts Electric Lighting Association. As far back as 1890 he was a vice-president of the National Electric Light Association, being in fact one of the very first men who had the foresight and fellowship that closed up the ugly gap between the arc lighting and incandescent lighting interests among local companies. Mr. Edgar is, indeed, a man who can work easily with others as leader or comrade, and many instances could be cited of his endeavors in taking up and pushing to success innovations in the art. He is also a charming companion with social instincts as strongly marked as his technical ability, and is a member not only of the University and Lawyers' Clubs of New York, but of the University, Art and Exchange Clubs, of Boston. He has a wife and one son of 15. The Association is to be congratulated on the willingness of such men to serve it.

The Photographic Group taken as usual cannot be said to be a great success as a comprehensive picture of those present. Possibly 200 to 250 were persuaded to go from the hotel down to the Art Institute, on whose steps it was taken. But as over 900 people attended the convention, it will be seen that the vast majority were "not in the picture."

The Convention Hall, known as the banquet room of the Auditorium, was in some respects well fitted for the purpose, but it was so remarkably crowded all the time, many delegates could not stand the heat. As for ventilation there was none. But after awhile some fan motors were introduced and conditions became bearable. The number of those in session each day was, if anything, a larger percentage of those present than at Cincinnati last year.

Visiting Fisk Street Station.—On Wednesday afternoon following the Robb paper on steam turbines, some 300 members went en masse to the new Fisk Street station of the Chicago Edison and Commonwealth Companies, headed by President Insull and Vice-President Ferguson, where, as already noted in these pages, bold engineering work of a sensational character is being done in the equipment of the largest steam turbine generating plant in the world. The party took trolley cars to the Van Buren Street bridge on the south branch of the Chicago River, and there boarded craft which carried them down the river to the imposing and handsome station now nearing completion and already a conspicuous landmark. On arrival the party broke up into squads of twenty each under a guide and every corner of the works was inspected. A group photograph was taken, and on the return trip a portion of the party was taken out to the lake and then landed at the Chicago Yacht Club. The Commonwealth Company owns and keeps in commission an electric launch for regular river service between the city offices, the Harrison Street station and Fisk Street station, and this was also availed of by many visitors during the morning hours of the week.

Mr. C. O. Baker, Jr., who always takes his duties as master of transportation very seriously, was greatly gratified at being able to put his special New York Central and Michigan Central train into Chicago more than an hour ahead of time. He and the party received many congratulations of the speedy trip and on the general excellence and comfort of the service. Mr. Baker is rather inclined to the belief that in these days of big overgrown conventions, the time for "specials" where everybody knows everybody, and it is all one jolly party, has gone by; but he may be persuaded to get up for the old-timers at least a car to St. Louis next year. It was there some years ago that in recognition of valuable services already renedred, the members of the Association presented Mr. Baker with a handsome loving cup.

Mr. Ernest H. Davis, second vice-president, in the unfortunate absence of Mr. J. B. Cahoon, from sickness, made an excellent secretary, and Mr. Cahoon's resignation being received, Mr. Davis was elected as honorary secretary and treasurer for the ensuing year. It is needless to say that the work of Miss Harriet Billings, the assistant secretary, was efficiency itself. Miss Douglas also rendered valuable help, as well as Mr. Freeman, from the forces of the Chicago Edison Company. Supplying over 800 people with documents and information and getting them registered, is no mean feat, when added to the work of a busy convention sitting twice daily.

The Question Box instituted last year by President Doherty was an even greater success this year. Mr. H. T. Hartman, who had been appointed editor, made a great success of his labor of love, and turned out a separate pamphlet in excellent style, embracing just 200 pages, with a careful index. All the matter was carefully and intelligently edited, and the bulk of it is very interesting data from men well posted on the details of the industry. Bulky as it is, the pamphlet does not include all the material offered, as some of the best stuff came in at too late a moment to be included.

Ladies at the Convention this year were strangely few and far between, from out of town, but the hospitality extended was none the less cordial and generous. There were tally-ho rides, receptions, theatre parties and other amusements to wile away the week, and occupy the hours when husband, brothers and other relatives were discussing Ohm's law in all its practical aspects and bearings. The Pompeian Court in the Annex became the general gathering place in the evening, where many ladies could be seen in handsome costumes.

New York Electrical Society.

The New York Electrical Society will hold its annual meeting for the election of officers at the Café Boulevard, Tenth Street and Second Avenue, New York, Wednesday, June 10, at 9 P. M. At 7 o'clock a dinner will be served for the members and their friends.

A special meeting of the Society was held on the evening of June 1 for the consideration and discussion of the amendments to the Constitution and By-Laws reported by the executive committee to the 234th meeting of the Society April 29. The meeting resolved that the amendments of the Executive Committee be adopted, with the exception of two clauses, bearing respectively on the eligibility of the president for a second immediate term, and the method of electing the officers of the society. In lieu of the first of these clauses, a motion was adopted that no officer except the secretary and the treasurer should be eligible for immediate re-election. As a substitute for the second clause it was resolved that the election of officers should be by ballot, and the method to be adopted should be substantially that now used by the American Institute of Electrical Engineers.

The attendance at the meeting could hardly be considered as representative, being only 15 out of a membership of over 600. A portion of the membership is strongly in favor of leaving the nomination of officers in the hands of a nominating committee.

Canadian Electrical Association.

The Canadian Electrical Association will hold its thirteenth annual convention at the King Edward Hotel, Toronto, June 10, 11 and 12. Papers will be read as follows:

Wednesday, June 10.—"Long-Distance Transmission," by Mr. Paul Lincoln, Pittsburg, Pa. Question Box.

Thursday, June 11 (10 A. M.).—"Individual Electric Drive and its Relation to the New Shop Methods," by Mr. R. T. Lozier, Cincinnati, Ohio; "Some Points Relating to Submarine Power Cables," by Mr. G. U. G. Holman, Quebec. 2 P. M.—"Single-Phase Alternating Motors as a Means of Increasing Station Earnings," by Mr. W. A. Layman, St. Louis, Mo.; "Transformers for High-Voltage Transmission Lines," by Mr. J. W. Farley. Question Box.

On Friday, June 12, the election of officers will be held.

Social Features.—Wednesday, June 10, 4 P. M., tally-ho drive to points of interest in the city by courtesy of Canadian General Electric Company; 8 P. M., excursion by special steamer and band concert at Toronto Island. Thursday, June 11, 4 P. M., visit by special cars to the works of the Canada Foundry Company, by courtesy of the company; 9 P. M., annual Association dinner, King Edward Hotel.

Cheap Food at Last.

The *London Lancet*, a medical publication, announce recently that some day the world's food supply may be furnished by electricity. By passing a current through soda water or water impregnated with carbonic acid gas, a series of products is formed culminating in sugars. But the food-value is dependent on the building up of proteid in the same way; and there lies the doubt. "Carbonic acid gas and water are abundant enough through the whole world," says the *Lancet*, "and to convert these simple substances into complex foodstuffs, for the supply of which we have to look to far countries, by simply manipulating them with the electric current, surely promises to bring about one of the greatest revolutions in the history of the world." We don't see any trouble at all about the "simple manipulation." All that is necessary is to do it.

CURRENT NEWS AND NOTES.

CABLE TO MANILA.—A cable dispatch from Manila of June 2 says: "The British cable steamer *Anglia*, engaged in laying the Commercial Pacific cable, arrived at Guam at midnight. She had good weather throughout and her trip from this port was entirely successful. It is expected that the Guam end of the cable will be spliced to-day, completing connection between Manila and Guam."

PHILADELPHIA MEETING A. I. E. E.—The last meeting for the season of the Philadelphia branch of the American Institute of Electrical Engineers will be held on Monday evening, June 8, at 8 o'clock, at Drexel Institute, Thirty-second and Chestnut Streets. Mr. Joseph Menchen, of New York, designer of electrical theatrical effects, will show how electricity is made use of on the stage, and will illustrate with actual apparatus and scenery, how such effects as waterfalls, sand storms, moving clouds, water ripples, rainbows, etc., etc., are produced upon the stage. Mr. W. L. Hodges expects to show experimentally the speaking arc. There will be an informal dinner at Boothby's, Chestnut Street, below Thirteenth, which all members are invited to attend.

INSTITUTE NIAGARA MEETING.—To judge from the interest that is being shown and the work being done at Chicago, the July meeting of the A. I. E. E. at Niagara Falls will be the most successful one in the history of the body. It it safe to say that Chicago and the middle west will be well represented, and will send not only a large delegation, but also the newly-elected president of the Institute, Bion J. Arnold. A most energetic campaign is to be made by a committee appointed by the local secretary, P. Junkersfeld. This consists of Homer E. Niesz, chairman; Trueman B. Gaylord and V. R. Lansingh. These gentlemen will also have charge of the transportation.

TESLA'S WORK.—The *New York Sun* has the following editorial note: "It is now a little more than two years since the *Sun* gave to the world Mr. Tesla's announcement that, some time within the eight months following, he would send a wireless telegram across the Atlantic Ocean. With the failure of that prediction the public is familiar, although not with the immediate cause. As we understand it, progress toward fulfilment revealed possibilities so much greater that it was determined to aim at a higher mark, and we are now authorized to say in Mr. Tesla's behalf that some time within the present year he will send wireless telegrams to the other side of the world. The Tesla oscillator is to deliver to the earth the shock that will be felt and recorded on its uttermost confines. As before, we have to wait and see, doubtful because of the miraculous character of the task, but hopeful on the strength of the wonders that science has already done."

WIRELESS TELEGRAPHY ON THE LAKES.—Special telegrams from Chicago state that the wireless stations at Chicago and Milwaukee exchanged their first dispatches on June 1. Mayors Harrison and Rose complimented each other, and several other persons exchanged greetings. At the Chicago station only four persons were present. They were Henry W. Beauclerc, Chicago representative of the Marconi Company; W. W. Bradfield, Marconi's chief assistant; H. J. Round, another of Marconi's engineering staff, and H. J. Moffitt. In Milwaukee the party which attended the opening consisted of Mayor Rose, F. G. Bigelow, president of the First National Bank of Milwaukee; John I. Beggs, president of the Milwaukee Electric Railway & Light Company; E. C. Lewis, of New York City, a director of the Marconi Company, and C. H. Taylor, who is in charge of the Milwaukee station. The two stations on Lake Michigan have been erected by the Marconi Company and will be used for the transmission of ordinary paid messages. Negotiations are now on with a board of trade concern for the transmission of market and stock quotations. A station will be built at South Haven within a short time, and the system will be gradually expanded until every port on the great lakes has a station. This is the plan of the Marconi Company. It is also intended to instal Marconi instruments on some of the larger lake vessels.

PREVENTION OF HUNTING.—A patent was granted on May 12 to Mr. Hermann F. T. Erben, of Schenectady, N. Y., for means to prevent hunting of synchronous alternating current machinery. This means consists in the use of conductors looped or short-circuited about the pole tips, together with bridging conductors extending between short-circuited conductors about adjacent pole tips. In case of hunting, the flux through the pole corners varies periodically, and this variation is strongly opposed by the currents induced in the above system of conductors. This reaction imposes a strong restraint upon any tendency to hunt which the machine may have, in a manner similar to the action of previous devices, designed for the same purpose.

POSTAL TELEGRAPH PENSIONS.—The Postal Telegraph Cable Company announces in a circular distributed broadcast over its system that it will pension all employees who have become incapacitated after having served the company continuously for fifteen years. After fifteen years such operator may draw 20 per cent. of his salary when he leaves the service. Every year thereafter an additional 3 per cent. is added to this until the beneficiary receives half of the salary he received when at his best. The pension plan becomes operative at once. It was the earnest desire of John W. Mackay, late president of the Postal Company, that some provisions be made for the benefit of faithful employees who had grown old in the service and whose usefulness had been impaired by age or misfortune.

SYNCHRONIZING APPARATUS FOR ALTERNATORS.—A patent was granted on May 12 to Mr. Fred T. Dow for a simple arrangement for connecting alternators in parallel. There is one common synchronizing circuit for all the machines of the station, which contains any desirable phase indicator, such as an incandescent lamp or a voltmeter, or both. This synchronizing circuit is normally closed, but the e.m.f. of any pair of alternators in the station may be impressed upon it. For this purpose each alternator is connected with the primary of a step-down transformer, and the secondary of each transformer may be inserted into the synchronizing circuit by simply putting a plug into a socket. When several machines are operating and another one is to be connected in parallel with them, the secondaries of one of the former and of the new machine are inserted in series into the phase-indicator circuit, and when the lamps indicate maximum potential and the voltmeter needle attains a condition of minimum vibration, the new machine is connected to the distributing circuit.

POWER FACTOR METER.—A patent was granted on May 26 to Mr. Otto Holz for various forms of a power factor meter for use in polyphase circuits, all forms being based on the principle that in an equally loaded polyphase system the ratio of the readings of two wattmeters, connected with different phases, is a function of the power factor. In each type of instrument, there is a fixed and a movable member, the latter being acted upon by two opposing torques, which represent the two wattmeter readings mentioned. The movable coil assumes a position in which the two torques balance each other and this position thus becomes a function of the power factor. The first type described contains two fixed current windings and two voltage windings, which are mounted on one movable shaft. Each current coil and its corresponding voltage coil constitute a wattmeter and the connections are so made that one potential coil tends to turn in a direction opposite from the other. In a three-phase system, for instance, the two current coils may be inserted in fuse 1 and 3 and the two voltage coils are connected between phase 1 and 2, and between phase 2 and 3 respectively. This type of instrument may be simplified by using only one fixed current coil and two movable voltage coils, or by using two fixed current coils and a single movable potential coil. Other types of this instrument operate by electrostatic instead of electrodynamic action, although the fundamental principle is the same.

WIRELESS TELEGRAPHY.—A patent was granted on May 26 to Mr. James Foster King on a form of receiving apparatus for wireless telegraphy which differs in several details from previous forms. While in ordinary practice the receiver-relay is operated in the receiving circuit direct, in the present case it is actuated from a secondary or induced circuit. The coherer is a glass-sealed tube in which are carried two silver plates with flat upper surfaces, separated longitudinally by insulation; of these plates the one is earthed and the other connected with the vertical wire. On these plates are placed the coherer particles which have a magnetic core of iron, surrounded by a very thin, well conducting, but non-magnetic and non oxidizable covering of platinum; the purpose is to prevent the destructive action of sparks and to produce a better contact between the particles, so that more current flows through the coherer than would otherwise be the case. Oxidation of the particles is further prevented by exhausting the air from the tube. The top of the coherer tube is secured to a magnet pole piece connected to the iron core of an induction coil. The primary of this induction coil is connected in series with the coherer plates, the coherer battery, a choking coil and a part of the aerial circuit. The secondary of the induction coil contains the receiving relay. When a wave arrives the particles cohere and the battery sends a current through the primary of the induction coil. This has a double effect: it induces a current in the secondary connected to the relay and at the same time energizes the magnet pole piece, which raises the coherer particles from the plates and causes them to decohere.

ELECTROLYTIC ARC LIGHT.—A patent was granted on May 19 to Mr. William J. Dean, of Chicago, assignor to the General Electric Company, for an electric arc lamp in which the principle of the Nernst lamp is employed in so far as the final arc is formed between two cores of some refractory oxide, such as zirconium or magnesium, which have a high resistance when cold, but become conductors when heated to incandescence, and remains incandescent with little loss of material. The difficulty of such an electrolytic arc lamp lies, of course, in the starting of the arc and the method of overcoming this difficulty is the essential point of Mr. Dean's invention. Both electrodes are in tubular form, with an inner core of the refractory electrolytic conductor, and an outer shell of carbon. The two electrodes are placed vertically one above the other, and the electrolytic core of the upper electrode is loose in its carbon shell. When no current is flowing, the end of the upper electrode rests upon the lower one, the two cores and the two shells being in contact. On closing the circuit, current passes through the two carbon shells, and by an electromagnetic clutch device the upper shell is raised and strikes an arc between it and the lower shell. This arc heats the two electrolytic cores until their resistance becomes less than that of the carbons; the current then passes mainly through the inner cores and, by the action of the increased current upon the electromagnetic clutch mechanism, the upper shell is further raised. In rising, it strikes a nose provided at the upper end of the core and thus takes this core upwards. The arc is then found between the two electrolytic cores.

POWER FACTOR REGULATOR.—A patent granted May 5 to T. J. Johnston describes a means whereby an alternating-current circuit may be automatically and continuously compensated for varying differences of phase between the e.m.f. and current flowing, due to inductive devices in the circuit. Advantage is taken of the property of the synchronous motor whereby through change of field excitation it may be caused to give either a leading or lagging current. On the shaft of a synchronous motor is mounted the armature of the motor exciter, this armature being connected by a pair of slip rings and brushes to the secondary of a transformer, the primary of which is in series with one leg of the circuit to be compensated. The field current for the synchronous motor is taken from a commutator on the exciter armature, there being a regulating rheostat in the field circuit. The polar points of the exciter armature should be so disposed that the maximum magnetization due to the wave of the main alternating current will be of opposite sign to the magnetization of the field poles and somewhat ahead of that due to the rotation of the armature across the poles. Under this condition if the current in the main circuit leads the e.m.f. the resultant magnetization due to the alternating current and the exciter field will be cut down, and the current in the field of the synchronous motor will diminish, lowering its magnetization. The synchronous motor thus becomes under-excited and furnishes an inductive reactance to the system which neutralizes the leading current. On the other hand, if the current lags the resultant magnetization of the exciter armature is such, inasmuch as the magnetic maxima due to the alternating current and to the exciter field come more in line, as to increase the potential and current of the exciter, thus raising the effective field magnetization of the motor and furnishing a capacity reactance which neutralizes the lagging current.

LETTERS TO THE EDITORS.

The Use of Differentially Wound Telephone Receiver in Electrical Measurements.

To the Editors of Electrical World and Engineer:

SIRS:—After I had forwarded you an article on the use of differential telephone receiver in electrical measurements, I found that the additional resistances, *r r*, in Fig. 1 for the comparison of capacities were superfluous. The necessary and sufficient condition is that the capacity reactances of the capacities to be compared are very large with respect to the resistance and the inductance of the receiver coils and *R*.

TOKYO, JAPAN. H. HO.

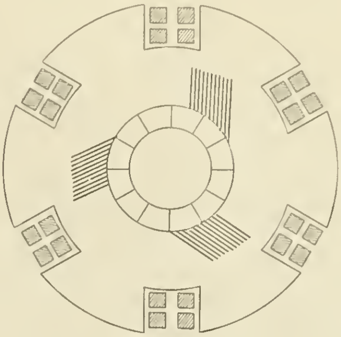
[The article by Prof. Ho appeared in our issue of May 23.—EDS.]

Commutation of Alternators.

To the Editors of Electrical World and Engineer:

SIRS:—I believe it would interest your readers to know that the commutation of alternators of my design, in which I make use of the ordinary winding of the continuous-current armatures is as good with few bars on the commutator as with many. With a drum winding consisting of twelve coils divided into six slots per complete magnetic circuit (accompanying sketch), the commutation is perfect. The damping of harmonics is produced automatically not only by the short-circuiting of the rotor through the exciting circuit, as before indicated by myself in these columns (April 5, 1902, p. 606), but also by the short-circuiting of the rotor coils through the brushes.

These two ways of damping of harmonics which I have personally discovered are more than sufficient to suppress every harmonic and to give a perfect commutation. Instead of placing the coils in one slot only it is possible to put them in several slots per pole, as proposed by Mr. Fischer-Hinnen for continuous-current dynamos.



COMMUTATION OF ALTERNATORS.

PARIS, FRANCE. M. LATOUR.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Non-Synchronous Alternating-Current Generators.—FEIDMANN.—An abstract of a paper read before the Cologne Electrical Society on non-synchronous alternating-current generators. After some general notes on the reversibility of induction motors for the purpose of using them as generators, he discussed the prospects of the new compensated Heyland machines in practice. They may be connected in parallel in the same simple way as direct-current dynamos, without regard for synchronism; if the non-synchronous dynamo is running too slowly when connected in parallel with another, it simply takes current as a motor; if it is running too quickly, it gives off to the network the power corresponding to its speed. Another similarity with direct-current, shunt dynamos is that they give more or less power according to their higher or lower speed. But this is the case only within certain speed limits; this fact gives new points of view for the construction of the steam engine regulators. Another new property is the possibility of using these machines in series. If, besides the shunt excitation, the main current is also led into the Heyland commutator, the machine may be absolutely compounded. Such compound generators have been bulit for trial by Brown, Boveri & Co. (100 hp), and some smaller ones by Schuckert, Lahmeyer, Siemens & Halske, and the General Electric Company, of Berlin. They may also be used instead of the synchronous machine required in the central station to set the step. The operation of such a station would be relatively simple, especially if the larger motors connected to the network were compensated for unity power factor, so that they take no wattless currents from the line. Of course, prophecy does not prove anything, but it seems as though this new type of dynamo may soon be of considerable importance in practice.—*Elek. Zeit.*, May 14.

Three-Phase Generator with Small Voltage Drop.—KEHSE.—A communication referring to a recent description by Heyland of a three-phase generator with small voltage drop, which in this case was due to high saturation of the pole cores. In order to reduce the voltage drop of a machine, it is necessary to have the counter-ampere windings and the stray field e.m.f. small; this can of course be done by designing machines of large dimensions, but they are expensive. Another method is the use of highly saturated teeth and the use of several (three to five) slots per pole and phase. He thinks the saturations of 20,000 to 24,000, as used in direct-current machines, may also be applied to alternators. While the loss per unit of volume is larger, the heat may be easily removed by air canals. The heat in the teeth is due to rotating hysteresis; as found by recent investigation, the losses at an induction of 20,000 are not much greater than at 16,000. He gives a numerical example showing the calculation of the losses.—*Elek. Zeit.*, May 7.

REFERENCES.

Compensated Alternators.—BRAGSTAD.—The first part of an article illustrated by diagrams, being a contribution to the theory of polyphase commutator motors with shunt excitation. The theories which so far have been published on such machines can be considered only as a first approximation, because the influence of stray fields, of ohmic losses and of the slip, are neglected. The author takes these factors into account, but does not consider what happens in the commutator, and in the coils which are short-circuited by the brushes. He first investigated what takes place when a direct-current winding revolves in a rotating field and discusses the ratio of the e.m.f's and currents in the stator and the rotor.—*Elek. Zeit.*, May 14.

Alternators in Parallel.—GEORGES.—A communication on the surging of alternating-current machines connected in parallel. He replies at length to some recent critical remarks of Benischke.—*Elek. Zeit.*, May 14.

Output of Traction Motors.—BARBILLION.—A brief mathematical article, illustrated by diagrams, on a simple practical method for determining the characteristic curves of a traction motor at various loads, if its characteristic curves are given for one special case. A series motor with resistance inserted in the armature for speed regulation, is considered; the curves of the speed, output and traction effort as functions of the current are assumed to be given for no resistance in the armature. He describes methods for determining therefrom the corresponding curves of the speed and output, when resistances are inserted in the armature.—*L'Eclairage Elec.*, May 16.

Converters.—VERHOECKX.—A mathematical article illustrated by diagrams in which he gives a general analysis of the currents in the armature of converters or double-current generators.—*L'Eclairage Elec.*, May 16.

LIGHTS AND LIGHTING.

Electric Lighting of the Aldershot Camps.—An illustrated description of a very large private lighting installation, with steam turbines for power generation. There are three turbines, running at 2,000 to 2,200 r.p.m., and directly coupled to 250-kw, shunt-wound, direct-current generators giving current at 300 to 450 volts. Regulation is accomplished by means of an electric governor consisting of a solenoid and a plunger acting against the pull of a certain spring. Each turbine is also fitted with a centrifugal governor. There is also one 100-kw turbo-generator with two dynamos mounted in tandem on the shaft, which may be used as a steam balancer when desired. For boosting and balancing, four machines are mounted on one shaft, and comprise two compound-wound machines for balancing, capable of dealing with 100 amp. out of balance, and driving two generators, each capable of raising the pressure 100 volts when 250 amp. is passing through them. There is a battery of 230 cells with a capacity of 100 amp. for 10 hours and 21 regulating cells at each outer end. There are about 16,000 lamps of 8 cp employed in internal lighting and 100 hp for motors for various purposes.—Lond. *Elec.*, May 15.

Mercury Vapor Arc.—STARK.—An illustrated description of some experiments with the mercury vapor arc. If such an arc is passed through a vacuum tube which communicates with another vessel not in the direction of the discharge, then there is a higher vapor tension of the mercury vapor in the discharge tube than in the vessel with which the tube is connected; some of the mercury vapor is, therefore, driven into this vessel and can be observed there because it is still incandescent. He also made experiments on the behavior of these mercury vapor rays in a magnetic field.—*Phys. Zeit.*, May 1.

REFERENCE.

Electric Lighting of Railway Cars.—GOETZE.—Continuations of his illustrated article on the various systems used for the electric lighting of railway cars.—*Centralbl. f. Accum.*, April 1, 15, May 1.

POWER.

California Petroleum as a Fuel.—HUNT.—An illustrated article on California petroleum and its use as fuel. The low price of crude oil during the past two years has entirely changed the fuel situation on the Pacific coast. It has very materially reduced the cost of steam power and has made it possible in many locations and under certain conditions of load factor to compete with transmitted power from hydro-electric stations. While the transmission of power has its own field when it will always control the situation, it is a broad contention that given the conditions of load such as exist in San Francisco to-day in the best equipped central stations, and with oil at prices at which long-term contracts have been made, steam generated power can more than hold its own.—*Jour. of Elec.*, May. The same issue contains an article on petroleum from a chemist's standpoint by O'Neill, and a very long and profusely-illustrated article by Bates on the application of crude oil to gas engines.—*Jour. of Elec.*, May.

REFERENCES.

Electric Driving in the Machine Shops.—The first part of an article giving some notes on two recent papers read before the British Inst. Elec. Eng. One, by Shatwood, dealt with three examples of electric driving in small machine shops; the other, by Williamson, is a description of the driving arrangements at the works of Vickers Sons & Maxim. The notes so far given do not seem to contain anything new.—Lond. *Elec. Rev.*, May 15.

Water Power Development.—JUDGE.—The first parts of a serial on the legislative questions involved in water power developments.—*L'Eclairage Elec.*, May 2, 9, 16.

TRACTION.

Electrolytic Action of Stray Currents from Tramways.—A reprint of the rules proposed by a special committee of the German Association of Electrical Engineers concerning the protection of metallic pipes against earth currents from electric tramways. The conditions of danger and the zone of danger are defined. To diminish these earth currents the following rules are given. With tramways using the two-wire system—if there is not a regular reversion of polarity, at least once a day—the rails are to be connected with the negative pole. If the voltage drop in the connecting wire is above 2 volts, this wire must be insulated. The rail joints must be of such a nature that the resistance of the rails is increased by the joints by not more than 0.03 ohm per km for a single track; besides this, the two rails of a track are provided with a cross connection at every tenth joint. For a double track there is a cross connection of the two tracks at every twentieth joint. The feeding points of the rails should be placed at as great a distance from the pipes as possible. Under no circumstances should the rails be connected with the pipes. For diminishing the voltage drop in the rails, return cables and sucking dynamos (negative boosters) may be used. The junctions of the water and gas pipes should be made of insulating material.—*Elek. Zeit.*, May 14.

Trolley and Conduit Systems.—An abstract of the chief engineer's report to the London County Council on the relative costs and advantages of the overhead trolley system and the underground conduit system. Some statistical data and estimates are first given on the cost of both systems and their relative advantages are discussed. The difficulties of construction in the conduit system are enumerated. Concerning durability and maintenance, the comparison is in favor of the conduit system by reason of the greater weight and rigidity, and the substantial method of support of the conductor tees as compared with the flexible overhead wires. In summing up the total costs, the following figures are given for the conduit system: Conduit construction, rails, roadwork, etc., $70,205; power station, cables, sub-stations, cars, etc., $61,300; total, $131,505. For the trolley system: Rails, roadwork, overhead line, etc., $37,480; power station, etc., $61,300; total, $98,780, or 33 1/3 per cent. more for the conduit system than for the trolley system.—Lond. *Elec.*, May 15.

REFERENCE.

Surface-Contact System.—LOEWY.—The first part of an illustrated paper read before the Vienna Electrical Society on surface-contact systems for electric tramways and especially on the system of Hillischer.—*Zeit. f. Elek.*, May 17.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Protection Against Atmospheric Discharges.—A report of a special committee of the German Association of Electrical Engineers on the protection of electric high-tension installations against atmospheric discharges. The committee had sent out letters of inquiry to 1,000 stations in Germany and received replies from 170. A great variety of different systems of lightning arresters is used, but as with all of them there have been accidents, it seems that there is no absolutely sure protection against atmospheric discharges. The opinion is, however, expressed that for high-tension installations horn lightning arresters have given the best results, and for low-tension installations, those with magnetic and with "automatic" extinction of the spark were the best. With horn lightning arresters in free air, short-circuits may be caused by rain or snow, when the spark-gap is short; but there are no bad effects, as the arc produced is at once extinguished as though it was caused by an atmospheric discharge. Of course, there is a considerable voltage drop in the network; to avoid this the lightning arrester should be placed under a roof which is preferred to using a long spark-gap. The lightning arresters should be examined from time to time. The fact that atmospheric discharges occurred at times when there was no thunderstorm, is confirmed repeatedly. In some installations the earthing is done by connections to water pipes, but the committee thinks this is not advisable, because if there are simultaneous discharges on lightning arresters of different poles, then the line is short-circuited by means of the arcs through the water pipes. Some notes are given on the earthing of machines or transformers. Among the plants—in which there have been no disturbances—there was a greater percentage in which the frames of the machines were especially earthed, than of those in which they were specially insulated. Nevertheless it would be wrong to conclude that the earthing of the iron frame is a means of avoiding disturbances due to atmospheric discharges, because the action of the lightning arresters must be taken into account and because the number of those plants in which the frames are either specially earthed or specially insulated, is too small to draw safe conclusions.—*Elek. Zeit.*, May 7.

Use of Meters.—An abstract of the report of a committee, appointed by the Professional Syndicate of Electric Stations, on the use of meters in the systems of French central stations. The report gives a summary of the replies received to inquiries sent to the different central stations. For direct current, motor meters are universally used. The meters are tested at different intervals by the different stations, these intervals varying between one month and two years; in some stations they are tested only upon a complaint of a customer. The replies received concerning starting and exactness were rather uniform; they indicate that a meter starts at about one-fiftieth of its normal power and that the accuracy is about one-twentieth of this power. The use of the O. K. (O'Keenan) meter is less general than that of the Thomson meter; but the former seems to be considered to be more sensitive. Concerning alternating-current meters, less replies were received. The following types are in use: Batault, Blathy, Japy, and that of the Creil Co. The meters are said to register the wattless current at a power factor above 0.6 to 0.8; some are said to be exact for a power factor of 0.3. They are practically independent of the variations of e.m.f., and of the wave form. Nothing is said on the influence of the frequency.—*L'Ind. Elec.*, April 25.

REFERENCE.

Switchboards.—BENISCHKE.—An illustrated paper read before the Vienna Electrical Society on the design and installation of switchboards for high-tension plants.—*Zeit. f. Elek.*, May 15.

WIRES, WIRING AND CONDUITS.

Standardization of Conductors and Cables.—Sets of standardization rules for electric conductors and cables of various types, as proposed by a special committee of the German Association of Electrical Engineers. In the rules for copper conductors, the specific resistance of copper is defined as the resistance in ohms of 1 meter length and 1 sq. mm cross-section at 15° C. The conductivity is the reciprocal value of this resistance. Copper, the specific resistance of which is greater than 0.0175, or the conductivity of which is smaller than 57, should not be accepted for conductors. Copper of the conductivity 60 is to be considered as standard copper of 100 per cent. conductivity. The temperature coefficient per degree C. is assumed to be 0.4 per cent.—*Elek. Zeit.*, May 7.

ELECTRO-PHYSICS AND MAGNETISM.

Dynamics of the Electric Field.—J. J. THOMSON.—A paper in which he investigates some of the consequences of the distribution of mechanical momentum in the electromagnetic field, occasioned by the presence of electric displacement and magnetic induction. He arrives at the view that the lines of electric force carry along with them a portion of the ether through which they pass, the mass of the ether entangled with the tubes being per unit volume proportional to the electrostatic energy of the field in that unit volume. The entangled ether can slide along the line of force, but cannot cross it. This may form the basis for explaining mechanical momentum on electric principles. The lines of force starting from the electrons contained in all matter, grip a certain amount of ether, and the "mass" of the body is really the mass of the ether thus gripped by its electrons. The potential energy of the field is, on this view, the kinetic energy of the turbulently moving ether imprisoned by the lines of force.—*Proc. Cambr. Phil. Soc.*, 12, pt. 2; abstracted in Lond. *Elec.*, May 15.

REFERENCES.

Changing Alternating Current into Two Unidirectional Currents.—BENISCHKE.—An account of some experiments in which he tried to decompose an alternating current into two unidirectional currents by means of a magnetic field, with the aid of an arc between two carbons, one carbon being divided into two halves insulated from each other by mica and each connected to a separate circuit. The experiment is similar to that of Morse and Cushman (ELECTRICAL WORLD AND ENGINEER, Vol. XL, p. 85). The author points out that there are no prospects of applying this experiment to practical use.—*Phys. Zeit.*, May 1.

Electrodynamics.—SCHWARZSCHILD.—A mathematical note in which he shows that the Lorentz-Wiechert theory of electrodynamics may be easily brought into intimate relation to Hamilton's principle.—*Phys. Zeit.*, May 1.

Electrons.—PLATNER.—A theoretical article on the nature of electrons. He considers the electronic hypothesis as suitable for explaining the transmission of electricity, optical phenomena and Faraday's law for electrolytic action, if the electron is considered to be a curl in the ether and not an elementary mass particle.—*Elektrochem. Zeit.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Hoepfner Process for the Electrolytic Production of Zinc.—GUENTHER.—A long illustrated article on the Hoepfner zinc process, which was in use in Fuhrfort, Germany, from 1895 to 1897; its discontinuance in 1898 was not due to technical failure, but mainly to personal differences. The raw material was cinder from zinciferous pyrite, mined in Westphalia, the zinc tenor of this cinder varying from 10 to 16 per cent. The preparatory treatment consisted in grinding the cinder, mixing it with common salt, and roasting. The charge was then leached with water or dilute liquor from a subsequent stage. The sodium sulphate was crystallized out by cooling, after which iron and manganese were precipitated by bleaching powder and marble dust and finally the electronegative metals by means of zinc dust. A clear solution of the chlorides of zinc and sodium thus obtained are ready for electrolysis. The anode and cathode compartments were separated by a diaphragm of nitrated cloth. Hard artificial carbons were used as anodes, while the cathodes consisted of discs of zinc or iron, arranged vertically on the horizontal shaft, so as to revolve between a pair of adjacent anode cells; during the electrolysis acid was added; a good deposit could not be obtained from neutral or alkaline solutions. The vats were connected in series and a current density of 100 amp. per sq. meter used; the terminal voltage of the bath was 3.3 to 3.6; in regular operation zinc would deposit on the cathodes in dense form, silver white in color, and the current efficiency was 97 per cent. or more. The chlorine gas liberated by electrolysis was used for making bleaching powder. He gives an estimate of the cost of a plant and operation for producing 650 metric tons of spelter per year and the corresponding quantity of bleaching powder, and reaches the conclusion that the profit in the whole process will be $13,500, as the return on an investment of $162,500 in plant.—*Eng. & Min. Jour.*, May 16.

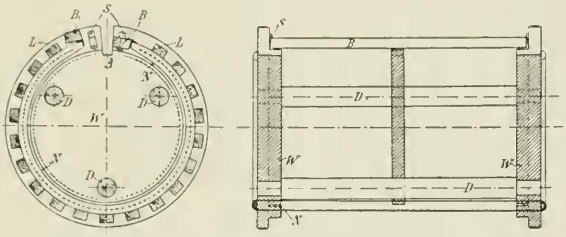
Preparation of the Active Mass for Lead Storage Batteries.—LEIMER.—The conclusion of his article, the first parts of which were noticed in the Digest. The results obtained with the various preparations of the active mass, are given. He divides the various materials used to make the mass more coherent and durable, into two classes: First, those which of themselves are of a pasting nature, like glue; second, those which produce greater adherence by chemical action. To the first group belong cobbler's wax, amber, collodium, gelatine, sugar, etc., which materials give to the lead oxide a strong mechanical firmness and a high electric resistance of greatly varying value. The principle underlying the second class is that a mixture of lead oxides with a chemical substance which changes them mostly into basic lead compounds, which produce a very firm mechanical binding material, whose resistance is relatively very low, and whose durability is also great. To this class belong sulphuric acid, many organic substances, organic and inorganic salts and bases, if free from chlorine. There are some in which the positive active mass is formed with 160 ampere-hours per kg, while the change of minium into peroxide theoretically requires 147; it is possible with a low watt load to get up to 105 amp-hours per kg of positive action mass from the plates; but this was possible only with the best materials of the above second class. In conclusion he mentions the following method of making an active mass: Bring the lead oxides after mixing with pure water and after having been pasted into the frames of grids, into an air-tight closed drying oven, through which the materials which should give greater coherence and durability, were passed in vaporized form; since 1898 batteries, made by this method, have been in continuous operation for benzine automobiles, and have proven very successful. The same method may be successfully used for hardening old plates which have become soft.—*Centralbl. f. Accum.*, March 15.

Siloxicon.—FITZGERALD.—An article on this new compound which was recently patented by Acheson. It is composed of silicon, carbon and oxygen, and promises well as a refractory material in furnaces. It seems to be a new material and to contain various oxygen compounds of carbon and silicon, is of a gray-green color, has a density of about 2.75, is inoxidizable, infusible, neutral, insoluble in molten metals and unaffected by any acid except hydrofluoric. The furnace for making it is briefly described. Many experiments have been tried on siloxicon as a refractory material for lining furnaces, crucible manufacture, etc., and as far as these experiments have gone, the substance promises to be a valuable addition to the industrial arts.—*Eng. & Min. Jour.*, May 16.

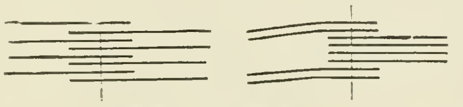
Formation of Insoluble Compounds.—Isenburg.—A long account of experiments on the formation of insoluble (or difficultly soluble) compounds, especially white lead, by electrolysis with soluble anodes, by the method of Luckow. The principle of this method is to use a mixture of two electrolytes with an anode of the required metal, one electrolyte having as anion the required acid radicle, the other being another indifferent salt, the acid radicle of which forms with the anode an easily soluble compound. An example of this method is the formation of lead chromate by using lead as anode and a mixture of potassium chromate and potassium chlorate as electrolyte, when the concentration of the chromate ions is small compared with the concentration of the chlorate ions, the formation of lead chromate goes on easily and the anode remains bright; the latter is explained by the assumption that the formation of lead chromate occurs at some distance from the electrode, namely at the points where the layer of lead chlorate is in contact with the potassium chromate; the lead chromate thus formed cannot adhere at the anode which, therefore, remains bright. The author has studied the analogous process for making white lead and found that in this case also the current efficiency is higher and the lead anode remains in better condition, the greater the amount of the radium chlorate compared with that of the carbonate. The current density was 0.5 amp. per sq. decimeter.—*Zeit. f. Elektrochemie*, April 9.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing the Magnetic Properties of Sheet Iron.—Richter.—An illustrated description of a method developed by the Siemens & Halske Co., of Vienna, in which, as already noticed in the Digest, the iron sheets are tested as a whole and therefore no samples need be cut from them. In the latest form the apparatus is in the shape of a drum in order to enable one to readily place the sheets in the apparatus, and to get as good a distribution of the flux as possible. The arrangement is shown in Fig. 1 and Fig. 2. The sheets are bent so as to form cylinders and are surrounded along nearly the whole circumference by the magnetizing windings. The drum form has the other advantage that the apparatus may be easily rolled from one place to another in the testing room. Fig. 1 is a cross-section and Fig. 2 a longitudinal section of the apparatus. In the side walls, *W*, which are held together firmly by the rods, *D*, the slots, *N*, are provided, into which the sheets are placed. They are introduced at the point, *A*. The magnetizing wires consist of bare copper wire stretched between the side walls, *W*. The wooden rods, *L*, are intended to protect the wires against injury. At the center of the magnetizing windings there is a terminal which enables one to connect the two halves of the winding either in series or in parallel. The dimensions of the sheets tested at the same time should not differ by more than a few per cent.; but he remarks that this is no disadvantage, as it is now proposed by the German Association of Electrical Engineers to have only two standard sizes of sheets; for each standard size there will be required a special testing apparatus. An important matter is how the end contacts of the several sheets are made; the best method which should be used in scientific investigations is illustrated in Fig. 3, while Fig. 4 shows an arrangement which is recommended in practice, and which is said to be nearly as good as the other one. For exact tests only two corrections must be made, the one due to the e.m.f. corresponding to the flux in the iron, the other for the measured watts from which the copper losses are to be subtracted. He remarks, however, that all known methods for determining the loss in dynamo iron sheets are not very exact. The wattmeter method, except in especially equipped laboratories, must be used with the greatest care in order to avoid errors of 4 per cent. For instance, it is impossible to get the exact specific gravity of every sample, which is necessary for the calculation of the iron cross section from the weight; an average value must be chosen. For this reason not too great an accuracy should be required from the tests of the losses.—*Elec. Zeit.*, May 7.

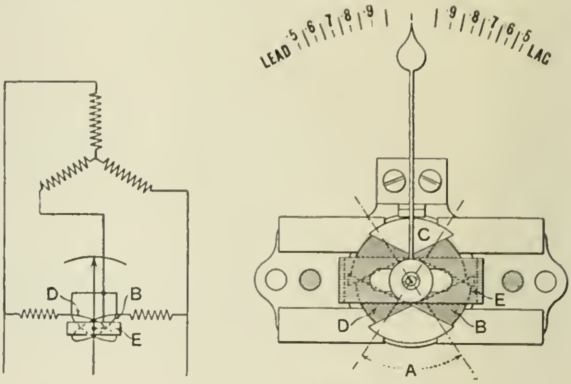


FIGS. 1 AND 2.—SECTIONAL VIEWS OF APPARATUS.



FIGS. 3 AND 4.—ARRANGEMENT OF SHEETS.

Power Factor Indicator.—An illustrated description of a direct reading power factor indicator, the design of which is based on the known fact that when two wattmeters, suitably connected, are employed to measure the power on a balanced three-phase system, the ratio of their readings varies with the power factor of the system. The arrangement is illustrated in the adjoining diagrams. If the two wattmeter movements are mounted with the moving coil on one axle, and the axes of the fixed coils at a suitable angle, the moving coils being perfectly free to turn without any control, and connected as shown in the figure, the moving coils will take up a position proportional to the phase angle. As the system is assumed to be balanced, the currents in the three-line wires are equal, and it is, therefore, necessary to have only one moving coil. *B* and *D* are two fixed coils of wire wound in annular grooves in the insulating former, *C*, which have their axes inclined at a suitable angle, *A*, according to the length of scale required for a given power factor, and are so wound that their magnetic fields are equal. The moving coil, *E*, is free to turn without any control, the electromagnetic forces being so large that friction, etc., is negligible. With a unity power factor the moving coil sets itself into the position where the forces exerted by the two fixed coils are equal; that is, midway between the coils *B* and *D*. In this position the pointer indicates 1 in the center of the scale. If the amperes are lagging behind the volts, the fixed coil, *D*, exerts less force on the moving coil than the fixed coil, *B*, and the moving coil is, therefore, drawn over to the coil, *B*, until the two forces are again balanced. Thus, on a lagging power factor of 0.5, the free coil, *E*, will be co-axial with the fixed coil, *B*, and the pointer will indicate 0.5 lag on the dial. The instrument is made dead beat by means of a damping disc carried by the moving coil, *E*, and moving between the poles of a permanent magnet.—Lond. *Elec.*, May 18.



POWER FACTOR INDICATOR.

Measuring Very Low Resistances.—Rennie.—A communication in which he comments on a method recently described and in use in the German Reichsanstalt for comparing very low resistances, and which he thinks is too complicated. He is of the opinion that a more promising method for this important class of measurement will be found on the lines of the differential galvanometer method. The present form of the Craley arrangement has shown itself amply capable of giving results to 1 in 10.000, while an accuracy of 1 in 1,000 is easily obtained. It is, therefore, thought that it is in the direction indicated by the differential galvanometer that progress is to be sought.—Lond. *Elec.*, May 1.

REFERENCE.

Goldleaf Electrometer.—Wilson.—An illustrated description of a very sensitive gold leaf electrometer. The gold leaf is opposite to a rectangular insulated brass plate in a box which is placed in an inclined position to adjust the sensitiveness of the instrument.—*Proc. Cambr. Phil Soc.*, 12, pt. 2; abstracted in Lond. *Elec.*, May 15.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Divided Multiple Switchboards.—Aitken.—The first part of an illustrated paper read before the British Institute Electrical Engineers on divided multiple switchboards as an efficient telephone system for the world's capitals.—Lond. *Elec. Rev.*, May 15.

Wireless Telegraphy.—Prasch.—The first part of what appears to become a long illustrated serial on recent improvements in wireless telegraphy. In the present issue the Slaby-Arco system is discussed.—*Dingler's polytech. Jour.*, May 2.

MISCELLANEOUS.

Acetylene Central Stations.—Vogel.—A lecture, held before the German Acetylene Society on the development of acetylene central stations for lighting towns in Germany. He thinks that now, after experience has been gained, the commercial prospects are much more promising, and recommends the erection of an acetylene central station for any town having a population of about 8,000 or 10,000 or less; the houses must not be scattered too much; there should be at least about 150 lights for each kilometer of street pipe, if the gas is to be sold at 45 cents per cubic meter, the present price of calcium carbide in Germany being $7 per 100 kg. The operation is claimed to be much simpler than that of any other gas works. The chief advantage is that the first cost of the plant is very low; for a town of 4,000 or 5,000 inhabitants with a pipe network of 8 km length, with 80 to 100 street lamps and a total of 1,500 connected lights, and a gas reservoir of 100 cubic meters capacity, an acetylene central station costs $17,500, while an electric plant costs $50,000. Reports from physicians state that the acetylene light is the best for reading.—*Zeit. f. Calciumcarbid Fab.*, April 3.

Acetylene Central Station.—An illustrated description of the acetylene central station in Doese, Germany.—*Zeit. f. Calciumcarbid Feb.*, May 8.

Acetylene.—Keppeler.—The conclusion of his article on impurities in commercial acetylene and on its purification.—*Zeit. f. Calciumcarbid Fab.*, May 1.

Engineering Education.—Dalby.—A paper read before the British Inst. Mech. Eng. on the education of engineers in America, Germany and Switzerland.—Lond. *Elec.*, May 1.

Biographical.—Benjamin.—An account, with portrait, of the life and work of Alexander Graham Bell.—*Sc. Am.*, May 2.

New Books.

The Induction Motor. Its Theory and Design Set Forth by a Practical Method of Calculation. By Henri Boy de la Tour. Translated from the French by C. O. Mailloux. New York: McGraw Publishing Co. 200 pages, 75 illustrations. Price, $2.50.

Mr. Mailloux's translation of M. De la Tour's treatise on "The Induction Motor" is a valuable addition to English engineering literature. The ever increasing importance of the induction motor and the desirability of extending a thorough knowledge of its working to wider circles than the designing engineer, have made Mr. Mailloux's translation a most timely one.

The French edition was reviewed at length May 10, 1902, in these columns. The American edition is, in many respects, superior to the French original. Not only the type, the diagrams and the paper are excellent, but the book contains a chapter on the Heyland motor, which is not embodied in the French edition. This chapter, which was written by M. De la Tour expressly for the American edition, is a succinct statement of the theory of this interesting machine. Another valuable addition is an introduction by Mr. Mailloux, whose literary art, moreover, makes the book extremely agreeable reading. We can heartily commend the work to those interested in the theory of the induction motor.

Elektrische Strassenbahnen. By Johannas Zacharias. Vienna: A. Hartleben. 240 pages, 128 illustrations. Price, 5 marks.

"Electric Streetrailways" is the literal translation of the title of this pamphlet, which is a small manual, descriptive of German practice in building electric railways. The book is divided into six chapters, the first of which deals with track construction, the second with the overhead line, the third with street car motors, the fourth with power stations, while the fifth and sixth are descriptive of some of the most prominent German installations. The work is almost entirely non-mathematical in character, but is generally descriptive of modern practice.

Die Bahnmotoren für Gleichstrom. By M. Muller and W. Mattersdorff. Berlin: Julius Springer. 418 pages, 231 illustrations and 11 plates. Price, 15 marks.

This is a treatise which, as its name indicates, is exclusively confined to a discussion of railway motors for direct currents. In America the latter half of the title would seem superfluous, as we are but just beginning to dream of alternating systems for railways, but evidently in Germany the progress has been such that the authors feel it essential to qualify their work by limiting it to its exact sphere. The book is certainly the most complete treatise on electric railway motors that has appeared, excepting possibly that of Blondel et F. Paul Dubois, "La Traction Electrique." The "Bahnmotoren," however, is limited to street car motors exclusively and does not deal with any other features of the electric railway.

The first two-thirds of the volume are devoted to the principles of dynamo machine construction, particularly applicable to street car motors and the various modifications which practice has shown desirable. The last third of the volume contains some excellent illustrations of the actual construction of street car motors in all of the representative types. An interesting and attractive feature to the practicing engineer is the profusion of dimensions which are given, for each motor is accompanied with a description giving the sizes of the various parts.

Finally, the volume concludes with 11 large folding plates, each containing a working drawing of a standard motor, giving its various dimensions and accompanied by the characteristic curves, from which the railway engineer can easily select such a motor as will best fill the schedule he desires to accomplish. In this respect the work is unique.

Die Funkentelegraphie. By C. Arldt. Leipzig: Theod Thomas. 72 pages, 75 illustrations. Price, 1.80 marks.

In "Spark Telegraphy," to translate literally, the German appellation of this pamphlet—the author has given quite a full resumé of Hertzian signalling up to date. The volume is purely descriptive in character, the excellent illustrations showing the more modern forms of induction coils, mercury circuit-breakers and Wehnelt interrupters. Next come diagrammatical illustrations of all the various forms of transmitting and receiving circuits that have been tried. The last third of the pamphlet is devoted to an illustrated description of the most prominent wireless telegraph stations, both on land and afloat.

Die Grundgesetze der Wechselstromtechnik. By Dr. Gustav Benischke. Braunschweig: Frederick Vieweg & Sohn. 141 pages, 113 illustrations. Price, 4.20 marks.

"The Fundamental Principles of Alternating Current Technics" is a somewhat free translation of the title of this volume. It is a book that is entirely mathematical in character, in which alternating currents are taken up and discussed in 140 pages. There is nothing particularly novel in the work, for it is generally a condensation into a more compact form of the principles of alternating currents that have already received treatment at the hands of many authors. In so far as the present book eliminates that which has become too thoroughly familiar it will be an addition to the electrician's library.

Directory of Electrical Societies, Etc.

American Electrochemical Society. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. General meeting, Niagara Falls, June 29, July 3.

American Order of Steam Engineers. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

Association of Edison Illuminating Companies. Secretary, W. H. Johnson, Philadelphia, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, Indianapolis, Ind., third Wednesday in June, 1904.

Canadian Electrical Association. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

Electrical Contractors' Association of New York State. Secretary, Wm. J. Davis, Ithaca, N. Y.

The Electrical Trades Society (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Engine Builders' Association. F. P. Ide, Springfield, Ill., Secretary.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. ext meeting, Atlantic City, N. J., September 2, 3 and 4, 1903.

Interstate Independent Telephone Association. Secretary, E. M. Coleman, Louisville, Ky.

National Electric Light Association. Secretary's office, 136 Liberty Street, New York. Next meeting, Boston, Mass., 1904.

National Independent Telephone Association. Secretary, J. B. Ware, Ellicott Sq. Building, Buffalo, N. Y. Next meeting Chicago, June 24 and 25.

New York Electrical Society. Secretary, G. H. Guy, 104 Liberty Street, New York.

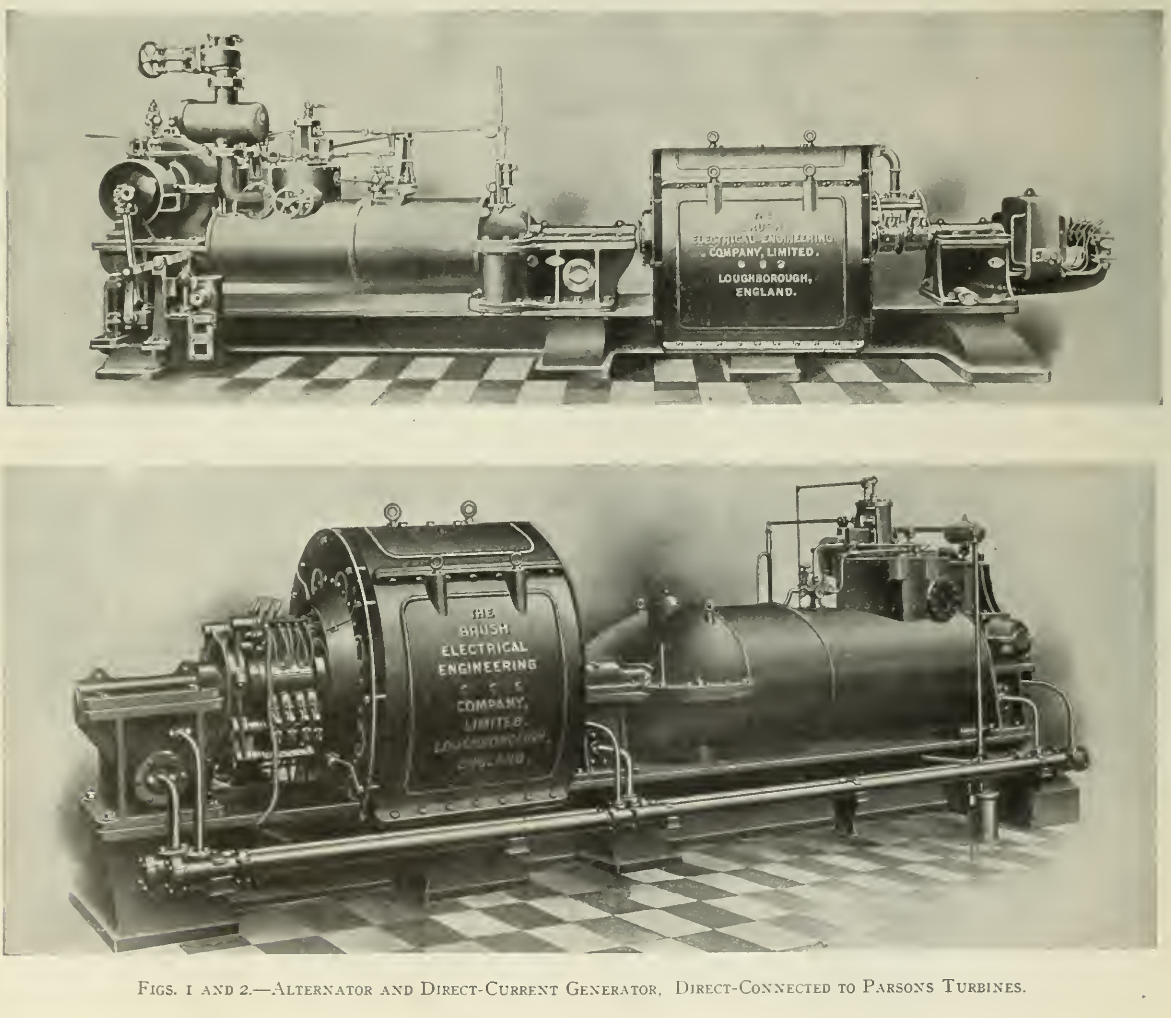
Northwestern Electrical Association. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

Southern Indiana Telephone Association. Secretary, F. W. Pichardt, Huntingburg, Ind.

English Turbo-Generators.

We illustrate herewith an English turbo-generator set made by the Brush Electrical Engineering Company, of London, which company has obtained full license to build and sell the Parsons turbine. This type is so well known that it hardly requires description. The company will build this turbine in all capacities up to 10,000 kw for direct current or alternating current generators.

One of the cuts show a Parsons turbine direct connected to a 300-kw Brush alternator, and another shows it used in connection with a Brush direct current generator. The company has also obtained a license under the Heyland patent to manufacture synchronous, single-phase and polyphase inductor generators. These are especially suitable for connections to turbines, and have the advantage of being self-exciting, with a facility for paralleling unknown in other machines. The actual drop with any power factor is said to be only 3 per cent., and if desired the machine can be compounded or even over-compounded.



Figs. 1 and 2.—Alternator and Direct-Current Generator, Direct-Connected to Parsons Turbines.

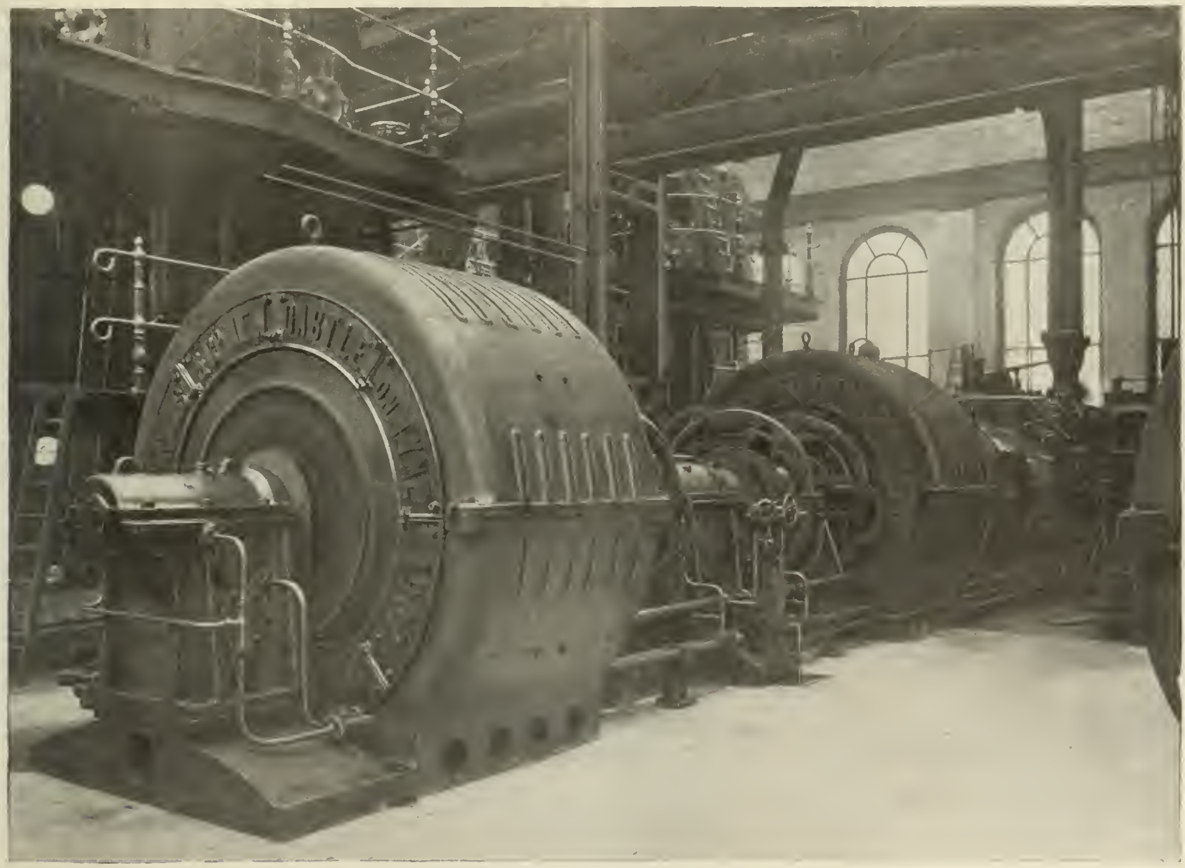
Steam Turbine Plant of the Manchester Corporation, England.

One of the largest and best municipal central station systems in England is that of the Manchester Corporation. It includes two plants, the total output from which has reached 13,200 amp., for light, power and traction. To the Dickinson Street Station have recently been added two turbo-generators built by C. A. Parsons & Co., as illustrated in the accompanying cut.

The equipment comprises two 2,500 hp Parsons steam turbines, each driving two separate six-pole, continuous-current, 1,800-kw dynamos coupled directly in tandem. The dynamos are intended for the lighting circuits only, are shunt-wound and capable of giving a voltage of from 400 to 450 volts. The armatures are coupled so that the commutators are together; they are surface-wound and weigh 10 tons each.

The condensing apparatus is of the jet type, fitted with Parsons compound air pumps driven directly by a 20-B.hp shunt motor running at 110 r.p.m. and of Siemens Bros. design. The discharge is effected by a Gwynne centrifugal pump, driven by a Siemens shunt motor of 80 B.hp and running at 500 r.p.m. Provision is also made for exhausting into the atmosphere when necessary, an automatic valve being provided for this purpose.

The total weight of each machine complete without condenser is 85 tons, slightly over 0.2 of the total weight of one of the Bloom Street Musgrave-Westinghouse reciprocating sets, and about 0.7 of the weight of the fly-wheel. The floor space occupied is 47 ft. 6 in. x 8 ft. 6 in., or 400 sq. ft.; i. e., 0.22 sq. ft. per kw. The average height is only 9 ft., while the highest point does not exceed 11 ft., all measured from floor level. The guaranteed steam consumption with 27 in. vacuum at full load is 20 lbs. per kw-hour, and at half-load, 23 lbs., the steam pressure at the stop valve being 125 lbs. per sq. in. without superheating. The armatures are connected up in parallel with each other, and an automatic brush rocking gear is fitted to each and actuated from the turbine so that the brushes are at the best position on the commutators at any load. The turbines are of the Parsons latest design for the power—viz., one cylinder, compound, parallel flow type, running at a speed of 1,040 r.p.m. It is fitted with mechanical governors which so govern the speed that from no load to full load the difference does not exceed 3 per cent. The first machine has now been running on load daily since the latter part of 1902, and has proved in every way satisfactory to the technical staff. The absence of vibration is most noteworthy. It is said, in fact, that if it were not for the slight noise made by the rapid whirr of the armatures and that caused by the brushes on the commutators it would be practically impossible to determine whether the units were running or not.



STEAM TURBINE PLANT, MANCHESTER, ENGLAND.

Wireless Telegraph Earnings.

In a booklet recently issued by Messrs. Munroe & Munroe, the following statement with reference to the earning power of the Marconi stations is made: "The earning power of these two stations (Wellsfleet and Glace Bay) when completed and in running order is a matter of easy computation. The practical maximum speed thus far attained by the Marconi system is thirty words a minute. An average of eighteen words per minute would be a safe basis for calculation. The cable charge for trans-Atlantic service is 25 cents a word. Assume the wireless charge to be an average of 10 cents a word, and the daily earning capacity of one station is over $2,500, or $925,000 per year. This earning capacity may be doubled by an increase of speed to the maximum attained; it may be increased tenfold, if it proves true that the same results may be achieved in transmitting messages across the Atlantic that have been achieved in transmision across the English channel." As to what users of the system may save, it is said: "In the case of the French ship which went ashore on the Goodwins, we have the evidence given in the Admiralty Court that by means of one short wireless message, property to the amount of $272,940 was saved."

3,000-Kw. Generating Units for the London Metropolitan Central Station System.

The largest generating sets thus far operated in Europe have recently been installed in the generating station of the Metropolitan Electric Supply Company at Willesden, London. These consist of two 3,000-kw, two-phase, direct-connected generators, each set being designed to operate at a speed of 75 r.p.m., and a frequency of 60 cycles. These generators operate in parallel with the existing 1,500-kw Westinghouse generators, which are of the revolving armature type, designed for 500 volts per phase, and stepped up to the bus bar pressure of 10,500 volts, or thereabouts, by means of 8,000 kw of step-up transformers.

The engines, which were made at the Sulzer works, Winterthur, Switzerland, are rated at 5,000 hp and are of the vertical three-cylinder compound type, the high-pressure cylinder being in the center. The crankshaft is extended at one end, in order to carry the revolving field of the generator, and the shaft projects beyond the outboard bearing, in order to allow the exciter armature to be mounted directly upon it. The engines are designed to work with a normal steam pressure of 150 pounds per square inch at the stop valve, with a normal vacuum of 28 in., and without any superheating whatever.

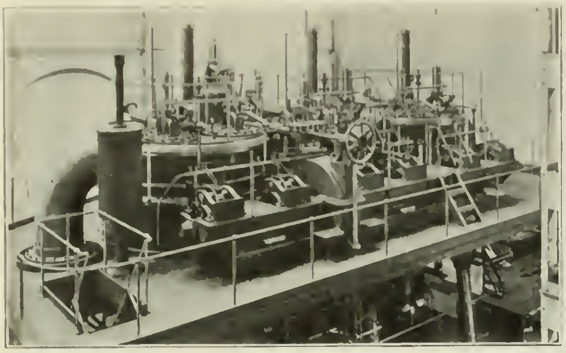


FIG. 1.—VALVE GEAR.

The valves and valve gearing of the engines are of the Sulzer type. The admission and exhaust valves are four-seated poppet valves, combining a very large port area with small clearances. They are placed in the upper and lower cylinder heads, to insure the shortest possible steam passages and the least clearances. The valves are operated from a horizontal shaft carried in an oil trough with the necessary bearings. This shaft is driven from a vertical shaft by means of a pair of spiral gears (bronze and steel) running in oil, and the vertical shaft itself is driven by means of a similar pair of gears from the crankshaft. All the valves, with the exception of the two admission valves of the high-pressure cylinder, are actuated by eccentrics in connection with rocking levers, the latter being arranged with long strokes on the ends opposite the valve rods in order to be able to obtain large curves. These levers give very favorable leverage at the moment of opening, fast motion afterwards and very soft closing motion again. The two admission valves of the high-pressure cylinder are operated by a releasing gear, which is varied by the governor from 0 per cent. to 55 per cent. cut off. The governor is mounted directly upon the vertical shaft before mentioned, in order to do away with an indirect drive. It can be altered by hand, while the engine is running to give speed variation of 5 per cent. There is also an automatic emergency governor provided, which comes into operation when a certain prearranged speed is attained and the vacuum destroyed, thus effectually providing against racing.

The economy guarantees are that at the stop-valve pressure of 150 pounds per square inch, and with a vacuum of 25 in. the consumption of dry saturated steam will not exceed the figures given below, and that the efficiencies will be greater than the values given in the second column:

	Steam consumption per i.h.p. hour, lbs.	Mechanical efficiency excluding air pump friction, (E.), %.
Full load	15	92.5
Three-quarters load	14	90
One-half load	14	86

It is claimed that should these engines ever be operated with steam superheated to say 117° F. (65° C.) above the temperature of saturated steam at 150 pounds per square inch, the steam consumption figures will be as under:

Full load	13¼ lbs. per ihp hour.
Three-quarters load	12½ lbs. per ihp hour.
One-half load	12¾ lbs. per ihp hour.

The generators were made by Kolben & Co., of Prague, Bohemia. Each generator is of the two-phase revolving field type, with stationary external armature and direct-coupled overhung exciter. The maker's rating of each generator is 3,500 kw, at a pressure of 10,500 volts per phase at 60 cycles, when driven at a speed of 75 r.p.m. But each generator has to be capable of giving an output of 3,000 kw at any pressure between 10,000 volts and 11,500 volts per phase. Actually each generator was guaranteed to give a continuous output of 3,000 kw upon a non-inductive load at a pressure of 11,000 volts per phase, for a period of twenty-four hours, with a temperature rise in any part of the generator or exciter of less than 70° F. above that of the surrounding atmosphere. The trials of the first machine have shown that the actual temperature rise, under these exact conditions, is only 45° F.

Each generator was, moreover, guaranteed to carry a non-inductive overload of 25 per cent., or 3,750 kw, for a period of four hours without undue heating or undue pressure drop. Trials on the first set (working non-condensing with high-pressure steam in low-pressure cylinders) have further shown that this overload can be carried with a pressure drop of only 8 per cent. from no load to full load at constant speed and excitation. The efficiency of the generators when working upon non-inductive loads including the excitation and ventilation losses as at full load, is 96 per cent.; three-fourths, 95 per cent.; one-half, 93 per cent.

The insulation of the armature windings withstood for a period of 20 minutes 30,000 volts, alternating, applied between the two phases, and 20,000 volts, alternating, applied between the windings of either phase and the (earthed) armature core.

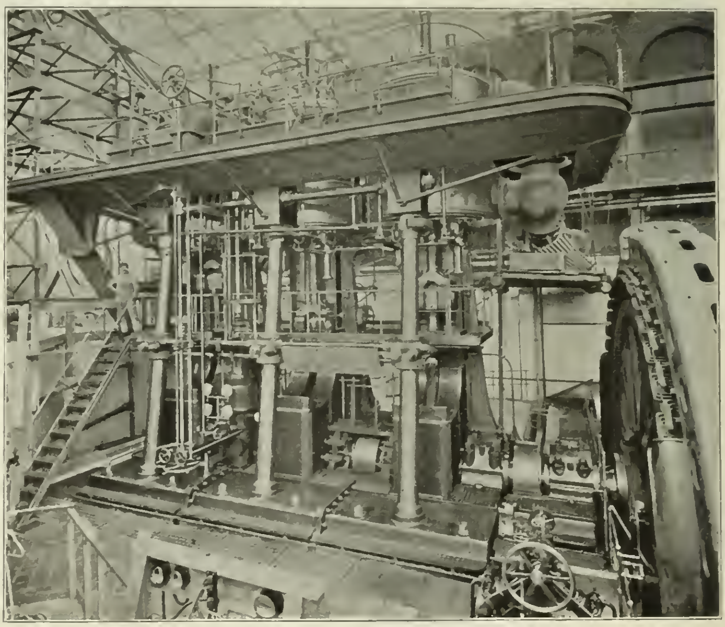


FIG. 2.—VIEW OF ENGINES, SHOWING UPPER GALLERIES.

The cast-iron armature case is in four pieces, secured by means of bolts and eight shrinking rings. The lower half of the casing, which is subjected to the greatest stresses, is supported below in the pit. In order to render the armature coils readily accessible at any time for cleaning or inspection the whole armature is capable of being moved in a direction parallel to the shaft, and suitable screw gear is provided for effecting this movement. The armature core discs are built up inside the casing and are secured to the latter by means of dove-tails. The armature coils are first form-wound in the micanite tubes, and then carefully taped and varnished.

The revolving field of each generator has a steel rim having a stiff U section, and being united to the center boss by means of twelve pairs of radial arms. This wheel is constructed in four sections, which are united by means of bolts and heavy shrinking rings. The center boss or hub, which is carefully keyed to the extended crankshaft, is also secured by means of bolts and shrinking rings, the latter having a section of 36 sq. in. The 96-pole cores are of the softest cast steel, of oval section, with the laminated pole shoes cast in with them.

The magnet windings consist of copper, strip-wound on edge, the adjacent layers of this strip being insulated by means of special parchment paper insulation, having a thickness of about 1-50 in. The slip rings which serve to lead the exciting current into the field winding are of phosphor bronze and are carried on a cast-iron spider. The brushes for these rings are of block carbon, the current density at the bearing surfaces being about 30 amp. per square inch.

Each exciter consists of a multipolar generator with cast-steel field system and a slotted, form-wound, drum armature of the series-parallel type. This is rated at 250 amp. and 150 volts. The brushes are of block carbon, and press upon the commutator, which is constructed of hard-drawn segments insulated by mica.

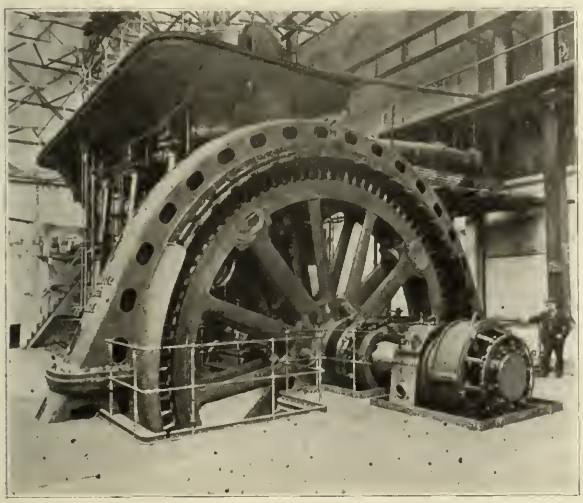


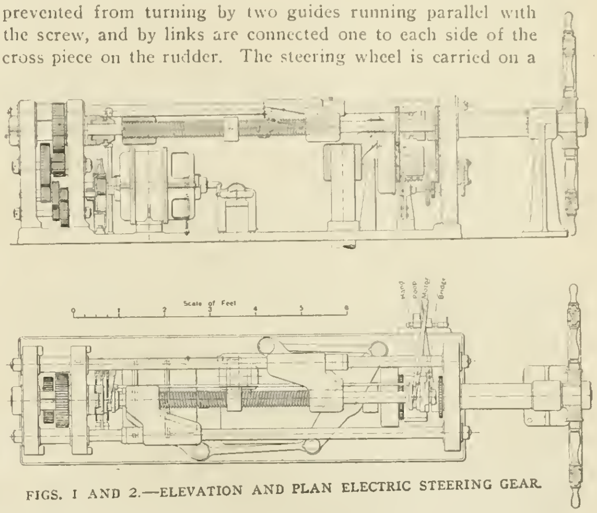
FIG. 3.—3,000-KW GENERATOR DIRECT-CONNECTED TO 5,000-HP ENGINE.

Ferranti & Co. supplied the switchboard, and it consists of three sections, one for each machine, and the third for the outgoing cables and forming an interconnector panel, enabling either of the machine panels to be made dead for cleaning purposes or for killing either pair of outgoing mains whilst under repair. The board is built for 11,000 volts and to control two 3,000-kw, two-phase alternators, and is complete with exciter gear, synchronizing arrangements and all necessary switches, fuses and instruments. The main frame is formed of horizontal enameled slate slabs, 3 in. thick, built into the engine room walls and divided into cells by vertical partitions.

The bus-bars are rectangular, 0.5 sq. in. in section, and totally enclosed in an insulated chamber, provided with plug sockets to enable any particular panel to be isolated. Oil-break fuses are provided for each phase, capable of safely breaking 200 amp. at 11,000 volts. The fuse is three-fourths of an inch long and drops into 24 in. of oil. Oil-break switches are used, one in each phase, capable of breaking 1,500 kw at 11,000 volts. The interconnector panel is supplied with oil-break switches also, but not for breaking full load, and also carries the cable receivers. All transformers are dry insulated. The wattmeters are recording and indicating, and are connected through the outer or earth side of the circuit. These meters, it is hoped, will not be affected by the power factor or change in periodicity. Single-pole shunt and main field switches are included, each with field-breaking switch arrangements.

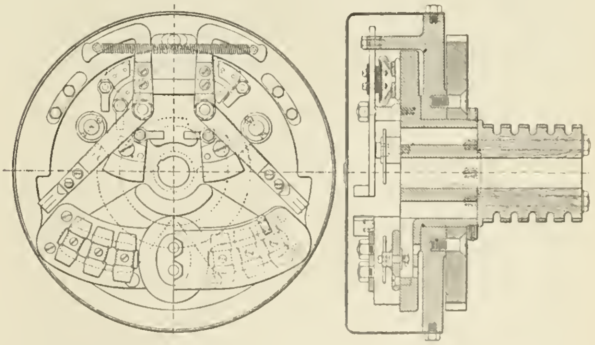
Electric Steering Gear on an English Yacht.

An electric steering gear has recently been installed by Siemens Bros. & Co., of London, aboard a yacht, one of the features of which is that the usual hand steering gear needs but slight alteration to adapt it to electrical control. The upper end of the rudder post passes through the base of a cast-iron frame bolted to the deck, and to it is keyed a massive cross piece, above which and running fore and aft is a right and left-handed screw supported by the frame and carrying one right and one left-handed nut, as shown in the accompanying illustrations. These nuts are supported and prevented from turning by two guides running parallel with the screw, and by links are connected one to each side of the cross piece on the rudder. The steering wheel is carried on a sleeve on an extension of the screw, to which it can be connected by means of a claw clutch.



FIGS. 1 AND 2.—ELEVATION AND PLAN ELECTRIC STEERING GEAR.

A four-pole motor, completely enclosed, is arranged to drive the screw through several reductions of spur gearing and a clay clutch, which is connected to the clutch on the steering wheel in such a manner that both are operated by one lever, and only one can be in gear at a time. It will thus be seen that the screw, which operates the rudder through the nuts and links, is capable of being turned either way by the motor, or by the steering wheel, but not by both at the same time. The motor is series-wound, and provided with a brake pulley and brake blocks which are held off by an electro-magnet in series with the motor and held on by a suitable spring. The brake is, therefore, put on and the motor promptly pulled up whenever the current is interrupted.



FIGS. 3 AND 4.—ELEVATION AND SECTION ROTARY HUNTING SWITCH.

The motor is controlled by a special hunting switch with two levers and two sets of contacts, one for each direction of rotation. This arrangement, which is shown in Figs. 3 and 4, was adopted instead of a single reversing switch in order to get a very reliable quick break action. Each switch has three contacts, so that resistance can be cut out in two steps, and they are so shaped that the actual contact surfaces are not touched by the arcs and therefore remain in good condition. They are reversible and can be easily replaced, the insertion of new ones occupying but a few minutes. A powerful magnetic blow-out, which operates upon all the contacts, is provided on each switch. Although the current is not more than 25 amp at 100 volts, these ample precautions against arcing troubles have been taken because of the extremely frequent switching off and on which is required in the ordinary steering of a ship, and in practice they have proved quite satisfactory.

The two switch arms are mounted on two pins at equal distances from the center of a metal disc geared to the steering wheel. They are cranked as shown, and are so arranged as to be operated by stops fixed to a second disc mounted concentrically with the first. The second disc is in gear with the screw and its motion is therefore proportional to that of the rudder. The switching on or off is, therefore, the result of the difference in the motions of the two discs, which are proportional to that of the rudder and the steering wheel respectively.

The cranked arm of each switch is so shaped that it clears the stops on the second disc when the motion is in one direction, but engages them when the motion is in the opposite direction. This insures that one switch only is operative in each direction of rotation. In order to obtain a quick break, both switches are pulled to the "off" position by springs, but they are also forced off positively by the stops, so that the breaking of a spring would not incapacitate the gear in any way, but only make the break rather slower. The two discs are provided with massive stops arranged to limit the difference of their motion to little more than the amount actually required to operate the switches.

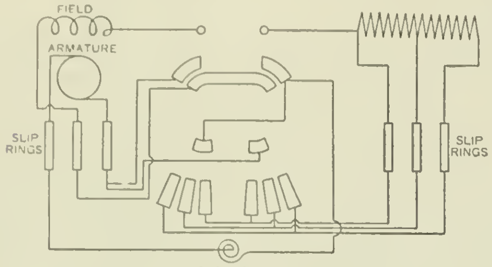


FIG. 5.—DIAGRAM OF CONNECTIONS.

The gearing is such that twelve complete turns of the steering wheel move the rudder from hard-a-port to hard-a-starboard, a total angular distance of 80°. A Geneva stop, in connection with the second disc, prevents the steering wheel from turning more than twelve complete revolutions, and when the second disc is brought to rest by the stop the first catches it up. The motor is thus automatically switched off when the extreme positions of the rudder are reached.

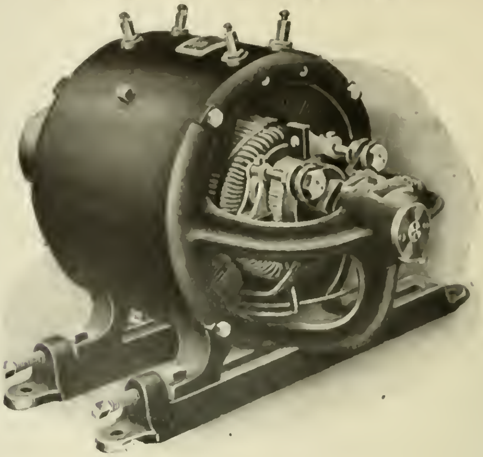
The gear as installed in the yacht has amply proved its efficiency, and gave complete satisfaction to the navigating officers, the control of the ship being as perfect as could be desired. The test imposed, which was considered the most severe, namely, throwing the rudder from hard-a-port to hard-a-starboard while steaming full speed astern, was accomplished with ease and without excessive consumption of current. When steered by hand the gear requires the combined energies of four or more men, according to the state of the weather.

Two Kilowatt Dynamo.

The 2-kw dynamo illustrated here is one of a line ranging from one-half to 20-kw, manufactured by the Hobart Electric Manufacturing Company, of Troy, O. This line has been developed with the idea in mind that most electric machines of small and moderate size go into places where they are handled by inexpert persons. This requires simplicity of all parts and a minimum of necessary adjustments. Such machines should be thoroughly well built both mechanically and electrically, that they may stand abuse. Hence all parts have been made as strong as is consistent with good engineering practice. They have also been rated very conservatively and are, therefore, not only capable of giving their rated output continuously without distress, but will also withstand severe temporary overloads.

The construction is of the conventional multipolar type, with radial pole pieces mounted in a circular frame, both frame and pole pieces being of Tropenas steel. In most of these machines the pole pieces are cast separately from the frame and bolted to the same. The seats for the pole pieces are turned concentrically with the shaft and give a joint of very low magnetic resistance.

The field coils are layer wound and are of a circular cross section. Before being placed on the pole pieces they are very carefully insulated so as to withstand unusual strains. The armature has been the subject of unusual care, both in design and in construction, and is the iron clad type. The coils are straight out and thoroughly insulated before being placed in the slots which are previously additionally insulated to receive them. A good-sized commutator is also characteristic of this line, thus reducing the heating and giving plenty of stock for wear.



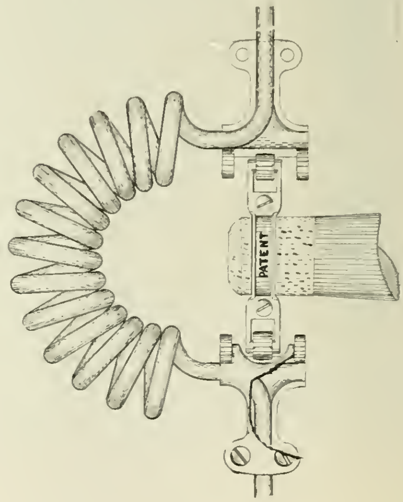
2-KW DYNAMO.

In the construction of these machines a novel feature is introduced in the bearings. These are large and self-aligning, and have a special arrangement for centering the armature with the magnetic center of the frame. This device overcomes a frequent fault—that the magnetic pull on the armature draws it strongly against one bearing, thus preventing end motion and causing the brushes to wear grooves in the commutator.

Not infrequently an armature improperly centered pulls so strongly against one bearing as to cause it to run hot persistently. This improvement is, therefore, one that will be greatly appreciated by practical men. Jigs are used in drilling all parts, and all turning is done to gauges, thus insuring correct fitting and alignment of all parts.

Stirrup for Arc Lamp Suspension.

Managers of electric light plants have long felt the necessity for a device to prevent the bending strain in wires transmitting energy to movable apparatus. In the operation of raising and lowering arc lamps, for instance, the wires frequently break at the insulation arm above the lamp or at the pole, and the swaying from side to side by the wind causes the wire to break at the binding post. These have been sources of considerable trouble ever since electric lighting first came into commercial use, and the device illustrated herewith, known as the 'Shickluna Vita Stirrup," has been designed for the purpose of overcoming these annoyances.



ARC LAMP STIRRUP.

The stirrups are applied at the insulation arm above the lamp, and in some cases at the pole as well, especially if it is necessary to have the wire drawn tight from the pole to the clamp. This device is manufactured by the White Star Appliance Company, 316 Potomac Avenue, Buffalo, N. Y.

Exhibits at the National Electric Light Convention.

The Roebling Construction Company was represented by J. T. W. Montgomery.

Ridgway Dynamo & Engine Company were represented by Mr. W. Sharpe, of Chicago.

Otis Elevator Company were well spoken of by Messrs. Ray D. Lillibridge and J. D. Sheldon.

Stanley Instrument Company, of Great Barrington, Mass., sent S. O. Ochs and F. J. Alderson.

Westinghouse, Church, Kerr & Co. had on hand in their interests Mr. E. Yawger, of Pittsburg.

Washington Carbon Company was appropriately represented by its well-known secretary, Mr. J. S. Krider.

Simplex Electric Company, of Boston, were represented by W. W. Tenney, of Chicago, and J. G. Brobeck.

Gould Storage Battery Company had present in its behalf Messrs. A. S. Hubbard, E. Lyndon, H. B. Oakman, E. L. Draffen.

American Steel & Wire Company.—Messrs. C. S. Knight, Jr., and F. A. Keyes were busy for the A. S. & W. specialties.

Simplex Electric Heating Company had a worthy representative in Mr. J. I. Ayer, past president of the association.

National Conduit & Cable Company were vouched for by W. S. Eckert, H. F. Tate, J. B. Honan, W. H. Pearl, F. B. Switzer.

Pass & Seymour's well-known porcelain insulators, etc., were shown and described by Messrs. B. E. Salisbury and J. W. Brooks.

Rossiter, MacGovern Company, of New York, had a dignified and adequate representation in President MacGovern and Mr. J. A. Peirce.

Sawyer-Man Electric Company, whose lamps bespangle the huge Auditorium, was also duly advertised by T. H. B. Whipple and F. S. Smith.

McIntosh, Seymour & Co., the Auburn (N. Y.) engine builders, were present in the person of Mr. J. A. Seymour, of the executive department.

Electric Storage Battery Company was represented by Messrs. Charles Blizard, general sales manager; G. H. Atkin, Otto E. Osthoff, G. W. Hill, H. B. Gay, R. H. Klauder.

John A. Roebling's Sons Company had a full contingent at the meeting, inclusive of F. W. Harrington, D. F. Ivins, G. C. Bailey, W. H. Slingluff, A. B. Conover, E. P. Bartlett.

Manhattan Electrical Supply Company, of New York City, were by no means forgotten or overlooked, thanks to the assiduous efforts of Messrs. J. W. McDowell, F. M. Pierce and A. J. Anderson.

Baker & Co., the platinum refiners and dealers, of Newark, N. J., were represented by their ever-popular and always-amiable principal, Mr. C. O. Baker, Jr., master of transportation for the association, and Mr. J. J. Lowthian.

Stanley Electric Manufacturing Company occupied handsome parlors and were represented by Messrs. Ray D. Lillibridge, E. L. Barr, V. W. Bergenthal, L. Etheridge, D. W. Dunn, M. C. Canfield, J. W. Chambers, G. W. Andress.

Crocker-Wheeler Electric Company were represented by Messrs. Putnam A. Bates and C. W. Startsman, both from the Ampere (N. J.) factories. Mr. Julian Roe, of Chicago, was also in active attendance with Mr. F. G. Whipple.

Mr. G. F. Porter, ex-secretary of the association, was warmly welcomed for his own sake by hosts of old friends, and was heartily congratulated on his recent connection with that vigorous and promising young concern, the Atlantic Insulated Wire & Cable Company. While in Chicago Mr. Porter had the satisfaction of securing a very substantial order, and was able to develop a large amount of new trade.

The Wagner Electric Company was ably represented by R. G. Russel, the assistant manager of sales, who, after an absence of several years, has returned to the fold; also by G. E. Foster, of Chicago, district manager. The well-known product of this company was exemplified by a 1-hp and one 4-hp single-phase self-starting motors, also a 3-kw type F ammeter. A new vertical edgewise illuminated dial switchboard voltmeter was also on exhibition.

Electrical Engineers and Contractors were out in force, many of the leaders in the profession and industry being present. Among them may be mentioned President J. G. White, of the J. G. White Company; F. W. Sargent, consulting engineer of the Chicago Edison and other companies; Prof. W. E. Goldsborough, of the St. Louis Exposition Department of Electricity; D. Carl Henry, the Henry Electric Light Company, of Denver; Louis B. Marks, Prof. Morgan Brooks, J. K. Soden, F. S. Hickok, A. M. Barron, L. A. Briggs, W. D. Ball, W. J. Warder, Joseph Bijur, Foree Bain, Bion J. Arnold.

Miscellaneous Concerns may be enumerated as follows: E. C. Lindsay, W. W. Lindsay & Co., Philadelphia; S. A. Douglas, American Vitrified Conduit Company; A. R. Battey, Pittsburg Sewer Pipe & Conduit Company; G. B. Davis, Standard Chemical Company; W. C. Bryant, Bryant Electric Company, of Bridgeport, Conn.; C. H. Macdonald, J. A. & W. Bird Co.; J. A. Vaughan, Carleton Chase Electric Company, of New York; A. A. Tibbe, Tibbe Electric Company, Washington, Mo.; R. Link, Keuffel & Esser Co.; J. C. Young, American District Steam Company; C. P. Hill, Doubleday-Hill Electric Company; W. S. Arnold, Arnold & Brownell Company; E. H. Noyes, Pittsburg Reduction Company; A. D. Wyckoff, Ball & Wood Company; C. F. Ziegler, Reynolds Electric Flasher Company; C. B. Colley, American Can Company; L. G. Le Bourveau, T. H. Bullock & Co.; W. F. S. Lake, Buffalo Forge Company; F. L. Collins, Illinois Steel Company; W. J. Best, Green Fuel Economizer Company; W. L. Goddard, McCormick Twine Works; E. H. Hammond, American Electrical Works, of Providence, R. I.; O. P. Cone, Hawks Electric Company.

The Western Electric Company had a series arc light equipment in operation in the engine room of the Auditorium Annex. The lamps installed in front of both hotels and in the engine room formed a part of this equipment. The local exhibit was in charge of Messrs. W. S. Hine and L. G. Basset. A large number of representatives looked after the interests of the company. The apparatus department was represented by Albert Tucker, in charge of the display; Prof. W. L. Stockton, C. A. S. Howlett, H. B. Squire and C. W. Cobb, of Cleveland and Detroit. The supply department was in charge of C. E. Scribner, general supply and sales manager, as well as E. W. Rockefeller, of New York; P. T. Ackerson, S. Reed Faris, George Lounsberry, C. H. Talmadge and R. M. Field, of Detroit. The Chicago supply department was represented by L. F. Milner, A. L. Brown, P. H. Aaron and William Devine. C. D. Crandall, general manager, and F. K. Kretschmar, advertising manager, were also present. The engineering department was represented by C. Wiler. W. T. Hessel, of the Standard Electric Company, of Cincinnati, which is affiliated with the Western Electric Company, also was in attendance at the convention. A miscellaneous line of apparatus was shown in one of the parlors on the second floor. Here were exhibited samples of arc lamps, American transformers, fan motors, "Sunbeam" incandescent lamps, and a complete sample line of circuit-breakers and switches. A folder in the shape of a postal card, which was distributed, called attention to the arc light equipment at the Annex, and also showed one of their series alternating arc lamps.

The Duncan Electric Manufacturing Company, of Lafayette, Ind., in one of the parlors on the second floor, made a very complete display of the Duncan wattmeter. It was in charge of Thomas Duncan, vice-president and general manager. W. J. Flanning, of the Electrical Material Company, of Baltimore, who is the Eastern agent, was also in attendance, as well as C. H. Norwoods, of Chicago. As is well known, the Duncan wattmeter is a commutating meter for both alternating and direct currents, and possesses a great many up-to-date features which make a meter of especial value to central stations. The great accuracy of the meter on light loads was forcibly illustrated by the ease with which one of the meters started on the low end of a Hylo lamp, the load being less than 1 per cent. of its rated capacity. This also illustrated the readiness with which the meter starts and stops when a large load is thrown on and off respectively. The various other points which make this meter of especial value are the accessibility to all of the parts by the mere removal of four screws, the dust and insect-proof character of the meter, the ease with which the revolving element can be removed for repair and inspection without taking the meter apart, and at the same time without altering the original calibration; and the specially insulated coils. An important feature is the direct reading dial used for all sizes, which readily permits the reading of the meter after installation in almost any position. These are manufactured for all voltages and sizes, from 2½ to 2,500 amp. A high-torque induction meter will be ready in about 60 days, which of course will be especially adapted for alternating circuits. Some very catchy advertising matter was distributed.

National India Rubber Company were represented by Mr. P. J. Lyons.

Benjamin Electric Manufacturing Company exhibited a line of the Benjamin wireless clusters.

Standard Paint Company sent Messrs. J. C. Shainwald and E. R. Willard to look after the welfare of P. & B.

The Triumph Electric Company, of Cincinnati, was represented, as usual, by W. H. Jacob, the sales manager.

New York Safety Steam.—The interests of the New York Safety Steam Company were looked after by Mr. Milton Thomas, of the Chicago office.

George L. Sayles, representing the Sterling Electric Manufacturing Company, of Warren, Ohio, made quite a showing with the Sterling Special incandescent lamp.

F. A. Churchill, Jr. represented W. N. Matthews & Bro., of St. Louis, who have the exclusive agency for the "Knocker" Boiler Cleaner and the Stombaugh anchors.

Mr. W. H. Porter, Western sales manager of the Alphaduct Manufacturing Company, made quite a hit with the delegates by distributing pipes made from their fire-proof conduit.

Sprague Electric.—Mr. Alex Henderson, of the Conduit department, was present in behalf of the Sprague Electric Company. With him was associated Mr. Kittle, of the Chicago office.

The National X-Ray Reflector Company, of which A. L. Moore is the secretary and treasurer, and E. L. Haines general manager, showed a line of sterling silver-plated glass reflectors.

The Diehl Manufacturing Company, Elizabeth, N. J., was represented by Mr. B. C. Kenyon, and had a display of its newest models in fan motors and deflector in the lobby of the Auditorium.

Mr. Mortimer Norden, of New York, looked after the interests of the Norden-Bittner Electric Company and the Electric Carriage Call Company, whose specialties in the lighting field were energetically advocated.

A. P. Hopkins & Company, of Escanaba, Mich., dealers in railway ties, poles and posts, were represented by M. Hopkins, vice-president. Although the company had a parlor on the sixth floor, no attempt was made to make an exhibit.

Central Electric Company, of Chicago, were out in force, and Manager Charles E. Brown was particularly in evidence throughout the convention, extending all hospitalities of the city to the patrons of Okonite and the other C. E. specialties and agencies.

Economical Electric Lamp.—A novel display was made on the first floor of the Auditorium by the Economical Electric Lamp Company, New York, to show off the merits of its "turn down" lamp. This attracted a good deal of notice and was in charge of Mr. M. Lobenthal.

Mr. A. R. Batley, an old-time clay conduit man, who has sold the material, it is said, in every country in the world except China and Japan, places he hopes soon to visit, was present in the interests of the Pittsburg Sewer Pipe & Conduit Company, of Pittsburg, Kan., as general manager. He had a neat exhibit of two and four-duct conduit, etc.

The Crouse-Hinds Electric Company made an interesting showing with their "Norbitt" and other specialties. Mr. Crouse and Mr. Hawkins, of the New York office in charge. A handsome souvenir in the shape of a pocket mirror in a neat leather case was distributed by the company. Other representatives were Messrs. F. F. Skeel, R. B. Kent and F. E. Hardin.

The Dale Company, New York had an interesting exhibit of specialties and Mr. John Dale, president, met a host of Western friends, who hastened to congratulate him upon the completion of the new building in New York City, into which the company has just moved. The Dale lighting specialties and standard goods have a well-established reputation now throughout the electric light and power industry.

The National Carbon Company, Cleveland, Ohio, as usual, was represented by a large contingent, the following gentlemen being present: N. C. Cotabish, the sales manager, and F. W. Wilkins; A. D. Spear, F. H. Murray, F. C. Park, T. H. McDowell, F. J. Aylsela, A. V. Ward, A. G. Henry, A. C. Carrier, Wallace O'Connor. The Columbia carbons being so well known, those present contented themselves with renewing old acquaintance.

The Gregory Electric Company were represented by A. L. Kuehmstedt, vice-president; George M. Ellis, secretary, and R. H. Watson, of the sales department. As the company is very busy looking after its business, which is quite extensive and of a large volume at the present time, it was not possible to make any exhibit at the convention. The company, however, reports that quite a number of the delegates called at its offices incidentally seeing the work which is being done at the shops.

Electrical World and Engineer received many congratulations on its "high water mark" issue of 220 pages, embracing first practical data as to the Curtis steam turbine; articles on the Chicago Edison and Commonwealth Companies; illustrated articles also on several smaller Western plants of interest, and a vast amount of general electric lighting material. The journal was represented by Messrs. J. M. Wakeman, J. V. S. Church and G. W. Elliott, of the business staff, and Messrs. T. C. Martin, J. R. Cravath, R. E. Sack and C. W. Whitney, of the editorial staff.

The Standard Electrical Manufacturing Company, of Niles, Ohio, had on exhibit a complete line of candelabra and decorative lamps. A special feature of the exhibit was the Star incandescent lamp, which consists of a star shade of any color, either fluted or plain, in combination with an incandescent lamp. The company, of course, manufactures a complete line of incandescent lamps of 50, 110 and 220 volts, and of any candle-power and size desired. J. P. Gilbert, secretary and treasurer, as well as H. H. Albert and John Rice, salesmen, represented the company.

Bryan-Marsh Company.—The interests of the Bryan Marsh Company were looked after by George C. Keech, general manager, and a full representation of the sales department, which included L. D. Sawyer, manager of the Minneapolis (Minn.) branch office; E. H. Haughton, manager of the Cincinnati branch; J. L. Barnard, salesman, Minneapolis and Wisconsin district; A. G. Bowers, Iowa salesman; J. S. Corby, salesman Illinois and Missouri, and W. J. Behn, salesman for Michigan. As the product of the Bryan-Marsh Company is so well known, no exhibit was made, although the various representatives of the company were in touch with the delegates to the convention.

The Valentine-Clark Company, of Chicago, because of its inability to show its product, which consists of Michigan, Wisconsin and Western cedars for electric light, telephone and railroad work, contented itself with a display of photographs showing the various yards of the company, which are located at Pinconning, Mich., and Green Bay, New London and Prentice, Wis. The company appreciates the fact that a readily available supply is of great importance, and for that reason the Washington cedar poles are handled principally through the Wisconsin yards, from which they can be obtained at short notice. Mr. E. L. Clark, the secretary and treasurer, looked after the company's interests, as well as F. L. McGillan, the traveling superintendent, and J. A. Greenwood.

The Bullock Electric Manufacturing Company did not make any exhibit, its product being well known to all central station men. The bulletin which was issued during the convention by Mr. Bolles was well appreciated, and went to fill a popular demand, as was evidenced by the rapidity with which each issue was exhausted. Mr. Robert T. Lozier, the second vice-president and general sales manager was ably assisted by F. G. Bolles, assistant general manager of the sales department, and George B. Foster, the Chicago district sales manager. The charms which were presented to visitors at their headquarters, as has been the case at past conventions, bore a representation of a generator and were much in evidence. Each delegate registering was also given a white button badge by the company to correspond with his number in the Bullock bulletin.

H. W. Johns-Manville Company, of New York, made a very elaborate and interesting exhibit of its well-known Sachs "Noark" enclosed fuse protective devices, at its parlors, No. 230 Auditorium Hotel. Particular interest was exhibited by those in attendance in the new large capacity service switch and fuse boxes, which have recently been developed as large as 600 amp.; also single and double-branch blocks, in three sizes, up to and including 100 amp.—two and three poles. These are very compact in their construction, and have many advantages. A line of high-potential strain insulators, guaranteed to stand 5,000 volts, and having a braking strain of 6,000 pounds, were also shown. A number of orders have been taken for immediate delivery. A number of other specialties of the company's manufacture were exhibited, and examined by the visitors, with considerable interest. J. W. Perry, manager of the electrical department from New York, was in attendance, and was assisted by S. H. Finney, manager of the electrical department of the Chicago office.

F. H. Gilmore expounded the virtues of the A. Sorge, Jr., & Co.'s system of water purification.

The Peerless Electric Company, of Warren, Ohio, was well taken care of by H. B. Ramey.

E. A. Rummler, of Rummler & Rummler, solicitor of patents at Chicago, was a visitor at the meetings.

E. A. Lindsley, of Lindsley Bros. Co., of Chicago, talked poles to all visitors, as did also J. Alex. Navarre.

M. S. Walker, of the F. Bissell Co., of Toledo, Ohio, enlightened all present on the value of the Nernst lamp.

Thos. H. Bullock and H. H. Albert represented the Standard Electric Manufacturing Company, of Niles, Ohio.

J. Harry Yost and Frank H. Chapman represented the Yost Electric Manufacturing Company, of Toledo, Ohio.

The interests of the Central Station Improvement Company, of Chicago, were well taken care of by F. R. Jenkins.

The Fuller Company, of Detroit, was brought to the attention of all visitors in an unassuming manner by R. Fuller.

C. R. Kreider, of Kohler Bros., the consulting engineer of Chicago, managed to consult a great many of the delegates in the interest of his company.

F. N. Jewett, in his usual affable manner, did not fail to impress upon the delegates the superiority of the Evans-Almirall system of central station heating.

Buckeye Electric Company.—The interests of the Buckeye Electric Company, were looked after by W. R. Bonham, A. J. Schrum, J. M. Corke and W. K. Eyre.

The Northern Electric Manufacturing Company, through the efforts of G. L. Stagg and Herbert Marks, informed the public of the merits of its apparatus.

The Guarantee Electric Company, of Chicago, was well represented by Charles E. Gregory, its president; Edwin R. Rockwell, the secretary, and E. H. Frank.

The Dearborn Drug & Chemical Works, of Chicago, as usual made its presence felt through the efforts of W. H. Edgar, its president. It distributed an amusing puzzle.

Porter & Berg, who make a specialty of "I. T. E" circuit-breakers and Keystone instruments, and also handle a general line of supplies, were represented at the convention by J. L. Porter, the president, and E. R. Mason, the vice-president.

Mr. C. A. Benton was present in the interests of the electric elevators of the Marine Engine & Machine Company, now on the circuits of many plants. Incidentally also he was able to escort many friends to the offices of the Pyle-National Electric Headlight Company, where one of the novelties was an able-bodied railway car lit throughout from tail light to headlight with the Commercial Acetylene Company's safety storage system of acetylene gas, stored in acetone. This proved very interesting to electric lighting men, so many of whom are now operating gas works also.

Illinois Electric Company.—The interests of the Illinois Electric Company, of Chicago, were well taken care of by Francis Edward Healy, president; Carl Keith, treasurer, and T. K. Cushing, secretary. D. Newman and C. J. Litscher, representing the sales department, were in charge of the exhibit. This included, in addition to the regular line of supplies, the transformers and fan motors of the Peerless Electric Company, the lamp of the Warren Electric & Specialty Company, the fans, motors and lightning arresters of the Westinghouse Electric & Manufacturing Company, the C. L. Pierce, Jr., line of construction material specialties, the Acme dial switch, Duncan direct-current meters, and a German lamp known as the "Sunshine," which is being introduced in this market.

The Fort Wayne Electric Company representatives managed to keep quite comfortable by means of a new revolving fan motor, which was suspended from one of the fixtures in the room. This is remarkable for its low consumption, as it takes but 17 watts for operation on direct-current circuits, which, of course, is about one-third of the energy consumed by an ordinary 16-cp lamp. It is sent out with a T.-H. adapter, and as its weight is but 3¼ pounds it can be readily adapted for many uses; in fact, a request has been received for providing the fan with a handle so that it can be readily used by barbers. The company did not attempt to make any extensive display, as its product is quite well known. The exhibit was in charge of F. S. Hunting, the sales manager and treasurer of the company, and he was ably supported by W. S. Goll, the manager of the Chicago office; T. J. Ryan, of the Cincinnati office, and W. C. Knight, of St. Louis. J. H. Raymond, Frank McMaster and I. S. Jackson, of the sales department of the Chicago office, were also in attendance, as also A. A. Serva, the assistant sales manager at Fort Wayne, and E. A. Wagner, of the sales department.

Elblight.—The Elblight Company of America was represented by Mr. Russell Spaulding, president; Mr. E. H. Abadie, general manager, both from New York; J. Allen Haines, Western manager. The South Parlor was handsomely decorated with Elblight cable and miniature lamps of many colors festooned and all covered with a profusion of greens. Portieres of Elblight cable and lamps covered with green foliage were in the doorways and lent to the reception to the delegates, ladies and members, a festive appearance in sharp contrast with the rest of the hotel. This same parlor was used as the headquarters of the General Electric Company and the decorations were so attractive they were left in place during the entire convention. The company had headquarters in suite 601-2, where they exhibited some decorations consisting of portieres and flags, together with a large collection of photographs, showing the many important and artistic decorations made throughout the country with the Elblight system. They also exhibited an aquarium with Elblight cable and a lamp burning under water. The lamp shown had previously been burning continuously under water for over three months without deterioration. The Elblight Company are to be congratulated upon the universal interest created by their brilliant and excellent display.

Westinghouse Electric.—Aside from occupying commodious headquarters, it may be said that the entire hotel was the exhibit of the Westinghouse Electric Manufacturing Company, for the reason that the Auditorium Hotel Company have in use over 38.000 Sawyer-Man incandescent lamps. The generating room is located in the Annex of the hotel, and furnishes light and power for the two hotels and the theatre. It is the largest isolated plant in the West and includes a 500-kw Westinghouse engine type direct-current generator. A special panel board designed to show the operation of various types of Westinghouse precision instruments was also to be seen in the dynamo room and attracted considerable attention. These included the synchroscope, the power factor meter, various wattmeters and voltmeters, and a frequency meter. The company had a large staff in attendance at the convention, including F. H. Taylor, vice-president; C. F. Scott, W. M. Probasco, E. W. T. Gray, A. L. Millard, E. J. Burke, A. E. Ransom, A. M. Miller, J. J. Gibson, P. S. Gibson, J. S. Peck, N. S. Braden, A. Hartwell, C. S. Cook, A. Huntington, R. E. Schanlin, R. N. C. Barnes, W. H. Whiteside, F. N. Kollock, R. L. Rathbone, S. H. Anderson, M. P. Randolph, S. B. Storer, W. D. McDonald, E. Dryer, N. Stewart, G. B. Dusinberre, H. P. Davis, W. C. Armstrong, W. Karapetoff, W. E. Foreman, T. P. Gaylord, G. W. Pulver, F. S. Smith, C. A. Ross, T. H. B. Whipple, H. C. Marsh.

Hylo.—A flash sign in the main lobby, which attracted universal attention and favorable comment was that of the Phelps Company, of Detroit, Mich., of which Mr. Alex Dow is the president. W. E. Phelps, vice-president; W. J. Phelps, secretary, and J. Wylie Phelps, sales manager, were in attendance at the convention, and explained the interesting features and the various makes of Hylo lamps which are being manufactured by this company. In addition to their regular lamp, a long-distance Hylo operated by means of a pendant switch, which obviates the necessity of a wall switch, and the new "Pull-string" lamp were shown. The valuable features possessed by this lamp are well known, although it may be well to mention the fact that the increased cost of the lamp is more than compensated for by the increased life. The Hylo self-flashing sign lamps are quite a novelty, as was attested by the interest the sign aroused. This is so different from anything that has been put on the market that it will prove quite a factor in the sign business. In fact, any sign which has lost its usefulness can be rehabilitated and rejuvenated by simply changing lamps. The objection that the information which the sign is to convey to the public at large is entirely lost for several seconds at a time, and as a consequence does not fulfil its purpose as well as might be, is overcome by the new self-flashing sign lamp. The entire outline of the letters is always visible, thus ever presenting the object of their mission; and because of the fantastic irregularity with which the lamps light up and the kaleidoscopic effect produced thereby, the sign not only attracts but holds the attention of all passersby. A valuable feature is the long life of the lamp and the saving in current, also the convenience which results from the use of the lamp, as it does away with the maintenance of switching apparatus.

"Flexduct" had both H. G. Osburn and C. E. Corrigan to sing its praises.

The Merkle Electric Company, of St. Louis, was represented by N. W. Ewing and Milton Mill.

The Chicago Insulated Wire Company appeared in the persons of William M. Smith and T. C. Turlay.

The McComber Whyte Rope Company, of Chicago, was represented by George Whyte and A. McComber.

Hart Manufacturing Company, Hartford, Conn., had an extensive exhibit of their switches on the main floor.

The Western Electrical Supply Company, of St. Louis, made its presence felt through R. S. Wakefield and L. F. Philo.

M. B. Austin & Co.—H. T. Tate, A. Mementa and A. H. Friend were on hand in the interests of M. B. Austin & Co., of Chicago.

J. M. Denniston, of Chicago, well known to many electrical men in the West, represented Joseph T. Ryerson & Son, iron merchants and special agents.

Fairbanks, Morse & Co.—The interests of Fairbanks, Morse & Co., of Beloit, Wis., were taken care of by L. J. Osborne and William A. Moore, of Chicago.

McRoy Clay Works.—E. F. Kirkpatrick, who never misses a convention, was on hand to tell the delegates with bated breath about the marvelous product of the McRoy Clay Works.

The Cutler-Hammer Manufacturing Company, of Milwaukee, the well-known manufacturers of rheostats, was ably represented by Mr. Hammer himself, A. P. Munning and W. H. Beattys, Jr.

Habirshaw Wires and cables were not forgotten, Mr. J. B. Olsen, sales manager, being on hand from the New York office. Regret was expressed on every hand at the absence of Dr. Habirshaw.

Eugene Munsell & Co., of St. Louis, were well represented and considerable attention was attracted by a fine specimen of sheet mica hung over the main stairway in the Auditorium like a framed picture.

Mr. W. B. Jackson, of the consulting engineering firm of D. C. & W. B. Jackson, Madison, Wis., was in attendance. It was regretted that Prof. D. C. Jackson could not attend, until the convention was partly over.

George Cutter.—No convention is ever complete without the presence of George Cutter, of Chicago, and this one was no exception. He was ably assisted by Albert Scheible, secretary of the George Cutter Company.

The Consolidated Engine Stop Company, through their representative, Mr. F. S. Palmer, showed their various devices for instantaneous control and stoppage of engines, etc., and the devices attracted considerable attention.

General Incandescent Arc Light Company, of New York City, made an excellent display and were represented by Mr. Martin J. Insull, Mr. H. P. Ball and Mr. J. H. Hallberg, the last of whom contributed an able paper to the programme.

The Shedd Electric Manufacturing Company added to the comfort of the delegates through the efforts of Mr. Peterson by placing several of their oscillating fans on the main floor. They were a great boon during the rather stifling weather of the week.

Standard Underground Cable Company had headquarters in parlor 126 and had a splendid corps of representatives, including Mr. C. J. Marsh, of New York; the veteran J. R. Wiley, of Chicago; E. J. Pietzcker and W. M. Rogers, the other two local members; T. E. Hughes, of Philadelphia, and A. A. Anderson. Mr. Wiley was unremitting in his thoughtful attentions to visitors from out of the city.

The Nernst Lamp Company was represented at the convention by Messrs. A. E. Fleming, Chicago; G. E. Bennett, Chicago; F. H. Carpenter, Chicago; Calvin W. Rice, Pittsburg; R. H. Lee, Jr., Pittsburg; M. W. Hanks, Pittsburg. It is needless to say that the Nernst lamp was one of the leading topics of discussion at the convention, among central station and supply men alike. Going to and coming from the convention, those who passed through Detroit were greatly interested in the depot lighting done there by Mr. Alex. Dow, who is himself very well pleased with the result. The long platform thus lit shows up remarkably well in comparison with an adjoining arc lit platform; and the depot staff appear to like the new light immensely.

Gest Conduit Materials.—Mr. G. M. Gest, of Cincinnati, the expert electrical subway contractor, who has come so rapidly to the front in subway construction in America, had a most interesting exhibit in the Auditorium Annex, in charge of Messrs. F. C. Mott and W. T. Jackson, the latter a newcomer lately on the *Cincinnati Enquirer*, who soon made himself a favorite and justified Mr. Gest's selection as representative of these important interests. Four distinct and valuable specialties were exhibited, namely the bracket frame, the mandrel, the trap valves and the smooth terminals. All these have been designed and invented to meet difficulties or drawbacks in conduit work, and Mr. Gest has proved himself a skillful worker in this field, whose conditions are so onerous and trying. But it is in thus solving the problems that he has created a large and growing business peculiarly his own.

Among those present at the convention, but not making any exhibits were the following: M. W. Thomas, of the Michigan Electric Company, of Detroit, Mich.; L. F. Mahler, western sales manager of the De Laval Steam Turbine Company; D. C. Hemingray Glass Company, of Covington, Ky.; R. J. Randolph, of the Bunny Company, of Milwaukee; W. R. Mason, general manager of the Mechanical Boiler Cleaner Company; Willard Fuller, of the Acme Switch Company, of Cleveland, Ohio; R. B. Corey, of the Columbia Incandescent Lamp Company, of St. Louis; E. A. Jenkins, of the H. T. Paiste Company; E. E. Woodward, the Woodward Governor Company, of Rockford, Ill.; Enos Bookwalter, representing A. L. Ide & Sons; John H. Fowler, of the Fowler-Jacobs Company, of Chicago; Wm. Coale, of the Sterling Electric Manufacturing Company, of Warren, Ohio; T. H. Rodman, of the Milwaukee Electric Company; V. G. Apple, of the Dayton (Ohio) Electric Manufacturing Company; J. B. Estabrook, of the Colonial Electric Company, Ravenna, Ohio; J. S. Crider, secretary of the Washington Carbon Company; G. G. Luthy, of the Royal Electric Company, of Peoria, Ill.; A. M. Searles, the Chicago representative of the Warren Electric Manufacturing Company, and Charles Messer, president of the Dearborn Electric Company.

Holophane Glass Company seemed to score more heavily than any one else at the convention, both by reason of its handsome souvenirs and because of its interesting educational exhibit of illumination effects. Mr. Van Rensselaer Lansingh, the illuminating engineer of Chicago, was in charge, and was aided by Mr. H. W. Lauritzen. A large room was occupied filled with a complete line of Holophane shades and globes—over 150 styles of globes, shades, etc. By means of two special dark rooms, demonstrations were made of the value of the holophane principle. In each case a copy of Electrical World and Engineer was laid on the floor open at the ad of the company. In test No. 1 two 32s and one 16 cp bare lamps were shown versus one 16-cp with a 5-in. Pagoda reflector. In test No. 2 three 16-cp lamps in a straw opalescent hemisphere were shown versus one 16-cp in a Holophane hemisphere. The contrasts gained were nothing short of sensational, and every visitor was convinced readily of the value of the holophane globes and shades for specific concentration or direction of the light, with resultant economy. The "prize package" was a large square cardboard box in which were nested three styles of holophane globes and shades—a most appropriate but at the same time a very expensive souvenir for a convention of nearly 1,000 people. But it was good advertising.

Among others in attendance at the convention were noted the following-named gentlemen: C. J. Kenny, Consumers' Carbon Company, Lancaster, Ohio; Col. J. H. Shay, Chicago Belting Company, Chicago; F. L. Merrill, Standard Railway Materials Company, Chicago; C. H. Wilmerding, Chicago Sectional Electric Underground Company, Chicago; John P. Dales, American Insulated Wire & Cable Company, Chicago; W. W. Merrill, Chicago Fuse Wire & Manufacturing Company, Chicago; T. O. Moloney, Moloney Electric Company, St. Louis, Mo.; W. J. Cooke, McGuire Manufacturing Company, Chicago; A. Lester Thayer, Browning Manufacturing Company, Chicago; H. A. Tremaine, Crouse-Tremaine Company, Chicago; A. Thurlby, Morriston File & Lock Company, Chicago; William Goltz, Goltz Engineering Company, Chicago; David Evans, Field-Evans Iron Company, Chicago; F. S. McCoy, Adams-McCoy Electric Company, Muscatine, Iowa; G. H. Barbour, De Forest Wireless Telegraph Company, Chicago; J. A. Johnson, Kuhlman Electric Company, Elkhart, Ind.; Edmund Dickey, Dickey-Sutton Carbon Company, Lancaster, Ohio; A. H. Charles Dalley, Underfeed Stoker Company of America, Chicago; R. V. Parkinson, Illinois Maintenance Company, Chicago; A. B. Rich, L. Klein, Chicago; Al Smith, Keelyn & Smith, Milwaukee, Wis.; H. G. Landis, Electric Supply & Construction Company, Wichita, Kan.; H. L. Davis, Home Rubber Company, Chicago; Frank H. Pond, Chase Engine & Manufacturing Company, Chicago.

OKONITE interests were looked after by George T. Manson, New York.

CHASE SHAWMUT COMPANY, Boston, had Harry P. Moore in charge of their exhibit.

MR. SEARS B. CONDIT, JR., of Boston, was busy explaining the merits of his various electrical specialties.

AMERICAN CIRCULAR LOOM COMPANY had H. B. Kirkland, R. B. Corey and Thomas G. Grier present to speak the word.

STANDARD VITRIFIED CONDUIT.—Here, there and everywhere was Captain B. S. Barnard talking and displaying the product of the Standard Vitrified Conduit Company. He found a few minutes' time to spare to get away from the Auditorium and take an order for about $10,000 in the city.

MR. J. S. MAURER looked after the interests of Hart & Company, of Chicago, of which firm he is manager, and the Marshall Sanders Company, of Boston. He was assisted in displaying the Hart goods by E. Kearns. Considerable attention was attracted by balloon signs to the Red Cross lubricant for commutators, a Hart product.

THE FOSTORIA INCANDESCENT LAMP COMPANY, of Fostoria, Ohio, occupied one of the rooms in the Auditorium, but made no exhibit Its representatives included H. H. Geary, sales manager; F. G. Kreatcher, Illinois and Missouri salesman; J. S. Maurer, Chicago agent, and C. J. Wells, salesman for the Ohio and Michigan territory.

THE MILLER ANCHOR COMPANY, of Norwalk, Ohio, displayed several types of Miller earth and rock anchors, and the augers used for setting them. G. H. Miller, the proprietor of the company, was on hand explaining the merits of his devices and stated that he had been meeting with great success in sales to telephone, electric light and street railway companies throughout the country.

PHŒNIX GLASS COMPANY.—Mr. T. H. Howard, son of Mr. Andrew Howard, president of the Phœnix Glass Company, was attending his first electric light convention and found it a very interesting and amusing experience. He was accompanied by the veteran, Mr. A. H. Patterson, who has forgotten the exact number of conventions he has attended, but still shows up with the same keen zest as of old.

AMERICAN PUSH BUTTON TELEPHONE COMPANY., of 136 Liberty Street, New York City, had a unique display, consisting of a complete telephone outfit, including telephones connected to 200 ft. of wire and batteries, etc., all contained in a small grip. The company was represented by the manager, Mr. W. V. Sweeten, who secured an order for 500 telephone equipments for Japan while at the convention.

REYNOLDS ELECTRIC FLASHER COMPANY, of Chicago, for whom Mr. C. F. Ziegler appeared, had one flasher operating a sign of four large letters for the Electric Appliance Company on the sixth floor, and another sign operating a "Sunbeam" lamp letter sign at the Western Electric Company's headquarters on the first floor. As this sign was not wired for a flasher, Mr. Ziegler was compelled to control the entire seven letters, containing 84 lamps, with one switch only; and it stood this extreme load remarkably well. The flashers naturally excited attention and aroused much favorable comment.

FRANCES BIEDLER & COMPANY, of Chicago, producers and wholesalers of Michigan and Idaho cedar poles, occupied one of the rooms in the Auditorium. M. D. Cross, manager of the cedar pole department of the firm, looked out for the company's interests and was assisted by Roy L. Jones and F. F. Gunninger, corporation salesman. Biedler & Company have recently branched out strongly in their Idaho cedar pole product, and they received many compliments for their neat invitations, sent out to their customers and friends before the convention, which contained sprigs of Michigan white cedar and Idaho red cedar. They distributed neat aluminum thermometers.

THE MONARCH ELECTRIC & WIRE COMPANY, manufacturer of Monarch brand weather-proof wire, and dealer in general electrical supplies and material, of Chicago, had an exhibit at the Auditorium. The company's weather-proof wire was shown in several sizes. This wire is said to be receiving favorable attention throughout the West, on account of its lasting qualities and other valuable features. In the way of supplies, the company showed several Westinghouse alternating-current fans, some Colonial direct-current fans, and some Flexduct and other standard material. C. A. Kuhlman and A. D. Gillespie were in attendance as representatives of the company and H. Schwab, secretary, was also an occasional visitor.

ROCKING GRATES.—The merits of the Martin anti-friction rocking grates were demonstrated by Secretary G. W. Tracy, of the Martin Grate Company, of Chicago. This grate is fitted to burn any kind of coal, but is said to be especially adapted for the slack and screenings of the soft coals. It is also said to have many other valuable features, which makes it adaptable and economical for central station use. One of the Martin grates was exhibited in room 214, and attention was called to it by a unique pamphlet entitled, "The Grate that Jack Built." Count Alexander Cavalli, well known to many Chicagoans, is a representative of the Martin Grate Company, and he was in constant attendance at the convention, where he renewed many friendships.

THE BANNER ELECTRIC COMPANY, of Youngstown, Ohio, made an interesting exhibit of its line of incandescent lamps. Of particular note was the company's four-coil, three-anchor, 220-volt lamps, which were shown in oval and round bulbs, and with frosted and clear glass. Other types of lamps shown included bung-hole lamps and those especially adaptable for sign and window lighting. The Banner goods were made especially evident about the convention rooms by "chirpers," which persistently called attention to the Youngstown products. The exhibit was in charge of N. L. Norris, general manager, and F. C. Kirchner, superintendent. They were assisted by R. T. Hamilton, J. E. Hart and E. N. Beach, traveling salesmen for the company.

NATIONAL ELECTRIC COMPANY.—This convention was the first one at which the new National Electric Company, of Milwaukee, appeared under that official name. This company, as has already been announced in these columns, is successor of the Christensen Engineering Company, and is continuing the manufacture of the latter company's excellent electrical and air brake products. The company made no exhibit of apparatus, but had in its room several excellent photographs of alternating and direct-current electrical machinery which it is now building in capacities up to 1,500 kw. The company was officially represented by F. L. Hutchinson, manager of sales department, of Milwaukee; Charles G. Burton, manager of the Chicago office of the company; Arthur Jones, Cook County sales agent, and W. L. Waters, chief engineer, and Charles D. Knight, engineer, of Milwaukee.

THE GENERAL ELECTRIC COMPANY occupied the large south parlor on the first floor of the Auditorium Hotel. Among those representing the company who attended the convention were Mr. J. R. Lovejoy, general manager lighting, railway and supply departments; Mr. B. E. Sunny, Western manager, Chicago; Mr. C. B. Davis, manager, Boston office; Mr. A. F. Giles, manager, Atlanta office; Mr. J. S. Anthony, acting manager, New York office; Mr. A. D. Page, manager incandescent lamp sales, Harrison, N. J.; Mr. C. D. Haskins, Mr. W. S. Moody, Mr. H. W. Hillman and Mr. P. D. Wagoner, of Schenectady, N. Y.; Mr. J. C. Calisch, Buffalo; Mr. George.D. Rosenthal, St. Louis, and Mr. W. M. Deming, Cincinnati; Mr. E. H. Mullin, publication department. During the week Mr. W. L. R. Emmet, who has done such brilliant work at Schenectady on the Curtis turbine, came on accompanied by Mr. Gilbert, and participated most effectively in the most important part of the programme —the discussion of the Robb paper on the steam turbine.

ELECTRIC APPLIANCE COMPANY.—One of the most frequented and popular quarters in the Auditorium during the convention was that of the Electric Appliance Company, of Chicago, which occupied rooms 614 and 616. These rooms were continually filled with a host of delegates and visitors, who were royally entertained by I. A. Bennett, manager of sales department, and W. P. Upham, they being ably assisted by P. R. Boole and S. A. Rall and others of the Electric Appliance staff. President W. W. Low was also in frequent attendance and made his energetic personality felt. The exhibit of the Electric Appliance Company was shown individually by the different companies which it represents as sales agent in Chicago. The New York & Ohio Company, of Warren, Ohio, manufacturer of incandescent lamps, was represented by W. D. Packard. A full line of Guttmann wattmeters was shown by the Sangamo Electric Company, of Springfield, Ill., the special merits of these meters being ably demonstrated by R. C. Lamphere. J. G. Pomeroy displayed the well-known line of incandescent lamps manufactured by the Adams-Bagnall Company, of Cleveland. Another one of the Electric Appliance Company's exhibits was a quantity of commutator compound and soldering sticks manufactured by the Crescent Company, of Chicago, and displayed by James McGill.

W. N. Matthews & Bro., of St. Louis, were represented at the convention by F. A. Churchill, Jr. A working exhibit was shown of the firm's steam scale knocker, which is a mechanical device that is said to be very efficient in removing scale from return tubular boilers by either steam or air. Mr. Churchill also called the attention of the visitors to the merits of the Stombaugh guy anchor.

The Electrical Equipment Company, one of the rising electrical contracting and engineering concerns, of Chicago, was represented at the convention by President J. W. Peterson, W. W. Kittleman, engineer and salesman, and A. W. Tobin. They were kept busy receiving congratulations on having recently secured a large contract for electric lighting and power machinery to be installed at Zion City, famed as the model city of John Alexander Dowie.

The Jewell Electrical Instrument Company, of Chicago, had an interesting exhibit in the Auditorium. Edward W. Jewell, proprietor of the company, assisted by W. H. Huson, was in attendance to explain the distinguishing features of the Jewell meters. There was shown a complete line of central station instruments, including illuminated dial voltmeters and ammeters, a switchboard with circuit breaking instrument, battery-charging outfits, and standard switchboard and laboratory instruments.

Federal Electric Company.—One of the most noticeable and interesting exhibits to the central station men was that of the Federal Electric Company, of Chicago. This company, as is becoming quite well known, is the originator of a new type of electric sign, which is being installed extensively throughout the country. In room 636, the company showed a full line of electric signs, and James M. Gilchrist, manager, with the assistance of J. D. MacKenzie, was on hand to demonstrate the advantages of the porcelain-enamel metal feature. The company is just beginning to push a new type of sectional sign, in which each letter is mounted separately. These sign letters are not on the market as yet, but a sample of what will be the company's standard 16-inch letter was exhibited. This separate letter sign will be especially adapted to central station work, for the reason that when the sign is furnished to a customer, the letters may be used over again for another sign after his contract expires. Among the other types of signs exhibited were the regular panel signs, steel circular signs for brewery trade, and steel letter signs in one solid piece, these latter being distinct from the regular Federal sign, which has the lamps arranged around the edge, with the letters in white enamel. In the convention hall the company had a circular sign, on which was the monogram of the Association, while the entrance to the hall was designated by a panel sign of the Federal type. The company also had two of its signs on the parlor floor. A useful folder that was distributed to the delegates contained the programme of the convention, a map of the business district of Chicago, and information regarding the leading theatres, hotels, hack fare, etc.

Electric Vehicles in Boston District.

It is announced in Boston that the recent combination of electric lighting companies within a radius of 25 miles of the city will result in the development of the use of electric automobiles. Up to the present time, charging facilities have been very limited, but by the end of the coming summer it will be possible to charge an electric automobile not only at every large garage in the Boston district, but at electric light stations and even in livery stables, and arrangements are to be made whereby most of these places will be open 24 hours per day and every day in the year. It has been proposed to use coupon books like railroad mileages, which will be accepted in payment for current at any of the stations. There will be a few stables and lighting stations in the district which will not be open between midnight and 6 or 7 o'clock A. M., but the majority will be open all the time. In each station special facilities for automobile charging will be provided.

Vehicles may now be charged at all times at power stations in Brockton, Brookline, Cambridge, Gloucester, Lawrence, Lynn, Lowell, Malden, Medfield, Salem, Stoughton and Weymouth. Other charging points, most of them open for limited periods each day, are located at Arlington, Brockton, Fitchburg, Lawrence, Lowell and Lynn; and three in Boston open all the time.

About the middle of July additional charging stations will be opened in livery stables in Milton, Dedham, South Framingham, Natick, Winchester and Grove Hall, and in lighting stations in East Boston, Somerville, Woburn and Watertown. By August 1 additional charging stations will be located in Arlington, Canton, Chelsea, Chestnut Hill, Forest Hills, Needham, Newtonville and Stoneham.

Thus about 40 charging stations will be available in Eastern Massachusetts, each within a fair running distance of some other. There will probably be no charge less than 30 cents, but for large quantities of electrical charging energy the rate will be 10 cents per kw hour.

It is expected that this extension of facilities will produce a large growth in the electric automobile business around Boston. The new stations will make it almost as easy for a man to use an electric carriage for business or pleasure as to hire a horse. The Edison Electric Illuminating Company, of Boston, has given orders for a special equipment of heavy electric trucks and lighter vehicles to replace the horses and wagons now used in the care and maintenance of its conduits, overhead circuits and lamps throughout the city and suburbs. These vehicles will be designed for special work in connection with hoisting poles, drawing cables through conduits, hauling apparatus and supplies from place to place, and later the company will put in service a light van for emergency repairs, capable of running 16 miles per hour, and also two trimmers' wagons for arc lamp maintenance.

The New Claypool Hotel in Indianapolis.

The new Claypool Hotel in Indianapolis, representing an investment of $1,400,000, has been opened to the public. The generating plant consists of three engine type generators built by the Jenney Electric Manufacturing Company, of Indianapolis, such machine having a nominal rating of 150 kw, and run at a speed of 200 r.p.m. These machines are of the latest design of the Jenney Company, and are of the six-pole construction. The details of brush-holder rigging are very complete; any one of the carbons on either set can be easily lifted from the commutator while the machine is in operation, and the tension on each set of brushes can be varied as desired, and the entire set can be lifted from commutator by means of a worm gear mechanism provided for each set of brushes.

In addition to the generating plant, the Jenney Company have also equipped numerous machines throughout the building with individual motors, being the motors attached to ice cream freezers, dish-washing machines, ice machine and crumbing machine. In applying the motors to these machines supports of special design have been made which make each equipment extremely compact and self-contained, there being no countershafts or jack shafts required in transmitting power from motor to its respective machine. The extensive laundry equipment is operated by means of a 20-hp Jenney universal motor driving to line shaft in the usual manner.

The wiring at the Claypool was done by the Sanborn-Marsh Electric Company, all the electric light and telephone wires being run in iron-armored conduit. The distribution for the electric lighting comprises 20 sets of feeders from the main switchboard in the basement which run to the centers of distribution throughout the building. The line loss and difference of potential is kept down to a minimum by this method. The tablet boards are made of slate and the cabinets of iron and the circuits are provided with jackknife switches and enclosed fuses.

There are more than 12,000 lights used in the installation and a special feature of the lighting of the large special rooms is that low-candle-power lamps are used and distributed in profusion, the result being an even and perfect distribution of the light, which serves to bring out the decoration and illumination of the building in a very satisfactory manner.

The telephone equipment consists of a central energy plant placed in the basement in a room especially designed for its use. On the first floor is a lamp switchboard for the accommodation of 400 telephones, which are placed in all of the sleeping rooms and departments of the building. An unusual feature of the telephone wiring is that all wires are run in iron conduits. It is said that this is one of very few buildings where the telephone wires are put in with the same care that the electric light wires are. It is expected that by this method the trouble in the line wiring will be reduced to a minimum.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 3½ per cent. for 60-day loans. The stock market was depressed and weak on continued liquidation and bearish pressure. The selling seemed to come from large interests, although there were no disturbing incidents in Wall Street circles, and the news regarding railroad and other properties continued mainly very favorable. Brooklyn Rapid Transit was the most active of the traction group, and was affected by heavy liquidation sales, due mainly to sympathy with the rest of the list. Amalgamated Copper was very active, and declined on heavy selling, from 64¼ to 57⅜, there being rumors of liquidation by interests which have lately been active in bulling this stock. Some of the high-priced industrial specialties, including General Electric, lost considerable ground on very small transactions, though this seemed to be due to the narrowness of the market and the absence of bids for such securities. The closing price of General Electric was 181, a net decline of 2¾ points. The extreme quotations for the week were 180 the lowest, and 184½ the highest, the sales aggregating 4,600 shares. One hundred shares of Westinghouse were sold at 191, which was the ruling price throughout the week, being a net decline of 4¼ points. Westinghouse rights closed at 5½—a decline of 1½ points. Brooklyn Rapid Transit fluctuated between 58¾ and 62½, closing at 59⅛, this being a net loss of 2⅝ points. Metropolitan Street Railway was quiet, and fluctuated within narrow limits, closing at 128⅛, which is a decline of ⅞. American Telephone and Telegraph suffered a net loss of 6¼ points on the week's transactions, closing at 153, which was the unvarying price throughout the week. Following are the closing quotations of June 2.

NEW YORK.

	May 26.	June 2		May 26.	June 2
American Tel. & Cable......	75	75	General Electric.	183¼	180½
American Tel. & Tel........	153	..	Hudson River Tel..........	..	..
American Dist. Tel....	29	29	Metropolitan St. Ry.........	129¾	128⅛
Brooklyn Rapid Transit ..	61⅝	59¼	N. E. Elec. Veh. Trns........	..	⅛
Commercial Cable.	..	.	N. Y. & N. J. Tel...........	..	..
Electric Boat	20	20	N. Y. E. V. T. Co......	6¼	5¾
Electric Boat pfd......	39	38	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.. .	1¼	1¼	Western Union Tel...... ...	82¾	84¼
Electric Vehicle...	8½	8¼	Westinghouse com....	190	.
Electric Vehicle pfd........	13½	14½	Westinghouse pfd...........	190	185

BOSTON.

	May 26.	June 2		May 26.	June 2
American Tel. & Tel	154¼	151⅛	Western Tel. & Tel. pfd....	95	92*
Cumberland Telephone....	..	..	Mexican Telephone.........	1¾	1¾
Edison Elec. Illum...	..	..	New England Telephone ..	136*	132
General Electric.............	..	255	Westinghouse	94	90
Western Tel. & Tel	17½	16*	Westinghouse pfd....... . .	94	90

PHILADELPHIA.

	May 26.	June 2		May 26.	June 2
American Railways.........	..	..	Phila. Traction..	96½	96½
Elec. Storage Battery.. ...	74*	64½	Phila. Electric	6¾	6¼
Elec. Storage Battery pfd..	74*	.	Pa. Electric Vehicle.........	..	..
Elec. Co. of America.	8¼	8⅛	Pa. Electric Vehicle pfd ...	..	..

CHICAGO.

	May 26.	June 2		May 26.	June 2
Central Union Tel.	..	..	National Carbon pfd........	95	95
Chicago Edison........	..	155	Northwest Elev. com........	..	..
Chicago City Ry....	200½	200	Union Traction	3⅛	4⅛
Chicago Tel. Co.............	..	140	Union Traction pfd.........	32½	32½
National Carbon	23¾	23¾			

*Asked.

THE LATEST U. G. I. DEAL.—A dispatch from Detroit, of May 30, in regard to a matter already noted in these columns, says: A deal of great import to the properties of the American Light and Traction Company is pending, in which it is probable that the United Gas Improvement Company, of Philadelphia, will take over the following companies included in the former corporation on a ninety-nine year lease: Western Gas Company, of Milwaukee; St. Paul Gas Light Company, of St. Paul; Grand Rapids Gas Light Company, of Grand Rapids; St. Joseph Gas Company, of St. Joseph, Mo.; Madison Gas and Electric Company, of Madison, Wis.; Binghamton Gas Works Company, Binghamton, N. Y.; Southern Light and Traction Company, of San Antonio, Tex.; Consolidated Gas Company of New Jersey, of Long Branch, N. J. These are all in the group of McMillan companies, and the president of the American Light and Traction Company is Emerson McMillan, of New York. Manager Paul Doty, of the Detroit City Gas Company, has confirmed the statements in the above story.

NEW ENGLAND TELEPHONE.—The directors of the New England Telephone and Telegraph Company are expected to take action on the annual new stock issue. The growth of the company's business averaging about 15,000 new subscribers annually requires about $2,000,000 each year for new construction. The company has about 53,000 subscribers in Greater Boston, which compares with 44,969 subscribers June 1 last year, and 30,809 June 1, 1901. The subscribers in Greater Boston represent about 50 per cent. of the company's total subscribers. Last year the New England Telephone Company expended on plant and equipment $3,941,896 against $3,801,383 in 1901 and $3,153,501 in 1900. This year it is estimated that $4,000,000 will be spent for new construction and maintenance, divided as follows: for new construction, $1,800,000; for maintenance, $2,200,000. Last year 36,047 shares of new stock were issued on a basis of one new share for each five outstanding. In 1901, 25,774 shares were issued on a basis of one new share for each six held.

BIG TROLLEY MORTGAGE.—A chattel mortgage for $20,200,000, given by the new Public Service Corporation to the Fidelity Trust Company, was filed in the County Register's office at Newark, N. J., this week. The mortgage covers all the stock of the United Electric Company and the trolley companies turned over to the Public Service Corporation in accordance with the merger proposition. The number of shares of stock of each company enumerated is as follows: North Jersey Street Railway Company, 138,069; Jersey City, Hoboken and Paterson Railway Company, 200,000; Elizabeth, Plainfield and Central Railway Company, 29,950; Orange and Passaic Valley Railway Company, 89,019, and United Electric Company, 181,469. The mortgage was executed June 1, and was given to guarantee the payment of interest-bearing securities awarded to holders of these stocks.

CUYAHOGA TELEPHONE COMPANY.—Stockholders of the Cuyahoga Telephone Company met recently and ratified the plan for refinancing the company as proposed by the directors. The common stock of the company is to be reduced from $3,000,000 to $1,500,000 by reducing the par value of each share from $100 to $50. The company will issue $1,500,000 of 5 per cent. cumulative preferred (par value $50), which will be sold to present stockholders at $35. The money derived will be used for cancelling the debt of the company and for making needed improvements. The report of the president was very gratifying. February, 1903, the company showed a deficit of $29,685, and the expenses were 51.06 of the earnings. At present the company is earning a surplus, and the operating expenses are now 46.07 per cent of the gross. The company will soon close a contract for a large switchboard of the latest design.

CLEVELAND AND SHARON BONDS.—The Cleveland and Sharon Traction Company has filed with the County Recorder a mortgage for $2,000,000 5 per cent. gold bonds payable in twenty-five years, in favor of the Eastern Trust Company of New York City. The company is incorporated to construct a standard gauge electric railway from Middlefield, Ohio, to Sharon, Pa., also an extension from the main line at Kinsman, Ohio, to Meadville, Pa. The main line will connect with the Cleveland and Eastern Company at Middlefield, Ohio.

CENTRAL UNION TELEPHONE COMPANY.—The earnings for three years ended December 31, 1902, compare as follows:

	1902.	1901.	1900.
Gross	$3,003,717	$2,584,789	$2,309,471
Expenses and taxes	2,341,989	1,973,501	1,674,395
Net	$661,728	$611,288	$635,076
Interest on bonds	481,383	386,762	317,567
Surplus	$180,345	$224,526	$317,509

SEATTLE ELECTRIC REPORT.—The Seattle Electric Company reports as follows for the year ended March 31, 1903:

Gross	$1,944,863
Expenses	1,385,863
Net	$559,000
Charges	271,207
Surplus	$287,793

AMERICAN TELEPHONE AND TELEGRAPH.—It is stated that the directors of the American Telephone and Telegraph Company are considering the advisability of issuing $20,000,000 additional capital stock, which will be offered to stockholders at the ratio of one new share for every five now held, the proceeds of the issue to be used for improvements and to extend the company's lines in the west. There is a possibility that the date of the issue will be postponed until the money market becomes more propitious.

WELLMAN-SEAVER-MORGAN.—Plans for a consolidation of two of the largest engineering firms in the steel and iron business have been completed, with the result that the Wellman-Seaver-Morgan Engineering Company, of Cleveland, and the Webster, Camp & Lane Company have been merged into a corporation, with a capital stock of $3,000,000. In addition, there is a mortgage executed to the extent of $800,000.

PUBLIC SERVICE CORPORATION.—The proposed lease of the Essex and Hudson County Gas Company for 999 years to the Public Service Corporation, the new $25,000,000 company which has taken over the traction companies of Essex, Hudson, Passaic and Bergen counties, New Jersey, is being opposed by minority stockholders. Influential interests in the big corporation say that a large majority of the stock will be voted in favor of the plan.

BOSTON EDISON INCREASE.—The stockholders of the Edison Electric Illuminating Company of Boston have voted to increase the capitalization of the company from $8,635,500 to $9,499,100 by issuing 8,636 new shares of stock, offered to stockholders of record June 2 at $200 a share, in accordance with the permission of the gas commissioners, at the rate of one new share for every ten shares now held.

DIVIDEND.—The Union Traction Company of Philadelphia have declared a second semi annual dividend of 1½ per cent. The terms of the lease by which the Rapid Transit Company absorbed Unioa Traction last July were that for the first two years a dividend of 3 per cent. was guaranteed, the next two 4 per cent, the next two 5 per cent., and 6 per cent thereafter for the remainder of the 999 years.

POWER FOR GREENWICH, CONN.—The Glenville Power and Water Company has been organized at Greenwich, Conn., with $10,000,000 capital for the purpose of supplying water and electric power to Greenwich, Conn.; Rye, Harrison and Mamaroneck, N. Y.

Commercial Intelligence.

THE WEEK IN TRADE.—Wholesale trade is in a waiting attitude on crop, labor and price developments. According to reports received from all quarters, there is a favorable crop outlook, although the conditions are extremely varied, heavy rains being reported in some sections and droughts in others. The labor situation is still unsettled, close on to 100,000 men being idle in and near New York, as a result of the practical suspension of work in the building and allied trades. Building trades in other cities are hampered by labor troubles, notably at Chicago, Philadelphia and Kansas City. The iron situation has been partially cleared up by the buying of 85,000 tons of pig iron by the United States Steel Corporation at a price 50c. to 75c. below nominal quotations. A sale of 10,000 tons for June delivery has brought a higher price. Structural material is in good demand, notwithstanding labor troubles. Old iron and steel have been reduced in price. The outlook as to the country's export trade, according to *Bradstreet's*, is by no means depressing. Exports of manufactured goods for the month of April were only twice exceeded in the country's history. The copper market was extremely dull, but there were no changes in the "official" price. The prices quoted by producers are still 14¾ to 15c. for Lake and electrolytic, and 14½ to 14¾c. for casting stock. The business failures for the week ending May 28, as reported by *Bradstreet's*, numbered 181 against 155 the week previous, and 163 the corresponding week last year.

AUCKLAND, N. Z., LIGHTING PROJECTS.—The Australasian electrical engineering and contracting firm of Noyes Brothers, which concern represents the Westinghouse, Brill, Niles-Bement-Pond and other American manufacturing interests in the Antipodes, has submitted two plans to the municipal authorities of Auckland for the electric lighting of that New Zealand city. Two alternatives are suggested—the carrying out of the scheme by the city council on its own account or the granting of concessions to a private company to supply light and power. Mr. Goodman, who looks after the Noyes interests in New Zealand, suggests that the arc system should be employed in the main thoroughfares, while the narrow streets could be lighted with incandescent lamps. Altogether, 189 arc lamps of 1,000 candle-power would be required. The mains would be carried underground in the principal streets of the city, and the overheard system would be employed in the outlying portions. The area lighted would approximate eighteen miles of streets by arc lamps and thirty-six miles by incandescent lights. For generating purposes, steam is recommended. The cost of the foregoing system is estimated at $370,000. These estimates refer to the city proper. If all the suburbs embraced in the larger Auckland scheme were included, the number of arc lamps would be increased by seventy-three, and the number of incandescent lights by 3,475. A plant capable of meeting the larger demand would involve an estimated expenditure of $650,000. The British Electric Traction and Power Company, of London, which owns the Auckland traction system—built by J. G. White & Co.—have also offered to supply the needs of Auckland in the matter of light. It is suggested that they are able to do so more economically than any other supplier because their present capacity—1,000 horse-power—could be doubled without doubling the expense.

EXPORTATION OF MANUFACTURES in April was larger than in any preceding month in the history of our export trade, excepting the months of March and May, 1900. The total value of manufactures exported in April, 1903, was, in round terms, forty million dollars, against twenty-six millions in April, 1898; twenty one millions in April, 1896; sixteen millions in April, 1895, and fourteen millions in April, 1893. Thus, comparing April, 1903, with April, 1893, the total is nearly three times as great. On only two occasions in the entire history of our export trade have the exports of manufactures during a single month reached as high a figure as that of April, 1903. The two months which show a larger total than April of this year are March and May, 1900. In March, 1900, the total exports of manufactures were $44,767,139; in May, 1900, $40,460,367; while in April of this year the total was $39,846,569. An examination of the details of the exports of these two months, which exceeded April of this year shows that the higher figures of these two months are due almost exclusively to the fact that iron and steel exports on those occasions were much larger than at present. The total value of iron and steel exported in March, 1900, was $11,858,387, and in May of that year, $12,026,681; while in April of the present year the total exports of iron and steel was $8,929,233. The total exports of manufactures in the ten months ending with April, 1903, are five million dollars in excess of the total for the corresponding ten months of last year, and practically the same as the total for the corresponding period of 1901, making it probable that the total exports of manufactures in the fiscal year which will close with June, will about equal those of any fiscal year, except 1900.

FISCHER 'BUS IN ENGLAND.—A Fischer combination electric and gasoline omnibus, built in Hoboken, N. J., for use in London, England, has arrived in that city, where it is attracting much attention. It is the first of a number of similar vehicles to be at once put into active service, the route being from the Angel, Islington, to Walham Green. The 'bus has a capacity of thirty passengers, having seats on the top which are reached by a stairway from the platform at the back. The engine and dynamo are in front, with the driver's seat above. The average speed is twelve miles an hour. The wheels have solid rubber tires. The gasoline motor is of the vertical four-cylinder pattern, and develops about sixteen horse power at 475 revolutions. The dynamo is coupled direct and has an output of nine kilowatts. The rear wheels are driven by separate motors suspended in front of the back axle. The battery consists of forty-eight chloride cells placed beneath the seats in the body. They have a capacity of 125 ampere hours at a three-hour rate of discharge. The electrical connections permit of the vehicle being run without the engine, and of the engine being started from the cells. Besides the ordinary electric brakes there are band brakes on each of the armature shafts of the motors and spoon brakes on the tires of the rear wheels.

IMPORTATIONS OF MANUFACTURERS' MATERIALS into the United States in the fiscal year which ends with June will be by far the largest in the history of our importations, and will amount to nearly or quite $500,000,000. Manufacturers' materials will form about 48 per cent. of the imports of the fiscal year. The ten months' figures of the Treasury Bureau of Statistics, just completed, show that manufacturers' materials formed 47½ per cent. of the imports for the ten months, and 49.77 per cent., or practically one-half of these of the latest available month, April; while in March they formed 49.06 per cent. Beyond doubt, the total importation of manufacturers' materials in the fiscal year 1903 will by far exceed that of any preceding year. The fiscal year 1902 was the banner one prior to the current year, its total being 415 million dollars; while the highest figure ever reached prior to 1902 was in 1900, when the total was 380 millions. The share which manufacturers' materials form of the total, as already indicated, will be about 48 per cent. of the total imports of the present fiscal year. In 1900 it was, in round terms, 46 per cent; in 1890, 34 per cent; in 1880, 37 per cent.; in 1870, 28 per cent., and in 1860, 25 per cent.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, announces the purchase, on June 1, of the Carpenter Enclosed Resistance Company, of New York City. The manufacturing plant of the latter company will continue in operation here in the East, forming the nucleus around which the Cutler-Hammer Manufacturing Company is planning to build a much larger and thoroughly equipped plant for the manufacture of the well-known "C. & H." and "Carpenter" electric controlling devices. The Cutler-Hammer Manufacturing Company is very fortunate in being able to secure the services of Mr. Chas. E. Carpenter, who has been so long and favorably known in this particular line, and who at once enters its organization. Friends of both concerns are much pleased by the arrangement, and the Cutler-Hammer Company again demonstrates its progressive tendencies by thus increasing its facilities for catering to the growing demands of its clientele.

NEWARK WESTINGHOUSE PLANT.—The large increase in sales of integrating wattmeters and other electrical recording instruments by the Westinghouse Electric and Manufacturing Company has made necessary an extensive addition to the Newark works of this company. Appreciating the economic features and value of concentration, the meter branch of the electrical manufacturing business is here given that special attention requisite for the securing of perfection. The extension now being made will practically double the size and productive powers of this factory. The company manufactures its own meter tools, jewels and special appliances. While the mechanical features mark the perfection of their kind, equal attention has been given to the question of the comfort and convenience of the 3,000 employees. In plan, construction, and product this plant is a worthy member of the extensive Westinghouse family of industries.

THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, LIMITED, outbidding German and Austrian manufacturers, has won another large municipal contract in England, the competition among manufacturers having been unusually keen and speculation rife as to the successful tenders. The London County Council, however, at a recent meeting, closed a contract with the British Westinghouse Company, amounting to about $590,000, and calling for 200 tramcars, which are to be used on its lines south of the Thames. This is the largest order ever given for electric cars in England. One-half of the cars are to be of the single-track type, thirty-two tenders having been received for these. The remaining one hundred, for which twenty-six tenders were received, will be double-deck, bogie-truck tramcars, which are to be delivered in twenty-eight weeks.

GENERAL SUPPLIES FOR JAPAN.—Francis A. Amdill, 96 Wall Street, New York, who represents the electrical engineering and contracting firm of L. J. Healing and Company, Yokohama, is now purchasing various supplies, etc., in this market for shipment to the far East. The Holtzer-Cabot Company, of Brookline, Mass., has received an order from Mr. Amdill for its specialties. The Hazard Manufacturing Company, 50 Dey Street, New York, will supply some telephone wire for the Japanese government system. Baker & Company, of Newark, N. J., will ship some platinum wire. The Diamond State Fibre Company, of Elsmere, Del., has secured an order for insulating fibre, and the Mica Insulator Company, of 218 Wall Street, New York, has obtained a fair-sized order for its specialties.

IDEAL ELECTRIC AND MANUFACTURING COMPANY is the name of a new concern just started at Mansfield, Ohio, by Messrs. S. Glen Vinson, who is its secretary and treasurer, and Mr. S. E. Huenerfauth as superintendent. The other officer is Mr. C. H. Voegele, president. The company is duly chartered under the laws of Ohio, and is erecting a modern fireproof building, which it will equip with the latest tools and appliances for the manufacture of a complete line of electrical machinery and appurtenances. The concern, which has offices for the present at Room 5, Blecker Block, Mansfield, would like to receive catalogues of machine tools, cranes, power equipment, etc., as well as of materials used in the production of electrical machinery.

THE CALEDONIAN RAILWAY.—Considerable interest has been shown by the railway officials in Scotland on two recent occasions when the powerful express locomotive built for the Caledonian Railway appeared at one of the Company's stations on trial runs. Though the engine is not yet finished and was unpainted, the massive proportions and liberal dimensions of the mechanical details were such as to attract the attention of even the general public. The engine is fitted with Westinghouse air brakes, and when completed, will weigh about 74 tons; while with the tender, six tons of coal and 5,000 gallons of water, the total weight will be about twenty tons more than that of any other locomotive in the British Isles.

BALL ENGINE ORDERS.—The Pennsylvania Railroad Company has purchased from the Ball Engine Company, Erie, Pa., for its Altoona shops, a 450-hp. tandem, compound engine, direct-connected to General Electric alternator. This engine is the fifth of this size purchased within two years from the Ball Engine Company. The Menominee Sugar Company, Menominee, Mich., will have an electric plant, consisting of two engines of 150-hp direct-connected to Crocker-Wheeler generators. The Ball Engine Company furnishes the engines, which are of the self-oiling type.

EQUIPMENT FOR CANADIAN COPPER PLANT.—The Canadian Copper Company, controlled by the International Nickel Company, 74 Broadway, New York, is now letting contracts in this market for considerable equipment for its new plant at Copper Cliff, Ont., which will eventually be operated by electricity. Thayer & Company, incorporated, have taken the boiler contract, which calls for four Cahall units of 400-hp capacity each. The engine will be of Corliss type, the Nordberg Manufacturing Company, of Milwaukee, having taken the contract.

HEATING AT RED OAK: A CORRECTION.—In the article on "Development of Light and Power Business at Red Oak, Iowa," in the issue of this paper for May 23, 1902, a statement was made that the Yaryan hot-water heating system was used there, which was an unaccountable error, for which the writer of the article wishes to humbly apologize, inasmuch as the Red Oak hot-water heating system is, as is well known to many readers of this paper, one of the oldest and most notable central station hot-water plants of the Evans-Almirall Company.

CONTRACTS FOR JAPANESE LIGHTING PLANT.—The Kobe Electric Light Company, Japan, is to double the capacity of its plant. American equipment will be installed. The machinery now called for will have a capacity of about 500 hp. The General Electric Company will supply the generator. The engine—a horizontal tandem one—will be built by McIntosh & Seymour. The Blake end of the International Steam Pump Company will ship the condensing equipment. The boilers will be Babcock & Wilcox.

BISHOP AND BABCOCK PLANT.—In addition to the equipment previously purchased from the Westinghouse Electric and Manufacturing Company, the Bishop and Babcock Company, of Cleveland, Ohio, has recently installed a 175-kw, two-phase, engine-type generator, direct-connected to a Ball engine, together with an exciter and four 40-hp and one 20-hp type induction motors. Geo. S. Rider & Company, of Cleveland, were the consulting engineers.

LIGHTING A CIRCUS.—Note was made recently in these columns of lighting Ringling Brothers' circus with Nernst lamps. We may add that the Marinette Iron Works, of Marinette, Wis., furnished for this installation two 30-hp, three-cylinder, Walrath gasoline engines, mounted on steel trucks. This makes a very neat outfit with the dynamo, and Ringlings already had two complete outfits of this size giving excellent results.

EQUIPMENT FOR TRANS-CASPIAN RAILROAD.—Several very large contracts are expected very shortly for American electrical equipment, machine tools, etc., for the Trans-Caspian railroad now under construction by the Russian government. The Russian Ministry of Ways and Communications is engaged in drawing up the specifications, which it is reported will call for an expenditure exceeding $5,000,000.

JAPANESE CONTRACT PENDING.—The Sanyo Railway Company, South Japan, is about to let contracts for an extension to its plant. The equipment will be of American manufacture. The specifications call for a 250-kw generator, 550 volts, 60-cycle, for direct connection to a vertical compound engine of 350-hp capacity. Exciters will also be ordered.

MACHINE TOOLS FOR THE PHILIPPINES, ETC.—The Dreses Machine Tool Company, of Cincinnati, Ohio, has been awarded a large contract for machine tools to be installed in the United States coaling station at Cavite, Philippine Islands. Orders have also been received recently for various tools to be shipped to Sweden, Denmark and Italy.

WESTINGHOUSE TRACTION BRAKES.—The Westinghouse Traction Brake Company has received an order from the St. Louis Rapid Transit Company to put brakes on 2,000 cars for use during the rush season, attendant upon the exposition. The order also includes the installation of forty compressor plants throughout St. Louis.

PIPE, ETC., FOR SOUTH AFRICA.—The Crane Company, of Chicago—New York offices, 490-502 Cherry Street—have secured a large South Africa contract for pipe, etc.

MILLING MACHINES FOR FRANCE.—The Cincinnati, Ohio, Milling Machine Company has been allotted a substantial French order for its specialties.

PELTON CONTRACT FOR THE ARGENTINE. The Pelton Water Wheel Company, 143 Liberty Street, has been awarded a large Argentine Republic contract.

ELECTRICALLY-DRIVEN TOOLS FOR AUSTRALIA.—The J. A. Fay and Egan Company, of Cincinnati, have taken a large contract for wood-working machinery to be shipped for installation in Australian railroad shops, and operated by electricity.

TOOLS FOR JAPANESE ARSENAL.—The American Tool Works, of Cincinnati, Ohio, will build several machine tools for shipment to the Japanese government arsenal at Kobe, where they will be electrically driven.

BARNES MACHINE TOOL FOREIGN CONTRACTS.—The W. F. and John Barnes Company, of Rockport, Ill., has lately secured good orders for its various specialties for shipment to Mexico, France, Belgium, Holland, Germany, Italy and Australia.

General News.

THE TELEPHONE.

POMONA, CAL.—The Pomona Valley Telephone Company has been organized and is at work installing an extensive system.

SAN PEDRO, CAL.—The Town Trustees have sold to J. C. Brainard a 50-year telephone and telegraph franchise for $100.

WHITTIER, CAL.—J. W. Boon, representing the Home Telephone Company, has purchased a telephone franchise from the town of Whittier for $100.

LOS ANGELES, CAL.—The Pasadena Home Telephone & Telegraph Company has incorporated with a capital stock of $100,000, of which amount $10,000 has been subscribed. The directors for the first year are John Van Loew, F. W. Wachter, D. F. Boyce, Arthur Wright and F. F. Graves.

DENVER, COL.—The Rocky Mountain Telegraph & Telephone Company has commenced an action in the district court to have the transfer of franchise and license made by S. W. Jacobs to the Denver Telephone Company declared null and void. It is contended by the plaintiff that the transfer was made by fraud and that the Denver Company has no right to operate under the franchise.

SAVANNAH, GA.—The underground system of the Southern Bell Telephone Company in Savannah will be considerably extended if the necessary permission can be secured from the city.

ATLANTA, GA.—A charter has been granted to the American Telephone & Telegraph Company, of Atlanta, with a capital stock of $25,000. E. J. Hall, of Morristown, N. J., W. E. Holcomb, of New York, A. Ward Cobb, of Atlanta, and others are interested. Work will begin at once constructing lines through the state.

COSAM, ILL.—The Cosam Camp Ground & Mt. Vernon Telephone Company has been incorporated with a capital of $2,500. The incorporators are James G. Williams, G. W. Clark and W. W. Duncan.

CARLINVILLE, ILL.—W. Roy McCann, of St. Louis, assistant secretary of the Kinloch Telephone Company, has closed a contract with the Macoupin Telephone Company, of Macoupin County, whereby they are to build jointly two metallic circuit lines from Alton to Springfield through this city, giving the Macoupin Company connection with St. Louis and the rest of the country and the Kinloch Company connections with Macoupin County and other cities having the independent system throughout this section. The contract calls for the new lines from St. Louis to Springfield within a year, but Mr. McCann says they hope to have the same completed by September.

MT. VERNON, IND.—The Posey County Telephone Company has filed articles of incorporation. The capital stock is $50,000. Allen Gray, Wm. M. Tow and others are the incorporators.

SALEM, IND.—The Hoosier Telephone Company will install a new exchange and offices here. The company's system covers Washington and adjoining counties. A number of improvements will be added.

GREENFIELD, IND.—The Ward Telephone Company of Hancock County, has incorporated with a capital stock of $1,400. A neighborhood farmers' system will be put in operation. J. M. Newhouse is president.

RICHMOND, IND.—The Home Telephone Company of this city has a hundred applicants waiting for service which cannot be had at present for lack of sufficient cables to carry the wires. The company will expend $10,000 in new cables and needed extensions.

MADISON, IND.—The Jefferson Telephone Company has incorporated with a capital stock of $10,000. The company will build lines and exchanges in Jefferson, Clark, Scott, Jennings, Ripley and Switzerland counties. Wm. A. Kirk, J. M. Benson and John McGregor are the incorporators.

GREENFIELD, IND.—The Sugar Creek Farmer's Telephone Company changed its name to New Palestine Telephone Company of Hancock County and the capital stock was increased to $15,000. The company will make extensive improvements. Henry N. Myers is president and Gas. Shramm, secretary

ALEXANDRIA, IND.—Farmers east of this city have organized a country telephone exchange which will cover a large part of Monroe township and connect with the Alexandria exchange. Marshall Walker, a former county commissioner, is at the head of the company which is backed by ample capital.

CRAWFORDSVILLE, IND.—The city council has granted the Crawfordsville Co-operative Telephone Company a franchise to run two lines of poles and wires in this city. The franchise contains some rigid provisions favorable to the city. The charges for residence telephones shall not be more than $6 and for business not more than $13 per year.

LOGANSPORT, IND.—The Northern Indiana Telephone Company has incorporated with a capital stock of $10,000. The organization is, in a sense, a merger of twenty-five companies operating in northern Indiana. The object is to pool the long-distance business of the various companies. The territory covered by the company will be from Lafayette in the south to South Bend on the north and from Chicago on the west to Winchester on the east, including forty-seven counties. The first move of the new company will be to build a number of toll cables out of Logansport where the company will maintain headquarters. These improvements the company considers will place the independent companies on a par with the Bell Company.

EVANSVILLE, IND.—The ordinance granting a franchise to the Evansville Municipal Telephone Company provides that at any time after the preferred stock has been redeemed the city may, at its option, purchase all property rights, contracts, franchises and all other assets of the company at a price equal to the par value of the outstanding common stock, and that it thereupon shall distribute the money paid for the same to each of the shareholders of such common stock *pro rata*. The city is the holder of 7,900 shares of the common stock, that being a large majority. The franchise is for a term of twenty-five years. The following charges have been decided on. Full metallic long-distance instruments for business houses not less than $3 nor more than $4 per month. Residences metallic long-distance $2. Party lines, selective signal, two on a line, $1.50. Four on a line $1. Mayor Covert says work will begin in ten days on the municipal plant.

LANSING, MICH.—The Benzie County Telephone Company has increased its capital stock to $10,000 and will make extensions. W. A. Young is president and H. B. Woodward, general manager of the company.

PINE RIVER, MICH.—The Pine River Telephone Association has been organized by local farmers and a number of farmers' lines will be installed. Connection will be made with the lines of the Union Telephone Company.

ELLENBORO, N. C.—The Ellenboro Telephone Company has been chartered by the secretary of state.

NEWARK, N. J.—The Northeastern Telephone and Telegraph Company, Newark, has been incorporated, capital $100,000. Incorporators: Union N. Bethell, William T. Bouchelle, Walter Brown, John H. Cahill and Howard Thurber.

XENIA, OHIO.—The Citizens Telephone Company is building new lines to Yellow Springs and Clifton.

ATHENS, OHIO.—The Athens Telephone Company is building a line to Uniontown and will connect up a large number of farmers.

WAPAKONETA, OHIO.—The Auglaize Telephone Company is building a line to St. Johns and will connect with the farmers in that district.

WARREN, OHIO.—The Phalanx & Leavittsburg Telephone Company has completed a line to Leavittsburg, giving it connection with all the lines of the Warren & Niles Telephone Company.

CONTINENTAL, OHIO.—The Putnam Telephone Company has 125 subscribers as compared with 79 a year ago. About fifty people are on the waiting list and the system will have to be enlarged to take care of them.

CANTON, OHIO.—The Stark County Telephone Company will spend $80,000 in immediate improvements. The company has nearly 500 names on the waiting list and will install a new switchboard to bring the capacity up to 3,500. A large amount of new cable will be erected in the city and new toll lines will be built to Middlebranch, Congress Lake, Hartville, New Baltimore, Uniontown, Greentown, Waynesburg, Magnolia and other towns.

OTTAWA, ONT.—A powerful rival to the Bell Telephone Company in Canada is now in process of formation. An application is before the Canadian parliament, on behalf of a number of American capitalists, principally residents of Philadelphia, for a charter for a telephone company with rights throughout the Dominion of Canada. The capital of this company is to be $30,000,000. The capitalists interested are also negotiating to purchase, or have already bought out the Merchants' Telephone Company, of Montreal, which company is only authorized to operate in the province of Quebec and most of the capital stock of which is now controlled by American capitalists. As soon as the Dominion government grants the charter to the company first referred to, it is understood that it will absorb the Merchants Company.

ST. GEORGES, S. C.—The St. Georges Telephone Company, M. S. Cannon, president, has been chartered with a capital of $5,000.

WILMINGTON, S. C.—The Southern Bell Telephone Company has just moved into its new exchange here. The wires in the business section have recently been placed underground.

CLARKSVILLE, TENN.—The Home Telephone Company, of Clarksville, is building a number of out-of-town connections to Guthrie and other points.

CHATTANOOGA, TENN.—The Hamilton Telephone and Power Company has applied for a charter in Chattanooga. It will probably establish an electric light plant. The company has strong financial backing.

PROVO, UTAH.—The Rocky Mountain Bell Telephone Company announces that its system will be extended in the near future to the small towns surrounding this city.

ELECTRIC LIGHT AND POWER.

SKAGWAY, ALASKA.—The Northwest Light & Power Company has the alternating-current system of the Stanley Electric & Manufacturing Company. The one dynamo is of 100-kw capacity. The company supplies 1,000 incandescent lamps of 16 and 32 candle power. Besides the steam plant, there is a water power developed by a Tuthill wheel of 175 horse power. Mr. Chas. D. Shepard, of Seattle, Wash., is president of the company, and Chas. H. Kiehl, of Seattle, is secretary and treasurer.

SANTA MARIA, CAL.—The Board of Supervisors has granted to Reuben Hart a 50-year franchise for an electric light and power system in the town of Santa Maria.

LOS ANGELES, CAL.—One of H. E. Huntington's large brickyards near Los Angeles is to be equipped for brick-making by electric power with a capacity of 40,000 brick per day.

FORT COLLINS, COL.—The Lonmer Light & Power Company has a capital of $50,000. It operates an alternating system, its lighting system consisting of 42 direct-current and 20 enclosed-arc lamps and 5,825 incandescents. It charges 10 cents per kw-hour for motor power.

GRIFFIN, GA.—Capt. Saton Grantland is interested in developing a large water power near here. The cost is estimated at about $200,000. Four thousand horse power is available.

SOUTH WHITLEY, IND.—The South Whitley Electric Light Company has increased its capital stock $12,000 and will make extensive improvements and install some new machinery.

RUSHVILLE, IND.—The report of the municipal electric light plant for the year ending May 1, shows an excess of receipts over expenditures of $842.10.

The plant has been self-sustaining for four and a half years and has given the people good service at low cost.

INDIANAPOLIS, IND.—The Board of Public Works has completed the specifications for the electric lighting contract for ten years, beginning January 1, 1905. The purpose of postponing until that date being that a successful bidder without a plant would have time to construct one. As a consideration the city offers to award a franchise for private lighting for a period of twenty-five years to the successful bidder for public lighting, the charge for private use not to be over 10 cents per kw-hour and the city to receive 5 per cent, of the gross receipts. The city reserves the right to buy the plant. Specifications and provisions of the contract are now ready to be sent out. Address Fred Joss, City Attorney.

STUART, IA.—The municipal plant furnishes twenty-nine 1,200-cp. arc and 100 incandescent lights.

FORT MADISON, IA.—The electric light plant of S. & J. C. Atlee has 87 arc lights and 4,000 incandescents.

NORTHWOOD, IA.—Mr. L. F. Madson is owner and manager of the Northwood Lighting Company, which has a capital stock of $10,000. He informs us that there is a good opening for an electric railway of about 18 miles, through a good country and two towns. The people want it and need it.

MASON CITY, IA.—The Brice Gas & Electric Company has a capital stock of $150,000, and operates both alternating and direct-current systems. It has 150 arc lights and 7 miles of circuit.. It has a motor service including about 50 machines, the prices for such service being 10 and 5 cents per kw-hour.

FAIRFIELD, IA.—The city owns the electric light plant, which is a very old one, and the question of replacing it with up-to-date machinery is to come up. At present there are twenty 2,000-cp arc lamps. There is an independent company here with a 15-year franchise to furnish incandescent lights.

ATCHISON, KAN.—The Atchison Railway, Light & Power Company has increased its lighting to 200 arcs and 12,000 incandescent lights. It furnishes 500-hp motor power at rates from 5 cents to 10 cents per kw-hour, and has ten miles of car track, nine motor cars and ten trailers.

HENDERSON, KY.—This place has a municipal plant which operates 225 2,000-cp arc lights and 2,500 16-cp incandescents. Twelve motors are furnished power at five cents per kw-hour, 5 to 20 per cent. discount.

CROWLEY, LA.—The Crowley Water Works & Electric Light plant has 23 arc lamps and 1,000 incandescents. The system is to be extended and a new plant of 10,000 light capacity put in. All machinery is required.

HOULTON, ME.—The electric light plant is the property of E. Merritt & Sons. It operates 15 arcs and 3,000 incandescent lights.

ROCKPORT, ME.—Seven thousand dollars in bonds have just been voted for the electric light plant, which is increasing its capacity. It now has 490 domestic and 180 street incandescent lights.

LAWSON, MD.—The electric light system is to be changed in the near future and a generator and storage battery will be required.

SALISBURY, MD.—The Salisbury Gas & Electric Light Company, E. G. Frost, manager, has $50,000 stock and $50,000 bonds. It furnishes seventy-seven 1,200-cp arc lamps and 1,600 16-cp incandescents.

HAZELHURST, MASS., established a municipal plant in 1902, with $45,000 bonds. It operates seven miles of wire, 35 arc lights and 1,800 incandescents.

STOUGHTON, MASS.—The Stoughton Gas & Electric Company, C. H. Swan, manager, has 37 miles of circuit, 73 arc lights, 2,800 incandescents and nine motors.

GARDNER, MASS.—The Gardner Electric Light Company has $65,000 capital stock, and operates 120 1,200-cp. arc and 6,000 16-cp incandescent lights. Motors are run on a sliding scale basis.

PLYMOUTH, MASS.—The Plymouth Electric Light Company has $90,000 capital stock and furnishes 30 arcs and 6,000 incandescents; also motors of 300-hp at ten cents to three cents per kw-hour.

BELLERICA, MASS.—The Lowell Street Railway Company has absorbed the Bellerica Electric Company, but a sub-office is maintained here. The town is lighted by 100 25-cp series incandescents and some 2,500 16-cp are in private use.

CLINTON, MICH.—The municipal electric light plant furnishes thirty-five 1,200-cp arc lamps and 1,200 incandescents.

MT. CLEMENS, MICH.—The Mt. Clemens Electric Company operates 150 1,200-cp arc lights and 7,500 16-cp incandescents.

HOLLY, MICH.—The Holly Electric Light & Power Company operates thirty-four 2,000-cp street arcs and 1,400 incandescents.

OTSEGO, MICH.—The electric light plant furnishes the village with 34 arc lamps. It gets current from the Kalamazoo Valley Electric Company.

PLAINWELL, MICH.—Messrs. Arnold & Brownell, owners of the electric light plant want 20 meters; 220 volts and 5 to 25 amperes, direct-current 2-wire.

FREMONT, MICH.—The Fremont Electric Light & Water Works, a municipal plant, has recently placed its service on a meter basis. There are twenty 2,000-cp arcs and 1,600 16-cp incandescents.

ISHPEMING, MICH.—The Negaunee & Ishpeming Street Railway & Electric Light Company operates 80 arc lights, forty 2,000-cp, forty 1,200-cp. It runs 15 motors at ten cent rates and several electric cars.

MILFORD, MICH.—Mr. F. S. Hubbell is the owner of the electric light works which operates 23 arc lights and 2,000 incandescents. Mr. Hubbell has plenty of power to spare by day, and would like to engage in some electrical manufacture.

THREE RIVERS, MICH.—The Three Rivers Light & Power Company furnishes 85 2,000-cp arcs and 3,000 16-cp incandescent lights and charges eight cents per kw-hour for motor power. There is splendid water power and a good route for an electric railway.

NEW RICHLAND, MINN.—The electric light plant, owned by Lea & Borge, furnishes five 2,000-cp arcs and 600 incandescent lights.

RED WING, MINN.—The Red Wing Gas & Electric Company, J. C. Pierce, president, has 45 street arcs and 92 incandescent lights.

OLIVIA, MINN.—It is the intention to install a larger dynamo engine and boiler in the municipal plant during the present season. The plant is under the control of the village council.

CHATFIELD, MINN.—The Chatfield Electric Light & Power Company has $50,000 capital stock, of which $22,000 is paid up. Jos. Underleak is president. It has about twelve miles of wire, twelve 1,200-cp arc lamps and 1,788 incandescents, mostly 32-cp.

RED LAKE FALLS, MINN.—The Red Lake Falls Electric Light Company, which was formed in 1898, has $8,000 capital stock. M. Johnson is president and S. M. Sivertson, secretary and treasurer. It has in operation twenty-four 2,000-cp arc lights and 1,600 16-cp incandescents.

ST. CLOUD, MINN.—The Light, Heat. Transit & Public Service Company, E. E. Clark, manager, operates a General Electric system, having 80 miles of circuit, 180 arc lights and 8,000 incandescents. It runs 11 cars on a charge of three cents per kw-hour; its motor rates being five cents to six cents per kw-hour.

KOSCIUSKO, MISS.—The Kosciusko Oil Mill & Fertilizer Company operates a General Electric plant of thirty-five 2,000-cp arcs and 1,500 16-cp incandescent lights.

GRENADA, MISS. owns a municipal plant of 30 arc and 1,500 incandescent lights. C. B. Bolton is superintendent. The Ayer Loyd Tie Company wants a complete installation of electrical equipment.

BATESVILLE, MISS.—The Panola Electric Light & Power Company was organized in April, 1903, with $12,000 capital. D. L. Rush and Roy Bell are partners. It has 15 miles of circuit and 1,000 16-cp incandescent lights.

MERIDIAN, MISS.—The Meridian Light & Railway Company has $250,000 capital and 200,000 bonds, and operates 120 arc lights and 5,000 incandescent lights. It runs four cars over 5½ miles of track, and is about to extend its line.

YAZOO CITY, MISS.—The Yazoo Improvement Company has sold its plant to the municipality. The city has sold $175,000 of bonds to a Cleveland firm. It will make improvements and extensions to cost about $150,000 to the water, light and sewage systems.

SEDALIA, MO.—The Sedalia Electric Light & Power Company operates 100 arc and 1,500 incandescent lights.

ST. LOUIS, MO.—The following named gentlemen were elected officers of the West St. Louis Water & Light Company: Thos. W. Crouch, president; J. B. Quigley, first vice-president; John F. Lee, second vice-president; E. S. Lewis, secretary and treasurer; N. D. Thompson, assistant treasurer; B. V. Beckman, assistant secretary.

WAHOO, NEB.—S. H. Jones owns the lighting plant and operates five 1,200-cp arcs and 1,200 16-cp incandescents.

TONOPAH, NEV.—The Tonopah Light & Power Company was organized in 1902 with $50,000 capital; W. C. Watson is president. The system is General Electric, there being 2½ miles of circuit, three arcs of 2,000-cp and 1,200 16-cp incandescent lights.

PLYMOUTH, N. H.—The Plymouth Electric Company has a capital stock of $10,000, the officers being J. N. McCoy, president, and F. C. Calery, treasurer and manager. The company's system is the Edison direct-current, there being two dynamos of 25-kw capacity each. The lighting consists of 7 arc lamps and 1,600 incandescents.

HICKORY, N. C.—The Thornton Light & Power Company is installing a $27,000 lighting plant in Hickory. M. E. Thornton is president of the company.

ASHEVILLE, N. C.—The W. T. Weaver Power Company of Asheville has let the contract to C. R. Willis for a dam across the French Broad River, five miles from Asheville, where a large electric plant is being erected. It is expected that the plant will be completed by September 1. (See article elsewhere in this issue.)

MAUMEE, OHIO.—The Maumee Electric Company has a capital stock of $30,000, and bonds to the amount of $10,000. Mr. D. W. Tryon is president and A. C. Tryon secretary and treasurer. The company operates an alternating current system, using Bullock and Warren generators. The lighting system consists of 36 arc lamps and 2,000 incandescents. Besides the regular steam plant, th company has a Sampson water wheel. The company does a general supply business in addition to its electric lighting service.

OTTAWA, ONT.—A charter has been secured from the Canadian parliament for the Sault St. Louis Light & Power Company to develop power from the Lachine Rapids, and at Ile Heron, Ile au Diable, and adjacent islands in the St. Lawrence River. The charter also provides for authority to manufacture calcium carbide and to operate vessels. The capital of the new company is placed at $1,000,000, and its headquarters are to be in Montreal, Que.

SALEM, ORE.—The Salem Light, Power & Traction Company has entered into a twenty-year contract with the Union Light & Power Company, of Portland, for the supply by the latter of all the electrical energy repuired during that period, which will be transmitted a distance of 17 miles to Salem.

SILVERTOWN, ORE.—The Union Light & Power Company, of Portland, is supplying current from its new power plant on Silver Creek to Woodburn, Silvertown, Mt. Angel and the Benedictine priory and college at the latter place.

COATICOOK, QUE.—The entire plant of the Coaticook Electric Light & Power Company has been purchased by the town of Coaticook, Que., for $36,000, and the corporation will assume control October 1, next. This action has settled amicably and satisfactorily a long and bitter dispute.

BISHOPVILLE, S. C.—The Lee County Manufacturing Company of Bishopville, has been granted a franchise to light the town by electricity.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—The Los Angeles & Glendale Electric Railway Company has incorporated, capital stock $1,000,000. Directors: L. C. Brand, R. H. Howell, E. T. Stimson, W. H. Holliday, George F. Cope, all of Los Angeles.

BAKERSFIELD, CAL.—The Bakersfield & Ventura Railway Company has incorporated, capital stock $5,000,000. Incorporators: H. M. Russell, Eben Smith, J. W. Burson, Gervais Purcell, A. N. Sanford, J. W. Swanwick, all of Los Angeles.

HARTFORD, CONN.—The House has passed a resolution incorporating the Wallingford Tramway Company. The incorporators are Walter J. Leavenworth, Frank A. Wallace, George E. Dickerman, Charles B. Yale and Ralph T. Ives, of Wallingford.

WASHINGTON, D. C.—The Chesapeake Beach Railway Company has under consideration the subject of converting its line into an electric railway.

FREEPORT, ILL.—The City Council has passed an ordinance granting a railway and lighting franchise for twenty years to the Freeport Electric Company.

STERLING, ILL.—The contract for constructing the Sterling, Dixon & Eastern Electric Railway has been awarded to the Columbia Construction Company, of Milwaukee, Wis. About 17 miles of road are to be built.

MOLINE, ILL.—It has been decided to increase the capital stock of the Kewanee, Cambridge & Geneseo Railway, which has in contemplation the construction of an electric railway to connect Kewanee, Cambridge and Geneseo, from $100,000 to $850,000.

METROPOLIS, ILL.—Capitalists in Paducah, Ky., and Cairo, Ill., and in the intermediate country are taking steps to organize a company for the purpose of building an electric railway between Paducah and Cairo, through the Kentucky territory opposite here. The distance is about 25 miles.

BELLEVILLE, ILL.—The City Council has granted twenty-year franchises to the Belleville & Mascoutah Electric Railway and the Belleville & Freeburg Electric Railway, to operate on certain streets of the city. A franchise has also been granted the Interurban Electric Railway Company to operate here.

DECATUR, ILL.—The Decatur, Springfield and St. Louis Railway Company, with a nominal capital stock of $500,000, has been incorporated here. The company is financed by Montreal, Canada, and Boston, Mass., capitalists, and a Montreal insurance company, the syndicate which owns the street railway and lighting and power plants of about a dozen Illinois cities.

SHELBYVILLE, IND.—The Shelbyville Traction Company is reported to have perfected arrangements for extending its line from Shelbyville to Greensburg, a distance of 20 miles. It is understood that the company plans eventually to extend the road to Cincinnati, a distance of 64 miles.

LOGANSPORT, IND.—The Logansport, Hammond & Chicago Traction Company has been incorporated, with a capital stock of $1,000,000, as an extension of the Union Traction Company's system now being built from Indianapolis to Logansport, and when completed will connect Indianapolis with Chicago. The incorporators are George F. McCulloch, Horace C. Stilwell, A. L. Drum, Harry E. Guthrie and Arthur W. Beady.

MADISON, IND.—In about sixty days the Madison, Greensburg & Indianapolis Railway Company expects to be ready to let contracts for furnishing the equipment and constructing its proposed line. The plan is to build between Madison and Osgood first and eventually extend the road to Greensburg. Thirty miles of line are to be built. The officers of the company are Richard Johnson, president; M. D. Wilson, vice-president and general manager; Lincoln V. Cravens, secretary; N. Horuff, treasurer.

BURLINGTON, IA.—The Burlington & Keosauqua Railway & Power Company is projected to build an interurban electric railway to Keosauqua. It is said that surveys have been made.

AUGUSTA, MAINE.—The Lincoln County Street Railway has completed its organization, electing Luther Maddocks, president and general manager; Cyrus W. Davis, treasurer; H. M. Heath, clerk and general counsel. The proposed road will run from Wisassett to Boothbay Harbor, with a branch to Newcastle.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company proposes to extend its lines from Boonesboro, Washington County, across South Mountain to Myersville, Frederick County.

LAUREL, MD.—The Laurel Traction Company has been granted a franchise for the construction of a third-rail electric railway in Laurel. Chas. L. Fox, Maury S. Chism and Chas. J. Barth, of Philadelphia, are interested.

BOSTON, MASS.—The Boston Elevated Company has voted to lease from the Old Colony Street Railway Company the whole of the railway and property of that company located within the city of Boston.

MIDDLETON, MASS.—The Middleton & Danvers Street Railway Company has petitioned the Railroad Commissioners for authority to increase its capital stock $24,000 for the purpose of purchasing the Haverhill & Andover Street Railway, and the Lawrence & Reading Street Railway has petitioned for the authority to increase its stock $24,000 to purchase the Reading, Wakefield & Lynnfield Street Railway.

DETROIT, MICH.—The attempt of the Michigan Legislature to pass the Gruesel bill, which provides for municipal ownership of the street railways of Detroit, has been defeated, for the present, at least.

HAZLEHURST, MISS.—Plans are being discussed for building an electric railway from Hazlehurst Point to Gallatin. R. P. Willing, Jr., is interested.

NASHUA, N. H.—The Goff's Falls, Litchfield & Hudson Railway Company has perfected its organization and will proceed with the work of perfecting arrangements for building its proposed line. The officers are Isaac N. Carter, of Litchfield, president; Arthur S. Campbell, of Manchester, vice-president; John J. Baker, of Hudson, treasurer.

OWEGO, N. Y.—The Binghamton Railway Company has filed application for permission to extend the line from the present terminus at Vestal to Owego.

NEWBURGH, N. Y.—Fred T. Ley & Company, of Pittsfield, have been awarded the contract for extensions of the Orange County Traction Company's system in and about Newburgh.

ALBANY, N. Y.—The Nichols and Northern Pennsylvania Railroad Co., of Nichols, has been incorporated, capital $40,000. Directors: C. L. B. Tylee, T. M. Fonts and R. B. Randall, Newark.

LITTLE VALLEY, N. Y.—A certificate of incorporation has been filed for the Ellicottville, Mansfield & East Otto Railroad Company. The capital stock is $300,000. The Board of Directors for the first year is composed of John S. Rockwell, Philip A. Laing, Clarence W. Hammond, Buffalo; Chas. G. Locks, Randolph; William G. Laidlaw, Charles A. Cease and John G. McMahon, Ellicottville; Hudson Ansley and Edward Bolard, Salamanca; Albert T. Fancher and Adelbert E. Darrow, Little Valley, and Owen S. Laing, Floyd W. Holmes, J. DeMott Laing and Charles T. Mason, East Otto.

OKLAHOMA CITY, OKLA.—The Oklahoma Electric Company has been incorporated to build an electric railway to connect Oklahoma City, Norman, El Reno and Shawnee. The capital of the company is $1,000,000, and the incorporators are F. B. Ziegler, William Young, J. S. Alexander and others.

LAWTON, OKLA.—The Lawton Street Railway Company has just been incorporated. Besides operating street cars the company will furnish power for lighting and commercial purposes.. The company is capitalized for $600,000, and among the incorporators are W. J. Pearson, of New York; S. O. Crutcher and W. E. Hudson.

KINGSTON, ONT.—The promoters of the Ontario Electric Railway are said to have decided upon developing power by damming the Trent River at Glen Miller, 7 miles from Trenton. An amendment will have to be secured to the act of incorporation.

LANCASTER, PA.—The Conestoga Traction Company has decided to survey for an extension of the New Holland branch to Terra Hill, a distance of almost five miles.

MOUNT PLEASANT, PA.—Surveys are completed for the new road of the Mount Pleasant, Unity & Baggaley Street Railway Company. This line will be 16 miles long.

CHAMBERSBURG, PA.—The Chambersburg & Gettysburg Electric Railway Company has given the contract for the overhead work on its line to I. J. Larch, of Reading. Two power houses will be erected, one at Fayette and one at Wolf Lake.

SHENANDOAH, PA.—The Shenandoah & Suburban Railway Company has been incorporated to build an electric railway from Shenandoah to Ringtown. The officers are Dr. J. M. Langdon, president; J. S. Hossnick, secretary; M. M. Mellett, treasurer.

EASTON, PA.—The Easton & Washington Traction Company has filed articles increasing the capital stock of the company from $100,000 to $1,250,000. This company contemplates building an electric railway from Easton to Hackettstown. The power house will be built at Washington.

WILKESBARRE, PA.—The Wilkesbarre & Wyoming Valley Traction Company has decided to spend $200,000 on betterments to its system during the coming year. A large storage battery is to be installed at Pittston and a new engine and generator will be placed in the South Wilkesbarre power house. The North Main Street line is to be rebuilt.

CONNELLSVILLE, PA.—The Pittsburg, McKeesport & Connellsville Electric Railway Company has filed a plan for the proposed extensions from Fairchance to the Pennsylvania-West Virginia State line, and from Fairchance to Smithfield and across George Township. The company is installing an electrical signal system along the Connellsville Division. If it proves a success it will be placed along the entire system.

HARRISBURG, PA. The shareholders of the Harrisburg Traction Company adopted the plan proposed by the directors for the formation of a new company with a capital of $2,100,000, to lease the present Harrisburg Traction Company at a guaranteed rental of six per cent. on its $2,100,000 stock, to which amount the existing stock will be increased by payment of a five per cent. stock dividend. The plans include a new power plant, new equipment, extension of lines in the city and to Dauphin, Linglestown, Hummelstown and possibly in other directions.

CHATTANOOGA, TENN.—Negotiations for the merging of the street railways of Chattanooga are said to have been practically concluded. The new company will be known as the Chattanooga Light & Power Company, chartered in New Jersey with $750,000 capital. Large sums of money will probably be expended in improvements.

LAREDO, TEX.—The Laredo Electric Light & Street Railway Company is planning to make a number of improvements to its system. A franchise will soon be asked for several short extensions.

WHATCOM, WASH.—The Whatcom-Skagit Interurban Railway Company has been incorporated by George G. Shelton, Thomas Tyler and others.

SHEBOYGAN, WIS.—The Sheboygan-Elkhart Railway & Electric Company has increased its capital stock from $25,000 to $700,000.

KAUKAUNA, WIS.—William Phillips, of Kaukauna, Wis., and others, have secured a right of way for the East Shore Interurban Electric Railway from Fond du Lac to Kaukauna.

LA CROSSE, WIS.—A bill has been passed granting the La Crosse & Black River Falls Railway Company the right to dam Black River three miles above the falls. The company plans to construct an electric railway from La Crosse to Black River Falls.

NEW INDUSTRIAL COMPANIES.

THE PERRY-BEASLEY ELECTRIC COMPANY, of Columbia, S. C., has been chartered with a capital stock of $2,500. Wm. Perry is president of the Company.

THE INTER-STATE ELECTRIC MANUFACTURING COMPANY, of New York, has been incorporated; capital $50,000. Directors: Randolph Hulsart, E. H. Adams and R. M. Clark, Brooklyn.

THE BUREAU OF EXPERT INVESTIGATION AND CONSTRUCTION, New York, has been incorporated; capital $2,000. Directors: J. B. Cahoon, M. H. Alberger and G. W. Birdsall, New York.

M. M. ROGERS & COMPANY have been incorporated at Chicago, Ill., with a capital stock of $2,500, for the purpose of manufacturing railway supplies. The incorporators are John H. McAdams, Myrtie M. Rogers and James S. Savage.

THE NORTHWESTERN ELECTRIC COMPANY has been incorporated at Chicago, Ill., with a capital stock of $5,000, for the purpose of manufacturing electrical supplies. The incorporators are Henry Cheney, Peter L. Evans and James R. Deane.

THE DIAMOND ELECTRIC ARC LAMP AND MANUFACTURING COMPANY, Jersey City, N. J., has been incorporated to manufacture electrical appliances; capital $100,000. Incorporators: P. H. F. Spies, George W. Smith and C. C. Brown, New York City.

THE BRAZIL ELECTRIC COMPANY, Brazil, Ind., has incorporated with a capital stock of $60,000. The company will promote and build electric railways, electric light, heat and power plants. Major Collins, H. D. Falls, P. D. C. Ball and O. E. Adams are the incorporators.

THE ELECTRIC LIQUID PURIFIER COMPANY, of Jersey City, N. J., has been incorporated to manufacture apparatus for purifying water; capital $250,000. Incorporators: Alfred O. Tate, New York City; George A. Burniston, Jersey City, N. J., and William G. Chittick, Jr., New York.

THE PITTSBURG GAS & IMPROVEMENT COMPANY has been incorporated at Camden, N. J., for the purpose of manufacturing gas and electric appliances. The capital stock is $100,000, and the incorporators are Norman H. May, W. C. Hagon, Wm. C. Hughes and W. H. McClelland.

THE CLEMENTON TOWNSHIP UNITED ELECTRIC IMPROVEMENT CO., with principal offices in Camden, N. J., has been incorporated in New Jersey to manufacture electricity. The capital stock is $100,000 and the incorporators are Howard W. Bassett, Jacob Ludy, Jos. J. Eldredge, Horatio E. Church, Wm. F. Hand, Robt. T. Watt and Jos. E. Borden.

THE HALSEY ELECTRIC GENERATOR COMPANY has filed an amended certificate at Trenton, N. J., increasing its authorized capital stock from $100,000 to $10,000,000. The incorporators named in the amended certificate are James C. Hayden, William S. Halsey, James D. Williams, Clifton V. Edwards, Clement R. Woodson, William M. Hager, Henry Halsey and Howard Williams.

LEGAL.

W. U.-PENNSYLVANIA FIGHT.—The Western Union Company has filed a brief with the United States circuit court of appeals at Philadelphia, asking for a modification of the decree under which the Pennsylvania Railroad destroyed Western Union property.

RIGHT TO MAKE PATENTED ARTICLES FOR EXPORT.—On May 16, Judge Thompson handed down a decision in the United States Circuit Court of the Western Division of the Southern District of Ohio, in the case of the Westinghouse Electric & Mfg. Company vs. the Bullock Electric Mfg. Company, in which the point concerned was whether the defendant had the right to manufacture in this country an induction motor covered by patents held by the complainant company, provided the machine were for use in Canada. The defendant, while admitting that the motor was made in this country, insisted that the plaintiff's patents were not infringed thereby for the reason that the machine did not enter into the combination covered by the patents concerned until it arrived in Canada. The court over-ruled this contention, and as a previous injunction had been issued against the defendant prohibiting the manufacture of induction motors, a fine of $500 was imposed.

PERSONAL.

MR. CHARLES DAY, of the firm of Dodge & Day, modernizing engineers of Philadelphia, read a paper on "Machine Shop Methods" before the S. K. C. Club at Pittsfield, on May 27.

MR. W. W. WHEATLEY, a well-known and highly competent street railway man has been appointed head of the traction department of the Public Service Corporation of New Jersey.

MR. H. A. LARDNER, electrical engineer with J. G. White & Co., and vice-president of the New York Electrical Society, has sailed for England accompanied by his wife, to enjoy a summer holiday.

MR. FELIPE G. CANTON, whose offices are in the Columbia Building, 29 Broadway, New York, will return next week from Yucatan with some fair sized orders for electrical equipment to be installed in the City of Merida.

MR. DUDLEY FARRAND, of the United Electric Company of New Jersey, where he has made his mark, is now promoted to superintendent of the big new Public Service Corporation of New Jersey, which has just consolidated so many of the lighting and traction interests.

MR. and MRS. WILSON BENSON announce the marriage of their daughter Isabel to Mr. Jacob Frank Worbs, on Wednesday, May 20, at Markdale, Ontario. It, of course, is needless to state that Mr. Worbs is the well-known manager of the Adams-Bagnall Electric Company, of Cleveland, O.

MR. W. EDGAR REED, of the Societe Anonyme Westinghouse, which concern operates an extensive plant at Havre, France, for the manufacture of Westinghouse electrical equipment for various Continental European countries is now on a visit to the United States. At present he is in Pittsburg.

MR. LEONARD ANDREWS, M. I. E. E., who is already well known in this country is again a visitor. He hopes to stay long enough to take in the Institute meeting at Niagara. To his other work and duties, Mr. Andrews has now added those of managing director of the Key Engineering Co., Ltd., of Manchester.

MR. W. H. S. CRAVEN, managing director of Craven Brothers, Limited, Manchester, which concern is one of the largest manufacturers of machine tools in Great Britain, sailed for Europe last week after a short visit to the United States. Some substantial contracts for American electrical equipment, etc., are expected to be placed as a result.

COL. R. C. CLOWRY, president of the Western Union Telegraph Company, has purchased the dwelling at the northwest corner of West End Avenue and Seventy-sixth Street, New York City. The house is very handsome and has frontages of 28 feet 4 inches on West End Avenue and 63 feet on the street. Col. Clowry will make it his residence .

MR. GEORGE F. KUNZ, the gem expert and a man well known in electrical circles has been made a doctor of philosophy by the University of Marburg. He has many other European honors and decorations. He has written largely on gems, meteorites, etc., and at the 1896 Electrical Exhibition in New York made a most interesting exhibit of flourescent diamonds under the arc light.

GEN. A. HICKENLOOPER, president of the Cincinnati Gas & Electric Co., has resigned on account of ill health, but will retain his seat on the board of directors. The veteran has been connected with gas interests in Cincinnati since the sixties and at one time was a sturdy and even vicious opponent of electric light. He became at last head of one of the largest electric lighting systems in the country.

MR. W. C. GOTSHALL.—Last week Alfred Hennen Morris and W. C. Gotshall, the well known electrical engineer, rode from New York to Albany in four hours and ten minutes on an automobile, which was driven by Mr. Morris's chauffeur, Alexander Van Valin. Although the hourly speed was about forty-four miles, on some of the good places along the road the vehicle was driven along at the rate of sixty-five miles an hour.

DR. R. MULLINEUX WALMSLEY, F. R. S. E., principal of the Northampton Institute, London, who has been spending two or three months in this country with his sister, Miss Walmsley, both studying American educational methods, and especially those relating to technical subjects, has returned home after an enjoyable stay on this side, where he had the pleasure of meeting a great many old friends and acquaintances.

MR. R. A. HADFIELD, managing director of Hadfield's Steel Foundry Company, Limited, Sheffield, which operates the largest steel casting plant in the world, returned to Europe June 9 after several weeks' visit on this side. Some large orders of American electric cranes, etc., will be placed as a result of Mr. Hadfield's present sojourn in the States. He has just returned to New York from a Western trip and may be found at the offices of Baring, Magoun & Company, 15 Wall Street.

MR. JOSEPH WETZLER, former editor of the *Electrical Engineer*, and for some years past president of the Electrical Engineer Institute of Correspondence Instruction, has sailed for Europe with his family on the Cunarder *Campania*, to take a well-earned rest and vacation of several months in continental travel. Mr. Wetzler has made a brilliant success of his popular educational work, setting his standard high and with the aid of leading talent giving instruction of the best quality to the great gain of the electrical arts.

MR. FEDERICO GRAEFF, of Hasenclever & Company, Buenos Ayres, one of the largest handlers of American machinery, etc., in South America, is now in the United States with a view to placing contracts for various machinery, including electrical apparatus, which will result in the expenditure of nearly $1,000,000. He is at present in Chicago, where he is a guest at the Auditorium Hotel. About the 15th inst. he will return to New York and will stay at the Hotel Belvedere for a few days prior to his departure for the Argentine Republic.

DR. MARCO A. SOTO, ex-president of Honduras and lately a candidate for the presidency, has sailed for Paris on the French S. S. *Gascogne*. Dr. Soto intends to stay in Paris for a few months, and will return to Central America to reside in Costa Rica. While in this country he has taken every opportunity to investigate the electrical power and transportation development with a view of interesting Honduras capitalists in using electricity in that country and will continue his investigation in Paris. He visited the great Westinghouse works in Pittsburg last week.

MR. J. K. ROBINSON, of Iquique, who represents the interests of the Westinghouse people, the Standard Underground Cable Company, the Manhattan General Construction Company and the Goulds Manufacturing Company in Chili, Peru, Bolivia and Ecuador, will arrive in New York next week for England. While here he will place contracts for considerable equipment including a complete water power plant of about 400-hp capacity. Mr. Robinson while in this city will make his headquarters down-town at the offices, 116 Broad Street, of the William E. Peck Company.

ADMIRAL SCHLEY.—A special despatch from Washington says: "Rear Admiral Schley has found a way, he thinks, of getting rich. He has worked all his life for Uncle Sam, and is poorer now, probably, than when he started. Lately he was able to join with former Senator Jones, of Nevada; John K. Cowen, of Baltimore, formerly president of the Baltimore and Ohio road; former Senator Butler, of North Carolina, and others in the organization of a Mexican mining company. It is purposed to engage in mining, cattle raising, water and electric power development and manufacturing."

Trade Notes.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is handling in large quantities direct and alternating current desk, bracket, ceiling and battery fan motors and ventilating fans of every description.

A JAPANESE CATALOGUE.—Siemens & Halske have issued in Japanese a catalogue which, judging in the absence of English text from the single illustration contained, relates to direct current motors.

THE EDISON PHONOGRAPH WORKS, Orange, N. J., have just sent a third order for exhaust heads to the Hurt Mfg. Co., Akron, Ohio. This tends to show that the Hurt exhaust head is very satisfactory to the user.

FORT WAYNE BULLETINS.—Fort Wayne Bulletins 1042-44 have for their respective subjects arc circuit cut-outs, single-phase generators and belt-driven direct-current generators, all of which are profusely illustrated in detail and minutely described.

FARMERS' TELEPHONES.—The Stromberg-Carlson Telephone Manufacturing Company, Chicago, has recently sold telephones and supplies to the Farmers' Mutual Telephone Company, of Rinard, Ill., Farmers' Mutual Telephone Company, of Richfield, Ill., and Farmers' Mutual Telephone Company, of Virden, Ill.

THE HARTFORD STORAGE BATTERY COMPANY, 28 High Street, Hartford, Conn., is making a specialty of automobile charging outfits, and is meeting with great success. This company also makes a specialty of isolated electric light plants for lighting houses, etc. Its catalogue on all this class of work is quite attractive and can be had for the asking.

THE YOUNGSTOWN ELECTRICAL & MANUFACTURING COMPANY, of Youngstown, Ohio, has commenced work on its new plant at Struthers, near Youngstown. The company will manufacture a general line of electrical goods, making a feature of an electrical recording scale. The main building will be 120 ft. long and 80 ft. wide and there will be aonther of 40 ft. x 30 ft.

BELT MANAGEMENT.—The Cling-Surface Mfg. Co., Buffalo, N. Y., has issued a neat cloth-bound volume of 72 pages containing information relating to the care of belts, with particular reference to the aid which may be rendered through the use of "cling-surface." The book bears the title "New Knowledge on Belt Management," and will be found of interest and instruction by users of belts.

MILLING MACHINES.—The Cincinnati Milling Machine Company has issued a handsomely illustrated 32-page catalogue entitled, "Examples of Rapid Milling." The catalogue is of particular interest for the reason that the cuts in every case show machines actually at work, thus giving concrete illustrations of their capabilities. Those interested in modern tool work will for this reason find the catalogue unusually instructive.

INTERNATIONAL TELEPHONE APPARATUS.—The International Telephone Mfg. Co., Chicago, has issued a 64-page catalogue descriptive of the standard types of its manufacture of telephones, telephone appliances and switchboards. An important feature of the apparatus of this company is that it is made by special tools, which not only ensures perfection of the mechanical execution, but enables any part to be replaced without returning the whole to the factory.

MR. W. L. HODGES has resigned his position with the Keystone Telephone Company of Philadelphia, to take charge of the Appraisal Department of the American Audit & Appraisement Company. This company is in a position to do any class of auditing, appraising and other financial work of a technical nature upon short notice and in any part of the country and is equipped to make expert examinations of all kinds of properties and render efficient assistance to the controlling interests of any financial enterprise.

STANDARDIZING TRADE PUBLICATIONS.—With the title, "It Would Be to Your Advantage," Mr. F. G. Bolles, chairman of the Ohio State Committee on Standardizing of Literature, has issued a neat pamphlet directing attention to the great advantage that would result if trade publications were confined to standard sizes. The standards that have been adopted in this country are 6 in. x 9 in. and 9 in. x 12 in. for catalogues, and 3½ in. x 6 in. and 4 in. x 6 in. for flyers. A copy of this pamphlet may be obtained by addressing Mr. Bolles at Norwood, Ohio.

H. O. S. ENGINEERING CO.—Mr. H. O. Swoboda, of this concern, 88 Warren St., N. Y., reports that its business is rapidly growing and that its factory at Reading, Pa., has purchased and installed a considerable number of new machines and tools which will enable it to increase its output fully 100 per cent., and make shipments in exceedingly short time. The H. O. S. Company also has now a considerable stock of panel boards and knife switches in its new store room at 88 Warren Street, so that a large percentage of New York orders can be executed the same day they are received.

MR. GUY M. GEST, of Cincinnati, is laying, under contract, 304,000 duct feet, or 22,000 trench feet of underground conduit for the feed wire system of the Louisville Railway Company, at Louisville, Ky. The construction will be of the highest class, embracing many new features, such as the Gest terminal frame and the Gest cable bracket frame. The manholes will be divided into two compartments, one for alternating-current circuits, the other for direct-current circuits, with no direct communication between them, the two vaults each being provided with a separate entrance. The work will cost between $75,000 and $100,000.

THE WARD-LEONARD ELECTRIC COMPANY, Bronxville, N. Y., manufacturer of a complete line of motor starters, speed controllers, etc., has recently obtained for use as a stock room for this branch of the rheostat business a part of the shops which have been devoted to the manufacture of automobiles. The great increase in the motor starter business during the last year has made it almost impossible to keep up with the demands for an entirely enclosed starter—with increased space the Ward Leonard Company now intends shipping directly from stock. The company reports that it will carry all sizes from ⅛-hp to 100-hp in stock at all times.

WILLARD STORAGE BATTERY.—In October, 1899, the Willard Storage Battery Company, Cleveland, Ohio, supplied a set of its automobile cells to [illegible] Loomis, of Akron, Ohio, for use in the electric patrol wagon built for that city. Since then the patrol wagon has been in continuous service and recently the police department rendered the Willard Company a detailed report as to the efficiency of the battery. From Oct. 14, 1899, to April 19, 1903, the vehicle covered in actual service, 6,706 miles. The total number of people carried was 12,085. It is calculated that the saving over the cost of a horse-operated vehicle has been 63 per cent. The battery has never been renewed and is still in first-class shape doing its work every day. This is considered a very creditable showing, especially in view of the fact that Akron is extremely hilly.

CRANES AND HOISTS.—Pawling & Harnischfeger, crane and hoist builders, Milwaukee, Wis., are booking numerous orders, though during April there was a decided hesitancy on the part of buyers who apprehended more than usual labor trouble to occur around May 1. Milwaukee, however, is more free from difficulties between employers and employees than any manufacturing city of note in the United States. The many new and modern shops planned by railroads have resulted in a large volume of estimates for crane equipment, and steel and iron plants still continue the heaviest buyers, though the demand for cranes is broadening. The market is about the same as during May, 1902, though does not reach the proportions prevailing last September. The old Nordberg shops, leased and equipped by Pawling & Harnischfeger to replace their erecting shop, burned April 15, have placed them in as good shape to build cranes as prevailed before the fire.

TRADE CARD INDEX.—The Albany Steam Trap Company, Albany, N. Y., has adopted a good method of placing information about the various things which they manufacture before its customers, through the use of a series of regular sized 3 x 5 inch index cards. Each card is limited to a single style of trap, pump or pump governor and contains a clear half-tone illustration of the article, as well as a description, together with sizes, weights, prices, and all other necessary information. The customer who receives these cards can select such subjects as he is interested in, and file them away where they will be readily accessible. In view of the numerous and for the most part unsuccessful attempts on the part of manufacturers to secure standard sizes for their catalogues, the convenience of these index cards will be readily appreciated. Furthermore the small size adopted is well within the limits of a pocket card. The first series of cards will embrace 12 subjects, four of which have already been issued.

THE CHICAGO ENGINEERING & CONSTRUCTION COMPANY, with a capital of $250,000, has acquired the engineering and contracting business of the firm of Weston Brothers. It may be mentioned that the latter firm has designed the intramural transportation system for the Louisiana Purchase Exposition at St. Louis, and also rendered valuable assistance to Mr. Bion J. Arnold in the preparation of his report to the Local Transportation Committee of the Chicago Common Council. The new company will engage in a general engineering and contracting business. It is prepared to make surveys, estimates, plans and specifications, examinations and reports upon proposed or existing properties, with recommendations for improved operation when desired. It will take contracts to construct steam, electric and elevated railways, bridges, buildings, tunnels, subways, viaducts, wharves, piers, manufacturing, gas and electric light plants, and will make a specialty of creating new electric railway properties delivered with operating organization perfected and in actual operation. The officers of the company will be Charles V. Weston, president, and George Weston, vice-president, both of Weston Brothers. George A. Yuille, formerly vice-president and general manager of the West Chicago Street Railway Company, will be secretary and general manager, and Harvey B. Hicks, counsel. Messrs. Addison E. Wells, Fred A. Wells and Edward B. Burling, all of Chicago, together with the above named officers, will make up the board of directors.

EXPORT INFORMATION.—Kelly's Directories, Limited, London, England, represented in the United States by Kelly's Directory Company, 418 Temple Court, New York, have just issued the seventeenth revised edition of "Kelly's Directory of the Merchants, Manufacturers, Shippers and Buyers of the World." It includes all countries, even Iceland and Greenland, and is thoroughly indexed, both geographically and as to trades. It contains a concise statistical account of each country, its ports and principal towns, with a short topographical account and the population of each, together with classified lists of consuls, bankers, importers, exporters, merchants, commission merchants, brokers and shipping agents and buyers of imported goods, or manufacturers of goods exported. There is also a section containing all the various customs tariffs. In importing countries, like South America, South Africa, Australasia, West Indies and Central and South America, the names of shopkeepers likely to purchase foreign made goods are given. This directory is issued annually, the information being compiled by a regular corps of travelers. The company publishes over 250 distinct directories, covering all official directories of England, both trade, county and town and the official post office directories of Australia, New Zealand and Tasmania. Its "General Directory of South Africa" is also just out, being the first book issued since the Boer war, the last one having been published in 1896. It embraces the whole of South Africa, including Cape Colony, Natal, Orange River Colony, Transvaal, Rhodesia, Basutoland, Bechuanaland, Mashonaland, Portuguese East Africa and other sections. It is classified by towns and also by trades. Another important directory is the "Post Office London Directory." There are in all 12 sections to this directory, the principal ones being the alphabetical lists, the court or elite lists, the business lists and a section for the banks of the world having British correspondents. The Australasian directories of which there are 7, or one for each colony, are published annually and are similar in arrangement to the South African directory.

LEEDS & NORTHRUP COMPANY.—The Leeds & Northrup Co. succeeded on June 1 to the business of M. E. Leeds & Co., Philadelphia. The change is a growth and expansion rather than a transfer of the business. Mr. M. E.

Leeds, who has been the managing member of the firm of Leeds & Co., is the president of the new company, and will devote himself particularly to the selling. Dr. Edwin F. Northrup is the secretary and will have charge particularly of the manufacturing. The new company starts under favorable conditions. The business of Leeds & Co. has enjoyed a steady growth during its existence, and in the year just passed, is it stated, increased its business 33⅓ per cent over the previous year. During this year since Dr. Northrup has been associated with the company there have been developed a number of new and important instruments, and at the same time the regular lines have been thoroughly revised where it was found necessary. The company has availed itself of the opportunities offered by the National Bureau of Standards to keep its reference standards carefully checked, and has made extensive additions to its equipment of tools and secondary standards. A complete catalogue of the apparatus manufactured by the Leeds & Northrup Company has just been issued, and includes the first descriptions of the new apparatus above referred to. In addition it is publishing the following special pamphlets: No. 1, Resistance boxes and Wheatstone bridges. No. 2, Potentiometers. No. 3, Moving coil galvanometers. No. 4, Standard resistances. No. 5, Portable testing sets and cable testing apparatus. No. 6, X-ray apparatus. No. 7, High grade keys for electrical testing. No. 8, Self induction apparatus. No. 9, Carey-Foster bridge. No. 10, Hoopes' conductivity bridge. These pamphlets are not confined exclusively to descriptions of the instruments which they cover, but they treat the subject in a broad way, going into the general question of the best designs, and in many cases including detailed instruction for using the instruments. In the belief that the requirements of its customers can best be met by dealing with them directly, the Leeds & Northrup Company has discontinued the exclusive selling agency arrangements of M. E. Leeds & Co. Detailed information in regard to points of design, conditions of use and performance of instruments is frequently of great importance to buyers, and this information can only be given by those who are intimately associated with the manufacture. The Leeds & Northrup Company consequently particularly requests that all correspondence in regard to apparatus of its manufacture be addressed to it directly.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 26, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

728,823. ELECTRIC CANAL SYSTEM; Frank Adams, North Adams, Mass. App. filed July 29, 1902. A peculiar construction of bracket supporting the trolley wire and preventing interference with the trolley.

728,851. VULCANIZED KERITE COMPOUND; William R. Brixey, Seymour, Conn. App. filed March 20, 1903. A vulcanized mixture of coal-tar, asphalt, linseed oil and sulphur.

728,891. STARTING MEANS FOR VAPOR ELECTRIC LAMPS; Stanwood E. Flichtner, Englewood, N. J. App. filed Aug. 23, 1902. In order to start two or more lamps in series by means of a single reactance device, a conductor connects the starting band of each lamp to the positive main at a point in advance of where it enters the first lamp of the series.

728,901. MEANS FOR OPERATING REVERSING SWITCHES ON ELECTRIC CARS; Edwin R. Gill, New York, N. Y. App. filed Oct. 6, 1900. Details.

728,902. ELECTRIC ARC LAMP; John O. Girdlestone and Carl F. G. Thorkelin, London, Eng. App. filed June 23, 1902. The carbons are fed at an angle to each other and are controlled by two spring-operated drums and a brake.

728,942. ELECTRICAL CUT OUT AND REGULATOR; Henry Leitner, Woking, and Richard N. Lucas, Byfleet, Eng. App. filed Dec. 22, 1902. A field magnet is made use of, the pole pieces of which are given opposite polarities according to whether they are energized by a dynamo or accumulator current; the armature operates under these changes of polarity to move a commutator for breaking the charging circuit. The apparatus is used for train lighting.

728,944. INTERCHANGEABLE ELECTRIC DISPLAY APPARATUS; Deronda Levy, New York, N. Y. App. filed Feb. 10, 1903. The commutator is provided with interchangeable bars for the purpose of variously operating the switches of electric signs.

728,968. BATTERY CHUTE; Frederick E. Paradis, Chicago, Ill. App. filed July 23, 1902. A vessel adapted to contain a battery cell and having a sealed cover and sealed outlet in the side for the wires.

728,970. METHOD OF VARYING THE OUTPUT OF TRANSFORMERS; John S. Peck, Pittsburg, Pa. App. filed Aug. 4, 1902. Consists in changing a number of equal sections of corresponding winding from series to parallel and increasing the rate of alterations supplied to the primary winding.

728,973. ELECTRIC HEATER; Edwin F. Porter, Boston, Mass. App. filed Feb. 6, 1900. A heater applied to the blades of an electric fan and a switch arranged to turn the current on and off to the heater and fan simultaneously.

728,975. SYSTEM OF MOTOR CONTROL; William H. Powell, Erie, Pa. App. filed Feb. 27, 1902. Consists in decreasing the effect of one field winding by shunting it with a gradually decreasing resistance, while increasing the effect of another winding at a rate depending upon the rate of increase of the counter-electromotive force of the armature as it increases in speed.

728,976. SYSTEM OF MOTOR CONTROL; William H. Powell, Ampere, N. J. App. filed July 11, 1902. Apparatus for carrying out the preceding method.

728,978. RHEOSTAT; Charles J. Reed, Philadelphia, Pa. App. filed June 3, 1902. A rheostat comprising two disks having non-conducting rims and helical coils of wire so disposed upon the rims as to mesh with each other when either disk is rotated.

729,033. MAGAZINE FUSE BLOCK; Glenn Baskerville, Charlotte, N. C. App. filed June 19, 1902. A carriage carrying a number of fuses is forced constantly towards a pair of terminals wherewith the fuses make successive contact as each one is destroyed.

729,065. RAILWAY SIGNAL; Marquis D. Hanlon, Wilkinsburg, Pa. App. filed Feb. 5, 1903. Details.

729,082. TROLLEY WHEEL AND HOLDER; Frank D. Moon, Lockport, N. Y. App. filed Aug. 1, 1902. Details.

729,100. SEPARATOR FOR STORAGE BATTERIES; Elmer A. Sperry, Cleveland, Ohio. App. filed Nov. 25, 1901. A corrugated and perforated diaphragm interposed between the plates, the corrugations being formed during vulcanization, so as to be unaffected by heat.

729,103. METHOD OF ELECTRICAL DISTRIBUTION AND SELECTIVE DISTRIBUTION; John Stone Stone, Cambridge, Mass. App. filed April 4, 1894. (See Current News and Notes.)

729,104. ELECTRICAL APPARATUS AND CIRCUITS FOR ELECTRICAL DISTRIBUTION AND SELECTIVE DISTRIBUTION; John Stone Stone, of Cambridge, Mass. App. filed April 4, 1894. (See Current News and Notes.)

729,108. THERMO-ELECTRIC GENERATOR; Albert Tissier, Paris, France. App. filed Nov. 30, 1900. A briquette capable of giving off a current when heated at one end and cooled at the other, consisting of a mixture of quartz and zinc which has been subjected to an intense heat.

729,114. ALTERNATING CURRENT ARC LAMP; Malcolm H. Baker, East Liberty, Pa. App. filed June 26, 1902. Means for regulating the resistance of the arc, consisting of independent magnetic fields acting differentially upon each other.

729,117. MOTOR CONTROL SYSTEM; Charles E. Barry, Schenectady, N. Y. App. filed Feb. 12, 1902. The object is to prevent the reapplication of current to the motor circuit after the circuit has been opened by the circuit breaking devices, until the motor or other apparatus in the circuit, has been protected by sufficient resistance.

729,120. THIRD RAIL ELECTRIC RAILWAY SYSTEM; Gustav Bertram, Brooklyn, N. Y. App. filed Feb. 28, 1903. Details.

729,134. SWITCH CONTROL MECHANISM; Paul L. Clark, Schenectady, N. Y. App. filed Sept. 11, 1902. A number of separately movable switches and means operated by the closing of any switch for throwing into the open position any other switch which may be in a closed position.

729,136. ELECTRIC RAILWAY; Albert N. Connett, London, England. App. filed Feb. 21, 1901. A removable cover for the conduit whereby the plow can be lifted out.

729,137. PLOW RAISING MEANS FOR CONDUIT RAILWAYS; Albert N. Connett, London, Eng. App. filed Feb. 21, 1901. A chain and gearing connected with the plow for raising it out of the conduit when necessary.

729,140. STORAGE BATTERY; Robert Darling, Rye, N. Y. App. filed Dec. 26, 1901. The negative element consists of a number of independent units attached to a conducting grid.

729,159. TELLTALE FOR SHIPS' RUNNING LIGHTS; John L. Hall, Schenectady, N. Y. App. filed July 30, 1901. Means for indicating the extinguishment of a lamp, consisting of an audible and visual signal connected in parallel, a switch for closing the circuit through them and an electro-magnet in circuit with the lamp and controlling the switch.

729,164. INDICATING INSTRUMENT; Caryl D. Haskins, Schenectady, N. Y. App. filed Feb. 28, 1901. An indicating instrument provided with two relatively movable parts having indicating members intersecting each other at an angle, one of said members having a curvature with a varying slope to render the calibration independent of the law of the instrument.

729,166. X-RAY TUBE; John O. Heinze, Jr., Chelsea, Mass. App. filed March 19, 1903. Means whereby the cathode stream can be controlled so that it has an area of bombardment of the smallest possible diameter on the anode.

729,171. ELECTRIC HEATING FABRIC; Joseph M. C. Herrgott, Valdoie, France. App. filed Aug. 12, 1902. Special manner of laying the heating wires in a woven fabric.

729,172. HIGH POTENTIAL LINE SWITCH; Edward M. Hewlett, Schenectady, N. Y. App. filed Aug. 16, 1900. A fluid-tight vessel mounted on a pole and containing a switch operable by means of a long handle.

729,173. CONTACT DEVICE FOR ELECTRIC RAILWAYS; Edward M. Hewlett, Schenectady, N. Y. App. filed Jan. 31, 1900. The ends of a stiff shoe are made yielding, so as to avoid a shock to the support of the shoe when it strikes the end of the conductor.

729,175. DYNAMO ELECTRIC MACHINERY; Henry M. Hobert, Berlin, Germany. App. filed Feb. 6, 1902. Permanently short-circuited conductors in close mutual inductive relation to the end connections of the armature winding and forming the seat of induced currents to reduce the self induction of the armature coil, of which the end connections are a part.

729,18[illegible]. INCANDESCENT ELECTRIC LAMP; Herman J. Jaeger, New York, N. Y. App. filed Jan. 27, 1903. The exhaust tube is joined to the inside wall of the hollow stem, so that the tip will not form an objectionable protuberance.

729,206. SELF REGULATING SYSTEM FOR ELECTRIC LIGHT AND POWER; Morris Moskowitz, Brooklyn, N. Y. App. filed March 3, 1902. The speed of a motor which drives an exciter and the field magnetism of the exciter are varied inversely with variations in the armature current of the generator.

729,211. CIRCUIT BREAKER; Clarence H. Norwood, Chicago, Ill. App. filed Nov. 4, 1899. A single latch which holds the circuit breaking lever, is actuated either by an overload or an underload.

729,216. ELECTRIC RAILWAY; Jesse S. Pevear, Schenectady, N. Y. App. filed Jan. 28, 1903. The switch controlling the current to the sectional rails and which are grouped in a vault, are made less dangerous from leakage by means of a master switch in the vault.

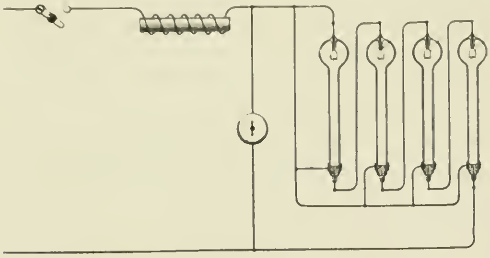
729,219. DYNAMO ELECTRIC MACHINE; Henry G. Reist, Schenectady, N. Y. App. filed Jan. 6, 1903. Details of construction.

729,222. ELECTRIC HEATING PAD; William Rickards, Los Angeles, Cal. App. filed April 29, 1901. A fabric containing heating resistance and adapted to be applied to the human body.

729,240. ELECTRIC BATTERY; Edmund Tweedy, New York, and Isaiah L. Roberts, Brooklyn, N. Y., and George R. Tweedy, Danbury, Conn. App. filed May 22, 1900. Relates to the manner of supporting a number of electrodes on a common frame.

729,253. PAWL AND RATCHET MECHANISM FOR ELECTRIC CLOCKS; Archibald Barr, Glasgow, Scotland, William Stroud, Leeds, Eng., and Ludwig Becker, Glasgow, Scotland. App. filed Feb. 5, 1901. Details.

729,255. ELECTRIC SWITCH; Henry Bayer, Schenectady, N. Y. App. filed Jan. 28, 1901. A lamp socket switch.



728,891.—Starting Means for Vapor Electric Lamps.

729,269. TRANSMISSION OF POWER; Harold W. Buck, Niagara Falls, N. Y. App. filed February 7, 1901. (See Current News and Notes.)

729,276. ELECTRIC SIGNAL; Albert E. Caughey, Omaha, Neb. App. filed Feb. 11, 1902. Details.

729,280. ELECTRICALLY OPERATED SYSTEM FOR CLOSING WATER-TIGHT DOORS, HATCHES, OR THE LIKE; William B. Cowles, Cleveland, Ohio. App. filed Aug. 1, 1901. By this mechanism the door can be closed from a distance or at the door itself and the operation can be accomplished either by hand or by an electric motor.

729,304. MOISTURE PROOF SWITCH CASING; Ernest L. Etheridge, Brooklyn, N. Y. App. filed Nov. 13, 1900. The casing is similar to a valve casing and contains a seat for the switch and means for packing the operating stem which projects to the outside.

729,308. CURRENT TRANSFORMER FOR HIGH VOLTAGE CIRCUITS; Augustine R. Everest, Lynn, Mass. App. filed March 21, 1902. Consists of an insulated ring core overwound with the secondary winding, insulating tubes both inside and outside the secondary, which support end pieces on which the primary winding is wound.

729,315. ELECTRIC ARC LIGHT; Walter C. Fish, Lynn, Mass. App. filed Jan. 27, 1903. A common regulating magnet for a number of arcs in series and a branch circuit for weakening the magnet at a determinate position of its core, whereby all carbons are fed simultaneously.

729,317. MEANS FOR TREATING NERVOUS DISEASES BY ELECTRO-MUSICAL VIBRATIONS; Henry Fleetwood, Los Angeles, Cal. App. filed May 5, 1902. Musical sound waves are transformed into electrical waves and applied to the human body for therapeutic effect.

729,323. CIRCUIT BREAKER FOR STORAGE BATTERIES; Henry Garrett, Dallas, Texas. App. filed Aug. 5, 1902. Details.

729,335. MECHANISM FOR OPERATING SNAP OR ROTARY SWITCHES; William A. Harvey, Scranton, Pa. App. filed May 17, 1902. A ceiling switch operated by a cord passing over a pulley and attached to a spring.

729,343. POWER FACTOR METER; Otto Holz, Schenectady, N. Y. App. filed Jan. 31, 1901. (See Current News and Notes.)

729,366. TROLLEY; Frederick Lehrmann, Turtlecreek, Pa. App. filed April 2, 1903. Details.

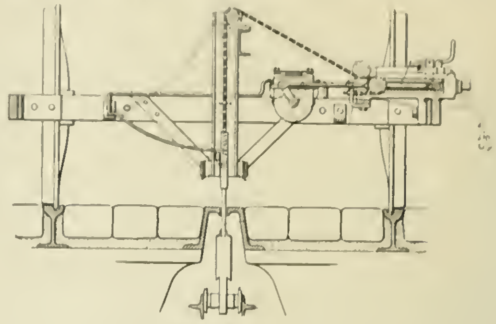
729,369. ELECTRIC HEATER; Max Loewenthal, New York, N. Y. App. filed Dec. 8, 1902. Improvements in the general construction of electrically heated irons.

729,411. SURFACE CONTACT RAILWAY SYSTEM; William B. Potter, Schenectady, N. Y. App. filed Feb. 11, 1899. Means carried by the car for shunting leakage currents from the sectional conductors directly through the car to ground.

729,414. FIELD MAGNET STRUCTURE; Henry G. Reist, Schenectady, N. Y. App. filed April 11, 1902. Braces are applied to the sides of the field magnet coils.

729,416. GOVERNING MECHANISM; Frank C. Rinsche, St. Louis, Mo. App. filed July 8, 1901. Details.

729,420. ART OF TELEGRAPHY; Henry A. Rowland, Baltimore, Md. App. filed Dec. 2, 1899. Consists in impressing an alternating electromotive force upon the line, adjusting the difference of phase between the impressed electromotive force and the resultant current to zero at or near the point of transmission, and modifying a predetermined number of the semicycles of current to represent each character transmitted.



729,137.—Plow Raising Means for Conduit Railways.

729,422. VOLT AMPERE METER; Maurice C. Rypinski and J. Le Conte Davis, Schenectady, N. Y. App. filed March 31, 1902. Two wires so connected to a movable pointer that the expansion of either one or the other will not cause the pointer to move, but the expansion of both will cause an indication of the product of the elongation of the two wires.

729,440. LOCKING HANGER; Louis Steinberger, Brooklyn, N. Y. App. filed Oct. 31, 1902. Details.

729,449. INDUCTION-MOTOR ARMATURE; Elihu Thomson, Swampscott, Mass. App. filed Jan. 28, 1903. (See Current News and Notes.)

729,458. BRUSH AND METHOD OF MAKING SAME; William J. Wallace, New York, N. Y. App. filed Feb. 27, 1903. A wire fabric is folded and pressed into shape, the raw edge being turned into the body of the pack.

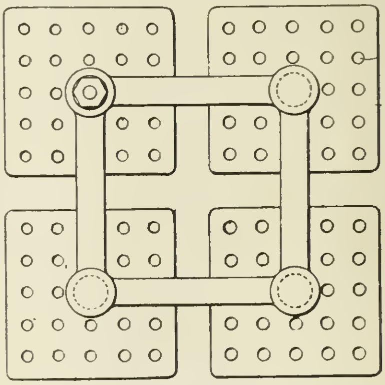
729,470. GAS BURNER; Charles T. Eilson, Amenia, N. Y. App. filed Aug. 9, 1902. Details.

729,472. LIGHTNING ARRESTER; Adniram J. Wilson, Westfield, N. J. App. filed April 24, 1899. Convolutions of coarse wire, insulated and surrounding an iron core, are placed opposite a ground terminal; the counter-electromotive force set up in the coil induces the lightning to jump from the coil to the terminal.

729,481. ELECTRIC RAILWAY; Granville T. Woods and Lyates Woods, New York, N. Y. App. filed Nov. 24, 1900. Details.

729,482. MECHANISM FOR MAKING AND BREAKING ELECTRIC CIRCUITS; Harry B. Wren, Washington, D. C. App. filed May 27, 1902. A keyboard adapted to operate levers and switches whereby electric circuits are completed in combinations, for electric sign purposes.

729,497. WIRELESS TELEGRAPHY; James Foster King, New York, N. Y. App. filed Feb. 5, 1902. (See Current News and Notes.)



729,140.—Storage Battery.

729,502. OXIDIZING ORGANIC COMPOUNDS; Martin Moest, Hochst-on-the-Main, Germany. App. filed March 11, 1903. Cerium compounds act on organic compounds in an acid solution coincidently with the passage of an electric current.

729,503. ELECTRIC SWITCH; Tage Muller and Charles O. Thompson, New York, N. Y. App. filed Nov. 19, 1902. A fluid pressure quick action switch.

729,505. ATTACHMENT FOR ELECTRICAL CONDUITS; Adnah McMurtrie, New York, N. Y. App. filed Jan. 11, 1902. An attachment interposed between the outlet box and the wall bracket, permitting of lateral adjustment to make the fixture plumb.

Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

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CONTENTS.

Editorial 1003
International Electrical Congress at St. Louis 1006
Telephony and Wireless Telegraphy in England 1006
Electricity at the Berlin Chemical Congress 1006
Crookes on Atomic Fog 1006
Rebuilding the Duluth General Electric Company's Station. By Clifford L. Higgins 1007
Lifting Electromagnets. By D. A. Willey. 1009
Telephone Exchanges—III. By Arthur V. Abbott, C. E. 1010
Steam Turbine Unit for Omaha Light and Power 1012
London Conduit Railway System 1013
Recent Electrochemical Developments. By Clinton Paul Townsend 1014
New Telephone Patents 1014
Data as to Western Union Pole Cutting 1016
Earnings from Street Railway Operation 1016
Current News and Notes 1016
Letter to the Editors:
Hieroglyphic Designations of Apparatus. By J. L. Crowell 1018
Digest of Current Electrical Literature 1019
New Books 1022
Combination Railway and Lighting Storage Battery at Milwaukee 1023
New Line of Switchboards 1025
Novel Form of Cast Grid Rheostat 1026
"No-Voltage Release" up to Date 1027
G. I. Enclosed Arc Lamp 1027
Departments:
Financial Intelligence 1028
Commercial Intelligence 1029
General News 1031
Trade Notes 1036
Record of Electrical Patents 1037

MANHATTAN MUNICIPAL PLANT.

Note has already been made in these pages of the report of Dr. Cary T. Hutchinson on the cost of furnishing and operating a municipal electric light plant for the Borough of Manhattan. This report is a sequel of the agitation last winter for a municipal plant, started by Commissioner Munroe, and may possibly be used as a basis of expenditure later on by the city. In this report Dr. Hutchinson has put the cost of one arc light, including interest, at 3½ per cent., and depreciation at 8 per cent., at $69.40 for 10,000 lights, and $80.80 for 5,000; with an obvious or apparent saving over present prices of several hundred thousand dollars annually. Of Dr. Hutchinson's expert ability and fairness there is no question, but his report has one or two curious features, and we doubt very seriously whether central station men will accept his data of maintenance and operation.

We note, for example, that "in the estimate of the cost of the central station, no charge is made for real estate," because the city has some available. But is that true finance and sound political economy? Whether the city owns it or does not, the use of the real estate involved just represents the employment of so much capital which comes in the end out of the taxpayers' pockets; and there is no dodging the item by mere omission. The proposed plant cannot be installed on a floating cloud; and every inch of real estate it occupies means an addition to the estimates, not less for the generating system than for the sub-stations. So, too, with regard to the subway ducts, an item of cost that is omitted by the instruction of the city authorities, because of their assumption that they can use all the ducts they want free of rental. Now that is a cool proposition we should very much like to see tried out. When we recall the severe cost of the subways to the private companies using them, we should note with much interest any endeavor of the municipal plant management to use even a single duct free of any cost and expense whatsoever. This is a fond and foolish superstition put forward from time to time with grave naiveté. Our modest opinion is that it will not stand the light of day for ten minutes. Then again, no allowance is made for "lost taxes," the reason being that "as a matter of fact, the taxation of the existing companies would not be affected in any way by the operation of this plant." Well, now, a contrary argument to that strikes us as strongly tenable.

Coming to costs, operation, etc., we note that Dr. Hutchinson is going to get some right smart work done in cheapening things. The cost of generating and distributing the current right up to the lamps, is to be only 1.27 cents per kw-hour. We have no such figures in our possession for a large network, and we question whether any central station manager has, either. Certainly, no such figures go in New York, with its extraordinary cost of every kind, letting alone duct hire. Then as to maintenance, $5 a year per lamp is enough for "the cost of inspection, trimming, carboning, globe breakage and repairs of arc lamps, and of renewals, metering, etc." We would greatly like to know where such estimates or actuality came from, and we venture to challenge the figure flatly, for if the data we are familiar with has any validity at all, $12-$15 would be nearer the mark. In the same manner doubts of a serious character might be put forward as to the figures for the incandescent service; but at this juncture we desire only to say that half-a-dozen reports of this kind, however estimable their authors, would not warrant the city in taking on further municipal business investments.

Even as the report stands, it reduces to absurdity the figures that Commissioner Munroe cited as to alleged cost in other parts of the country, and shows that some persons who assume that arc lighting can be done for some of the rates then quoted are either cheating themselves or fooling other people. Back of all lies the danger of any further investment by New York in business enterprises, not one of those it now owns being administered on proper and profitable lines.

On Electrical Larceny.

The report of the Committee on Theft of Current, at the recent National Electric Light convention, was a grim, almost facetious comment on the frailty of human nature. The acute desire to get something for nothing which we regret to say is one of the mainsprings of original sin, does not always stop on the hither side of honesty; and the report of its incursions into the field of petit larceny is almost amusing. It would be interesting to know the actual extent to which stealing current has been carried, but the appointment of a committee on the subject indicates that the aggregate amount at least is a subject of some importance. We hope that the explanation of the various devices for beating the company will not be given too wide publicity, for a too general dissemination of the preferred methods would constitute a sort of current thief's *vade mecum*. Fortunately, most seekers after free current are not skilled electricians and generally do but a bungling job—in fact, we have heard of magnets and chunks of iron being placed where they would accelerate the meter and hoist the well-meaning but misguided trespasser with his own petard. We commend to the W. C. T. U and kindred organizations the statement that saloons seem to be specially addicted to a longing for free current, but are somewhat shocked to learn that large and supposedly reputable customers have shared in the spoliation. However, no very considerable amount of current can be long abstracted without detection by a careful manager, and a very few detections and punishments of so petty and sneaking an appropriation of other people's goods will serve to scare away similar sinners. As to remedies, constant vigilance seems to be the most effective, and systematic metering on the various feeders will generally give a clue to any material losses. Installation of meters and switches in easily viewed positions would seem to us one of the best preventive measures. Snarls of wires in dark corners are bad in themselves and give peculiarly good opportunities for dodging the meter.

The Enclosed Arc.

It is a pleasure to read so clear and judicious a discussion of an electrical topic as Prof. Thomson's convention paper on the enclosed arc. No man knows better the history of arc lighting, or the minute technical details of his subject. Especially valuable is his dispassionate and accurate estimate of the limitations of the enclosed arc, theoretical and practical. The commercial phase of the subject speaks for itself. During the last half dozen years, the enclosed arc has gradually crowded out its predecessor, until at the present time one would almost be justified in saying that no station uses open arcs as a deliberate matter of preference. It may retain them temporarily, but as a rule discards them as soon as it can "raise the wind" to replace them. In the early days of enclosed arc lighting, all kinds of troubles were encountered—inner globes grew smoky, or melted from the excessive heat; unskillful trimming produced sticking of the carbons or left leaks which resulted in the rapid consumption of the carbons; and divers other troubles were encountered. These have gradually been eliminated by experience, so that they are now of small moment. But as Prof. Thomson points out, the quality of the carbons is the fundamental thing in working enclosed arcs, and we may add that this is particularly true of alternating enclosed arcs. Very homogeneous and pure carbons of just the right degree of hardness and of very exact dimensions are the prime necessity; and as enclosed arcs have become more common, the carbon manufacturers have risen to the occasion. And with carbons of this class came the success of the improved carbon feed, which has reduced the arc lamp to practicable dimensions for general use. Perhaps the greatest value of the enclosed arc lies in the field thus widened. Its great steadiness and brilliancy has pushed it into indoor illumination to an astonishing extent, and while its color and efficiency are not all that could be wished, its convenience lessens the gravity of these limitations.

Electrical Salt Works.

It will be new to most of our readers we fancy to learn that a dozen or more electric plants situated in the salt belts are actually making use of their exhaust steam in working salt evaporators. Mr. Dow's N. E. L. A. paper gave something of the relations of the process, but we wish that he had gone into some detail as to the real financial results. In some respects salt evaporation is a particularly good way to use waste steam, for there is no peak to that sort of load, and the use of steam can be the better adjusted to meet the conditions of economy. We wish some engineer without a bias for or against the extra territorial use of steam would make an exhaustive study of the working conditions in electric light plants to see to just what extent the sale or utilization of exhaust steam is really more profitable than employing it in the condensers and feedwater heaters. We have seen plants which obviously made money on this by-product and others which have apparently lost, and between these two extremes lies a debatable ground which has been very imperfectly explored. Not many plants are fortunate enough to have available salt supply for working up in the manner described by Mr. Dow, but we should say that those thus situated could utilize the exhaust with exceptional chance of profit. Hence, all the more we wish that the actual results reached in the process could have been put on record; we hope that at some future convention the topic, in the larger aspects as well, will be made the subject of a full discussion. Any means of increasing the final dollar-and-cent economy at small stations will certainly be welcome.

The Field Surrounding a Crookes Tube.

In the last number of the *Proceedings* of the American Philosophical Society (No. 172, Vol XLII, January, 1903, page 96), is a paper by Prof. A. W. Goodspeed on some peculiar effects of secondary Röntgen radio-activity. He noticed that when a sensitive photographic plate was supported upon an iron tripod with a ring top, and an active x-ray tube was supported above both, the sciagraph of an object, such as a circular piece of bronze, laid upon the upper surface of the plate, seemed to be affected by the presence of the iron tripod ring on the under surface. The sciagraph, as developed, was less dense just over the tripod ring.

A number of interesting experiments are detailed with excellent sciagraphic illustrations, only, unfortunately, these sciagraphs are reversed by printing and appear as positives, instead of being reproduced by reprinting, in the original negative condition; so that the results are not easy to interpret. The effect seems to be due to scattering and irregular reflection of the x-rays. Thus, it has been known that a fluorescent screen will show a feeble glow, and x-ray activity, behind a large thick steel plate, when an active Crookes tube is held in front of the plate. It is known that x-rays cannot be reflected in the optical sense by a plane surface. There is no x-ray mirror; but x-rays will scatter and fly out in all directions from such a surface, so that when they strike an opaque or semi-opaque substance, the surface of that substance will act as a secondary and relatively feeble source of x-rays. Consequently, when a developed plate is blackened by exposure to x-rays, most of the blackening is due to frontal attack, but some comes from x-rays that have performed a flank movement by scattering and recoil, from more distant bodies, to the back of the plate. An opaque screen at the back of the plate cuts off the flanking movement. If this theory is correct, it would seem that the most accurate sciagraphy requires a leaden back plate for the sensitive plate so as to eliminate all but the frontal attack and direct beam.

LOOKING A GIFT HORSE IN THE MOUTH.

Mankind values things somewhat in proportion to the difficulty of obtaining them, and perhaps this mental obliquity may account for the hypercritical attitude of people at large toward those things which have lost the charm of novelty. We were greatly impressed in reading Mr. Cooper's convention paper on variable speed control, with the singularly perverse attitude of the layman toward electric motive power as displayed in the requirements noted in the study in question. Mr. Cooper has set them forth as they confront the engineer, and they are strenuous, indeed. Just because the electric motor can be given a very wide range of speed things are demanded of it as a matter of course, which no one would ever dream of demanding of other motive power, and there is a strong disinclination to pay for the piper. A man who fifteen years ago had requested a lathe fitted to vary three hundred per cent. in speed by steps of one per cent. would have been bidden hence to the place of sinful departed souls, but now he brazenly stands up and demands it, and expects to get it at the same price he would pay for an extra set of back gearing. His old engine of the slide valve persuasion would vary five per cent. in speed fifty times a day, but when he puts in a motor he specifies that the speed shall not vary more than two per cent. from no load to fifty per cent. overload. Now these refinements cost money, often quite out of proportion to their real importance, and the burden of this note is to suggest a certain attitude of mental perspective on the part of the public. If purchasers would lay stress only on those qualities which are of practical importance in their particular case, the whole electrical business would be simplified. Drop long-winded specifications and get down to hard pan, and the way will become easy and relatively cheap.

A. S. M. E. AND THE METRIC SYSTEM.

The report of the committee of the American Society of Mechanical Engineers appointed to discuss the arguments in favor of and against the metric systems, has just been published. It is a heavy paper. It weighs 127 grammes, occupies 82 pages of printed matter, and 150 c.c. of volume, besides forming part of Volume XXIV of the *Transactions*. It is a most interesting document and presents its interest in a variety of directions. Four members were appointed on the committee, two metric and two antimetric. They have evidently performed their task fairly and in good faith. With excellent judgment they all four signed a joint report covering such articles as they could all unite upon and then proceeded to draw up their respective metric and anti-metric briefs in parallel columns. The metric brief is much the briefer of the two, occupying 197 lines of text; whereas the anti-metric argument occupies 513. Clearly the laboring oar is the one on that side of the boat which tries to defend the existing disorder of things. Nothing more clearly indicates than this the steady progress of the country towards the international metric system. Only about twenty years ago, the mechanical engineers and mechanics of this country would not even have deigned to consider the question of the national adoption of the metric system. Now they not only consider, but they move earth and heaven to procrastinate the inevitable doom of the unfittest which in the natural course of civilization ever goeth to the wall.

The joint report of both sides is a very sensible page. Its gist is that Congress should not, would not, and could not, legislate as to the particular kind of weights and measures that a citizen may elect to use. This sentiment we endorse heartily. If a man prefers to sell his land by the toise, vara, cubit or Flemish ell, he should not be penalized or legally oppressed. Moreover, every effort should be made to spare the expense and annoyance of change in standards such as must fall more particularly upon the mechanical industries. The trouble can be minimized by intelligent co-operation, and the expense of any section of the community can only be justified by the gain of the commonwealth at large. It is wonderful that some mechanics and engineers can be so oblivious of these defects in our ancient medley of measures which the European perceives so glaringly. We have in this country no less than three ounces, a hideous trinity, to wit: the troy ounce, the avoirdupois ounce, and the fluid ounce. They are all in extensive use, and no man may know what an ounce is, save by context or qualification. To add to the absurdity, there is an appreciable difference between the British and the American fluid ounces. There are two different pounds—the avoirdupois and the troy. There are two different tons, the long and the short. There are three kinds of drams, two kinds of hundredweights, three kinds of gallons, three kinds of quarts, three kinds of pints; besides various other incongruities and ambiguities in units less frequently, but not less actually, employed. Against this absurd jumble that a hottentot would despise, there are the metre, the litre, and the gramme, which are one and the same all over the world. The metre, the litre and the gramme are interconnected throughout all their multiples or subdivisions by decimal ratios like those between the dollar, dime, cent and mill. The 64 units in actual use entering into our grand old jumble are interconnected by ratios and cross-ratios so quaintly complex, and so incongruously inexpedient, that no man can remember them. It is like reading "Alice in Wonderland" to review them. It is cruelty to teach this medley to children, stultification to study it among adults, shame to perpetuate it for the race. And this is the labor-creating barbarism that some of our mechanics would maintain at all hazards, despite the fact that to mechanics as a body we owe all our labor-saving devices.

In the days of old Rome, all numerical values, and therefore all quantities, such as sesterces, talents, sheep or oxen, were written down in Roman numerals. The addition or multiplication of quantities thus symbolized was a task of relatively tremendous magnitude. Even the professional clerks, trained to the yoke, had to employ the abacus to help them. The labor wasted in the Roman system by the community aggregated a heavy tax. The Arabic system of numerals, which is now international, came to the Roman empire from the east. It offered enormous saving of labor, and rendered all weighings, measurements, records and bookkeeping much easier. Every man could reckon for himself. But the Arabic system was only introduced after a long and protracted struggle against the fanaticism of the "sweating calculators" who opposed the innovation by every means in their power. In England at this date there appear to be very many intelligent men who oppose the introduction of a decimal currency such as ours, and advocate the retention of their ridiculously cumbersome and labor-creating system of pounds, guineas, shillings, florins, crowns, half-crowns, sixpences, threepenny bits, pence, half-pence and farthings. The arguments they offer bear a gruesome likeness to those which are offered by the anti-metric system conservatives in this country.

International Electrical Congress at St. Louis.

The following is the Committee of Organization of the International Congress of Electricity to be held at the St. Louis Exposition in 1904:

President—Elihu Thomson. Vice-presidents—Prof. H. S. Carhart, C. F. Scott, Prof. W. E. Goldsborough, Dr. W. S. Stratton. General Secretary—Dr. A. E. Kennelly. Treasurer—W. D. Weaver. Advisory Committee—B. J. Arnold, B. A. Behrend, C. S. Bradley, J. J. Carty, A. H. Cowles, Prof. F. B. Crocker, Dr. L. Duncan, H. L. Doherty, Prof. R. A. Fessenden, W. J. Hammer, C. Hering, L. B. Stillwell, C. P. Mathews, R. D. Mershon, K. B. Miller, Dr. W. J. Morton, Dr. E. L. Nichols, Prof. R. B. Owens, Dr. F. A. C. Perrine, Prof. M. I. Pupin, Prof. J. W. Richards, Prof. H. J. Ryan, William Stanley, Prof. C. P. Steinmetz, A. J. Wurts.

The duties of the organizing committee will be to prepare a programme for the International Congress of Electricity, to name the participants therein, to secure the ways and means for the conduct of the Congress, and to promote general interest in the congress.

The Exposition has set aside the week beginning Monday, September 12, 1904, for the meeting of this congress, and will at that time place at its disposal halls sufficient in number to accommodate the general sessions and department meetings. The committee will be subject to the call of the president and secretary.

Telephony and Wireless Telegraphy in England.

In the British House of Commons on June 8, Mr. Austen Chamberlain, the Postmaster-General, explained his attitude toward Marconi's enterprise in Great Britain, which has been condemned in some quarters as checking progress in wireless telegraphy. Mr. Chamberlain said he did not desire to hamper a new invention, but the post office did not intend to throw away its right of monopoly in public communications as it had done in the early days of the telephone. He had not been dealing with Mr. Marconi, but with the company owning Marconi's invention. The company asked for a permanent exclusive right to use ethergraphy in Great Britain. This was refused, on the ground that the request was not business-like. When the company was prepared to talk business he was prepared to deal with it. The company asked the post office to act as its agent in the collection of messages in Great Britain for transatlantic Marconigraphing.

Mr. Chamberlain submitted certain conditions with the view to preventing interference with the Admiralty and also for strategic reasons, adding that when the conditions were accepted and the company satisfied the post office's experts of its ability to send messages across the Atlantic the post office would appoint the company its agent, as it already has done in the case of the cable companies. That letter was sent to the company on March 31, but no reply had been received. Mr. Chamberlain contended that the post office was in no way to be blamed for the delay, but it refused to take the public's money for messages until the company was willing to allow the post office experts to go to Poldhu and satisfy themselves that the wireless system is workable.

Referring to the National Telephone Company, whose conduct of business, he said, had long been a source of public anger, Mr. Chamberlain said he rejoiced that its license would expire in 1911. He declared that never again would the monopoly in telephones pass out of the hands of the post office.

Electricity at the Berlin Chemical Congress.

According to cable advices from Berlin of June 7, as to the meetings of the Chemical Congress at Berlin, Prof. W. Markwald, of Berlin, showed the electrochemical and physical section a smudge of dark powder on a piece of paper, which was the first time that any of those eminent scientists had seen the metal polonium, discovered by Prof. and Mme. Curie, of Paris. The latter doubted whether polonium was a primary element or related to bismuth, but Prof. Markwald demonstrated that it was, indeed, a primary element. He exhibited a bit of the metal, weighing 15-100 of a grain, which was produced from two tons of uranium at a cost of $75. It is more thinly distributed in uranium than xenon, the most rarefied gas, is in the atmosphere.

Prof. Markwald proceeded to give an exhibition of the powers of his speck of polonium. It intercepted a strong current of electricity passing through the air from the generator to the receiver, the air ceasing to be a conductor for the flashes. The room was then darkened and pieces of barium, platinum and zinc blende, placed near the polonium, glowed with a bright greenish light.

In the section of organic preparations, Prof. Proskauer, of Berlin, read a paper on the sterilization of drinking water with ozone and on ozone waterworks, the German electricians having succeeded in cheaply producing a concentrated solution of ozone. The speaker, with Profs. Ohlmuller and Prall, of the Imperial Health Office, made exhaustive experiments with the solution in purifying water. The experiments included tests with water artificially impregnated with the deadliest disease germs, like typhus, cholera and dysentery. Such water was pumped through the so-called "ozonizing tower" and then rigidly analyzed. All the germs were found to be killed, whereas the ordinary method of sand filters left the germs living. Moreover, the water was greatly improved in quality through the increase of oxygen from the ozone. Prof. Proskauer said the ozonizing plant was cheaper than the sand filtering system usually used in city waterworks, hence the time had come for the general introduction of ozone plants. The town of Wiesbaden, added the professor, already has one of these plants, which sterilizes two hundred and fifty cubic meters of water hourly.

Crookes on Atomic Fog.

Prof. Sir William Crookes, before the International Chemical Congress in Berlin last week, dealt with the possibility of reducing all the elements of matter to one, and ultimately finding this resolvable into a single form of energy. The subject was "Modern Views on Matter—the Realization of a Dream." Sir William cited the utterances of Sir Humphrey Davy and Faraday as anticipating the possibility of reducing the elements to simpler bases, spoke of the significance of the Röntgen rays and Becquerel rays, and the experiments of Curie and others, and said:

"All these observations find internal connection in the discovery of radium, which is probably the basis of the coarser chemical element. Probably masses of molecules dissolve themselves into the ether waves of the universe, or into electrical energy. Thus we stand on the border line where matter and force pass into each other. In this borderland lie the greatest scientific problems of the future. Here lie the final realities, wide reaching and marvelous.

"The nineteenth century saw the birth of new views regarding the nature of atoms, electricity and ether. While our views about the composition of matter are generally satisfactory to-day, will that be the case at the end of the twentieth century? Do we not again see that our investigations have only a temporary value? Will we be content to see matter dissolving into a multitude of revolving electrodes? Such a mysterious dissolution of atoms appears to be universal. It occurs when a piece of glass is rubbed with silk. It is present in sunshine, in a raindrop, in lightning, in a flame, in a waterfall, and in the roaring sea. Although the whole range of human experience is too short to form a parallax whereby we can foretell the disappearance of matter, nevertheless it is possible that formless nebulæ will again prevail when the hour glass of eternity has run out."

Notice Serving by Wireless Telegraphy,

Mr. Hearst, proprietor of the *New York Journal*, was served with notice by wireless telegraphy, in a suit concerning death and damage caused by election fireworks. Mr. Hearst was on the *Kaiser Wilhelm II.*, bound for Europe. It was easy to send a cable message, but not so easy to get proof of its delivery. Accordingly this message to Mr. Hearst was sent across, to be transmitted by the Marconi system to the steamship as she neared Plymouth: "City of New York has been sued for $25,000 in New York County Supreme Court by Solomon Landau for damages for death of George Landau by your fireworks explosion on election night, November 4 last, and notifies you to defend this action." When the *Kaiser* got here on the return voyage, it was learned by the Corporation Counsel that George Kroncke, the operator aboard, had received the message from the coast of Ireland while the ship was a day out and that the message had been delivered to Mr. Hearst in his stateroom at 2 o'clock in the morning. Kroncke made an affidavit to this effect.

Rebuilding the Duluth General Electric Company's Station.

By Clifford L. Higgins.

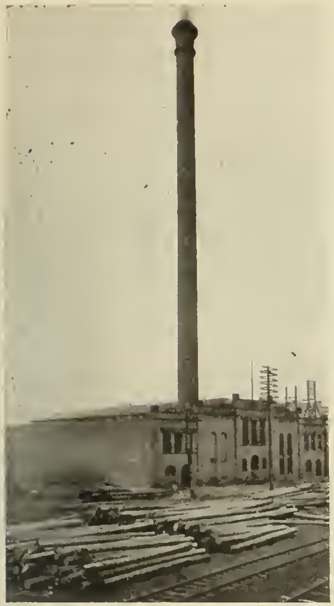


FIG. 1.—EXTERIOR VIEW OF STATION.

It is a well-known fact that as the population of a city increases old methods, appliances and machinery become obsolete, and the demand for electric light keeps pace with such growth. Thus sooner or later the entire electric plant has to be either built anew, added to or remodeled. The latter method was chosen by the Duluth General Electric Company during the winter of 1901-2. At that time the steam plant consisted of one 00-hp Scotch marine boiler, three upright Butman boilers and five horizontal Butmans. This steam plant having been enlarged shortly previous to this, needed no changes, as it was of ample capacity for the proposed increased load. In the engine room there were two 650-hp Allis cross-compound engines, one 400-hp single-cylinder condensing Hamilton Corliss, and one 150-hp Hamilton high-pressure, single-cylinder engine. One of the first two engines mentioned was belted to a line shaft in the basement beneath the dynamo floor. From this were driven one 120-kw, 1,100-volt alternator, one 120-kw, 2,200-volt alternator, one 75-kw, 550-volt direct-current generator, seven 50-light Thomson-Houston arc machines and one 30-light Excelsior arc dynamo. The line shaft of the second large engine was run by a rope drive, and attached to this shaft were two 120-kw, 1,100-volt alternators, one 60-kw, 2,200-volt alternator, one 250-kw, 550-volt, direct-current generator and three 50-light Excelsior arc machines of 9.6 amp. The 400-hp Hamilton engine drove three 120-kw, 1,100-volt alternators, and one 35-kw, 1,100-volt alternator. Attached to the small engine were one 120-kw, 1,100-volt alternator and one 35-kw machine of the same style. All of the above alternators and the 250-kw, direct-current generator were of the General Electric make.

Thus it will be seen that, as in so many of the older heterogeneous plants, there were in all about thirty-six machines, including the exciters. To control the output of the alternators, there was a marble skeleton switchboard having 14 panels, one to each circuit, by means of which board any circuit or combination of circuits could be carried as a load on any of the machines. The arc current was handled and distributed by a wooden plug and socket board, which adjoined the alternator board. This arc board was provided with amperemeter voltmeter and ammeter jacks and from it were run 16 circuits. But the plant became far overloaded and as the equipment was nearly worn out, it was decided to remodel it to conform as nearly as possible to the best modern practice.

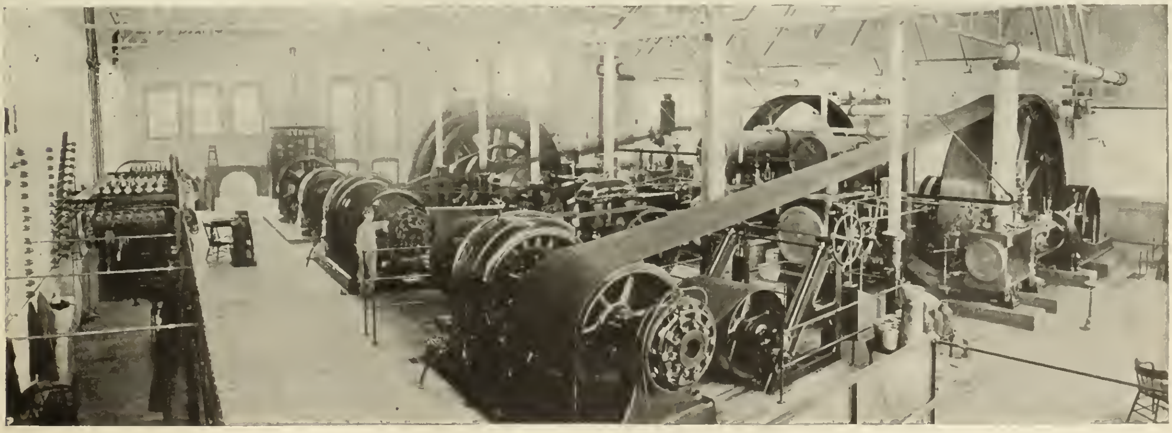


Fig. 2.—General View of Completed Station, Duluth.

The distributing system was entirely rebuilt during the summer of 1901, and the various districts are now fed by banked transformers operating on a 208-volt, three-wire secondary system. During the entire time that the changes were being made, it was necessary to carry nearly the full load on the old machines; and the problems met with in doing this can be better imagined than described. The floor of the old dynamo room had to be lowered six feet to the level of the engine room floor, but of course this was accomplished a little at a time, as one unit after another was placed on the new foundations, and it was possible to shut down the old machines, which were operating on the floor above. Much of the work was done on Sundays and at night, when the load was somewhat lighter. The first of the new three-phase alternators was unloaded from the cars, was placed on its foundation, and was supplying current inside of forty-eight hours, between October 14 and 16, 1901. This machine was a 500-kw, 4,000-volt, 60-cycle generator, and was belted on to the first of the large engines mentioned above.

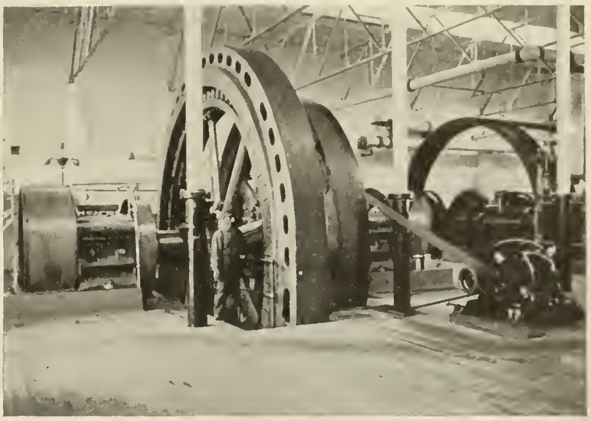


FIG. 3.—1,500-HP ENGINE AND 1,050-KW GENERATOR.

On one end of this generator shaft a pulley was placed which drives the old 75-kw, 550-volt, direct-current generator, which served to care for overloads and emergency cases on the direct-current service. Bolted to the opposite end of this machine also there is an exciter whose armature is mounted directly on the generator's shaft. On December 15, the same year, the second large alternator was connected up by the rope drive to the other large Allis engine. At the same time, the new three-phase board was placed in position, the first new machine having been operated from a temporary board until then. Even with the new big machines and what remained of the smaller ones, it was just barely possible to carry the heavy load at Christmas time.

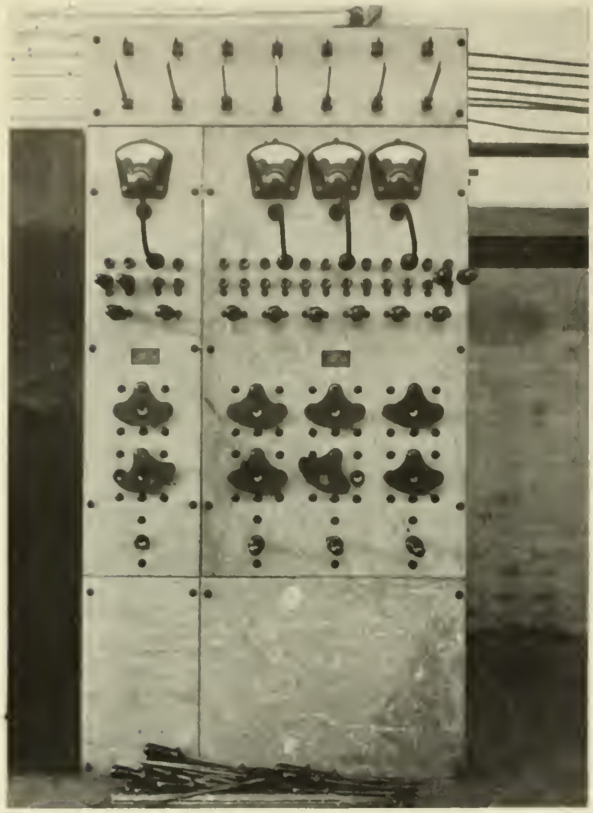


FIG. 4.—ARC SWITCHBOARD.

During the summer of 1902 the two small engines and foundations were removed and the concrete foundation was built for a 1,500-hp cross-compound Allis-Corliss engine 26 x 52 x 48 in., 100 r.p.m., which is direct-connected to a revolving field, 1,050-kw, three-phase, 60-cycle generator. The fly-wheel of this engine weighs 56 tons, the fields also being very heavy. From this fly-wheel is belted a 35-kw, 125-volt, direct-current exciter. On account of the station standing over what was formerly swamp land, the vibrations of the ground caused by the big engine were felt in some tall wholesale houses nearly a block distant; but this trouble was soon overcome.

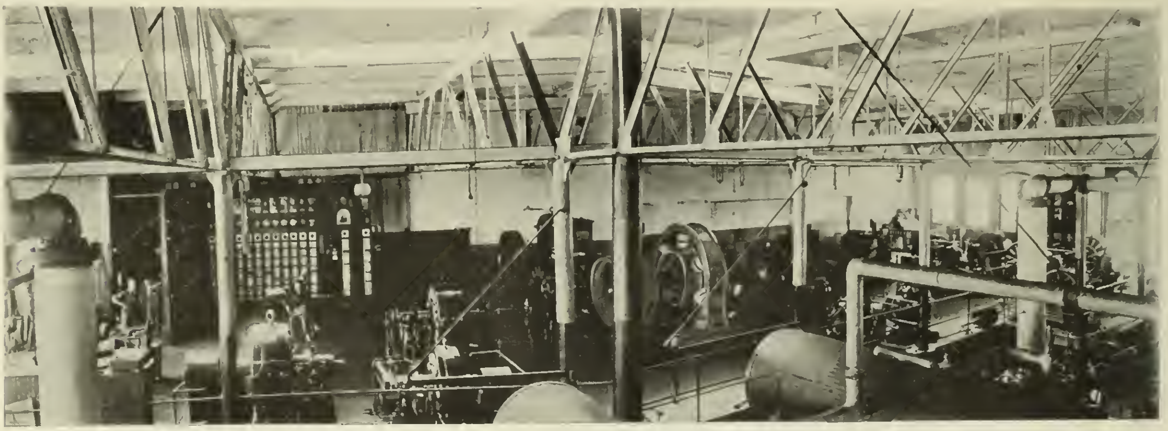


FIG. 5.—GENERAL VIEW OF STATION BEFORE TEMPORARY WIRING WAS PUT IN.

Turning our attention now to the switchboard, we find that it is of fine gray Vermont marble, and from it all the generators and circuits are handled except the arcs. The system used is three phase, four-wire, with a grounded neutral. The board originally built consisted of two generator panels, one synchronous motor panel, and three feeder panels, all supplied by the Stanley Electric Company. The feeder and motor panels are fitted with combined circuit-breakers, and switch and plug and cable connections. There are nine feeder circuits leaving the station. The last panel at the left is the one installed by the General Electric Company, and is used to control the output of the 1,050-kw generator. Near the center of the board is the panel to control the 4,000-volt, three-phase, 300-kw General Electric synchronous motor, which is connected by an insulated coupling to the old 250-kw, 500-volt, direct-current generator. The compensator for this motor sets out in front of the switchboard, but separate entirely from it. Besides the usual voltmeter and lamps, there is a Lincoln synchronizer on a swinging arm at the end of the board for use while placing the alternators in parallel.

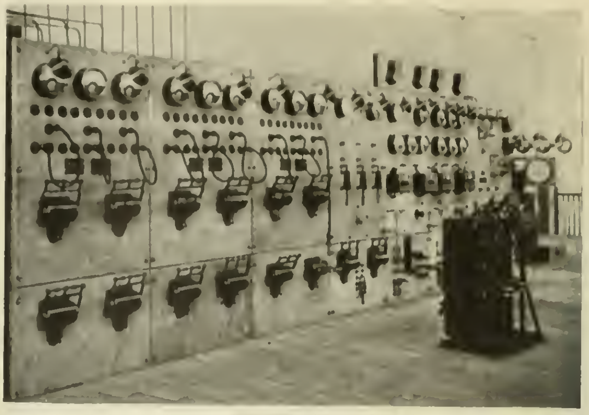


FIG. 6.—GENERATOR AND FEEDER SWITCHBOARD.

Standing in line with the main board, but away from it about 6 feet, is the arc board. The General Electric enclosed series constant-current system is used entirely for street lighting. This board has on it the usual plug switches, ammeters and knife switches to cut it off from the main board. There are seven of the arc circuits on which are operated 360 6.6-amp. enclosed arc lamps. In a well-lighted basement beneath the board are placed the four constant-current General Electric transformers.

At the present time the company are still furnishing the 550-volt, direct-current to their customers through the old wooden switchboard, but this will soon be discarded for a new marble one to correspond with the rest of the equipment.

The remodeling of this plant was done under the supervision of Sargent & Lundy, of Chicago, who were directly represented on the work by Mr. B. J. Jones. The General Electric Company furnished all the new machines, and also all the transformers, both for the arc service and the entire line service. The work is interesting in many ways, and is doubtless typical of much that remains to be done in other large systems of early design and construction, in which the increase of the business and the growing demands for current necessitate radical changes to meet the newer conditions in the industry.

The new engines, as well as the old ones, were given a severe test during February of this year. Peculiar atmospheric conditions existed which caused an abnormal amount of static current on the lines. This static caused a fuse to blow on the arc board, which started a blaze that short-circuited the main bus-bars, into which were feeding a 500-kw and a 1,050-kw generator. It was seen in an instant that nothing would stop the blaze except the shutting-off of all current, so the load was pulled off both engines without warning. Neither ran above speed; and the blaze going out, the generators were paralleled again, and service was resumed in less than a minute. Needless to say, the fuses were then moved to the basement and enclosed in separate brick compartments.

Lifting Electromagnets.

By D. A. WILLEY.

IN several large industrial plants in the West the electromagnet is being put to a comparatively new use in lifting and transferring loads of various sizes. The familiar hook and block is replaced by a mass of metal, varying in size according to the service required. It is connected with the generator by wiring, the magnet usually being constructed with one coil and one center pole, while the two outside poles with the plate connect the three together. The ends of the coil through which the current passes come through the top of the plate and are connected across the line. However, the magnets are sometimes made with several poles and coils varying from two to a dozen or more. In this case the coils are usually connected in series.

The remainder of the mechanism is similar to the crane usually installed in ordinary shop practice, but at the elbow of the motorman is a special switch for controlling the electromagnet, which is, of course, separate from that which is utilized for lighting and transferring. If a slab of steel or a plate of iron is to be handled it is only necessary to run the crane to a point above it and lower the chain or cable with its magnet attached. The current is, of course, turned off from the latter as it is not needed when "light." When the magnet has been lowered sufficiently to come in contact with the surface of the slab or plate, by a push of his lever or perhaps the mere pressure of a button, it is energized by the application of the current and holds the load until it is raised, carried to its other position when the current is turned off and the magnet again becomes "dead," instantly releasing it from the other weight.

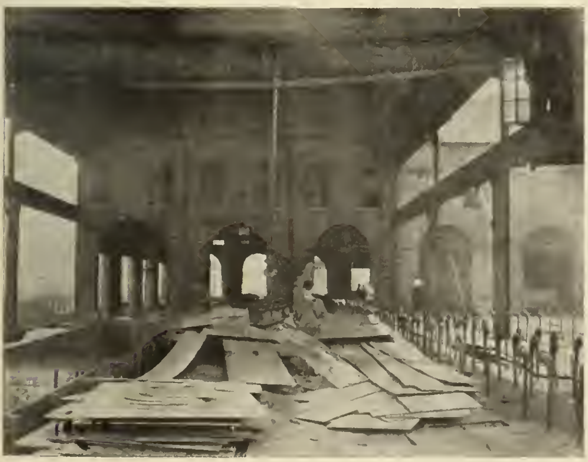


FIG. 1.—REPILING LONG PLATES—LIFTING FOUR AT ONE TIME.

The advantages of this system are obvious. In service the time and labor required in fastening loads to the block of the ordinary crane—an operation often lengthy, as the load may have to be carefully bound with chains or cables and the services of perhaps a dozen men required, to prevent the load from slipping. After the magnet has a grip upon the iron or steel it can be handled with perhaps the aid of but one man besides the motorman merely to guide it into position. Here again the services of the hands are dispensed with since with the electric current turned off, the load is automatically released.

Bars of iron and steel, plates of different sizes as well as slabs can be transferred to and from railway cars and vessels, carried from the stock yard to the furnace, shears, drill or other machine by this system as readily as by the ordinary electric or steam crane, and it is calculated that the time and labor saved represent nearly 50 per cent. in the cost of handling. A magnet of sufficient power will pick up not only one but three or four plates, if desired, transferring the lot as readily as one piece. It can be used in repiling merely by applying it to the edges of the sheets or plates, which can be again deposited in such regular order that the services of one man are merely required to "even up" the heaps.

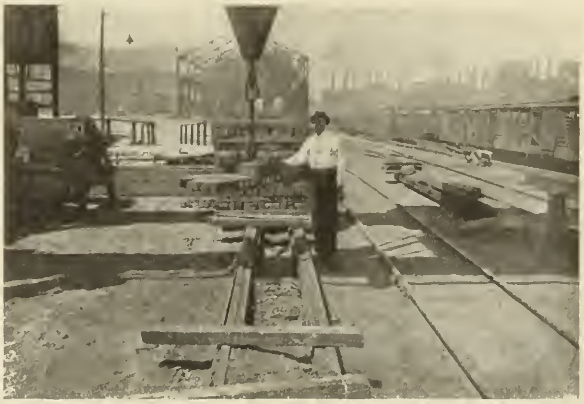


FIG. 2.—TRANSFERRING PIG IRON IN A RAILROAD YARD.

As yet the electromagnet service, as it might be called, has been confined to handling comparatively light loads, but its capacity is only limited by the size of the magnet and the current provided. A magnet weighing 350 pounds will easily pick up and transfer any distance a load weighing five tons, while the power required is about 3 amp. at 220 volts. If two or more magnets are connected with the same crane, of course the load can be increased accordingly by supplying each magnet with its own current. This merely means a little extra wiring. Among the plants where the service has been used with satisfactory results are the works of the Illinois Steel Company at South Chicago, the works of the Ohio Steel Company at Cleveland; while it has been adopted by a number of railroad companies for use in yards at Cleveland and elsewhere.

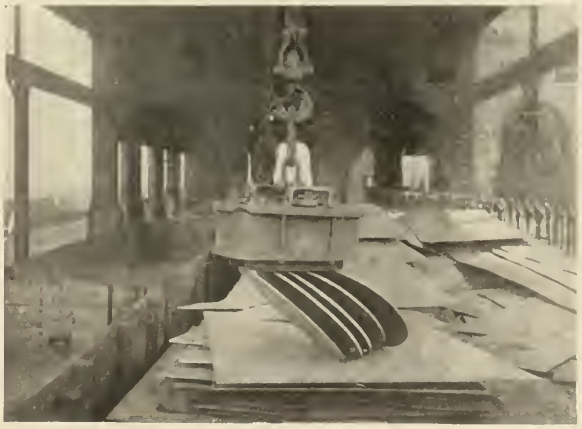


FIG. 3.—RAISING STEEL PLATES BY CONTACT MERELY WITH THE EDGES.

Telephone Exchanges—III.

By Arthur V. Abbott, C. E.

THE MAGNETIC SYSTEM OF THE RECEIVER

THE earliest models of the receiver employed an electromagnet to create the field in which the diaphragm should swing, but this complication was almost immediately perceived to be unnecessary, and the simpler permanent magnet, amply sufficient for the purpose. It was at first considered desirable to secure the strongest possible magnetic field with which to surround the diaphragm, and receiver magnets were bent and contorted into all conceivable shapes, so that one leg of the magnet could be connected to and polarized the diaphragm, but with very disappointing results. With present familiarity with the theory of magnetism this failure is easily understood, but twenty years ago much less knowledge existed.

To view the magnetic system of a telephone receiver from the standpoint of the present conception of magnetism is to clear up many obscure points in receiver design, for we now believe that electricity and magnetism are so closely related that similar methods of reasoning apply to both, but as the units now employed in calculating magnetic mechanisms, and their use, is less familiar than the similar formulæ applied to electrical estimations, a brief *resumé* may be valuable to refresh the mind of the reader

If the poles of a battery, dynamo or other electric generator be joined by a wire, something which we call "electricity" seems to traverse the conductor, apparently going away from the generator and returning thereto over the circuit. The amount of this something is found by experiment to be directly proportional to the power (e.m.f.) of the generator to push it along, and inversely proportional to the resistance of the circuit. This relation is stated by the famous Ohm's law to be $C = \frac{E}{R}$, in which C is the current in amperes, and E the e.m.f. in volts, which propels the current against the resistance, R, in ohms. Similarly when magnetism is under consideration there appears to be a something which traverses the bodies magnetized in a manner somewhat analogous to the electricity on the wire. To produce magnetism in any body a certain amount of force must be applied which may be termed *magnetomotive force,* as analogous to *electromotive force,* and the amount of magnetism produced will be directly proportional to the amount of magnetomotive force, and inversely proportional to the resistance of the body to be magnetized.

As a magnet seems to exercise more or less attraction or repulsion upon bodies or its neighborhood, it was natural to picture magnetism as something emitted, or projected from the poles of the magnet into space. Faraday gave the name of *"lines of force"* to this something, and conceived that these lines of force issued from the north pole of the magnet in the form of closed curves which swept through the surrounding material back to the south pole, in much the same fashion that electricity proceeds from the generator through the circuit and returns to its source.

We really know absolutely nothing as to the true nature of magnetism, but a very satisfactory working hypothesis is to imagine that this phenomenon is due to a stream, or flow in the ether. Suppose AB (Fig. 12) to be a tube or pipe, with a centrifugal pump located in the middle at C, and conceive the entire apparatus to be submerged in a tank of water. If the pump, C, be operated, it will force the water along the tube toward B. As soon as the end of the confining walls of the tube is reached at B, the water current will fan out in all directions through the tank. Meanwhile to supply the place of the water forced out at B new supply must enter the tube at A. So presently a current is set up running through the tube in the direction AB, then spreading throughout the tank in all directions and returning by the end A. Evidently the amount, or velocity, of the current will depend on the power of the pump, the resistance offered to the water flow by the friction of the walls of the tube, and the viscosity of the surrounding fluid. We may imagine that this is a rough analogy of the phenomenon of magnetism. The tube is the analogue of the ordinary bar magnet, the pump the magnetomotive force that sets up streams of ether that flow through the bar, issuing from the north pole, streaming through space to return by the south pole, and it is these streams of ether which we term a magnetic field. Now the amount of magnetism, or quantity of ether streams, will be proportional to the power of the pump (the magnetomotive force) and the resistance of the tube (the magnet) and that of the surrounding medium in which it is placed. In the case of the water pump the friction of the tube and fluid in the tank requires a constant expenditure of energy to maintain the current, but the ether is supposed to be *frictionless,* hence while an ether stream will always require the expenditure of energy to start it, or stop it, after it is once set in motion, it will continue to flow until forcibly arrested; herein lies the explanation of the constant exhibition of magnetism by a magnet after it has once been magnetized.

But all this, while a beautiful though somewhat fanciful theory, is too intangible for the engineer who wishes to express in definite units the entities with which he deals and calculates therewith.

In the c.g.s. system the unit of force is that amount of force which, acting for one second, will produce a velocity of 1 cm per second, in a mass of 1 gramme; this is called the *dyne;* measured in gravitation units, this force is approximately equivalent to the weight of a milligram. As a magnet exercises a force upon a body placed in its vicinity it was natural to assume as the unit magnet, such a magnet as would exercise a force of one *dyne* upon another exactly similar magnet 1 cm away from it. To project its force over this centimeter of space the magnet must display a certain amount of magnetomotive force, in order to overcome the resistance or *reluctance* as this opposition is usually called (in contradistinction to electrical resistance) of the air space, so the *reluctance* of a cubic centimeter of air is assumed as the unit of magnetic resistance. Theoretically the unit of reluctance is that of a cubic centimeter of an air pump vacuum, but to all intents and purposes, for practical work at least, the magnetic reluctance of a cubic centimeter of all non-magnetic materials (everything but iron, nickel and cobalt) is the same as that of an air pump vacuum. This unit of reluctance is called the *"oersted"* and is symbolized by the script letter, $\mathcal{R}$. From what precedes the unit magnet will exercise a pull or a push of one unit of force at a distance of one unit of space; in other words, it delivers a unit of magnetism through a unit of reluctance. This unit of magnetic *flow,* or *flux,* or *stream,* as it is variously called, is termed the maxwell, and it is usually indicated by the Greek letter, Φ. Lastly, the unit of magnetomotive force is the *gilbert,* and from the foregoing is that amount of magnetomotive force needed to drive one maxwell through one oersted. The symbol for the gilbert is usually a script letter, $\mathcal{F}$. The law of the magnetic circuit can now be stated in terms which are as similar and as simple as those which apply to the electric circuit.

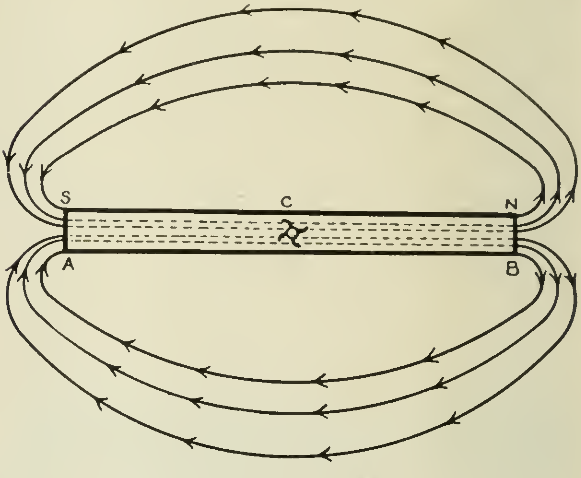


FIG. 12.—DIAGRAM OF HYPOTHETICAL MAGNETIC CIRCUIT.

$$\Phi = \frac{\mathcal{F}}{\mathcal{R}} \quad \text{or}$$

$$\textit{The flux} = \frac{\textit{The Magneto-motive-force}}{\textit{The Reluctance}}$$

For example, if a magnetomotive force of $\mathcal{F} = 500$ gilberts be applied when the total reluctance, $\mathcal{R} = 5$ oersteds, the total magnetic flux in maxwells, or number of lines of force, will be

$$\Phi = \frac{500}{5} = 100$$

We now know of but two sources from which a magnetomotive force can be derived. The first, oldest, and in many respects the least valuable source is that peculiar property which seems to be inherent in the molecules of certain kinds of matter, such as the loadstone, iron, nickel and cobalt, by reason of which they not only become magnets themselves, but are capable of creating the same condition in other similar bodies, and of filling the space that surrounds them with magnetic flux. The second is by the use of an electric current, for it is found, by experiment, that the space surrounding every conductor traversed by a current is invested with the properties of the magnetic field, and that the intensity of this field is proportional to the current. Now, if the conductor be bent in the form of a ring there will, with any given current, be a certain flux, or definite number of maxwells inside this ring, and if the current be doubled the flux will be doubled. Evidently the same result can be attained by keeping the current constant and causing the wire to make two turns; hence the magnetomotive force of any coil of wire carrying a current will be proportional to the current, and the number of turns; or that is the same thing proportional to the product of the amperes and the turns as *ampere-turns.* It is found that one gilbert is equal to 1.257 ampere-turns, or one ampere-turn equals .795 gilberts, hence the magnetomotive force of any coil can at once be expressed in gilberts by multiplying the ampere-turns by 1.257.

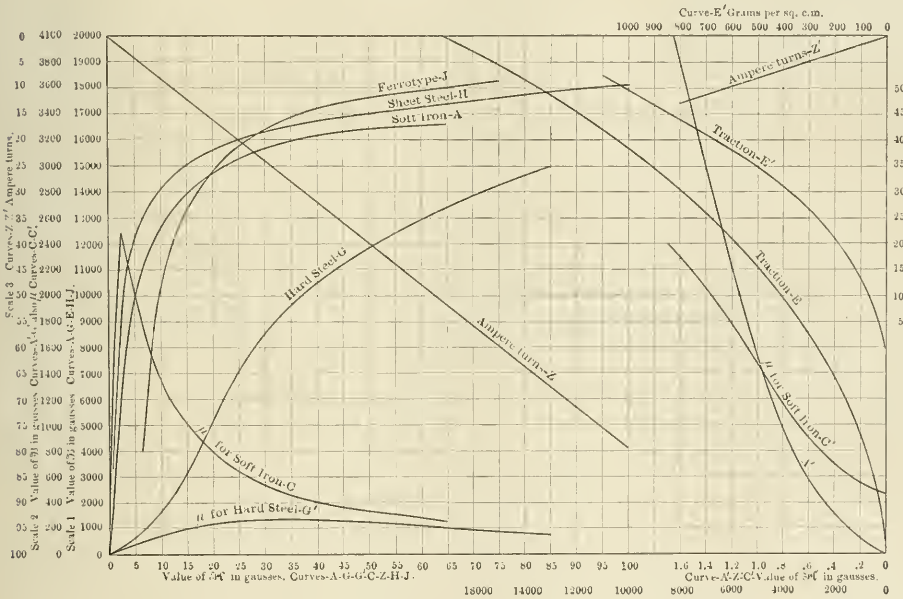


FIG. 13.—MAGNETIC CONSTANTS.

For example, assume a ring of wood having a cross-section of 5 cm² and a circumference of 100 cm, and suppose the ring to be covered with 500 turns of wire through which 2 amp. flow. The magnetomotive force, $\mathcal{F} = 500 \times 2 \times 1.257 =$ (number of turns × number of amperes × 1.257) = 1,257 gilberts. As the reluctance of wood is unity per cm³, the total reluctance of the ring is evidently directly proportional to its length, 100 cm, and inversely proportional to its area, 5 sq. cm, or $\mathcal{R} = \frac{100}{5} = 20$ oersteds. The total magnetic flux in maxwells is $\Phi = \frac{1257}{20} = 62.85$. According to present ideas, this stream of magnetism circulates round and round inside of the coil, and as the area is 5 sq. cm the intensity or number of maxwells per sq. cm, or number of lines per sq. cm, is $\frac{62.85}{5} = 12.57$. In electrical measurements this corresponds to *amperes per square unit of area of the conductor,* a unit of measurement frequently used, but for which there is no individual name. In magnetism, however, there is a special unit for intensity of flux called the *gauss.* Its value is one maxwell per sq. cm, hence in the preceding example the intensity is 12.57 gausses. The total magnetomotive force, $\mathcal{F}$ was found to be 1,257 gilberts, and as the ring is 100 cm around it the magnetomotive force per centimetre of length is $\frac{1{,}257}{100} = 12.57$ gilberts. The magnetomotive force per *unit* of *length* of a coil is usually symbolized by a script letter, $\mathcal{H}$, and when the coil contains only non-magnetic material it is numerically equal, as shown above, to the flux density, and so $\mathcal{H} =$ gilberts per linear centimetre in gausses.

The analogy so far traced between the electrical circuit and the magnetic circuit has been exceedingly close, but in two respects there are very grave differences. To the passage of both electricity and magnetism it is found by experiment that different substances offer very different amounts of opposition per unit of volume. Thus all of the metals are relatively very perfect electrical conductors when compared to the non-metals, although the poorest metallic conductors offer upwards of a hundred times the resistance of the best ones. In the case of electricity, the resistance per unit of volume is *constant,* no matter what amount of electricity may be driven through the conductor; thus any given wire will have exactly the same resistance whether it carries one-hundredth of an ampere or a hundred amperes. With magnetism, however, there are two striking peculiarities. In the first place there are only three substances, iron, nickel and cobalt, whose magnetic conductivity differs greatly from unity, and secondly the opposition which these three exceptions offer to magnetic flux is *not constant* as in the case of electricity, but varies with the *amount of magnetic flux* that happens to be passing. The result of this is to greatly add to the difficulty of making magnetic calculations, particularly as it is impractical to express this change in reluctance, in a simple form, and the only satisfactory way yet devised is to test experimentally samples of various substances and plot as a curve the relation between the magnetomotive force and the resulting flux. Fortunately only the various forms of iron are used to any extent in electromagnetic mechanisms, otherwise the labor of investigating, plotting and using a multitude of curves would have been overwhelming.

So far as telephone receivers are concerned, soft iron and hard steel are the only magnetic materials of which cognizance need to be taken. Fig. 13 gives a set of magnetic constants chosen as particularly applicable to receiver design. On the left-hand side of the sheet curve *A* relates to soft iron and is applicable to pole pieces and diaphragms, while curve *G* is for glass-hard steel, useful in connection with permanent magnets. The lower horizontal scale, beginning at the left-hand corner and reading to the right, gives the value of $\mathcal{H}$ in gilberts *per centimeter of length* of coil; that is, if we suppose the magnetomotive force to be created by coil of wire supplied by a current, each centimetre of the coil must produce $\mathcal{H}$ gausses. This is the intensity of the field, or number of lines of force, or number of maxwells per sq. cm, inside the coil, so long as it is occupied by air or other non-magnetic material. Now, suppose a piece of soft iron to be inserted in the coil, and the current traversing it to be slowly augmented so that $\mathcal{H}$ may increase from zero to any desired amount. Instead of the flux Φ being numerically equal to and growing in direct proportion with $\mathcal{H}$, as would be the case if the coil were occupied by non-magnetic material, it is found to be enormously increased, and by measuring the values of the flux with different values of $\mathcal{H}$, a curve can be plotted showing the relation between them. Curve *A* is such a line Scale No. 1 on the left-hand side of the sheet gives the number of gausses or maxwells per sq. cm in the iron, which is usually represented by a script letter, $\mathcal{B}$. In order to exhibit the entire curve rather small scales had to be chosen, but as for receiver design the lower portions of the curve are important, and the beginning of curve *A* is shown considerably magnified on the right hand of the sheet marked *A′*. The lower horizontal scale designated *A* gives the value of $\mathcal{H}$ in gausses for this curve and reads from *right* to *left*. Scale No. 2 on the left hand of the cut gives the corresponding values of $\mathcal{B}$. When $\mathcal{H}$ equals 1 (curve *A′*) $\mathcal{B}$ is found to be 1,550, with $\mathcal{H} = 2.5$, $\mathcal{B}$ is 6,250 (curve *A*) and this enormous increase in flux continues in nearly the same ratio till $\mathcal{H} = 5$. It seems, then, as if the ability of the iron to carry the flux gradually became exhausted, and as $\mathcal{H}$ is increased the ratio between $\mathcal{B}$ and $\mathcal{H}$ decreases until it finally falls nearly to unity. This curious property of iron to increase the flux has been usually explained by saying that the *reluctance* of the iron is much less than that of air, or in other words that its *permeability* is much greater. The symbol of permeability is the Greek letter μ and the points on the curves, *A* and *A′*, may be expressed by the relation $\mathcal{B} = \mu \mathcal{H}$. In electrical parlance one would say that the iron was a much better conductor, or had much less resistance. It is improbable that this explanation is a correct one, but it forms the easiest working hypothesis that one can employ. By calculating the various values of μ in terms of $\mathcal{H}$ from the formula $\mu = \frac{\mathcal{B}}{\mathcal{H}}$ a very useful curve may be plotted showing the reluctance of iron as compared with air for all values of $\mathcal{H}$. Such a curve is shown at *C* (Fig. 13). The values of $\mathcal{H}$ are shown on the same lower scale as for curve *A*, while the values of μ are given by scale No. 2 on the left hand. This curve rises suddenly from 0 to about 2,500, then abruptly turns and drops toward the horizontal axis, at first very rapidly and then slowly, till it nearly reaches unity. By means of the data exhibited in these curves, it is easy to determine for soft iron either the reluctance per cubic centimetre, the magnetomotive force needed to produce any desired flux, or the flux which will be obtained with any given value of $\mathcal{H}$. For example, with a magnetomotive force of $\mathcal{H} = 15$ gilberts per linear centimetre, the value of $\mathcal{B}$ is 14,000 gausses, μ is 1,000, and the reluctance per cubic centimetre is $\frac{1}{1{,}000} = .001$ oersteds.

Curves *G* and *G′* contain similar data for hard steel such as might be employed for receiver magnets. There is a striking difference between the curve for steel and that for iron. At all points the value of $\mathcal{B}$ for steel is much less than for iron with the same value of $\mathcal{H}$, and consequently μ is correspondingly smaller. Again, the curve $\mathcal{B}$ is less concave toward the horizontal axis, which means that steel, unlike iron, does not show so marked a saturation point beyond which it is difficult to push magnetization. Curve *G′* gives the value of μ for curve *G* in a manner similar to the data shown by curve *C* for curve *A*.

Steam Turbine Unit for Omaha Light and Power.

On account of the increase in its lighting and power business in Omaha, Neb., and the purchase of the central station in Council Bluffs, Iowa, the New Omaha Thomson-Houston Electric Light Company is planning improvements to its system and an important addition to its power station. This new addition will consist of a 1,500-kw Curtis turbo-alternator, four boilers and condensing apparatus. The power house of the company is located on the Missouri River in the eastern part of the city and at present contains five direct-connected units, the plant having been changed over from a belt-driven system about five years ago. Two of the units consist of 300 kw alternating-current generators, driven by 400-hp horizontal tandem-compound engines. Another engine of the same type and size drives a 300-kw alternating-current and a 325-kw direct-current generator on the same shaft, current being taken from either machine to meet the demands on the alternating and direct-current distribution. A 750-hp tandem-compound engine drives in a similar manner a 500-hp alternating-current and a 325-hp direct-current machine. The fifth unit comprises a 1,000-kw alternator driven by a 1,500-hp cross-compound engine. All of the engines are of the McIntosh & Seymour make, and the generators are General Electric machines. All five units are run in parallel with very little trouble.

The alternators are monocyclic, delivering current at 2,300 volts. The direct-current generators deliver a 500-volt current that is used principally for light and power purposes. Alternating current is distributed for lighting and power through 236-volt secondaries. Arc lamps in six series circuits of 100 lamps each are operated through constant current transformers, the voltage varying from 7,500 to 8,000 volts. Service is supplied from the power house to South Omaha and Council Bluffs through 5,500-volt transmission lines, the power being distributed in those cities from transformer stations at 2,300 and 236 volts. A short account of the Omaha lighting situation, printed in the ELECTRICAL WORLD AND ENGINEER of November 24, 1900, gave a mere detailed mention of the monocyclic system and the South Omaha plant.

The new steam turbine unit will be installed in the present power house. It will be of the new Curtis vertical type as manufactured by the General Electric Company, and described in ELECTRICAL WORLD AND ENGINEER of May 23, 1903. The unit will have a speed of 900 r.p.m. and will deliver a 2,300-volt, three-phase, 60-cycle current. The capacity per phase will be 377 amp. The machine will have eight poles and will be designated as the company's A T B type. Its speed variation is not to exceed two per cent. from no load to full load, although a sudden variation may cause a four per cent. momentary speed fluctuation. The regulation is guaranteed to be within eight per cent., and for a 50 per cent. overload for two hours the temperature rise is not to exceed 55° C. The maximum excitation is to be 125 volts. The turbine unit is guaranteed to be capable of carrying a 100 per cent. overload momentarily without injury. It will operate on 150 pounds steam pressure or possibly on 200 pounds with superheat. A steam consumption of 20.5 pounds of dry steam per kw-hour is specified at full load and 22 pounds at half load. The turbine will be 16 ft. 9 in. high and will be 10 ft. in diameter at the base. Its weight is 125,000 pounds. According to contract, the unit is to be shipped in January, 1904. For condensing purposes in connection with the turbine there will be installed a 2,000-hp Worthington surface condenser.

The present boiler equipment of the Omaha Thomson-Houston plant comprises four 375-hp Heine, one 375-hp Edgemoor and five 125-hp tubular boilers. The tubular boilers are to be replaced by four 500-hp Babcock & Wilcox boilers, set in two batteries. They will be equipped with superheating coils and Babcock & Wilcox chain-grate stokers.

After the new turbine unit is installed it is the company's plan to change over the monocyclic to a three-phase system.

The company has just completed putting its wires underground in the central district of the city, the area extending ten blocks east and west and five blocks north and south. In the underground work there was used 250,000 ft. of cable, 400,000 ft. of duct and 25,000 ft. of Edison tube. McRoy & Camp conduit and bituminous paper duct were used. Practically all the construction lies in the alleys, and transformers of 20 to 50-kw capacity are located in manholes every block.

On May 1 the new Omaha Thomson-Houston Electric Light Company purchased the Citizens' Gas & Electric Company, of Council Bluffs, to which it had been supplying power for the past two years, the Citizens' Company having leased two years ago the Council Bluffs Gas & Electric Company, the original lighting company in Council Bluffs. The Citizens' Company has $150,000 capital stock and is bonded for $388,000. It will probably be continued under its present name.

As the Omaha Thomson-Houston Company acquired control of the South Omaha plant nearly three years ago (see ELECTRICAL WORLD AND ENGINEER November 24, 1900), it now controls the lighting and power situation in the three cities—Omaha, South Omaha and Council Bluffs. Steps are being taken to reorganize the company in order to issue new bonds and take up the old ones at a lower rate of interest. It is proposed that the new company issue $1,350,000 5 per cent. first mortgage bonds, $481,800 preferred cumulative 5 per cent. stock and $2,000,000 common stock to take care of its bonded indebtedness, floating debt, new improvements and the acquisition of the Council Bluffs property. It is probable also that a new name will then be adopted by the reorganized company.

In addition to the increase in generating capacity of the power plant spoken of above, there has been considerable talk of the company developing directly or indirectly some of the water powers that lie from 30 to 100 miles west of Omaha. There are said to be several excellent opportunities in that direction and the question of their successful development would depend upon receiving the lighting and street railway power in Omaha.

The officers of the new Omaha Thomson-Houston Electric Light

Company are as follows: President, Fred. A. Nash; vice-president, Henry W. Yates; secretary and treasurer, S. E. Schweitzer; directors, Fred. A. Nash, Henry W. Yates, C. E. Yost, George W. Holdrege and Guy C. Barton; general superintendent, R. A. McLaughlin; purchasing agent, W. B. Whitehorn.

London Conduit Railway System.

Last month the first section of the electric railway system of the London City Council was put in operation, comprising 8 miles of double track on Surrey side. A second section of 19¼ miles is now under construction, and a third section of 7 miles will soon be commenced.

A central power house for the completed system is being erected at Greenwich, current being at present supplied from a temporary plant. The order already placed for generating plant includes two 1,500-kw direct-current machines and three-phase machinery, consisting of two 1,500-kw alternating generators and eleven 300-kw motor-generator sets, and other small auxiliary sets, including small motor-generator sets and steam-driven exciters. Two 1,500-kw direct-current machines are coupled direct to Ferranti vertical engines. They are 12-pole compound-wound generators, and when running at a speed of 150 r.p.m. develop at full load 2,400 amp. at 625 volts. All of the electrical machinery will be supplied by Dick, Kerr & Co., which firm has also supplied the complete equipment of 200 cars for the section just opened. All the track work for the first section was done by Messrs. J. G. White & Co., under specifications of Dr. Alexander B. W. Kennedy, of Kennedy & Jenkins, which were somewhat modified to suit the circumstances.

The conduit system is employed, and in its construction some novel features were encountered, owing to the fact that the former horse car track was laid in concrete. It was found that the old method of breaking out the old construction with road spikes and sledges was not only slow but costly, and some other quicker method had to be adopted.

The margin of the old track on the outside was broken out just enough to permit the insertion under the concrete bed of special lever jacks. A distance of some 50 ft. to 60 ft. was dealt with at a time, and the jacks are spaced at about 4 ft. to 6 ft. centers, as the lifting resistance of the bed may require. The entire existing concrete bed and track was then lifted bodily, when it could readily be broken with spikes and sledges in the ordinary way from the top and removed.

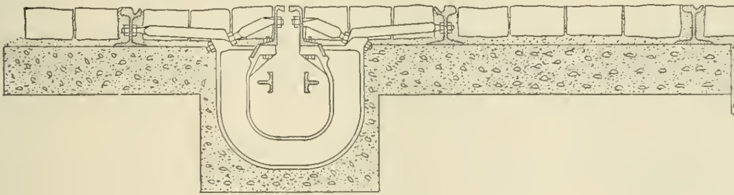


FIG. 1.—CROSS SECTION OF YOKE.

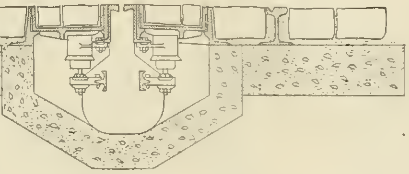
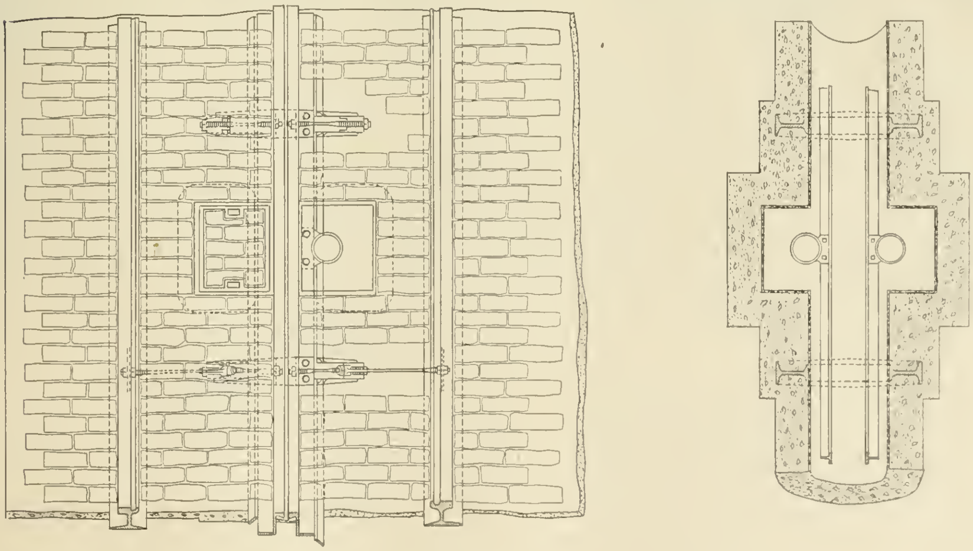


FIG. 2.—CROSS SECTION AT INSULATOR BOX.


FIGS. 3 AND 4.—PLAN AND SECTION.

Spaces were first cut in the trench for the cast-iron yokes, which are at 3-ft.-9-in. centers throughout the whole length of the conduit, after which the rails were put in place and aligned, and the conduit was built up by wooden molds. With the yokes as closely placed together as this a lighter form can be used, and in some ways it strengthens the construction, especially preserving the position of the slot rail and preventing it at all times from closing by outside pressure. The slot rail is of the Z-type, having a vertical web, and is constructed so that any surface water drops easily to the bottom

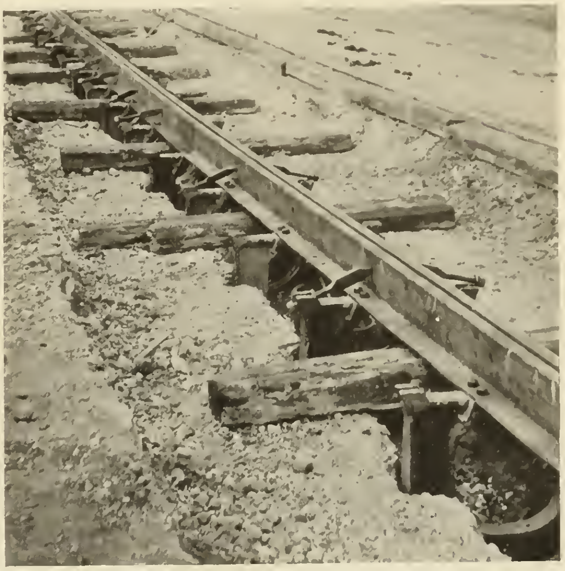


FIG. 5.—SLOT RAILS AND YOKE.

of the conduit from which it is drained by special sewer connections. The service rails are 7 in. high, with 7 in. width of base, having a groove 1 1-16 in. wide for straight track and 1 3-16 in. on the curves. The tie-bars are attached not only to the slot rail and the yoke, but by extension pieces they are attached to the rail so as to preserve a perfect gauge. The wooden molds used for building up the conduit are in two parts.

The conductors used are similar to those employed in New York, and are supported by insulators every 15 ft. As provision has to be made for inserting or removing the conductor bars special gaps are left in the conduit, except where, as in most cases, the sump holes for draining the conduit to the sewers afford this facility. The conductor bars are fed into the conduit at the manholes and are suspended by means of special tools to small carriages running on the tops of the slot rails, and in this way are carried to the point where they are required and secured to each insulator; the necessary bonds for connecting electrically the adjacent T-rails are fixed in position by a special hydraulic press, which can be used through the insulator box opening.

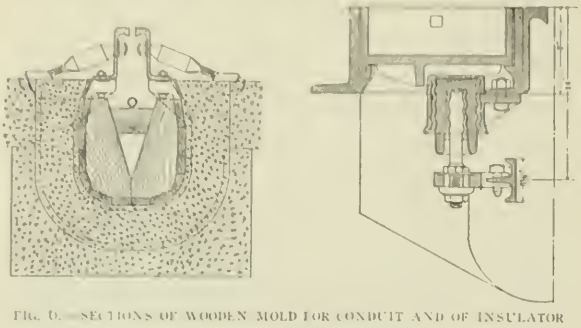


FIG. 6.—SECTIONS OF WOODEN MOLD FOR CONDUIT AND OF INSULATOR BOX.

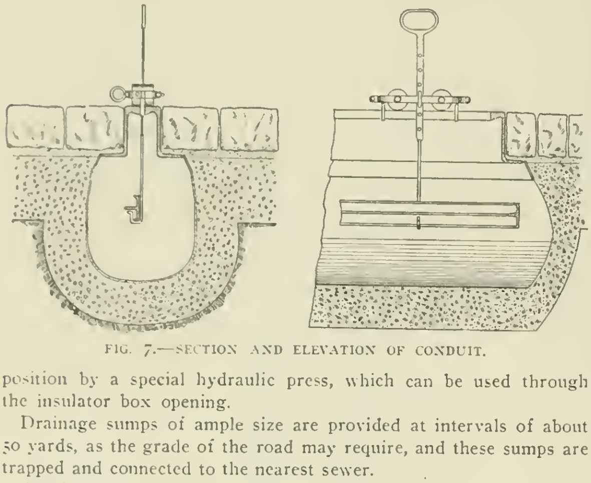


FIG. 7.—SECTION AND ELEVATION OF CONDUIT.

Drainage sumps of ample size are provided at intervals of about 50 yards, as the grade of the road may require, and these sumps are trapped and connected to the nearest sewer.

Another point of interest in connection with the equipment of the lines was the fact that the present horse traffic was kept going during the reconstruction. Moreover, the vehicle traffic on the streets under reconstruction was considerable, so that provision and maintenance of a temporary track became an important factor, and necessitated a special flat section rail which would be surmounted without injury to springs of the passing vehicles.

A. S. M. E. Meeting.

The forty-seventh meeting of the American Society of Mechanical Engineers will be held at the United States Hotel, Saratoga, June 23 to 28. The programme includes papers on the following subjects: T. A. Waldron, on "Steam Turbines from the Operating Standpoint"; D. S. Jacobus, "Curves of Water Consumption for Various Horse-Powers of Several Engines"; W. I. Slichter, "Alternating-Current Motors for Variable Speed," etc. Trips will be made to the General Electric factories, Hudson River power plants, Union College, Schenectady, etc. The local committee has Mr. A. L. Rohrer as chairman and includes H. G. Reist, secretary; H. G. Hammett, treasurer; August H. Kruesi, J. F. McElroy, H. A. Moody, W. B. Potter, Prof. W. L. Robb, W. L. R. Emmet.

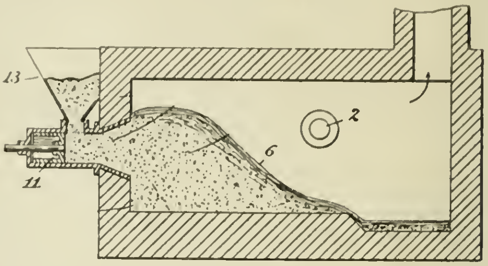
Recent Electrochemical Developments.

By Clinton Paul Townsend.

ELECTRIC FURNACE.

An electric furnace method patented by Carl Gustaf Patrik de Laval, of Stockholm, Sweden, is intended more particularly for the reduction and distillation of such volatile metals as zinc, the heat being radiated against the charge from an arc or incandescing conductor placed at some distance therefrom, thus following the lines of the Gibbs method for the distillation of phosphorus. The feature of novelty lies in the form given to the stack of the charge in the furnace and its position relative to the source of heat, the arrangement being such that the reduction of the ore occurs in the less intensely heated portion of the furnace whereby danger of a too rapid or even explosive liberation of gas is avoided. The reduced metal is continuously moved forward toward the source of heat, the final and quieter reaction involving the fusion or distillation of the metal occurring in immediate proximity to the arc.

The arrangement of the furnace is illustrated in the cut, in which 2 represents an arc, or incandescing carbon rod, and 6 the furnace charge; a hopper, 13, and reciprocating piston, 11, are provided for maintaining the form and dimensions of the latter. The reaction begins under the moderate temperature conditions at the peak of the stack, and is completed on its middle or lower slope, at the region of highest temperature.



ELECTRIC FURNACE.

Reference should perhaps be made in this connection to the simple furnace construction of Chavarria-Contardo, heretofore described in these columns (July 13, 1901). This furnace resembles the present construction in that it subjects the charge to the heat of an arc located out of contact with the material and in that the charge is subjeced to a progressively increasing temperature in the course of its movement through the furnace; it goes a step beyond the present construction, however, in that the escaping gases of reaction are utilized for a heating of the charge which is preliminary to the reduction.

New Telephone Patents.

AUTOMATIC PAY STATIONS.

For some few years automatic pay stations have been the subject of very general consideration among telephone men. The pay station has always been practically attractive as a source of revenue, but the difficulty of collecting for calls has at times been no mean one. Many of the early automatics were very crude, and it was possible not only to deceive the operator, but to rob the pay station, of which possibilities certain persons were not slow to take advantage. The next difficulty with this type of apparatus was the substitution of slugs for coins. Then came the annoyance from the depositing of coins when the operator was not present upon the circuit, and the consequent disputes regarding the return of such coins. These

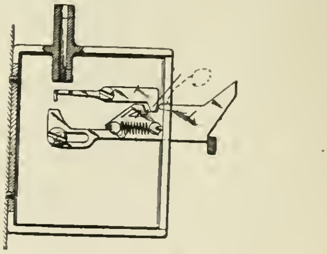


FIG. 1.—LEWIS TELEPHONE LOCK.

and other early difficulties bring us down to the pay station coin collectors of the present day. Of these, there are several types, and as evidence that perfection has not as yet been attained, we have for present consideration five patents just issued for coin collecting pay stations.

One of the most novel of these collectors is that by W. S. Paca, of Erie, Pa. The top of the box of this collector carries a central crank and a set of circular apertures, each of the exact size of a particular kind of coin. Immediately beneath the cover of the box are two metal plates, one moving with the crank and having apertures exactly to correspond with those in the top; the other stationary and mounted immediately beneath the movable plate. Annular slots are made in the underside of the cover, one for each aperture, and these are of such depth that taken with the thickness of the moving plate just sufficient vertical space is left for a coin of the thickness proper for that denomination. The crank is allowed a slight angular rotation, and when a coin is dropped in place, and the crank turned, the coin passes at once beneath the cover. As it progresses, it passes over an aperture in the stationary plate slightly smaller than its nominal size. If it be too small, it will fall through without result. If of proper size it will pass to a trigger, which being engaged will sound a distinctive gong, thus indicating its receipt. After sounding the gong, it drops through a second aperture in the stationary plate into the coin box. If a thin coin of proper diameter is tried, it will follow exactly this course, but will ride over the signal trigger. If a coin be once started under the cover it is impossible to return the crank until it has been deposited, as a ratchet prevents such return until such time as a lifting guard plate has raised the pawl at the end of the normal stroke.

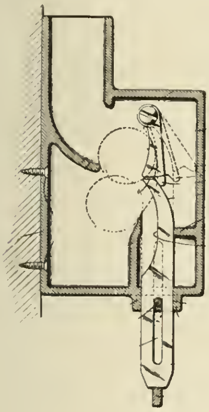


FIG. 2.—SCOTT TELEPHONE LOCK.

TELEPHONE LOCKS.

Two of the present patents are for "Telephone Locks," arranged to engage the switch hook of a telephone set until released by a coin. One of these, shown at the left of Fig. 1, is almost self-explanatory. The switch hook, shown in shaded section, engages a spring latch. When a coin is deposited, it trips the trigger, but is held in the slot until the latch has receded its full extent under the influence of the rising switch hook. The second lock is rather simpler than the first, and is shown in Fig. 2. The descending coin trips the trigger, and is held until the ascending latch opens a passage into the coin box. The patents for both these locks are assigned to the Controller Company of America, the former being the invention of E. G. Lewis and the latter of W. H. Scott.

COIN COLLECTOR.

Charles E. Scribner has patented the fourth coin collector under consideration and has assigned his patent to the Western Electric Company, of Chicago. Mr. Scribner's apparatus provides that in case an unsuitable coin is deposited, or in case the desired connection fails, the coin is returned to the depositor. It also provides for the return of a coin deposited in the slot, while another coin is within the machine and unused, a condition which sometimes exists. Still another feature of the device is that no signal can be given the central office until a coin is in the slot; and thus no useless annoyance is given the operators, such as false calls or waiting for change to be obtained. Fig. 3 shows two vertical sections of the collector. From that to the left it will be seen how a coin follows the slot until it strikes the pin, a^5, and drops between the pins, e^1 and e^2. The pin, e^1, is rigid, while e^2 is pivoted and held toward e^1 by a spring. When the coin drops between these pins, e^2 is pushed back and closes the normally open signal circuit, so that the rising of the hook may signal central. Only in case the coin is of normal size will it remain between these pins. If it is too small, it will fall through, and, striking projection d^3, will pass into the return chute. Now the pins, e^1 and e^3, are carried by the armature of a polarized relay, and either may be withdrawn from the coin slot by the central office operator at will, by the mere application of current of the proper polarity. If the connection fails, she withdraws, e^1; if it succeeds, she withdraws, e^2, the coin taking a course to the right into the coin box or to the left into the return chute. The return of a second coin deposited while another is already in place is evident, as striking the top of the unused coin, it is deflected into the chute around the pin, a^5.

PAY STATION SIGNAL.

A pay station signal is the subject of a patent granted to E. P. Baird. This signal is that which notifies the central office that a coin has been deposited. It consists of a tongue of sheet metal which is attached to the coin box and is in position to be plucked by the coin-depositing apparatus. This spring can give three distinctive tones: first, when free to vibrate at its normal pitch; secondly, when its vibrating length is shortened by setting up a screw against it midway of its length; and, thirdly, when the screw is set up lightly so that it is tapped by the spring at each vibration.

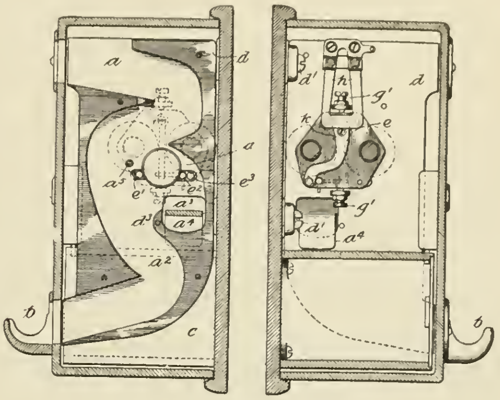


FIG. 3.—SCRIBNER PAY STATION.

SIMPLE CENTRAL ENERGY SYSTEM.

Of the other patents one of the more interesting is that of C. B. Smith, of New York City, which describes a rather simple central energy system, in which the auxiliary apparatus is reduced to a very few elements. The system has the disadvantage of using series spring jacks, but it has the advantage of a two-strand cord, which, from a maintenance point of view, somewhat offsets it. Fig. 4 shows the circuits of this system. It will be seen that both poles of the common battery are permanently connected to the subscriber's line; one directly and the other through a retardation coil. The closing of the circuit of a line causes the line relay to attract its armature and light the line lamp, the circuit of this latter passing through the series contacts of the several jacks. When a plug is inserted the line lamp circuit is opened, while a supervisory lamp circuit is formed involving the back contact of the relay. The lighting of the lamp in this circuit, therefore, corresponds to deenergization of the relay; i. e., the return of the receiver to the hook. The talking circuit also involves a novel feature, viz.: the use of an induction coil in the cord circuit, serving for both subscribers of any one connection. Thus, the primary circuit is traceable from the battery through the subscriber's line and instruments and the coarse winding of the cord circuit coil, while the secondary

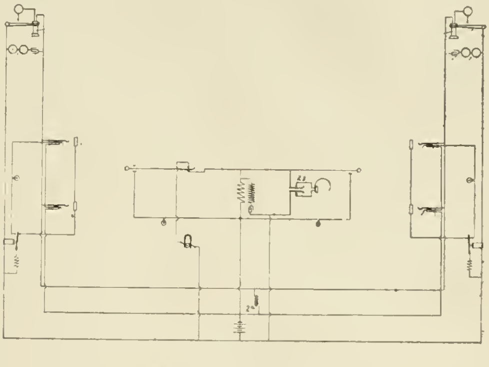


FIG. 4.—SMITH TELEPHONE EXCHANGE.

comprises a bridge consisting of the fine winding of this coil and the condenser in series.

COMBINATION DROP AND JACK

S. M. Ericsson, of Sweden, has invented a combination drop and jack which has the feature of causing a line to test busy as soon as a signal arrives. The drop coil is situated in the base of the jack and releases a spring-actuated telescoping sleeve, which, therefore, bounds forward, indicating the arrival of a call. As the sleeve moves forward, it contacts battery with the test ring circuit of the spring jacks. The insertion of a plug in the answering jack makes the normal test circuit, restores the sliding sleeve against the spring pressure and latches it ready to indicate another signal whenever the plug has been removed.

A receiver holder is the subject of a patent to A. J. Briggs, of Allegheny, Pa. This consists of the usual receiver-holding clamp upon the end of an adjustable linkage. The novelty comprises a system of levers connected to the hook switch to render the depression of this a matter of convenience. A short adjustable transmitter arm has been patented by Wm. Kaisling. This arm is pivoted behind the plane of the inside of the hinged box cover, bringing the transmitter close to the box, yet giving a satisfactory vertical adjustment to accommodate persons of different heights. This arm is made tubular, and therefore forms a runaway for the cords, thus removing these from liability to abuse.

A "Vocal Guard," comprising a semi-flexible horn for confining the sound of the voice has been invented by W. J. Donihue. This horn can be clamped to the transmitter forming an air-tight joint. The outer edge is shaped to the face so as to contact with the chin, cheeks and bridge of the nose. Thus the voice of the speaker is confined entirely within the horn and cannot be heard by others in the neighborhood.

Mr. Y. S. Stone, of Boston, has obtained two more patents concerning features of his selective signalling system depending upon resonating circuits. Both new patents refer primarily to the simultaneous signalling of two or more stations, and both are assigned to the American Bell Company.

A pole-changer and a magneto complete the inventions at hand. The former is shown in several forms in a patent issued to Mr. J. Crawford, of Denver, and comprises a pole-changer designed to give not only alternating currents, but also to give positive and negative impulses for selective ringing. The improvement in magnetos consists of a built-up armature, the winding for which can be made up on spools within which the core can be assembled.

Data as to Western Union Pole Cutting.

According to data from Western Union sources, the Pennsylvania Railroad has cut down thus far 680 miles of poles and 9,813 miles of wire in Pennsylvania, and 245 miles of poles and 403 miles of iron wire along the Pennsylvania Railroad system in the State of Pennsylvania and the West Jersey & Seashore Railroad, in New Jersey. In no other States were any considerable amount of poles and wires cut down. The Western Union values the property destroyed at $1,000,000. The cash value of this property is conservatively estimated at $850,000.

Should the United States Supreme Court sustain the appeal of the Western Union from the United States Circuit Court, the Western Union will immediately bring suit against the Pennsylvania for this property destroyed and the damages resulting therefrom. On the other hand, should the appeal of the Western Union be dismissed by the United States Supreme Court, the Pennsylvania will sue the Western Union for the expense of cutting down and removing this property from land belonging to the Pennsylvania.

For the year ending June 30, 1902, the Western Union had 196,115 miles of poles and 1,029,984 miles of wires in operation. The total amount of property destroyed was 925 miles of poles and 10,216 miles of wire. This is less than one-half of 1 per cent. of the total mileage of poles and less than 1 per cent. of the total mileage of wires. As the Western Union is still operating its system in the State of Pennsylvania along the highway and on private rights of way, it is said that the loss in revenue to the Western Union is rather inconsiderable. Of course it does no business at stations of the Pennsylvania Railroad. Apart from that, it is still operated throughout the entire State. The loss of revenue to the Western Union will be exceedingly small and will, it is asserted, not in any way affect the dividend rate for 1903.

Earnings from Street Railway Operation.

The recent census office report on street railway operation in the United States showed gross earnings for the 967 systems of $241,584,007. It is now interesting to note some comparative figures compiled by the *Street Railway Journal* for 1902, from the data prepared for its annual volume of "American Street Railway Investments."

Thirty-eight companies report gross income of over $1,000,000, compared with 34 for 1901, every company showing an increase. This is somewhat remarkable, as 1901 was considered a successful year, while several causes, including the anthracite strike, affected 1902 earnings.

Nineteen roads each showed in 1902 gross receipts of between $500,000 and $1,000,000; 88 earned between $100,000 and $500,000; 65 between $50,000 and $100,000, and 58 between $25,000 and $50,000.

The average rate of increase of the receipts in 1902 over 1901 is, in the first group, 8 per cent.; in the second group, 16.3 per cent.; in the third group, 14.2 per cent.; in the fourth group, 10.4 per cent., and in the fifth group 17 per cent. The general average increase for 1902 over 1901 for the 268 companies compared is 9 per cent.

Gross earnings by groups compare:

	1903	1902.	Increase.
First group	$159,336,273	$146,579,211	$12,757,062
Second group	13,303,572	11,432,553	1,871,019
Third group	18,898,211	16,546,196	2,352,015
Fourth group	4,408,531	3,903,313	505,218
Fifth group	2,166,688	1,850,929	315,759
Total	$198,113,275	$180,312,202	$17,801,073

Assuming roughly that like periods are compared—which, of course, is not the case in all instances, it will appear that while 268 companies thus earned $198,113,275, the other 699 companies earned only $43,471,422, or an average of about $60,000 apiece. It may be pointed out, however, that the 268 companies are rarely single roads, but consolidations, as there are some fifteen or sixteen hundred street railways in the country.

CURRENT NEWS AND NOTES.

UNSIGHTLY ADVERTISING ON POLES.—With a desire to make Brooklyn's streets more sightly, Deputy Commissioner Van Iderstine, of the New York Department of Water Supply, Gas and Electricity, is about to begin a vigorous campaign against persons who have been using the telegraph and telephone poles for advertising purposes. Thousands of poles throughout the borough, says the commissioner, are thus defaced, in violation of the law, and are an eyesore to any one with the least ethical sense and civic pride.

POSTAL WIRES TO PACIFIC.—Officials of the Postal Telegraph Company have been in Omaha several days in consultation with the officials of the Union Pacific Railroad relative to construsting a line of wire from Omaha to San Francisco along the right of way of the Union Pacific road. It is understood from Union Pacific sources that while no definite arrangements have been made for securing the right of way to the Postal Telegraph Company, negotiations are still on and will probably result in securing the concession that will enable it to string a long stretch of wires parallel and competing with the Western Union. The Postal several months ago began the construction of a part of this line as a test case, and then awaited the outcome of the case of the Pennsylvania road.

WESTERN UNION-PENNSYLVANIA FIGHT.—It is stated that the Pennsylvania Railroad Company directors have appropriated $289,000 for the building of telegraph lines along the company's system east of Pittsburg and Buffalo, to replace the lines of the Western Union Telegraph Company recently destroyed. The Postal Telegraph Company will be permitted to string wires on the new poles, and it is expected that the new line will be finished before cold weather sets in. On June 5, counsel for the Western Union Telegraph Company filed a petition in the United States Circuit Court at Baltimore for condemnation of a right of way for its poles and wires along the line of the Pennsylvania Railroad between Philadelphia and Washington. The petition claims the right to condemn under an act of Congress passed on July 24, 1866, which provides for the right of telegraph companies to construct their systems along the post roads of the United States, it being contended that the Pennsylvania Railroad is such a road.

COLLISION IN LONDON TUBE.—A cablegram from London of June 5 says: The failure of a brake to work caused a collision on the Underground Railway at Westminster this morning. Five persons were slightly injured and traffic was completely disorganized. One locomotive was derailed.

BAPTISTS BAR BABBLE.—At Goshen, Ind., on June 3, the old order of German Baptists, whose national conference closed at Wakarusa, voted not to permit its members to use telephones in their homes. Nearly five thousand people attended the conference. Indiana has been one of the great centers of the independent telephone movement.

AUTOS FOR ST. LOUIS.—It is stated that a syndicate of St. Louis merchants is contemplating the establishment of an automobile line to the Louisiana Purchase Exposition in 1904 from the stations and hotels. According to the plans several hundred electric omnibuses will be employed, and the company will have a capitalization of $1,000,000. The promoters estimate that from 8,000 to 10,000 persons an hour could be handled in the automobiles, thus relieving the regular transportation lines to that extent. Meantime the trolley lines are also making extensive plans and arrangements.

LIGHTNING EXPLODES MINES.—A cable dispatch from Paris of May 30 says: "The *Matin's* correspondent at Cherbourg telegraphs that while a violent storm was raging yesterday afternoon lightning caused the explosion of three submarine torpedoes at the west entrance to the harbor. The explosion threw up a column of water to a great height and caused a panic among the vessels at anchor. No damage was done, but the Hamburg-American liner *Fuerst Bismarck,* on her way from Hamburg and Southampton to New York, had just entered the harbor. Had the explosion occurred a few minutes earlier it might have caused a great disaster."

FRUSTRATING COMPETITION IN VIENNA.—A cable dispatch from Vienna of May 30 says: "Mayor Dr. Lueger has ordered the hook and ladder companies, by a general alarm, to stop the International Electrical Company from making connections without special permit. Wherever the American monopolists attempt to tear up the pavement or string wires, the fire laddies turn the hose on them and drive them out of business, unless properly authorized. Lueger has started a municipal electrical plant and will not permit its business to be interfered with or reduced by private concerns." The use of the word "monopolists" is rather amusing, in view of the fact that the public "monopoly" is the source of the trouble.

ROMANCE OF A TELEPHONE BOOTH.—A note from Chicago remarks that modern invention made an elopement easy for Mary Schultz, nineteen years old, but trouble came thereafter. Miss Schultz is a Joliet girl, and when her father, John Schultz, stepped into a telephone booth she saw her chance and seized it. Slamming the door of the booth, she turned the key, and then, with her father locked in, she went to another telephone and called him up. "Papa," she said, "you're whipped. I am going to run away with Harry Cowan, and—I'm—going—to—do—it—right—away." Run she did, but Schultz broke out of the telephone booth and followed them to Chicago by the next train. Then he caused Cowan to be arrested on a charge of abduction.

INDUCTION MOTOR.—A patent granted May 26 to Mr. Hans S. Meyer, of Rugby, England, on a method of reducing to a minimum the wattless current required by induction motors. For many purposes induction motors must have a large starting torque, and if they are designed with this point in view, they will take a large magnetizing current and will, therefore, load the mains with wattless current, when running under normal load as well as when running at light load. The inventor proposes to obviate any excess of magnetizing current without reducing the starting torque or the output of motor. He points out that the starting torque and the output are proportional to the square of the potential at the motor terminals, while the magnetizing current is directly proportional to the potential; hence the desired results can be obtained by means of a regulating device which operates automatically to adjust the potential at the motor terminals in such a manner as to cause it to increase with an increase of the load on the motor and to decrease with a decrease of the load. This regulating device is actuated by electromagnetic means, according to the load.

CONSTRUCTING PLANTÉ PLATES.—A patent issued May 19 to Joseph Bijur describes a method of constructing Planté plates of the type consisting of panels of fine lead strips or shreds between horizontal and vertical solid supports. The panels are supported in a mold and separated vertically by horizontal strips the width of the panels and which later form continuous horizontal bars. Tubes project into the channels left for the vertical supports. After the mold and its contents are heated above 200° F., lead or a lead alloy is poured into the tubes, which latter are gradually withdrawn until finally the channels are entirely filled with lead. By this means the molten lead is not flowed along the unoccupied part of the channel, but is deposited at the place where it is to solidify and fuse into union with it the cross-bars and lead strips.

INDUCTION MOTOR ARMATURE.—A patent was granted on May 26 to Prof. Elihu Thomson for an improvement in the mechanical construction of armatures of induction motors of the squirrel-cage type. Heretofore it has been the practice to make each lamina a complete ring where the diameter of the armature is small, and to cut the ring into halves, thirds or slightly shorter segments where the diameter of the armature is greater, and to punch therein a large number of slots for the conductor bars. In cutting or punching such rings or segments for armatures of different diameters it is necessary to cut the rings also of different diameters. This necessitates the use of special dies for each size of the armature. Prof. Thomson proposes to cut the segments much shorter than thas been the practice heretofore, and shapes their ends so that adjacent pieces may be assembled at different angles to each other. This construction permits the same segments to be used in armatures of varying diameters, and in the manufacture of squirrel-cage armatures the conductor bars not only do not interfere with the assembling of the segments, but they may be used to bind the segments together. This construction does not require any expensive dies and renders available almost all of the sheet-metal stock, while making it possible to make the outer surface of the armature smooth or slotted, as desired.

ARC LAMP REGULATION.—A patent was granted May 12 to Mr. Albert G. Davis on a method of regulating arc lamps on constant-potential, alternating-current mains, whereby the current in the arc is maintained constant, not through the regulating action of the carbon-controlling mechanism, but through the interaction of lagging and leading currents flowing in circuits operatively related to the lamp. Across the mains is connected for each lamp a circuit for supplying current to an arrangement somewhat similar to a Wheatstone bridge and designated under "monocyclic square." Two opposite sides of the square are formed by reactance coils, while the two remaining sides include sources of leading currents, such as condensers. It is possible to produce leading currents in these two latter sides by means of a single condenser, if the latter is connected with the secondary windings of two transformers, the primaries of which are directly in the two sides of the "monocyclic square," in which the leading currents are to be produced. The arc light terminals and the arc-striking coil of each lamp are connected in series across the diagonal of a bridge. The two opposite reactance coils in the monocyclic square, instead of forming separate pieces of apparatus, constitute regulating coils on the lamp magnets, these coils acting in opposition to the arc-striking coil. By a suitable proportioning of the condenser effect with respect to the reactance coils in the square, a constant e.m.f. can be made to give rise to a constant current in the bridge circuit of the "monocyclic square." As the length of the arc increases, the e.m.f. necessary to maintain constant current in the arc likewise increases, the increase in e.m.f. of this constant current or arc circuit being accompanied by an increase of current in the sides of the "monocyclic square" and also in the supply circuit from the mains. This fact the inventor takes advantage of to secure regulation of the arc. As the arc lengthens, due to the action of the arc-striking coil, the currents in the reactance coils in the two opposite sides of the monocyclic square increases, thereby opposing the action of the arc-striking coil with gradually increasing force. A point of equilibrium is finally reached at which no further lengthening of the arc takes place. By suitable adjustment this point may be made to correspond to any desired length or e.m.f. of the arc, which may be either greater or less than the e.m.f. across the mains.

WEIGHTS ON BROOKLYN BRIDGE.—To relieve the dead weight on the Brooklyn Bridge, Commissioner Lindenthal has ordered the removal of many of the wires belonging to telegraph and other companies. Last week the sixteen cables belonging to the Stock Quotation Telegraph Company and the Gold & Stock Telegraph Company were taken down. The new cables of these companies have been laid over the bed of the river.

ROTARY CONVERTER CONNECTIONS.—A patent was granted on May 19 to Mr. Alexander D. Lunt for a "system of electrical distribution" which, when applied to a rotary-converter, largely reduces the heating of the armature conductors and at the same time improves the commutation of the machine, thereby increasing the output and improving the efficiency. When applied to a twelve-phase converter, the system is as follows: The three primary windings of a transformer are connected to a three-phase supply circuit, and are in inductive relation to twelve secondary windings, each primary being in inductive relation to four secondaries. The secondary windings are interconnected in such a way that they form three distinct polygons of electromotive forces, two of the polygons representing a triangular relation of electromotive forces and the third a connection of electromotive forces in such a way that they may be represented by a hexagon. From points in the connections which interlink the various secondaries, leads extend to the 12 collector rings of the twelve-phase converter. The effect of this arrangement is that the currents which circulate in the transformer windings are in phase with the electromotive forces induced therein and are, therefore, of minimum value. This permits the use of a minimum amount of copper, securing decreased cost and increased efficiency. Another advantage is that the cross-connection between the various points of the armature winding afforded by the various secondaries thereto, serves to balance the electromotive forces acting about the armature winding and thereby prevents large and useless cross-currents in the armature winding, so securing better commutation.

POWER TRANSMISSION UNDER DIRECT CONTROL OF THE OPERATOR.—A patent was granted on May 26 to Mr. Harold W. Buck for a means of transmitting a motion synchronous with that of a controller operated by hand or otherwise, yet with any required augmentation of the power, so that a mechanism at a distance may be driven at proper speed or power, and under the direct control of the operator either from a single place or from any one of several positions. The receiving device is electrically connected with the transmitting device through intermediate direct-current generators, which provide the means for the required augmentation of the power. The transmitting device is connected between the field windings of these direct-current generators and any convenient source for successively carrying the field excitation of these machines through complete cycles (from a positive maximum through zero to a negative maximum, etc.). The transmitting device is rotateable, and by operating it at any desired speed, the e.m.fs produced by the several generators are caused to vary gradually in like manner as the fields are varied, the variations in the e.m.f. of one machine following those of the other, so that the currents produced in the armatures of the generators have their corresponding values displaced in time by an amount depending on the speed of operation of the transmitting device. While the transmitting device is being rotated, the currents generated in the machines have all the characteristics of alternating currents displaced in phase, and have constant values when the transmitting device is at rest. The receiving device is similar in its general construction to the ordinary polyphase motor. By this method it is possible to successfully control the application of large powers, involving the use of powerful currents without introducing or removing resistances in the circuit of the receiving device, the system being controlled by varying only the small currents which are required for exciting the fields of the generators.

RECTIFIED CONSTANT CURRENT FROM CONSTANT-POTENTIAL ALTERNATING CURRENT.—A patent was granted on May 19 to Mr. Edwin W. Rice, Jr., for a system of electrical distribution by which a rectified constant current may be obtained from a source of alternating current of approximately constant potential. The three-phase currents of the supply network are first passed through a device transforming from constant potential to constant current. This transforming device consists essentially of a closed circuit including inductance coils and condensers alternately arranged, and of proper magnitude. This arrangement may be diagrammatically represented by a triangle, each side of which contains an induction coil and a condenser; the mains carrying the constant potential alternating currents are connected to the three corner points of this triangle, and the three circuits carrying the constant effective alternating currents are connected each between one corner point and the middle of the opposite side (this middle being the point separating the induction coil and the condenser of this side). To render the constant effective current circuits thus obtained electrically independent of each other, the mains carrying these three currents are connected to the primaries of three transformers. The secondaries of the same are connected to rectifying commutators, which are driven in synchronism with the waves of the alternating current; for instance, by means of a synchronous motor,. These rectifying commutators are connected, in series with each other, to the consuming circuit, containing, for instance, arc lamps. To reduce the maximum potential difference between any two points of this circuit, some of the arc lamps may be interposed in a circuit joining each pair of rectifying commutators in series, this arrangement being commonly designated as a "multi-circuit" connection. In case independence of the constant-current circuits is not desired, the transformers between the constant-potential, constant-current transforming device and the rectifying commutators may be omitted and the whole arrangement thus greatly simplified.

ELECTRIC REGULATOR.—A patent was granted on May 19 to Mr. Edwin W. Rice, Jr., for an electric regulator, in which the regulating action is checked as soon as the proper regulating effect has been secured without permitting the regulating action to pass through a series of oscillations or surges of decreasing amplitude about the desired point; in other words, the phenomenon of hunting or pumping of the regulator is avoided. The regulator, which may be of any kind, is governed in its motion by a special mechanism which contains three electrically-controlled contacts, a main contact and two co-operating contacts; all respond to variations of the quantity to be regulated (for instance, the voltage of the system), but the two co-operating contacts are subject to less movement than the main contact for any given variation, and means are provided for causing the co-operating contacts to return to normal position at a slower rate than the main contact. Under very small variations, the regulator controlled by the contact-making device is actuated by the main contact, as though the co-operating contacts were fixed. If, however, a large variation of voltage were to occur on the mains—as, for example, a drop in voltage of 15 to 20 volts—then the main contact instantly moves into engagement with its co-operating contact, and the regulator is turned quickly and continuously in a direction to raise the voltage of the mains; this action continues uninterruptedly until the voltage has been brought back within say a volt or two of normal, whereupon the main contact separates from the co-operating contact and commences to return to its normal position. As soon, however, as the separation takes place, the movement of the regulator ceases. In the mean time, the co-operating contact slowly returns until contact is again made with the main contact, whereupon the regulator is again moved, thus bringing the voltage of the mains still closer to normal value. The main contact then again moves away from the co-operating contact toward its normal position, again causing a separation and a repetition of the action described, until the voltage of the mains is brought back to normal, this action taking place without the liability of the regulating action going beyond the amount required.

LETTER TO THE EDITORS.

Hieroglyphic Designations of Apparatus.

To the Editors of Electrical World and Engineer:

SIRS:—Does it ever occur to the editors of technical journals that many of the readers whom they serve are not so fortunate as to have their names on the mailing lists of manufacturing companies, and, therefore, are not kept supplied with the trade literature of such companies? This query is occasioned by the frequent occurrence in descriptions of trade designations of apparatus or appliances, the writer often taking it for granted that the jotting down of such designations relieves him from conveying further information respecting the said apparatus or appliances. It is, to say the least, annoying to the uninformed reader when he comes to the most important detail of an operation, to be informed that this is effected by a "Mark-X-006 Robinson gyro-inductor"; or that some salient feature is the "Well-known Smithson Type Z 4-11-44 Apparatus," when said apparatus is in fact unknown by such designation except to the fortunate few who receive the trade bulletins or catalogues of the Smithson Company. The appearance of these strange prefixes is also apt to excite in the mind of the reader a suspicion that the article containing them is from the same hand that prepared the aforesaid trade matter; for who else would have stored in his mind for ready use such arbitrary combinations?

There may be reasons unknown to the writer why such empirical trade designations may not be neglected in descriptions, but if obligatory, why not relegate them to one or more final paragraphs containing the names of the several manufacturers with whom the purchaser of the plant dealt, together with an enumeration of the respective articles they supplied, wedded to their respective hieroglyphics.

CHICAGO, ILL. J. L. CROWELL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Size Constant of Dynamos.—ROTHERT.—A communication in which he refers to some recent remarks of Arnold, and discusses the use of the "machine constant," as Arnold calls it, or "size constant" (Groessenkonstante), as the present author prefers to call it, in dynamo design. He gives the following formula: the size constant equals the iron cross-section, multiplied by the iron breadth, multiplied by the number of revolutions, divided by the capacity in watts. He always uses this formula for the first calculations in the design of a new machine. He proceeds in such a way that for a given size constant he makes the calculations by varying the numerical values, and then chooses a set of values which seem to be the most convenient. Except in very extraordinary types, he thus gets a good starting point for the following exact calculation. The above formula is a good means for comparing roughly various machines with regard to economical design. It would, however, be wrong to overestimate this formula; it only determines the dimensions of the armature. He has collected from his experience numerical data for the size constant; for a machine of about 100 kw it is 350 and for high-speed machines it becomes about 270 at 1,000 kw, while for slow-speed machines it becomes 250, considerably below 1,000 kw. —*Elek. Zeit.*, May 21.

Polyphase Motors.—HAHN.—A highly mathematical article, in which the author discusses the influence of the shape of the current curve on the efficiency. His conclusions are: The sine curve gives the highest efficiency for the rotor, while the peaked and trapesoid curves cannot produce any material improvements. The peaked and trapesoid curves on the other hand influence materially the total efficiency of the motor, as they lower the total loss to a great extent. The peaked curve is the most favorable form.—*Elek. Anz.*, May 24.

Induction Motors with Commutators.—ALEXANDER AND FLEISCHMANN.—An article illustrated by diagrams, in which they give a simple explanation of the main phenomena which occur if an armature provided with a Heyland commutator is used in a revolving field. In connection with this general problem they discuss the use of an ordinary commutator; that is, one without Heyland's connections between the segments, for the purpose of avoiding the phase difference between e.m.f. and current. The paper gives a systematic and simple explanation of the phenomena which are known to exist in such motors.—*Zeit. f. Elek.*, May 10, 17.

Induction Motors with Commutator.—BRAGSTAD.—A continuation of his theoretical article on polyphase induction motors, with commutator, and with shunt excitation. He gives the diagram representing the action in such motors.—*Elek. Zeit.*—May 21.

Failure of Direct-Current Dynamos to Generate.—PARHAM.—An article enumerating the various reasons why direct-current dynamos sometimes fail to generate. The author also gives various ways of ascertaining whether or not a dynamo has lost its residual magnetism.—*Amer. Elec.*, May.

LIGHTS AND LIGHTING.

Special Connections of Lamps.—BOJE.—An illustrated article pointing out the saving which can be obtained in many lighting installations by special systems of wiring. The case in point is the lighting of a river front of 800 meters length with 10 arc lamps of 12 amp.; they had been connected in pairs in series across the 110-volt mains, the current being supplied by a 2 x 110-volt, three-wire system. It is stated that a considerable saving in electric power could have been accomplished if it had been possible to light only those lamps which were needed at any one time. This may be done by connecting each arc lamp by means of two wires to a plug which may be inserted in a switchboard. In an estimate he shows that the additional expense for copper in the first installation would have been covered by the saving in power in one and a half years.—*Elek., Anz.*, May 3.

Sirius Lamps.—An article on the Sirius lamp, which is an incandescent lamp made by a German firm, according to patents of Fernery. A higher economy is claimed, although the life is more limited. The color of its light is between that of the ordinary carbon incandescent filament lamp and the Nernst lamp; the price of the Sirius lamp is about the same as that of the ordinary incandescent lamp. Nothing is said concerning the preparation of the filament. The results are given of some comparative tests of Sirius lamps and ordinary incandescent lamps, in the form of tables and diagrams. The candle-power of the Sirius lamp decreases in 200 hours from 15 to 10, the ordinary incandescent lamp from 17 to 15, the watts per candle increase with the Sirius lamp in the same time from 2.4 to 3.5, in the ordinary incandescent lamp from 3.1 to 3.2. It is said to be a special advantage of the Sirius lamp that its absolute life and economical life are nearly equal, about 180 hours.—*Elek. Anz.*, May 10.

POWER.

Induction Motors in a Factory.—CRAVATH.—An illustrated description of the plant of a glass factory at Rosford, Ohio. The generating station has a capacity of 4,350 kw; there are twenty motors of 450 hp each, twenty of 200 hp each, ten of 50 hp each, and fifteen of 5 to 10 hp; all are three-phase induction motors, since the conditions in this class of manufacture are such that the work would be very trying for direct-current motors on account of the escaping gases and products of combustion from the furnaces in some places and the dust which collects in other places. The motors are wound for two speeds at a frequency of 40 cycles; and since for polishing glass three speeds are needed, an additional current supply is provided at 25 cycles, which gives the third speed. When the polishing table is first started, its motor is connected to the 25-cycle circuit; later it is thrown on the 40-cycle circuit at slow speed, and finally brought to full speed on the same circuit. The motors are started with the polishing wheels on the glass plates, which necessitates a starting torque equal to if not exceeding the running torque. The controllers are similar in external appearance and operation to street railway controllers, and they make the various combinations required by the three speeds on a contact drum, like in street railway controllers; the main circuit, however, is broken by a special switch operated by a movement of the controller handle, this switch taking all of the arcing and so relieving the contact drum from deterioration due to that cause. The power plant contains four generating units of 4,000 kw and one unit of 350 kw. These generators all give three-phase, 40-cycle currents at 580 volts. There is also a motor-generator, the motor of which is a 40-cycle, 300-hp machine, and this drives a 25-cycle, 330-volt alternator and a 125-volt, direct-current generator, having an output of 800 amp.; this generator is used as an exciter and for furnishing current to traveling cranes and transfer cars. The ordinary operation of the plant calls for the running of the four

1,000-kw units simultaneously, but these are not ordinarily run in parallel.—*Amer. Elec.*, May

Tests of a Belgian Engine Using Superheated Steam.—An article with illustrations and tables giving the performance of a horizontal tandem compound 250-hp Van den Kerchove engine, tested by Prof. M. Schroter, of Munich. The economical performance of the engine was unusually good, the steam consumption with saturated steam being only 11.82 pounds per indicated hp per hour under load, with the most favorable period of admission. On no load, the steam consumption was 13.7 pounds. The rate of consumption at 256° superheating was 9.62 pounds of steam, which dropped to 8.09, with superheating of 343° F.—*Amer. Elec.*, May.

REFERENCES.

California.—WRIGHT.—An illustrated historical article on long-distance, high-tension transmission of power in California, dealing with the historical development and present status of the subject.—*Scien. Am.*, May 16.

Large Gas Motors with Electric Transmission of Power.—A popular article, discussing some conditions under which such installations might prove profitable.—*Glueckauf*, May 23.

Some Difficulties of Long Distance Electric Transmission.—LINCOLN.—An abstract of his paper read before a meeting of the Electric Club, of Cleveland.—*Amer. Elec.*, May.

Richmond-Carey Electric Lift.—A short illustrated article dealing with the construction of this type of lift.—Lond. *Elec.*, May 22.

TRACTION.

Traction on Canals.—SZASZ.—An illustrated description of a new system of electric traction on canals devised by Ganz & Co. for a competition in relation with the Teltow Canal in Germany. The system generally used up to the present consists in letting an electric locomotive run without rails on the path along the canal and drag the ships; but this system requires a very good path and is expensive in the cost of road construction and maintenance; moreover, the unavoidable vibrations of the locomotive are a disadvantage and the driver has a great responsibility. If two rails are used on which the locomotive runs, the roadbed construction is less expensive, but there is the serious disadvantage that the adhesion is not sufficient for dragging heavy boats, unless very heavy locomotives are used; the roadbed construction becomes still cheaper if a single rail is used, but the adhesion difficulty is still in existence. This difficulty is overcome by means of an idea of Fabre, developed by Ganz & Co.; instead of the usual two-wheel axles, each with two vertical wheels, they use two-axle pairs inclined against one another; on each axle a wheel is mounted, and each pair of two such wheels grips the single rail. To support the locomotive, one broad lateral wheel is provided which runs on the road. The purpose of this arrangement is to increase the adhesion and stability of the locomotive. The construction is described in detail and illustrated with diagrams. The author finally compares the cost of this system with that of three others designed for the same canal, which has a length of 3.7 km, with an annual traffic of 1,500,000 tons. In the cost of operation the price of 3 cents for one kw-hour is assumed. The first cost is as follows: for the Siemens & Halske system, $625,000; Rudolf system, $649,000; Ganz system, $251,965; the cost of operation per ton-km is: for Siemens & Halske, 0.27 cent; Feldmann & Zehme, 0.167 cent (first cost not given); Rudolf, 0.15 cent; Ganz, 0.103 cent.—*Zeit. f. Elek.*, May 3, 10.

Petrol-Electric Automobile Omnibus.—A note on a recent trip made in London with an automobile omnibus; the primary source of power is a four-cylinder petroleum engine, which drives a dynamo, the current generated in turn driving two electric motors, which are geared to the rear wheels of the omnibus. Storage cells are also provided to which current may be diverted when the vehicle is at rest or when running down hill. The object is to provide a reserve of power for extraordinary occasions, thus enabling a smaller engine to be used than would otherwise be needed for starting and climbing hills. The speed is controlled by an ordinary series-parallel controller.—*Eng'ing*, May 8.

REFERENCES.

Suspended Railroad.—A note on the project of a railroad of the above type for the City of London, to cross the River Thames. Electricity will be the motive power.—*Scien. Am.*, May 16.

Mersey Railway.—The conclusion of the article previously noted in the Digest, containing an illustrated description of the track construction and rolling stock.—Lond. *Elec.*, May. 22.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Testing of Alternating Current Switches and Fuses.—HOWE.—A short article in which he gives some formulas to show that the severity of a test on the circuit breaking capabilities of a switch or fuse is not only dependent on the current and voltage, but also on the power factor. For a given current and voltage the test is severer if the current lags. A very convenient method of testing switches and fuses is to put them in circuit with a number of choking coils, which, by means of variable air gaps and alternative connections, allow of a wide range of currents and voltages. The power factor being low, makes the test more severe than is perhaps necessary, but this is certainly a good fault, and can be allowed for.—Lond. *Elec., Rev.*, May 1.

REFERENCES.

Wiesberg.—STOLGER.—A detailed illustrated description of the hydroelectric plant of Wiesberg in Tyrol destined chiefly for the electrochemical works at Landeck. In view of the motor load and of a prospective traction load, three-phase current at 12,000 volts and 40 periods per cycle was chosen; three 1,000-kw generators have been installed, with room for three more. In the electrochemical works of Landeck calcium carbide, pure silicon and silicon copper are made, and it is intended to also undertake other electrochemical work.—*Elek Zeit.*, May 14.

Worcester, England.—An illustrated article describing the new works. Steam is supplied by three Babcock & Wilcox boilers, driving three triple-expansion Bellis engines, two of which are connected each to one 250-kw dynamo and one to a pair of 125-kw dynamos. A battery of 250 Ashmore cells is also installed. Current is mostly used for traction purposes.—Lond. *Elec.*, May 22.

Electric Installation of a Farm.—GRUNDMANN.—An illustrated description of a lighting and transmission plant on a farm near Leipzig, Germany. It supplies current for lighting the residences and various industrial buildings, for power purposes and for a small railway. A 20-kw, 240-volt dynamo gives direct current and a storage battery sub-station is provided which is charged during the day and gives the lighting current for the residence bulidings during night hours.—*Elek. Anz.*, May 10.

A Simple Form of Circuit-Breaker.—KINTNER.—An illustrated article describing a simple form of circuit-breaker and giving directions for its construction. The breaker consists of a strip pivoted at the center, one end of which contains contacts dipping into mercury, the other end being under the influence of an electromagnet.—*Amer. Elec.*, May.

ELECTRO-PHYSICS AND MAGNETISM.

Radio-Active Change.—RUTHERFORD AND SODDY.—A long paper in which the authors discuss the products of radio-active change and their specific material nature, the synchronism between the change and the radiation, the material nature of the radiations, the law of radio-active change to chemical change, and the energy or radio-active change and the internal energy of the chemical atom. Radio-activity, according to our present knowledge, they say, must be regarded as the result of a process which lies wholly outside the sphere of known controllable forces and cannot be created, altered or destroyed. Like gravitation, it is proportional only to the quantity of matter involved. Assuming that an atom of radio-active matter cannot produce less than one and not more than 200 "rays" or projected particles, the authors deduce 10^6 gramme cal. per gramme as the least possible estimate of the energy of radio-active change in radium. As the reaction which sets free more energy for a given weight than any other chemical change known, namely the union of hydrogen and oxygen, liberates only approximately 4,000 gramme cal. per gramme of water produced, the energy of radio-active change must be at least twenty thousand times, and may be a million times as great as the energy of any molecular change. Calculating the rate at which this store of energy is radiated, the authors deduce that in one gramme of uranium and thorium less than a milligramme would change in a million years. In the case of radium, however, this amount must be changing per gramme per year. Therefore, the "life" of the radium cannot be more than a few thousand years, on this minimum estimate, and it appears certain that the radium present in a mineral has not been in existence as long as the mineral itself, but is being continuously produced by radio-active change.—*Phil. Mag.*, May. A long editorial on this paper is in Lond. *Elec.*, May 22.

Influence of Radium Rays on Organisms.—BOHN.—An account of experiments made to investigate whether, to the destructive action of radium rays upon animal tissues, there would correspond, on homœopathic principles, a stimulating action when applied in small doses. He discovered such a stimulating action by exposing larvæ of frogs and toads to radium rays. Some larvæ showed a decided acceleration of growth, others a diminution. If the animal is exposed at an early age to radium rays for a few hours, an abnormal development is produced at a later age which remains latent in the interval. —*Comptes Rendus,* April 27; abstracted in Lond. *Elec.,* May 15.

REFERENCE.

Radio-Activity from Snow.—WILSON.—A description of experiments made with freshly-fallen snow; the experiments were made in the same way as the previous ones with freshly-fallen rain. There is no indication of any difference in the intensity of the radio-activity obtained from equal weights of snow and rain.—*Proc. Cambr. Phil. Soc.,* 12, part 2; abstracted in Lond. *Elec.,* May 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Solution in Amyl-Amine.—KAHLENBERG AND RUHOFF.—An account of an experimental investigation of the electrical conductivity of certain solutions in amyl-amine. The molecular conductivities were found to be very small; this is interesting in studying the rôle of the solvent in causing electrolytic conduction. In these amyl-amine solutions the ability of the solvent to produce with the solute a liquid having electrolytic conductivity is slight. From the point of view of the Nernst-Thomson theory, the conductivity of solutions in amyl-amine is relatively high as compared with solutions in chloroform and ether. A comparison of existing data on the conductivities of solutions in solvents in a certain series would indicate that the conductivity of the solutions diminishes as the solvent occupies a higher position in the series. This behavior is similar to that found in other homologous series of solvents: the series of the primary alcohols, of which water may be considered as the first member, presents a typical example.—*Jour. Phys. Chem.,* April.

Unipolar Conduction in Electrolytes.—ISENBURG.—An account of some experiments made by him concerning conduction in only one direction. He electrolyzed a 1.5 per cent. solution of a mixture of sodium nitrate and carbonate with lead electrodes, and measured the various e.m.fs of the electrodes against an auxiliar cadmium electrode, and found that of the cathode remaining constant, while that of the anode increased; the e.m.f. of the cell increased in six hours from 1.6 to 30 volts. The e.m.f. of the polarization current increases from 1 volt to only 4 volts. The enormous rise of the e.m.f. of the cell is due, he believes, to the formation of a layer of a bad conductor on the anode. The behavior of an aluminum anode is similar and at the same time there is a condenser action.—*Zeit. f. Elektrochemie,* April 9.

Fixation of Atmospheric Nitrogen.—RASCH.—A summary of the theoretical and experimental work done in the fixation of nitrogen from the atmosphere by means of electricity. Instead of applying high-tension sparks, he proposes to use heat generators giving extremely high temperatures without being attacked themselves. This may be done by using solid electrolytic conductors (like the Nernst lamp filament) heated by Joulean heat, and he thinks that double the output can then be obtained, as compared with that of the electric spark. A still better means, he thinks, is to produce electric arc light discharges between solid or liquid electrolytes; such stable discharges can be obtained either in gases, or in vacuum, if the initial discharge is enforced by heating the electrodes or by spark-gaps; relatively low voltages (40 volts) are sufficient for this purpose. Arcs between incandescent electrolytes are said to give the highest temperatures which can be obtained at present.—*Dingler's Polyt. Jour.,* April 25.

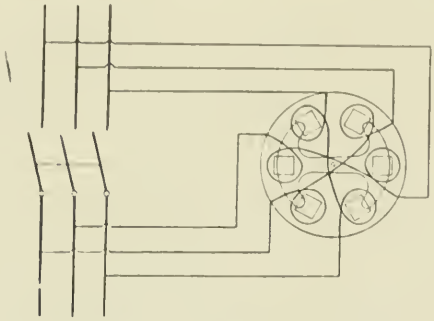
REFERENCE.

Ozone.—KAUSCH.—The first part of an illustrated article on the preparation of ozone by electricity. The original apparatus of Werner Siemens and the modern arrangements of Siemens & Halske are described.—*Elektrochem. Zeit.,* April.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Small Capacities and Inductances.—FLEMING AND CLINTON.—A description of an apparatus "designed more from the point of view of an engineer than an electrical instrument maker," for measuring small capacities and inductances. This problem is important for Hertzian wave wireless telegraphy; the experimental determination of the electrical capacity of telegraph wires and of the overhead wires used for the conveyance of high-tension alternating currents, is also called for in connection with the calculation of sending speeds and of voltage drop in the line. For the measurement of small capacities when the dielectric is air or some other substance not possessing the quality of absorption, no method is so easy to apply as that depending upon the rapid charge and discharge of a condenser through a galvanometer. This method has been extensively used, the only difference being in the nature of the commutator for charging and discharging the condenser. Various types have been applied, but the present authors apply a new form of rotating commutator. A small 100 to 200-volt shunt-wound electric motor of 1/6 to 1/2 hp is bolted down upon a baseboard and has connected with it a starting and regulating resistance. To the shaft of this motor the commutating arrangement is connected by a flexible coupling; it gives four charges and four discharges in each revolution. This commutator is fixed on a shaft on which are held, by means of ebonite brushes and washers, three connected disks or wheels, of which the center one is shaped like an eight-pointed star, while the two outer ones are like crown wheels, each having four teeth. The three wheels are so set on the shaft that the teeth or projections of each of the two outer wheels interlock or fall in the space between the teeth of the other, while the radial teeth of the intermediate wheel occupy the intervals between the teeth of the two outer wheels. The whole outer surface is turned true and forms a barrel about 4 inches in diameter and 2½ inches wide. On this barrel rest three brass gauze brushes, the two outer ones resting on the continuous portions or flanges of the two outer wheels and the middle brush occupying the center line and making contact with either one or the other outer wheel or with the intermediate wheel. As the commutator runs round, the middle brush is alternately brought into metallic connection with first one and then the other of the two brushes on either side. The function of the middle wheel is to afford a stepping place and prevent and shock or jar when the middle brush passes over from one connection to the other; it also prevents the middle brush from short-circuiting the two outer brushes at any time. If one terminal of the galvanometer is connected to the brush pressing against one outer wheel, and one terminal of a battery is connected to the brush pressing against the other outer wheel, and one terminal of a condenser is connected to the middle brush, the other terminals of battery, galvanometer and condenser being connected together, then as the commutator runs round, the condenser is first charged by the battery and then discharged through the galvanometer. In their experiments they used a speed of 1,200 to 1,700 r.p.m.—*Phil. Mag.,* May.

Electric Devices for Comparing and Measuring Speeds.—BENISCHKE.—An illustrated paper read before the Berlin Electrical Society. When three-phase machines are connected in parallel, it is often desirable to see at once, whether the machine which is to be connected in parallel, runs at too high or too low a speed. Phase lamps and phase voltmeters indicate only whether sychhronism has been reached or how far the machines are from synchronism, but they do not show whether the speed of the machine to be connected to the others is too high or too low. An apparatus which indicates this was devised by Michalke; it consists of a series of three incandescent lamps, which are lighted in succession, either in one or in the opposite direction, according to whether the speed of the machine is too high or too low. The present author thinks that the observation of the lights is somewhat inconvenient, and has devised an apparatus by which the motion of a needle gives the indication. Its principle is that if both machines are in synchronism, the magnetic fields which are generated in the instrument, balance each other; if there is no synchronism, a resulting field is produced which rotates either in the one or the other direction. The instrument, as shown in the adjoining diagram, consists of six electromagnet cores, arranged in a circle and placed on a base wound of band iron. The windings of two opposite cores are in series, and the instrument is connected to the circuit and to the machine to be connected in parallel, in the way shown in the diagram. Over the poles of these electromagnets there is an iron sheet of the form of a double T, it is provided with a needle. The magnetic field revolves either in the one or the other direction and carries the iron sheet with it, which thus indicates whether the speed of the new machine is too high or too low. When the two machines have equal number of periods, the needle is at rest. Whether the proper synchronism with regard to the three phases is reached, is not indicated by this instrument, because the needle may be at rest also when the two machines are in opposite phase, but have equal numbers of periods. This instrument indicates only whether the number of periods in both machines is exactly the same, the phase must be observed by means of a phase voltmeter or by phase lamps. In high tension installations the instruments may be connected to the same step-down transformers to which the volt and ammeters are connected. He then briefly describes electric speed counters. The first type consists of a small direct-current dynamo with permanent magnet, together with a direct current voltmeter which is directly calibrated in revolutions instead of volts. Such an instrument was used on one car during the high speed railway tests at Zossen; the vibrations of the car did not change the permanent magnets of the instrument in the least. Another type of this instrument consists of a small single-phase alternating-current machine with permanent magnets, together with an alternating-current voltmeter. The length of the partitions of the scale follows approximately the law of squares, so that the scale has more extended portions in those parts of the scale where the instrument is to be used. Another advantage is the absence of a commutator which in time may get dirty and cause small errors. He finally notices a theoretically interesting design; if a shunt machine is constantly excited and runs without load, a voltmeter connected to this machine can be calibrated directly in revolutions instead of volts, because the e.m.f. of the machine is directly proportional to the revolutions. If the machine is loaded the voltmeter no longer indicates the proper e.m.f. of the machine, but the e.m.f. at the terminals. In order to make the voltmeter indicate the e.m.f., a compensation for the ohmic loss in the machine must be applied; this is accomplished by introducing in the voltmeter a compensating winding through which a part of the armature current flows. If the magnetic field is constant, the number of the revolutions is directly proportional to the e.m.f and the instrument can be directly calibrated in numbers of revolutionis. But in practice there is a continuous changing of the magnetic field, and the application of a compensation for such changes is very difficult, especially because in this case there is no proportionality and the characteristic curve of the machine must be taken into account. For each type of machine a special compensation winding must be calculated, and this is the reason why the use of such instruments is limited.—*Elek. Zeit.*, May 21.



COMPARING AND MEASURING SPEEDS.

Telegraphy, Telephony and Signals.

Remarks on Marconi's Ocean Telegraphy.—Koepsel.—An article giving conclusions drawn by the author from a description of Marconi's apparatus. He calculates that there must have been a wave length of 2,600 meters, which would demand a wire 600 meters long, in order to get good resonance. In reality the wire is only 90 meters long, and the author, therefore, concludes that a system of 400 parallel wires, as used by Marconi, is not as much for the purpose of increasing radiation into space, but is necessary in order to shorten the length of resonance, when such large capacities and wave lengths are used. The author gives the following explanation of the fact that the station on the Lizard, only 11 km distant, was not affected, while communication was maintained for over 1,600 km. If the latter sender system was very closely coupled and worked with an enormous wave length, while the receiver on the Lizard was very loosely coupled and tuned to perhaps one-tenth of that wave length, then there is no cause for wonder at this independence, because the first station sends out strongly damped long waves of great intensity, which naturally have as good as no action on the loosely coupled receiver, which works with considerably smaller wave lengths. The case would be different, if the wave length of both systems were interchanged, because the shorter sender usually disturbs the longer receiver. The author concludes that Marconi's system, to enlarge the wave length and to decrease the length of resonance of his air conductor by enlarging its capacity, has a practical limit, which is given by the relation of the capacity of the condenser circuit to that of the air conductor circuit. It is, therefore, not possible to send out unlimited amounts of energy into space, and Marconi might not be very far away from the limit, for if the capacity of his conductor system is estimated at 50,000, which is probably very near the truth, this comes close to the magnitude 900,000 of his condenser capacity, and the fall of tension cannot be disregarded any more.—*Dingler's Poly. Jour.*, May 23.

Miscellaneous.

Sheffield.—The first part of an account of a recent visit of a number of student members of the British Institute of Electrical Engineers to Sheffield. The Sheffield central station was started in 1886 and rebuilt in 1893; owing to the gradual development there is a great variety of different types of machinery installed in the present plant, but a new uniform plant is to be opened shortly. The power plant of the Sheffield tramway company has a normal capacity of 3,675 kw. Cooke & Co.'s works were also visited; the entire process of the manufacture of wrought iron from the crude pig was shown, also the manufacture of wire rods; the principal work of the firm is making ropes for mining purposes. They have tried electric welding for joining strands when necessary, but have abandoned this in favor of the older method, as the newer process has been found to make the joint more brittle and not so reliable for cables which are required to pass over pulleys.—*Eng'ing*, May 8.

German Electrical Industry.—Howe.—A brief article with a diagram giving curves which represent the variation of the stock quotations of seven of the largest German electrical manufacturing firms during the last six years. The maximum of the stock quotation was in all cases in 1898 and since that time the curves have dropped continually. Kummer is now at zero, and the Helios Company not far off, but even the curves of the large German companies show the same continuous dropping off. "The diagram is worthy of attention and shows only too plainly the terrible dangers arising from overcapitalization."—Lond. *Elec. Rev.*, May 1.

Copper Ores.—A note stating that there is evidence to show that in Northern Rodesia and in Central Africa there is an enormous wealth of copper ore awaiting only the advent of the railway to be made readily available for the purpose of consumers in Europe and elsewhere. It is believed that Africa will in a few years become the world's greatest source of supply. Some reports of Farrell are quoted. —*Eng'ing*, May 1.

New Books.

Telephone Lines. Methods of Construction, Overhead and Underground. By Walter C. Owens. London: Whittaker & Co. 390 pages, 265 illustrations. Price, 5 shillings.

In the preface to this further contribution to telephonic literature, the writer modestly remarks that he believes "this to be the first book that has ever been written, dealing exclusively, fairly and exhaustively with this subject." A casual examinatinn of the 380 pages of this volume reveals that the author must either have had a very limited acquaintance with scientific literature, or must have omitted to insert the adjective "English" prior to the phrase "first book," for the manuals of Miller, Kennelly, Hopkins, Dobbs, Webb and others in America, and Montilot, Weiller et Vivares and Bussac in France are not unknown, are fairly complete and apparently impartial.

There is, however, no denying that this presentation possesses some novelties and is thoroughly up to date from the somewhat insular and English point of view. The first half of the work is explanatory of aerial line construction and is noteworthy in giving details of iron poles in the use of which foreign engineers far excel American practice, but with this exception there is little that is novel. Then follows a short chapter on telephone circuits which is succeeded by a chapter upon aerial cables. Part II is devoted to underground construction; here but two forms of conduit are illustrated and little or no attention is devoted to the methods of conduit building. In conclusion there is a somewhat trite chapter upon electrical testing that merely recites old and well-known methods.

The volume is useful to the American telephonist in giving him quite a clear idea of the English point of view of the art, but excepting the data upon structural iron aerial construction the American telephone engineer has little to learn from it. The typography of the volume is good, but the cuts, and particularly those from half tones, are undeniably remote from the American standard of such work.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty Street, New York. General meeting, Niagara Falls, June 29, July 3.

American Street Railway Association. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. ext meeting, Atlantic City, N. J., September 2, 3 and 4, 1903.

National Electrical Contractors' Association of the United States. Annual convention, Detroit, Mich., July 14, 15 and 16. Frank J. Miner, chairman Exhibition Committee, 207 Jefferson Ave., Detroit.

National Independent Telephone Association. Secretary, J. B. Ware, Ellicott Sq. Building, Buffalo, N. Y. Next meeting, Chicago, June 24 and 25.

Combination Railway and Lighting Storage Battery at Milwaukee.

The Milwaukee Electric Railway & Lighting Company has just completed the installation of a large storage battery plant at its central power station, which is notable as being the first large storage battery installation in this country, installed for use on both lighting and railway circuits. The Milwaukee Electric Railway & Light Company operates all the street railways in Milwaukee, and also all the electric light service. It has an Edison three-wire, direct-current network, for the downtown district.

The use of the same batteries for either railway or lighting involves a little more complication in switching, but has certain advantages in the way of affording a reserve for either railway or lighting plants. These advantages have already been demonstrated at Milwaukee, as there have been times when the ability to work the entire battery on the railway load has helped the railway part of the plants over a very tight place.

The battery is installed on the upper floor of the company's station on East Water Street, located on the east bank of the Milwaukee River. This station was built several years ago, and provision was made for the storage battery at that time, but it is only recently that the battery has been installed. John I. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, foresaw the advantage and flexibility of a battery so connected as to be used on either railway or lighting circuits; and although this has not been the standard practice, he insisted that this company's batteries should be so arranged that they would afford a reserve to be connected to either the railway or lighting loads. As said before, the wisdom of this selection has already been demonstrated.

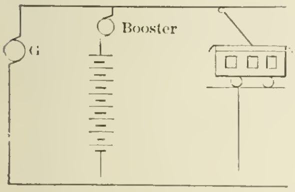


FIG. 1.—RAILWAY BATTERY.

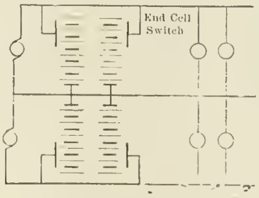


FIG. 2.—LIGHTING BATTERY.

This battery, which was furnished and installed by the Electric Storage Battery Company, consists in all of 608 cells. These are grouped in various combinations, according to the uses to which they are being put. What will be designated as the railway battery in this article, because it is usually operated on the railway load, consists of 288 cells connected across the railway bus-bars in series, with a special booster, as seen in Fig. 1.

The battery ordinarily placed on the lighting load has its connections indicated in Fig. 2. In this battery there are 320 cells, divided into two series of 160 cells each. They are connected across the direct-current, three-wire incandescent lighting bus-bars. A switch by which some of the end cells can be connected in or out, is placed in each series of cells.

In case it is desired to connect both batteries to the railway load, switches are provided by which the arrangement shown in Fig. 3 can be obtained. Here the railway battery is connected between the railway bus-bars just as in Fig. 1. The cells comprising the lighting battery have all been placed in series, and are connected through a second booster across the railway bus-bars. The voltage of the lighting battery is raised or lowered to correspond to that of the railway bus-bars by cutting in or out cells with the end-cell switches.

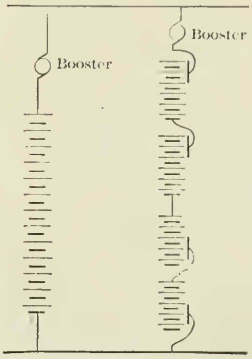


FIG. 3.—BOTH BATTERIES ON RAILWAY SYSTEM.

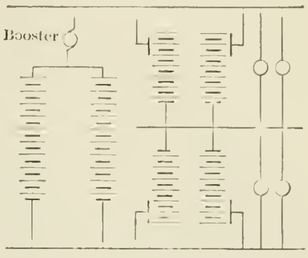


FIG. 4.—BOTH BATTERIES ON LIGHTING SYSTEM.

In case both railway and light batteries are to be connected on the lighting circuit, the arrangement shown in Fig. 4 is adopted. Here the lighting battery is connected, as in Fig. 2, and the railway battery has been divided into two sets, which are put in multiple with each other. These two sets charge or discharge on the lighting bars through the booster.

The arrangement is thus very flexible. The railway battery can be charged on the lighting bus-bars when the lighting generators would be otherwise idle, and can be put on to the railway load to help in summer traffic. In other words, the lighting generators can be made to help the railway generators without interfering with their usefulness on the lighting load. On the other hand, the railway generators might be made to help out the lighting load by charging batteries for use on the lighting circuits. The batteries act as a reserve to tide over emergencies in either railway or lighting departments.

The cells of both batteries consist of 39 plates in lead-lined tanks. The tanks are 41¼ in. wide, 20¾ in. long and 24½ in. high. The plates are 15½ x 15½ in. These cells have a capacity of 1,500 amp. for one hour, or 750 amp. for three hours. Since the railway battery consists of a single series, its capacity is 1,500 amp-hours for one hour, and that of the lighting battery, consisting of two series, is double this. The normal charging rate for the lighting battery is 750 amp., or 375 amp. per series. The end-cell regulating switches have 21 points, thereby permitting the cutting in or out of 21 cells. These switches are of 2,000-amp. capacity. The copper bus-bars from the end cells have a cross-section of ¾ sq. in. At the points where the bus-bars are taken off at the end of each series of cells, and also at each end cell, the capacity of the lead plate connectors on the cell is reinforced by a lead-covered copper bus-bar, which is connected to two points of the lead connector to which the battery plates are burned.

Figs. 5 and 6, which give an idea of the extent of the battery room, show this arrangement of bus-bars well. They also show the flexible suspension of the lead-covered bus-bars from the ceiling. This battery room is peculiar in being located over the generating room, and as one of the officers of the company put it, "We have a million pounds of batteries suspended from the roof." It is a fact that the actual weight of the batteries, with bus bars, is something over 1,000,000 lbs., as the weight of one cell alone is 1,026 lbs. The room is 71 x 98 ft.

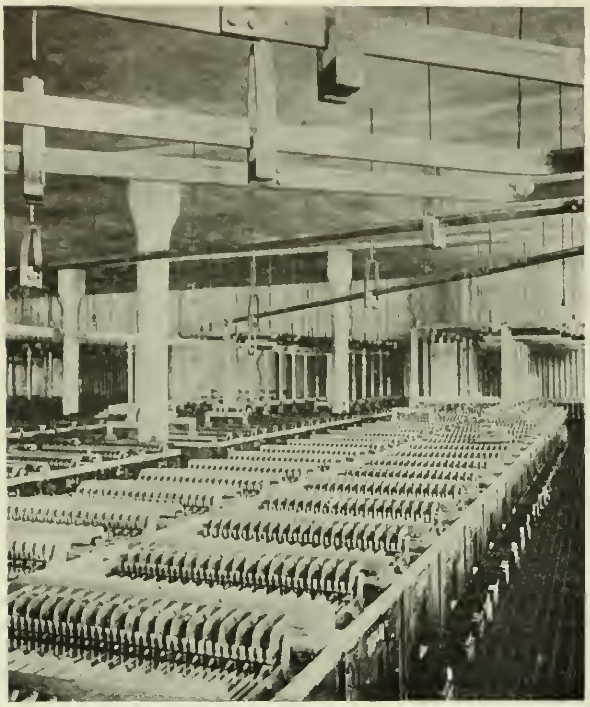


FIG. 5.—VIEW OF BATTERY ROOM.

The switchboard by which the various combinations of railway and lighting batteries can be made is shown in Fig. 7. It is located directly under the gallery containing the regular feeder board of the Edison three-wire network, as can be seen from the engraving. At the left is a panel containing the apparatus for controlling the four end-cell switches, circuit breakers, are all of the I. T. E. laminated edgewise type. There is a circuit breaker in the motor circuit of each booster, and this circuit breaker is made inter-locking, with the circuit breaker in the circuit of the booster armature. In case the motor circuit breaker opens, the interlocking device causes the booster circuit to be opened also. This is to prevent the booster from running away and tearing itself to pieces, as it might if its circuit were kept closed with the motive power from the booster motor cut off. The circuit breaker in the booster circuit does not, however, disturb the circuit breaker of the motor driving the booster by its opening, as there is no reason why the booster should be stopped every time its circuit-breaker opens.

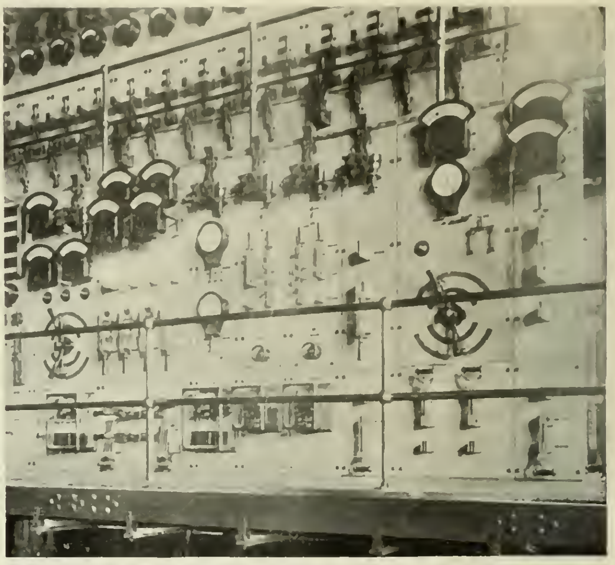


FIG. 7.—VIEW OF SWITCHBOARD.

The boosters are shown in Fig. 8. They can be controlled so as to cause a battery to charge or discharge at any predetermined point,

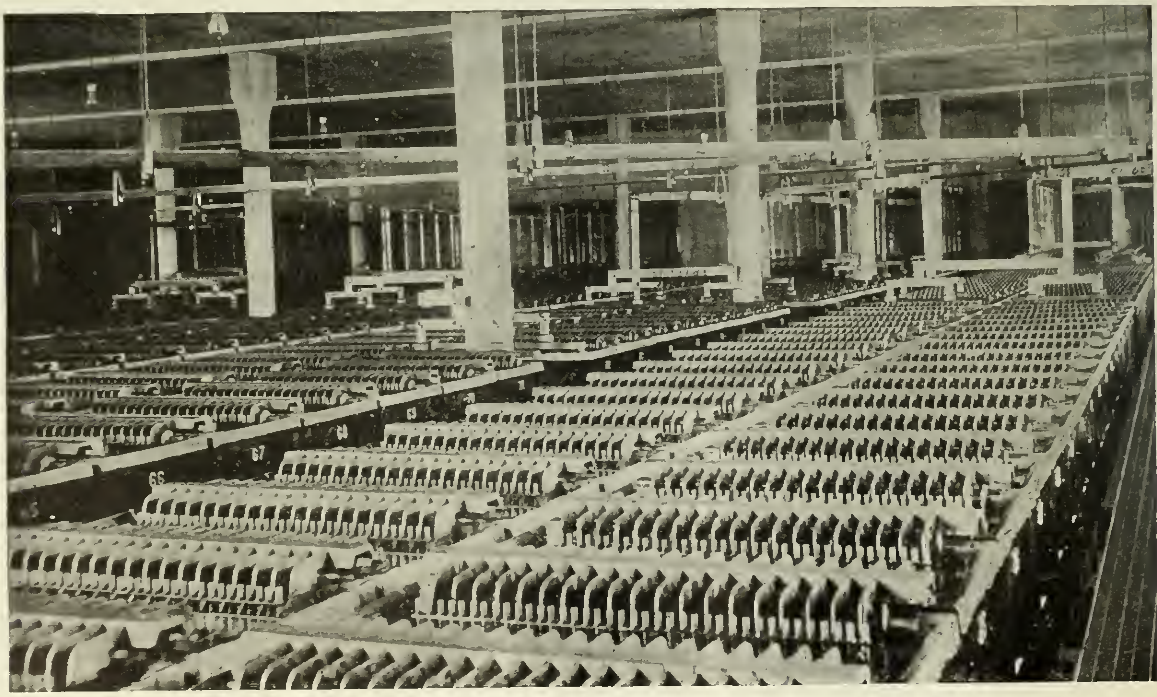


FIG. 6.—ANOTHER VIEW OF BATTERY ROOM.

by varying the strength of the shunt field, or if necessary, changing its direction. By using railway generators with very little compounding effect, the battery with the aid of the booster takes the fluctuation above or below a certain amount, which amount is determined by the adjustment of the shunt field of the booster.

The battery room was fitted up with great care to prevent any possible leakage of acids through the floor onto the ironwork, or onto the generating machinery below. On top of a layer of concrete, tar paper and pitch were spread, and over this a tile, burned extremely hard, was laid, with spaces between of ¼ in. Into this space was poured pitch even with the top of the tile. Sheet lead was laid around the edges of the room to prevent acid getting through at the place where the floor joins the wall. This lead was carried up like a baseboard for a short distance above the floor. The same precautions were taken at the pillars. The whole interior of the room is coated with acid-proof cement.

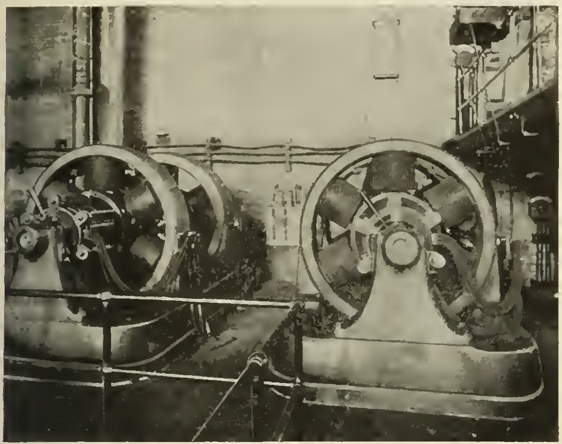


FIG. 8.—BOOSTERS.

New Line of Switchboards.

In most instances where small isolated electric plants have been installed for lighting one or two buildings, no standard lines have been followed, and consequently the switchboard had to be specially designed for the requirements of each case. No uniformity has prevailed, and the renewal of parts has caused great inconvenience. As a solution of this difficulty, the General Electric Company has recently placed upon the market a line of standard switchboards for small isolated lighting plants. The design includes a complete series of combination generator and feeder panels for direct-current service. Each of these panels is a separate and complete switchboard, and is not intended for combination with other panels. These small plant switchboards, within reasonable limits, the cost has been kept, are manufactured only for use on voltages of from 125 to 250 continuous current and only in capacities as specified in the appended list.

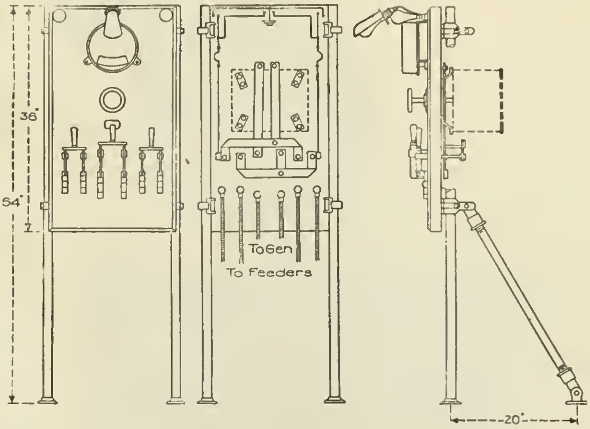
The switchboards provide for the generator and two feeder circuits, which arrangement provides for all ordinary classes of service. The material used in the construction of the boards is a fine variety of slate; the panels are hand finished to a perfectly smooth surface, after which several coats of lacquer are applied, thus producing a dull black, but extremely smooth surface. The slate is 1½ in. thick, has square corners and bevel front edges. The dimensions of the slate are 36 in. x 16 in. to 20 in., depending upon the capacity. All exposed metal parts on the front of the switchboard, except the live copper, have dull black finish.

The support of these panels consists of two one-inch gas pipes, each 64 in. long—the panels being fastened to the pipe by means of four cast-iron clamps, while the pipes are held in position by two cast-iron flanges, which are bolted to the floor by lag screws. Fastened to the center of each of these pipes is a tie rod which permits the panel to be supported from the wall, from the machine frame, or to stand in the center of the room. The tie-rods are provided with clevises, having a hinged joint, which will allow the flanges at the end to be bolted in a vertical, inclined or horizontal position.

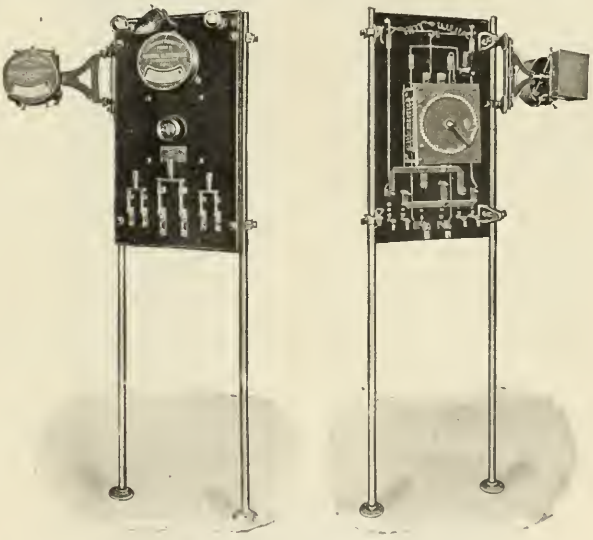
The rheostats are not included with the standard switchboards. The panels are, however, supplied with four wrought-iron legs, which are so arranged as to support the standard rheostats used with the machine corresponding to the rating of each standard size of switchboard.

The switches used on all panels of this class are lever switches, having solid forged clip blocks and studs, the blades being rigidly fastened to the cross-bars. The blades, clips, clip blocks, and studs are of copper, and all the smooth surfaces have ground finish. Three complete sets of fuses are provided with all switches. Each feeder fuse has approximately 75 per cent. of the capacity of the generator fuse.

On all of these panels the current indicator is permanently connected to the generator circuit. This current indicator is the General Electric Company's round pattern instrument, particularly adapted for long continuous hard service. Its few parts are strongly constructed, and having no spring it is free from any element likely to change. A potential indicator is not provided with these panels, since in some installations where they will be used, the illuminating lamp of the current indicator may serve sufficiently well as a pilot lamp. A potential indicator of the same type as the current indicator previously described, and provided with either a pivoted bracket supported at the top of the panel, or with a swinging bracket supported at the side of the panel, may, however, be applied and all panels are drilled for mounting these brackets.



FIGS. 1, 2 AND 3.—FRONT AND REAR ELEVATIONS AND SECTIONAL VIEW OF SWITCHBOARD.


FIGS. 4 AND 5.—FRONT AND REAR VIEWS OF SWITCHBOARD.

The standard two-lamp ground detector is used on these panels; that is, one lamp is connected from each bus-bar to the ground, the voltage of the lamp always being the same as the voltage of the panel. A 16-cp lamp supported on a curved lamp bracket with a half round metal shade is included with each of these panels. When a panel is installed and later it is desired to have a pivoted potential indicator bracket mounted on top of the board, the lamp bracket is removed from the panel, which allows for the mounting of the pivoted bracket without any additional drilling of the panel, the lamp bracket may then be mounted on the pivoted bracket, which is so designed as to receive it

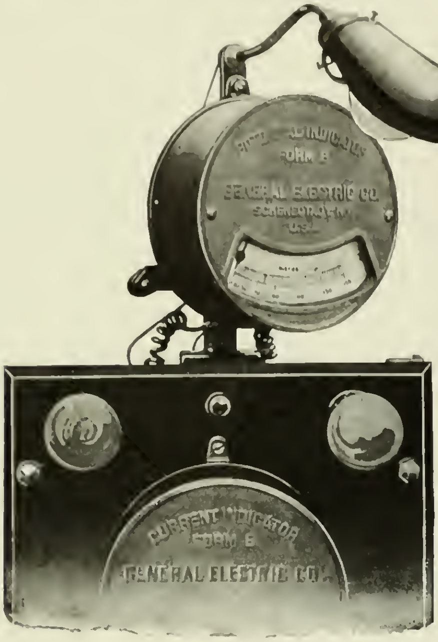


FIG. 6.—GROUND DETECTOR.

The electrical connections of the various parts of the panel are shown in the accompanying cuts, Figs. 1, 2 and 3. All connections are made of bar copper, and terminals are provided for connections to the system. The switchboards are made for capacities ranging from ¾ to 20 kw, 125 volts, and from ¾ to 40 kw, 250 volts.

◆

Novel Form of Cast Grid Rheostat.

An improvement in rheostats is noted in the appearance on the market of the cast grid type of the Stanley Electric Manufacturing Company, of Pittsfield, Mass. It is said to be the only rheostat in which the resistance units are directly connected to the contact studs. In other types, the units are connected to the studs by wires, a construction which necessitates soldered contacts, set screws, or a combination of the two. It is urged that the use of solder in a rheostat is highly objectionable, and, in practice, the set screws prove equally so, as they work loose and give rise to bad contacts. Moreover, short circuits sooner or later develop between the intercrossing wires as the insulation becomes impaired by the heat developed within the rheostat. The bulkiness of rheostats of the larger capacities has also, it is claimed, been an undesirable feature.

The S. K. C. rheostat consists of fifty to sixty iron grids radially arranged, as shown in the lower part of Fig. 2. This arrangement results in an exceedingly simple and compact mechanical construction.

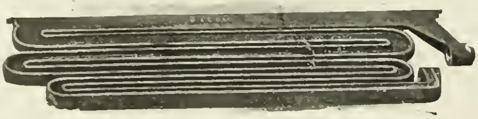


FIG. 1.—RESISTANCE UNIT.

Each unit, as shown in Fig. 1, is formed with a projection extending at such an angle from the plane of the unit proper as to permit direct connection with the next unit.

A contact stud passes through two adjoining units, furnishing electrical connection between them and supporting them in place, and, at the same time, supplying a contact surface for the contact arm. Each unit is thus firmly fastened by two studs or bolts to the substantial slate slab through which the studs pass. A corresponding slate

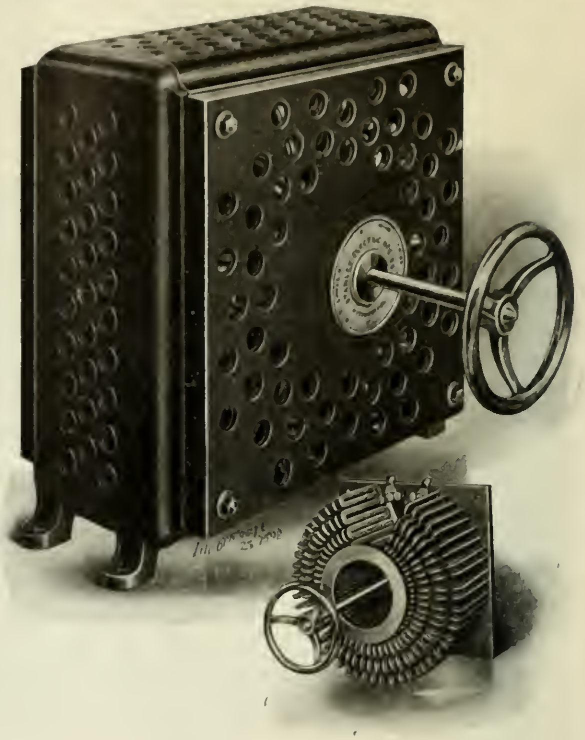


FIG. 2.—CAST GRID RHEOSTAT, SHOWING RADIAL ARRANGEMENT OF UNITS.

slab on the further side gives an additional support to the units, resulting in a very rigid outfit and one of pleasing symmetry. The

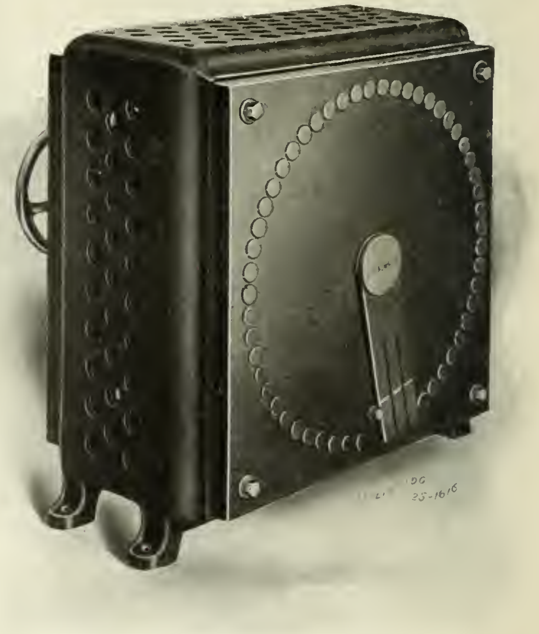


FIG. 3.—CAST GRID RHEOSTAT, CONTACT SIDE.

whole is mounted in a substantial and well ventilated iron case.

The resistance units are cast of such a shape as to furnish the best possible radiating and convective surface. The contact arm, as can be seen in Fig. 3, is unusually broad, giving a good contact surface and permitting the ready dissipation of heat.

"No Voltage Release" Up-to-Date.

The shunt field current of an electric motor of a certain horse-power and volts has always been an extremely indefinite quantity, and for many years past a comparison of the shunt field current in motors of various makes, having identical power and voltage, has shown that this variation in field current covers a range as great as 6 to 1. The tendency to-day is rapidly in the direction of a still wider range in the shunt field current, because modern practice in motor-driven tools and in every other line demands a wide range in the speed of the motor; and the simplest and one most efficient way to get such variations in speed is to vary the current in the shunt field circuit. The sparking troubles due to the armature reaction have been so overcome that it is no uncommon thing to find motors whose field currents are reduced to one-half, one-third and even one-fourth of their full strength in order to secure speed variations by imperceptible increments and with high efficiency.

It will be evident from what has preceded that the form of "no voltage" release in which the holding magnet is in series with the shunt field current may become unreliable and troublesome when the shunt field current varies in motors of different makes as much as 6 to 1, and, in addition, a speed control is used which increases the range some three or four times more. There are also more and more motors used having both a series and a shunt winding. This again introduces a further variation in the shunt field current, even if the horse-power, volts, speed and make be the same. It is evident that the holding magnet will give theoretically perfect results if it be connected so as to be dependent upon the counter e.m.f. of the motor only and independent of the field current or the armature current. Such a holding magnet will hold perfectly so long as the motor is producing the necessary protective counter volts and will automatically release whenever for any reason the counter e.m.f. falls below a properly protective amount. In addition, such a "no voltage" release is perfectly adapted for use upon any known kind of direct-current motor of a certain horse-power and volts, whether the motor be shunt-wound, series-wound, accumulative-compound, differential-compound, separately excited or magneto, and the current in the shunt-field winding or the series-field winding can be varied in any desirable manner for speed control without in any way affecting the perfect operation of the "no voltage release."

A patent on this counter e.m.f. "no voltage" release was issued to H. Ward Leonard June 29, 1897, but for many years it added so materially to the cost of starters and controllers as to make a material difference to the user. Inventions of Mr. Leonard in the past few years have, however, so reduced the cost of this form of "no voltage" that the counter e.m.f. form is now supplied whenever desired by the customer at the same price as the types dependent upon the shunt-field current and not really upon the voltage.

The advantage of this form of starter will be appreciated by every concern which has received orders for starters and has only the information that it is of so many horse-power on a circuit of known voltage, and consequently have not known whether the motor was shunt-wound, series-wound or compound-wound. This form of "no voltage" release has also many applications to other apparatus such as storage batteries, etc., and lends itself particularly well to various forms of push button control and distant automatic control, as the current through the magnet and the volts on its terminals are both so low that the magnet can be short-circuited or open-circuited with the most perfect, simple and reliable results.

It may be added that the improvement which has led up to the present encouraging state of affairs is based upon the production of an extremely high-resistance tube. By his new invention, Mr. Leonard is able to get 700 ohms on a square inch of surface, whereas with his enamel types used for field rheostats, theatre dimmers, etc., only about 30 ohms concentration to the square inch was feasible.

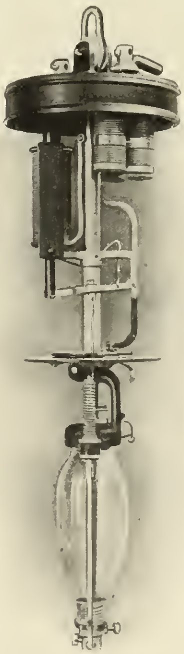
Irrigation in California.

It is stated that irrigation by electrical power is to be tested practically on a large scale near Anderson, Shasta County, California. The Northern California Power Company, which has its headquarters in Redding, its power plant being in the Shingletown country, has just purchased the Bellevue tract, near Anderson, and is stringing wires from its sub-station in that village to its pumping plant on the Bellevue land. It has there set up a pump that has a capacity of 4,000 gallons a minute, the water to be lifted from the river. Hitherto there has been little or no irrigation of the fruit orchards about Anderson, because of the expense of constructing irrigation ditches or the expense of maintaining pumping plants operated by gasoline or steam. But electrical power is now so cheap that there can be no question of its ultimate adoption throughout the fruit belt. With plenty of water at the critical period of ripening, the productiveness of the orchards is increased 25 per cent., while without the water at that time one-quarter of the crop is lost. The value of fruit lands about Anderson has suddenly taken an upward bound in price as the electric power lines are being extended through the valley.

G. I. Enclosed Arc Lamp.

The General Incandescent Arc Light Company has made a number of improvements, noted below, in its enclosed arc lamp, with interchangeable parts, for 100 to 120-volt direct-current, constant-potential circuits.

The clutch is entirely insulated from the mechanism and therefore no current can sneak over the working joints of the clutch, clutch links, feed lever and dash-pot. The adjustable regulating resistance is mounted on several porcelain units, and is fastened by screws to a light circular casting, which is attached to the top casting of the lamp. These resistance units are connected by screw clamps, and the beginning and end leads are connected to the proper binding posts under the top casting. This form of resistance permits of the highest possible operating and maintenance economy. Damage occurring in any part of the resistance wire does not disable the entire coil, but only a quarter or sixth part is affected, and such damaged part or unit can be replaced by removing three screws and inserting a new interchangeable unit. The whole resistance can be removed from the lamp by unscrewing the two supporting and two clamping screws.


ENCLOSED ARC LAMP.

The adjustable resistance clamp is a much more important factor in a constant-potential lamp than is generally understood. A well-designed clamp must always make a good "elastic" contact with the wire, and it should preferably cover a considerable wire surface, so as to prevent the wire from rusting and also to preserve a perfect contact and allow the expansion and contraction of supporting porcelains under all possible conditions. A poorly designed adjustable contact will cause much trouble, allowing the arc adjustment of the lamp to change, due to increase of resistance in contact between the clamp and the wire.

It frequently happens, due to lack of appreciation of the importance of the above, that lamps are hung and allowed to operate year in and year out until the arc voltage gets so low that the lamp burns out or the customer complains. The increased resistance and excessive heating at the point of contact between the clamp and resistance wire will, moreover, cause the wire to get so brittle and weak that it is liable to break without warning. It is claimed that such troubles are practically impossible with the new style broad contact clamp by the General Illuminating Company.

The solenoid (or magnet coil) construction differs from the type used on previous lamps in that the coil is form-wound and is removable from the dash-pot tube. This improvement separates the dash-pot plunger with its tube from the magnet coil. In consequence of this change, the new magnet coil can be placed on the lamp without the dash-pot and graphite plunger. This form-wound magnet coil does not require brass heads or tube.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money hardened but was freely obtainable, the closing rates being 3½ per cent. for 60 days and 4 a 5 per cent. for 90 days to six months. The stock market was disturbed by a brokerage failure at Toronto, and suffered also from continued liquidation in Pennsylvania, Amalgamated Copper and other active stocks, the movement giving rise, in fact, to various disquieting but vague rumors. Other portions of the share list, however, exhibited a great deal of activity and participated in prevalent tendencies to an extent which made their action a matter of importance. The anthracite stocks were affected somewhat by the reports of the new danger of a strike in the anthracite region, but held better the latter part of the week. The traction shares were rather neglected, and no particular effect was produced by the fact that the July dividend on Manhattan was at the rate of 1½ per cent. for the quarter or 6 per cent. per annum. The explanation offered was that as a 7 per cent. rate is conditional upon the amount of the earnings for the full year, the extra 1 per cent. will not be declared until the termination of the first twelve months of the lease. The United States Steel stocks were active, with a tendency toward improvement in both common and preferred shares and the new 5 per cent. trust bonds. The quotations in the electrical and traction list, in most all cases, touched the lowest points of the year. Brooklyn Rapid Transit fluctuated between 60⅜ and 56⅜, closing at 57½, this being a loss of 1⅝ points. Metropolitan Street Railway closed at 127½—2 points below the highest figure of the week, and a net loss of ⅝. Manhattan closed at 136½, this being a net loss of ¾. The electrics were decidedly weak, and closed with a loss of several points in each case. General Electric fell to 175, but regained some of the loss, and closed at 177¼, being a drop of 3¾ points net. Westinghouse common lost 9 points, closing at 182. American Telegraph and Cable closed with a net loss of 3 points at 150, which was the lowest quotation of the week. Western Union was the only exception, and remained steady at 84, this being the closing quotation. Following are the closing quotations of June 9:

NEW YORK.

	June 2	June 9		June 2	June 9
American Tel. & Cable	75	75	General Electric	180½	175
American Tel. & Tel	.	140	Hudson River Tel	..	..
American Dist. Tel	29	25	Metropolitan St. Ry	128½	122¾
Brooklyn Rapid Transit	59¼	56¼	N. E. Elec. Veh. Trns	⅛	..
Commercial Cable	..	.	N. Y. & N. J. Tel	.	..
Electric Boat	20	20	N. Y. E. V. T. Co.	5¾	5⅛
Electric Boat pfd	38	38	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1¼	1¼	Western Union Tel	84½	83½
Electric Vehicle	8¼	6½	Westinghouse com	.	178
Electric Vehicle pfd	14½	12½	Westinghouse pfd	185	175

BOSTON.

	June 2	June 9		June 2	June 9
American Tel. & Tel	151½	145¾	Western Tel. & Tel. pfd.	92*	91
Cumberland Telephone	.	..	Mexican Telephone	1¾	1¾
Edison Elec. Illum	.	251	New England Telephone	132	133*
General Electric	255	175	Westinghouse	90	..
Western Tel. & Tel	16*	13	Westinghouse pfd	90	..

PHILADELPHIA.

	June 2.	June 9		June 2.	June 9
American Railways	..	.	Phila. Traction	96½	96½
Elec. Storage Battery	64½	63	Phila. Electric	6¼	6⅛
Elec. Storage Battery pfd		.	Pa. Electric Vehicle	..	..
Elec. Co. of America	8½	8⅛	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	June 2.	June 9		June 2.	June 9
Central Union Tel	..	..	National Carbon pfd	95	94
Chicago Edison	155	154	Northwest Elev. com	..	..
Chicago City Ry	200	190	Union Traction	4½	3½
Chicago Tel. Co	140	135½	Union Traction pfd	32½	30
National Carbon	24¾	23¾			

*Asked.

STREET RAILWAY INVESTMENTS.—The McGraw Publishing Company has just issued the tenth annual volume of the *Street Railway Journal's* publication, entitled "American Street Railway Investments," containing reports of 1,361 companies, showing in detail the physical and financial condition of the properties. Of this number nearly 1,300 reports are of an official character, the information being furnished by the railroad companies themselves. These figures include both operating and leased roads, and include data of all new roads. The figures are given for all important consolidations during the year. The reports of companies are arranged by States this year, instead of alphabetically by towns as heretofore. The book contains about twenty-five folding maps, some in colors, of the most important street railway systems in the United States. It also contains a table showing by comparisons the gross receipts of all companies earning $25,000 or more for the years 1901 and 1902. These figures are referred to in detail in an article appearing elsewhere in this issue.

LIGHTING MERGER IN PENNSYLVANIA.—The United Gas Improvement Company has acquired interest in gas and electric companies in Delaware, Montgomery and Chester counties, Pa., and will merge all the companies under the name of the Merion and Radnor Gas & Electric Company, with a capital of $1,000,000. Samuel T. Bodine, second vice-president of the United Gas Improvement Company, is to be president of the new company, which is to be subsidiary to the present corporation. The United Gas Improvement owns the gas and electric companies at Ardmore, Haverford, Bryn Mawr, Rosemont, Villanova, Wynnewood, Llanerich and Narberth. The other companies which are said to have been absorbed are the Lower Merion Gas Campany, Wayne Electric Light Company, People's Gas Company, of Delaware County; Radnor Township Light Company, Radnor Township Heat Company, Eastown Township Light Company, Eastown Township Heat Company, and Upper Merion, Haverford Township, Newton Township, Radnor Township, Eastown Township, Tredyffrin Township and Willistown Township Electric Light Companies.

DEAL AT URBANA, OHIO.—On June 1st the stock of the Urbana Electric Light and Power Company, of Urbana, Ohio, was sold to the Dayton, Springfield and Urbana Electric Railway Company. The plant thus becomes the property of, and will be controlled by, the Appleyard syndicate of Boston. It is the intention of the D. S. & U. Company to abandon the present lighting station, and to operate from the sub-station of the road now nearing completion at this point, the power to be transmitted from the company's central power house at Medway, near Dayton, at 26,000 volts. The organization was effected as follows: John S. Harshman, president; C. H. Ganson, vice-president; A. E. Appleyard, treasurer, and W. R. Pomerine, secretary. The above, together with Richard Emory, C. A. Alderman, George W. Hitt, John C. Powers and Frank E. Valentine constitute the new directorate. Mr. Valentine will be retained as manager.

COPPER STOCKS AND LOSSES.—It is stated that in the general decline in stocks, which has now extended over a period of three months, the copper shares of this city and Boston have suffered most severely. Twenty-four of the prominent copper companies whose shares are dealt in have lost in value $82,918,700 since the beginning of the year. Early in the year there was a boom in copper on account of the great improvement in the price of the metal. Copper advanced from 12 cents a pound to 15, and there has been no severe setback in the price of the metal since 15 cents was reached. Notwithstanding the maintained strength of the metal market, the shares of the various companies which are publicly traded in have sunk to low levels. Of the copper stocks, Amalgamated Copper has lost not less than $38,000,000 in market value.

DIVIDENDS.—The directors of the Commercial Cable Company have declared the regular quarterly dividend of 2 per cent., payable July 1. The directors of General Electric have declared the regular quarterly dividend of $2 on the common stock, payable July 15. The regular quarterly dividend of 1¾ per cent. on New York Metropolitan Street Railway is payable July 15. The directors of Detroit United Railway have declared the regular quarterly dividend of 1 per cent., payable July 1. The Boston Suburban Electric Company has declared a regular quarterly dividend of 1 per cent. on the preferred stock, payable July 15.

NEW WIRELESS COMPANY.—Information comes from Harrisburg, Pa., to the effect that Daniel Drawbaugh, the inventor, has virtually closed a deal whereby a syndicate, to be called the United States Wireless Signal Company, will acquire all his wireless inventions. It is said that he will receive $10,000 in cash and one-tenth interest in a $3,000,000 company recently organized to put the Drawbaugh wireless telegraph and telephone on the market. Mr. J. R. Stokes, of Philadelphia, is president of the company.

CHICAGO EDISON STOCK.—Stockholders of the Chicago Edison Company, at their annual meeting this week, authorized an increase in their capital stock from $10,000,000 to $15,000,000. It is not expected that any portion of the authorized issue will be put out before next year. There are two quarterly instalments of the $2,276,210 authorized at the beginning of the year to be paid in. The Board of Directors last November recommended the increase voted.

HAVANA TROLLEY FINANCES.—The stockholders of the Havana Electric Railway Company have given their approval of the proposition to issue $250,000 bonds out of the $2,500,000 of authorized consolidated mortgage bonds, for the purpose of construction, equipment, and improvement of lines of railway owned or to be owned by the company.

MONTEREY ELECTRIC TRACTION.—There is an extreme likelihood that notwithstanding the bankruptcy of the banking house of Sperry, Jones & Company, of Baltimore, Monterey will soon have an up-to-date electrical traction system, as New York parties are seeking to make financial arrangements for the acquisition of the existing horse-car lines and the Mackin & Dillon electric traction concession. The Sperry Jones people agreed to purchase the Companie Urbanos Ferrocarriles de Monterey—better known as the Empresa Company—of which Francisco Belden, of the Bank of London and Mexico, Monterey Branch, is president. The company operates a mule line thirteen miles in length. Thirty-three cars are employed. The franchise runs for sixty years, and permits of a six-cent fare. R. B. Sperry, acting on behalf of the Baltimore firm, agreed to pay $504,000 Mexican currency for the system. He also undertook to buy the Monterey & Santa Catalina railroad, better known as the Slayden lines, of which S. W. Slayden, 50 Broadway, is president. This is also a mule system. Its length is about fifteen miles. Twenty cars are in operation. The line runs to Topo Chico Springs, a popular summer resort in the vicinity of Monterey. The franchise runs for eighty years. The fare is six cents. Mr. Sperry, engaged on behalf of his firm to purchase the Slayden lines for about $150,000. The Mackin & Dillon concession, which is owned by the American contracting firm of that name, is for all the other streets of any value in Monterey not covered by the mule systems. There are about twenty-three miles in routes, including one to the huge plant just completed for the Monterey Iron and Steel Company. The franchise is for ninety-nine years. The concession permits of charging a fare of ten cents first-class and five cents second-class within the city limits. Mr. Sperry also agreed to purchase this franchise. Mackin & Dillon were promised ten per cent on the cost of electrifying the Empresa and Slayden system, and on the construction of the electric system for which they hold the concession. They were to secure the contract. It was also understood that $75,000 in bonds would be given them. These bonds were to be issued by the Monterey Street Railway Company, which was to be floated with a capital of $1,500,000 for the purpose of acquiring the existing lines and the Mackin & Dillon concession, and to build and operate the new system. Sperry, Jones & Company were unsuccessful in floating the company here, the parties approached considering the undertaking largely over capitalized. Three parties are now endeavoring to enlist capital to acquire the Monterey lines and to build an electric traction system. Mr. Blair, of the legal firm of Blair & Rudd, 32 Liberty Street, is seeking to interest British capital. Mr. Blair's firm acted for the Slayden people, and also for Mackin & Dillon, with a view to taking legal claim against Sperry, Jones & Company for breach of agreement. Mr. Blum, manager of the Federal Electric Company, 141 Broadway, is also trying to interest Britishers in the venture, while Mr. Mackin, of Mackin & Dillon, is bringing the project to the attention of Cleveland capitalists.

FEDERAL TELEPHONE.—At a special meeting of stockholders of the Federal Telephone Company, held at East Orange, N. J., June 2, it was voted to reduce the capital stock from $10,000,000 to $1,000,000, by the reduction of the par value from $100 to $10. A collateral trust bond issue of $6,000,000 was authorized.

Commercial Intelligence.

THE WEEK IN TRADE.—Weather and crop conditions were the uncertain features in the general trade situation. Heavy rains and consequent disastrous floods in the Southwest have caused much loss of life, property and crops, and trade and transportation in that section has been checked. Drought in New York and New England has hurt cereal crops, and forest fires have added to the damage from this source. In the Northwest the crop conditions are almost perfect, while in the South much impairment is still shown over last year. Cotton conditions are reported by the government to be the poorest on record at this date, but the predicted increase in acreage has materialized in a gain of nearly 4 per cent over last year. Prices for cereals are reflected in the damage inflicted on growing crops, and the principal ones are higher. The labor situation is still unsatisfactory, and it is reported that there are about 250,000 men still idle. Talk of a strike of anthracite coal men is not regarded seriously. Iron and steel prices tend lower. A settlement of the Amalgamated Association wage scale tends to give stability to this trade. In spite of the labor troubles, the demand for structural material remains surprisingly good. The railway gross earnings thus far reported for the month of May show a gain of 11 per cent. over last year, while April returns indicate profitable operation. Money is slowly hardening, but collections range from fair to good. The country's foreign trade promises well; failures are down to a low minimum, and bank clearings point to record totals outside of a few important speculative centers. The copper market is decidedly unsettled, producers holding firmly to their prices and consumers purchasing as sparingly as possible. Producers' official quotations are unchanged at 14¾ to 15c. for Lake and electrolytic, and 14½ to 14¾c. for casting stock. The business failures for the week ending June 4, according to *Bradstreet's* records, numbered 157, against 181 the week previous, and 153 the corresponding week of last year.

BELL AND KELLOGG INTERESTS.—Sensational developments have been made public the past week in Chicago in connection with the Kellogg Switchboard & Supply Company, of Chicago. The majority of the stock of this company was acquired some months ago, it seems, by Bell interests, a fact not known to the minority stockholders engaged in conducting the Kellogg business, until very recently. This controlling interest was originally held by Milo G. Kellogg. Mr. Kellogg went to California for his health, leaving all his affairs in the hands of an agent, with a blanket power of attorney. During his absence the stock was sold, and it is said that Mr. Kellogg has since been making the effort of his life to regain it quietly. Failing to do this by quiet means, the minority stockholders, including Messrs. Miller, Dunbar, Dommerque, Burlingame and Dean were informed, and a temporary injunction was secured by them preventing the majority stockholders from interfering with the operation of the company until the minority stockholders can get a hearing in court. The case is a most peculiar one in many ways and puts the minority stockholders, who have conducted the business, in a very embarrassing position, since a large amount of business has been secured by them recently on their personal assurances, backed by their personal convictions, that the Kellogg Company was not controlled by Bell interests.

LARGE MEXICAN HYDRAULIC PLANT.—Plans are now being prepared by Henry Ide Wiley, engineer of the mine, and W. W. Allen, consulting engineer, for the construction and equipment of a large water-power plant to operate the smelter which will ultimately have a capacity of 5,000 tons a day, and to drive the rock-drilling equipment and other machinery at Campo Santo mine, in the State of Sonora, Mexico, owned by the Yaqui Copper Company, offices, Broadway-Maiden Lane Building. The company is controlled largely by interests identical with those of the Greene Consolidated Copper Company. The Yaqui hydraulic plant will be the largest one hitherto employed to furnish power for mining operations. Power will be derived from the Yaqui river, which runs through the property. Owing to the large volume of water available, the working head will only be thirty feet. The initial capacity of the plant will be 1,000 hp. Four water wheels of 250-hp each, direct-connected to generators, will be purchased. Eventually the capacity of the plant will be increased to 5,000 hp.

EQUIPMENT OF ARIZONA SMELTER.—The Douglas, Arizona, copper smelting plant of the Copper Queen Consolidated Mining Company, 99 John Street, is to be operated by electricity. A 1,800-kw plant will be installed. There will be four 18 in. x 36 in. x 42 in. cross compound Corliss engines, direct connected to generators of 450-kw capacity each. The engines have been ordered from the C. & G. Cooper Company, Mount Vernon, Ohio, through that concern's New York offices in the Havemeyer Building, of which Mr. F. W. Idell is manager. The generators are to be of Fort Wayne make.

BALL ENGINE ORDERS.—The Tawas Sugar Company, East Tawas, Mich., will have an electric plant, consisting of two engines of 150 horse power, direct-connected to Crocker-Wheeler generators. The Ball Engine Company, Erie, Pa., furnishes the engines, which are of the self-oiling type. The Owosso Sugar Company, Owosso, Mich., will have an electric plant, consisting of two engines of 150 horse power, direct-connected to Crocker-Wheeler generators. The Ball Engine Company furnishes the engines, which are of the self-oiling type.

AFTER JAPANESE LIGHTING CONTRACT.—Frazar & Company, of Japan, 63-65 Wall Street, is figuring on a contract about to be awarded for the equipment of a Japanese lighting plant. The machinery includes a three-phase, 250-kw alternator for direct connection to a 350-hp vertical compound, condensing engine. The Frazar people have lately secured some fair-sized orders for electrical supplies for shipment to Japan.

NEW POWER PLANT FOR OMAHA.—A three million dollar power canal and electric power house will be built immediately on the Platte river, near Omaha, to furnish power to the South Omaha and Lincoln packing houses and street-cars. Work will begin immediately. New York capital is interested. Mr. W. J. C. Kenyon, manager of the stock yards, announces that details have been perfected and contracts will be made.

EQUIPMENT FOR CEMENT PLANT.—The Quaker Portland Cement Company's plant now under construction at Sandts Eddy, in the vicinity of Easton, Pa., is to be equipped with two 18-in. x 40-in. x 42-in. Cooper cross-compound, Corliss engines, to be direct-connected to Crocker-Wheeler generators of 400-kw capacity each.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, manufacturer of the Strowger automatic telephone equipment, reports an increasing demand for automatic telephone apparatus. It has recently sold to the Columbus Automatic Telephone Company, Columbus, Ga., complete equipment for a present installation of 700 lines, the switchboard to have an ultimate capacity of 3,000. Among other orders recently received by the company are the following: 100 station switchboard for the Mount Olive Telephone Company, Mount Olive, Ill., 100 station switchboard to the Home Telephone Company, Birmingham, Ala., to be located in a branch exchange and work in connection with the larger exchange of that company in Birmingham; 100 station switchboard to the Vermillion County Telephone Company, Danville, Ill., to be located in a branch exchange, and to be connected with the exchange in Danville; 50 station switchboard to the United States Arsenal, Rock Island, Ill.; 40 station switchboard to the University of North Dakota, Grand Forks; 40 station switchboard to the Cape Railways Company, Cape Town, Africa; 150 station switchboard to A. J. Perkins & Son, Medford, Wis. The large exchange of six thousand stations which the Automatic Electric Company is building for the Dayton Home Telephone Company, of Dayton, Ohio, is rapidly nearing completion, and it will only be a few weeks before the citizens of Dayton will have automatic telephone service.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, of Buffalo, will shortly open the Le Roy Telephone Company's exchange at Le Roy, N. Y. This exchange was built complete and all apparatus furnished by the Century Company. The equipment consists of two hundred line (present equipment) full common battery electric light line signal board, and double supervisory lamp signals. The power plant consists of storage batteries with the usual equipment of motor dynamos, switchboards and customary apparatus. This plant is one of the most complete and up-to-date telephone plants in the country. The Century Company has also just completed the plant for the Avon Telephone Company, Avon, N. Y. The outside construction is substantial, and the central office equipment consists of a visual target signal, common battery switchboard, with double supervisory visual target signals, one of the Century Company's latest productions. The power plant consists of the usual storage batteries, motor dynamos, switchboards, etc.

THE DAN RIVER POWER AND MANUFACTURING COMPANY will equip its cotton mill at Danville, Va., with electrical machinery throughout, and for this purpose has recently ordered from the Westinghouse Electric and Manufacturing Company two 750-kw and one 500-kw. 6,600-volt generators, together with two 125-kw exciters, each generator to be direct-connected to an independent water wheel. The current is to be transmitted three thousand feet to a step-down transformer station, in which will be located four 600-kw Westinghouse, oil and water-cooled transformers, which will step-down the 6,600 volts to approximately 500 volts. From these transformers the current will be carried to a sub-station switchboard, from which lines will run through underground vitrified conduit, to the various buildings where the current will be used for the numerous Westinghouse induction motors, which will drive the cotton mill machinery.

WESTINGHOUSE CORLISS ENGINES.—The extent of the large Corliss engine business, conducted by the Westinghouse Machine Company, through Westinghouse, Church, Kerr & Co., is well brought out by the fact that within the five years, during which the Westinghouse Machine Company has taken up the manufacture of large Corliss engines, a total of over 160,000 horse-power in engines has been sold, comprising four distinct types: vertical 3-cylinder compound, vertical cross compound, horizontal cross compound, and horizontal tandem compound. The equipments now in service include such plants as the New York Edison, Brooklyn Edison, Third Avenue Railway, New York, and Boston Elevated Railway. This record is particularly gratifying to the Westinghouse interests in that it represents but one branch of effort in the engine-building business, the Westinghouse Machine Company being also builder of the largest American gas engines and steam turbines.

A NEW GAS ENGINE CENTRAL STATION.—An interesting example of the application of gas engines to central station service is afforded by the new plant of the Franklin Electric Company, Franklin, Pa. The gas power equipment will supplant a large steam plant which the company has in operation at the present time, and will supply current, for electric light and power service throughout the city. The present equipment comprises five 125-hp Westinghouse vertical, 3-cylinder gas engines, which will be belted to a corresponding number of 75-kw alternating current generators. An interesting feature of the equipment is the provision made for the operation of the alternating-current generators in parallel. This has proven to be a very difficult matter up to the present time in gas engine practice. The plant operates upon natural gas fuel.

WESTINGHOUSE, CHURCH, KERR & CO., have recently sold additional train lighting equipments to the Chicago, Milwaukee and St. Paul, and the Northern Pacific Railway Companies, for service on their special limited trains. The outfit consists of a 25 or 30-hp Westinghouse standard, vertical, single acting engine, direct connected to a direct current generator of corresponding capacity. The units are extraordinarily compact, and are located in the front part of the baggage car, a location which is favorable for supplying high pressure steam directly from the locomotive boiler through flexible piping. The system is now in use on a large number of roads in this country, including the Chicago & Northwestern, Union Pacific, Lake Shore & Michigan Southern and Duluth, South Shore & Atlantic.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed another large contract for the installation of Chloride accumulators on the Pacific Coast. The Seattle Electric Company, which in April, 1903, closed a contract for the installation of a battery at the Fremont sub-station, for use in regulating the railway load, has now contracted for 154 cells, to be installed in the Post Street Station, at Seattle, to be used in connection with the lighting load. These elements will have a capacity of 14,400 amp. hours, and aside from caring for the peak, one of the most important features in connection with the installation is its value as a reserve. The containing tanks for this battery will be of sufficient size to allow an increase of 25 per cent. in capacity.

INGERSOLL-SERGEANT PLANT.—The Ingersoll-Sergeant Drill Company, Havemeyer Building, has just let contracts for considerable electrical equipment for its new plant at Phillipsburg, N. J. The Crocker-Wheeler Company has secured the contract for the generators and motors. The C. & G. Cooper Company will build the engines. There will be three direct-connected generators of 300-kw capacity each, and one of 100-kw capacity. There will be more than 100 motors, both grouped and individual. The engines will be of high duty, cross compound, Corliss type, to operate at 100 r.p.m. Three will be 14 in. x 36 in. x 36 in., and another will be of 9 in. x 22 in. x 30 in. dimensions.

AXLE LIGHTING EQUIPMENT FOR FOREIGN RAILROADS.—The Consolidated Railway Electric Lighting & Equipment Co., 100 Broadway, New York, recently secured a contract through the Japanese house of Mittsui & Company, New York offices 445 Broome Street, for several axle lighting equipments for use on Japanese railways. The specialties of the company are now being manufactured on a large scale in England. Vickers, Son & Maxim, the British representatives of the company, having erected an extensive plant in the vicinity of Birmingham for the purpose of turning out the equipments for British and Continental European railroads.

CREDIT MEN'S CONVENTION.—The convention of the National Association of Credit Men will be held in St. Louis June 9, 10 and 11, when questions affecting legislation and betterments for creditor and debtor will be discussed. The National association numbers about 5,000 members in thirty-four local associations, that of New York being the largest. Among the delegates who represent the New York branch are F. K. Dolbeer, Edison Manufacturing Company; A. P. Eckert, Electrical Trades Society; Charles E. Meek, National Lead Company.

THE BUFFALO STEAM PUMP COMPANY, whose works are at North Tonawanda, N. Y., has been purchased by Messrs. William F. and Henry W. Wendt, who are also owners of the Buffalo Forge Company and the Geo. L. Squier Manufacturing Company. The North Tonawanda Works of the Steam Pump Company are to be continued as heretofore, and the main offices will be in Buffalo.

HIGH SPEED JAPANESE TRACTION.—Frazar & Company, of Japan, 65 Wall Street, are figuring on behalf of American concerns on the contract about to be awarded for ten sets of four motor equipments, ten double trucks, etc., for use on a Japanese Electric road now under construction, on which the speed will be between 40-50 miles per hour. Each motor will be of 60-hp capacity.

ELECTRIC HOISTS FOR BROOKLYN DOCKS.—The Lidgerwood Manufacturing Company, 95 Liberty Street, New York, has just been awarded a contract for six hoisting engines for installation in the New York Dock Company's Brooklyn docks, where the equipment will be used for handling cargo. The hoists will be operated by G. E. motors of 25-hp each.

N. Y. SUBWAY SIGNALS.—The Union Switch and Signal Company, of Pittsburg, it is stated, has received a contract from the Interborough Rapid Transit Company to equip the subway in New York City with its signals in time for the operation of trains within a year.

ENLARGING LEWES, DEL., PLANT.—The Board of Public Works, of Lewes, Del., are enlarging their municipal plant. They will place a new engine and new dynamo in the power house, and will also extend their power and water mains.

General News.

THE TELEPHONE.

FLORENCE, ALA.—The Bell Telephone Company is installing a new system here at a cost of $9,000.

MONTGOMERY, ALA. The Old Dominion Telegraph Company has been incorporated, with a capital stock of $10,000, by W. F. Dunn, E. R. Humphrey, J. J. Byron, W. F. Roberts and Thomas Young.

LITTLE ROCK, ARK.—The Southwestern Telegraph and Telephone Company, on May 26, opened a new long distance telephone connection with Memphis and points to the north and east in Arkansas. Its line extends north along the Iron Mountain Railroad to Hoxie, thence along the "Frisco" to Jonesboro, Sedgewick, Bonnerville, Nettleton, Marked Tree, Marion. Big Bay, Mosher, Culberthouse, Deckerville and Dague to Memphis. A branch line is being built to Paragould, giving connection with Piggott, Rector, Gamesville, St. Francis, Greenway and Bethel. Other lines are being built to Pocahontas, Black Rock and Powhatan.

SAN JOSE, CAL.—The fruit growers of Santa Clara County, it is stated, intend to establish a co-operative telephone system to connect their several farms.

SAN BERNARDINO, CAL. Telephones are to be furnished for the trolley cars in Redlands, so that passengers can telephone, if they wish, while en route between Redlands and this place. Ten cars will be equipped with apparatus and there will be five stations between the two cities and one at each end of the road.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company will rebuild its plant in this city during the next twelve months, and will thus expend about $1,500,000. It proposes to provide a capacity for 100,000 subscribers, the number at the present time being something over 40,000. The improvements will include new buildings or large additions for all the exchanges and new apparatus.

COLUMBUS, GA.—The City of Columbus will probably enforce an ordinance requiring the local telephone and electric light companies to place their wires underground.

DRIGGS, IDA.—A telephone line has been completed from here to Victor, and in the near future connection will be made with St. Anthony.

WATSEKA, ILL.—The Watseka Home Telephone Company has been incorporated by J. E. Bundey, J. A. Bundey and H. M. Fiske. The capital stock is $20,000.

LAWRENCEVILLE, ILL.—The Citizens Telephone Company, of Lawrence County, has filed a charter of incorporation. The capital stock is $25,000 and the incorporators are J. K. Dicherson, J. M. Spangler and C. W. Parkinson.

ANDERSON, IND.—The Orestes Telephone Company has been incorporated with a capital stock of $4,000.

INDIANAPOLIS, IND.—Sixteen new telephone companies were incorporated in this State during the month of May.

CONNERSVILLE, IND.—The Connersville Telephone Company has filed articles increasing its capital stock from $50,000 to $100,000.

LOGANSPORT, IND.—The Electrical Investment Company, of Ft. Wayne, which owns a half interest in the Logansport Telephone Exchange, announces an issue of $150,000 5 per cent. bonds to cover extensions and improvements in the Logansport system.

PLAINFIELD, IND.—The Plainfield Telephone Company has increased its capital stock from $25,000 to $100,000. This company and the Danville Telephone Company recently consolidated. Extensions and improvements will be made. Amos Carter is president.

FT. WAYNE, IND.—Financial concerns have been busy with new business propositions calling for investment money. The Home Telephone Company put on the market an issue of $50,000 bonds, 6 per cents, to cover cost of extensions in building a south side exchange and underground cables, and making other improvements to increase the capacity of the system so as to take care of the business offered.

INDIANAPOLIS, IND.—The Central Union Telephone Company will remove its general offices from Chicago to this city within a short time. The company has leased capacious quarters in the Majestic building and will establish therein the headquarters for Indiana, Illinois and Ohio. The company will bring 200 employees and employ an additional number by July 1. The supply department and shops will also be removed to Indianapolis as soon as an available site can be secured. The company has options on several sites now, and the location will be decided on within the next few days. The general officers and their families that will come to Indianapolis are: L. G. Richardson, president; Horace F. Hill, general manager; W. S. Chapman, secretary-treasurer; C. F. Hege, auditor, and J. C. Renney, purchasing agent. The movement is claimed to be for the bringing of the company into closer touch with the people of the three states and the improvement of the service in general.

EVANSVILLE, IND.—The announcement of four councilmen that fellow councilman Culbertson had attempted to bribe them to vote against the repeal ordinance relating to the franchise of the Cumberland Telephone Company which was passed some months ago has created a genuine sensation in this city. The Councilmen under oath testified that each of them were approached by Culbertson who said if they would vote against the ordinance to repeal the franchise there would be $2,000 for each of them; that the money was deposited in the bank. The matter will be taken to the grand jury. Councilman Culbertson says the charge is false in every particular. The attorneys for the Cumberland Telephone Company say that Culbertson acted, if at all, without any authority from the Cumberland Company. City Attorney Funkhouser claims to have had knowledge of the attempted bribery for several months. He withheld his information until the eve of the trial to oust the company.

DEWITT, IA.—The Dewitt Telephone Company has increased its capital stock to $30,000.

CANISTOTA, IA.—The Canistota Telephone Company, with a capital stock of $2,000, is of recent incorporation.

SHENANDOAH, IA.—The Independent Mutual Telephone Company, of this place, has increased its capital stock from $50,000 to $100,000.

OTTUMWA, IA. It is reported that the Bell Telephone Company has appropriated $75,000 for an exchange; for underground work and for other improvements in this city. The work will be carried out this year.

ELLIOT, ME.—The Elliot Telephone Company has been incorporated with a capital stock of $5,000 by George E. Hammond, John L. M. Oaks, E .Edward Bartlett, George O. Athome and Henry I. Durgin.

CITY OF MEXICO, MEXICO.—Pablo Martinez del Rio, representing the Mexican Telephone Company, has applied to the city council for an extension of time in which to put into effect its telephone service in this city.

ANN ARBOR, MICH.—The Washteneau Home Telephone Company has been incorporated with a capital stock of $250,000.

CAMBRIDGE, MICH.—The Cambridge & Woodstock Telephone Company has elected these officers: George Ebbert, president; S. Alderdyce, vice-president, and Clarence Neely secretary-treasurer.

WINDOM, MINN.—The Windom Mutual Telephone Company has been incorporated with a capital stock of $45,000.

MINNEAPOLIS, MINN.—The Twin City Telephone Company is planning to extend its lines into North Dakota and Wisconsin, as well as in Minnesota. This company was incorporated under the laws of Maine with a capital stock of $6,000,000.

HOLLY SPRINGS, MISS.—The Memphis Long Distance Telephone Company has accepted the franchise for a telephone exchange granted by the Council of this place.

HARWOOD, MO.—The Harwood Telephone Company has been incorporated with a capital stock of $50,000, by I. R. Dale, J. P. Davis, J. B. McCrary, T. V. Hayes, G. H. Wilson, Charles Steincross, J E. Underwood, and others.

RIVERTON, NEB.—The Riverton Telephone Company has been incorporated with a capital stock of $2,500.

GRAND ISLAND, NEB.—The Home Telephone Company, of this place, is of recent incorporation, its capital stock being $20,000.

LINCOLN, NEB.—The Western Union Independent Telephone Company has been incorporated with an authorized capital stock of $1,000,000. The company began business last March. The names of the incorporators are Charles J. Bills, A. W. Field and Frank H. Woods.

ALAMAGORDO, NEW MEX. The Alamagordo Telephone Company is constructing a new telephone line from this place to El Paso, Texas. Homer M. Shofield, of Alamagordo, is general manager.

ROCHESTER, N. Y.—The Rochester Telephone Company will issue an additional $100,000 of accumulated preferred stock for the purpose of providing more switchboard capacity, additional telephones, underground cable and equipment.

MIDDLETOWN, N. Y.—The Orange County Telephone Company has awarded a contract to the Stromberg-Carlson Company, of Chicago and Rochester for the installation of a central-energy double supervisory multiple switchboard with an ultimate capacity of 1,600 drops.

YELLOW SPRINGS, OHIO.—The Miami Telephone Company has secured a franchise in this city.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association (Bell) has purcahsed property at the corner of Race and Canal streets and proposes to erect one of the most modern telephone exchanges in the country. It is expected the entire outfit will cost about $500,000.

THOMAS, OKLA.—The Thomas Telephone Company has been incorporated with a capital stock of $10,000, by R. A. Smith, F. T. Crowley, J. E. and Oscar Zimmerman, of Lawson, Mo.; D. L. Kinzer, of Holt, Mo.; Jas. T. Riley, of Liberty, Mo., and O. F. Mitchell, of Thomas.

PHILADELPHIA, PA.—The Keystone Telephone Company's earnings for May show a handsome increase over those for April. The figures compare: May 3, gross, $38,480; increase, $3,664. Net, $18,174; increase $3,796. The Keystone is installing new telephones at the rate of about 500 a month, and by June 30 expects to have 10,000 installed.

DELL RAPIDS, S. D.—The Dell Rapids Farmers' and Merchants' Rural Telephone Company has been incorporated with a capital stock of $15,000. The names of the incorporators are M. R. Kenefick, O. F. Bowles, M. A. Dieson, H. O. Rime, O. O. Sawyer, L. K. Larson and Henry Robertson.

LYONS, TEX.—The Weiss Texas Telephone Company is preparing to build a line to Birch by way of Frenstat.

GONZALES, TEX. The Gonzales Telephone Company is preparing to place its telephone cables underground on several streets of this place.

CHARLOTTESVILLE, VA.—The Albemarle Telephone Company has made arrangements with the Bell Company for long distance service.

RICHMOND, VA.—The Virginia Telephone Company, to operate in Amelia and other counties in Virginia, has been chartered with a capital stock of $10,000. R. H. Bruce is interested.

LEESBURG, VA.—The Leesburg & Point of Rocks Telephone & Telegraph Company has completed arrangements to connect its system with that of the Maryland Telephone & Telegraph Company.

LEVELS, W. VA. The Levels Telephone Company has been incorporated to build a line from Southbranch to Romney via Levels. The capital stock of the company is $5,000. The incorporators are W. H. Harmon, D. M. Dickend, H. Rounells, Ed. Johnson and M. L. Snyder.

ELECTRIC LIGHT AND POWER.

CLAYTON, ALA.—Bids will be received until June 15 for $6,000 municipal electric light and water works bonds. J. J. Winn, Jr., is City Clerk.

GENEVA, ALA.—The town is about to petition the Legislature for permission to construct water works and an electric light plant.

MONTGOMERY, ALA.—It is stated that Alex. Rice and associates will construct an electric light plant, to supply commercial lights in the business district.

SALINAS, CAL.—The Salinas Water, Light & Power Company has 50 arc lights and 1,200 incandescents. Philo Jones is superintendent.

SANTA PAULA, CAL.—The Santa Paula Electric Company was organized in 1902 with $22,000 capital. C. C. Teague is secretary. It operates a General Electric system with 2,000 16-cp incandescent lights.

BENICIA, CAL.—The Solano Electric Light & Gas Company buys its power from the Bay Counties Power Company. It supplies 20 arcs and 3,000 16-cp incandescent lights, and power for five motors at ten cents per kw-hour.

GORE CANON, COLO.—The New Century Light & Power Company, formed in 1903, has $4,000,000 capital. R. G. Munn is president; R. L. Harper, secretary and treasurer. It is just beginning business.

SOUTH NORWALK, CONN.—The municipal plant here furnishes 106 street arcs and 20 others; 5,000 incandescent lights, 200-hp for motors at five cents per kw-hour and charges automobiles. This place offers splendid inducements for electrical industries, as there is cheap power, fine transportation, etc.

SOUTH NORWALK, CONN.—The contract for constructing an electric light plant here has been awarded to Bellman & Sanford, New York City, for $13,070. The works are now in the market for 110 series enclosed arc lamps for direct current street lighting, 5 amp., 70 to 75-volt; they also have for sale a complete arc dynamo-engine unit of 1,100-hp, two 60-light arc dynamos and 100 open arc series lamps.

DOUGLAS, GA.—The Douglas Ice & Power Company will install an electric light plant.

SPARKS, GA.—R. A. Knights, of Adel, Ga., contemplates installing an electric light plant at this place.

ATHENS, GA.—The Athens Electric Railway Company, capital $75,000, operates 47 arc lights and 7,000 incandescents.

WASHINGTON, GA.—This place has a municipal electric light plant. The city engineer, Mr. T. Ludlow, informs us that he holds options on water power suitable for electrical transmission and would like to hear from interested parties.

CALDWELL, IDA.—The Caldwell Power Company, formed in 1902, has about 1,200 incandescent lights.

BLOOMINGTON, ILL.—The Bloomington & Normal Railway Electric & Heating Company operates 150 arc lights and 6,000 16-cp incandescents.

GALVA, ILL.—The Chairman of the Lighting Commissioners has been instructed to correspond with electrical engineers in regard to preparing plans and specifications and superintending the construction of an electric light plant.

TAYLORVILLE, ILL.—The Taylorville Gas & Electric Company, of Taylorville, has been incorporated with a capital of $85,000. Incorporators: D. D. Shumway and Thos. R. Johns.

BREMEN, IND.—This town has a municipal plant supplying 25 arcs and 2,100 incandescent lights.

BLUFFTON, IND.—Robert S. Ashe, of Richmond, has secured the contract for the construction of an arc and incandescent lighting system for $31,748.

ROYAL CENTRE, IND.—The Royal Electric Light Company was organized in 1901 with $10,000 capital. W. G. Sweet is president. It operates 12 miles of circuit with 15 arcs and 600 16-cp incandescents.

WAUKON, IA.—The Waukon Electric Light Company has four arc lamps and 1,300 incandescents.

NEW ORLEANS, LA.—Bids will be received by V. Tajague, City Comptroller, for the construction of an electric lighting and power system for the city.

ORANGE, MASS.—The Orange Electric Light Company has 51 1,200-cp arc lights and 3,000 16-cp incandescents.

NEWTON, MASS.—The Newton & Watertown Gas Light Company has been bought by the Edison Illuminating Company of Boston. It operates 220 arc lights, 1,042 incandescents, 9 motors at 18 cents per kw-hour and charges automobiles.

NORWAY, MICH.—The City Lighting Department supplies 70 arc lamps of 1,500-cp and 3,500 incandescents of various candle powers.

GRAND RAPIDS, MICH.—The Edison Electric Company has, it is reported, been granted permission to construct a dam across Flat River in Vergennes Township.

CALEDONIA, MINN.—Bids will be received by Jerry Kenny, Village Recorder, for furnishing the following machinery, etc.: for an electric light plant: a 125-hp engine; 2 boilers, 80-hp each, and 2 dynamos, 400-kw each.

ST. CHARLES, MINN.—The citizens have voted to issue $10,000 bonds for an electric light plant.

CANTON, MISS.—The Canton Light & Water Works supplies 38 arc lights and 3,500 incandescents.

BUTTE, MONT.—The Phœnix Electric Company operates 150 arcs and 5,000 incandescent lights, with small motors of about 100-hp at 12½ cents per kw-hour.

BOZEMAN, MONT.—It is stated that bids are now being received for constructing an electric light plant for the People's Electric Light & Power Company, to be located at Gallatin Valley. The plant is to be operated by water power, and is to have a capacity of 75 arc and 3,000 16-cp incandescents. The estimated cost is $75,000. Address G. L. Hogan for further particulars.

LIBERTY, MO.—The Liberty Electric Light Company operates 28 2,000-cp arc lights and 1,400 16-cp incandescents.

MEMPHIS, MO.—The Memphis Electric Light, Heat & Power Company has been incorporated. The capital stock is $10,000. The incorporators are A. F. Platter, Elias Scofield, F. Brainard, Geo. W. Shacklett, W. B. McLane and others.

HEBRON, NEB.—The Hebron Light, Power & Heating Company has been incorporated with a capital of $12,000, by C. M. Wetherald, C. L. Richards and others.

WOODSVILLE, N. H.—The Woodsville Aqueduct Company has 2,000 incandescent lights.

BERLIN, N. H.—The Cascade Electric Light & Power Company has been making additions to its plant, and is running six electric cars on a flat rate basis.

DOVER, N. H.—The United Gas & Electric Company operates 600 arc and 20,000 incandescent lights and 300-hp in motors. It runs the Dover, Somersworth and Rochester Street Railway. A new station is being constructed with two 500-kw General Electric three-phase generators direct connected to a steam turbine. It will furnish power for the Dover, South Berwick & York Beach Railway.

YARDVILLE, N. J.—The Yardville Electric Light, Heat & Power Company is making arrangements to extend its system through Groveville.

ATLANTIC HIGHLANDS, N. J.—This place has a municipal plant which furnishes seventy-five 2,000-cp arc lights and 4,500 incandescents. Automobiles are also charged. There is great need of an electric railway.

HIGHLAND FALLS, N. Y.—The Buttermilk Falls Electric Company supplies 1,200 incandescent lights.

ITHACA, N. Y.—The Brush-Swan Electric Light Company, owned and operated by the Ithaca Street Railway Company, has 150 2,000-cp arc lights and 13,000 16-cp incandescents.

HUNTINGTON, N. Y.—The Light & Power Company was formed November, 1902, with $75,000 capital. R. de Forest is president and F. P. Willets, superintendent. The circuit will cover about 30 miles, but business has not been commenced yet.

CHATEAUGAY, N. Y.—The Chasm Power Company formed in 1892 has $20,000 stock and $2,000 bonds. C. S. Bentley, is president, W. B. Ryan, vice-president; A. B. Cooney, secretary, and H. S. Duffy, treasurer. The company expects to start lighting service this summer.

ROCHESTER, N. Y.—The following contracts have been awarded for electric work in the Rochester State Hospital. Engines, generators, etc., to the Fred. Fish Company, Rochester, for $5,466, to include Watertown engines and Thompson-Ryan dynamos; switchboard, electric light wiring and fixtures to F. L. Frost, of Albany, $8,775, and telephone and watchman's clock systems, to McDonnell & Dumond, Rochester, at $1,292.

BISCOE, N. C.—The Biscoe electric light plant is owned and managed by R. L. Chandler. It has 200 16-cp incandescent lights.

HICKORY, N. C.—The Thornton Light & Power Company, organized in 1903, has $50,000 capital stock. M. E. Thornton, president and manager, informs us that he is the owner of good water power and is largely increasing his incandescent circuit. He operates 19 arcs of 3,000-cp and 384 16-13-32-cp incandescent lights.

WELLSTON, OHIO.—This place has a municipal plant operating 100 arc lights and 4,000 incandescents.

STRASBURG, OHIO.—The Strasburg Electric Company operates 10 arcs and 500 incandescent lights.

FT. RECOVERY, OHIO.—The Municipal Light & Water Works has 28 arc and about 500 incandescent lights.

BELLAIRE, OHIO.—The Bellaire Light & Power Company supplies 150 arcs and 8,000 incandescent lights.

BARNESVILLE, OHIO.—The Gas & Electric Light Company has about 34 arc lights and 78 50-cp street incandescents.

NEW BREMEN, OHIO.—The village authorities are planning to purchase the local lighting system now owned by private parties.

JEFFERSON, OHIO.—The Jefferson Light & Power Company operates 2,000 incandescent lights. The company's office is at Warren, Ohio.

BLOOMDALE, OHIO.—The Bloomdale Electric Light Company operates 10 arc and 700 incandescent lights. It wants a 50 to 60-hp engine.

NORTH BALTIMORE, OHIO.—The North Baltimore Electric Light & Power Company has 20 miles of circuit, 75 arcs and 2,700 incandescent lights.

BELLEVUE, OHIO.—The Bellevue Light & Power Company shows an increase in electric lighting, having now 30 200-cp arc lights and 3,000 incandescents.

AKRON, OHIO.—City officials are considering installing a lighting plant in the new City Hall. F. F. Loomis, mechanical engineer for the city, will design the plant.

CHILLICOTHE, OHIO.—Mr. J. S. Dailey is the proprietor of the Electric Light & Water Works, established in 1891. He operates 92 electric light contracts and 279 telephones.

LISBON, OHIO.—The New Lisbon Gas Company supplies fifty 1,200-cp and fifteen 2,000-cp arc lights and 800 incandescents. An electric railway across the country is badly needed.

DELPHOS, OHIO.—The Delphos Electric Light & Power Company has just completed the reconstruction of its plant. It supplies 75 street enclosed arcs and 5,000 incandescent lights.

MARTIN'S FERRY, OHIO.—The municipal electric light plant operates 110 2,000-cp open arcs, but contemplates adopting enclosed arcs. There are also 3,500 16-cp incandescents.

ADA, OHIO.—The Ada Water, Heat & Light Company, formed in 1901 with $75,000 capital, has 12 miles of circuit and 60 arc lights. C. S. Ames is president. There is an opportunity for an interurban railway.

XENIA, OHIO.—The People's Gas & Electric Light Company was organized in 1902 with $175,000 capital. J. H. Brown is president. It has 147 arc lights, 5,000 incandescents and 30 motors at five cents to ten cents per kw-hour.

ALLIANCE, OHIO.—The Alliance Gas & Electric Company has made great improvements in its plant this year, having put in General Electric machines and Hartford transformers, giving a first-class system. There are 125 arcs and 5,000 incandescents, besides a few small motors.

FINDLAY, OHIO.—J. M. Barr, of Findlay, and W. V. Coons, of Cleveland, are organizing a company for the purpose of securing the local lighting contract and erecting a lighting system. The present contract is held by the Toledo, Bowling Green & Southern Traction Company.

McCONNELLSVILLE, OHIO.—The McConnellsville-Malta Electric Company derives its power from a dam in the river. The normal head is 10 feet, but at times it is reduced to three, hence the necessity for engine and greater turbine power. It operates 52 street arcs and 900 incandsecent lights.

COLUMBUS, OHIO.—The Columbus municipal electric light plant installed in 1898, has $68,000 bonds. It has 50 miles of wire and operates 320 arc lights. It is now installing a plant with 1,500 alternating enclosed arcs, the station being operated by Westinghouse turbines. P. Okey is superintendent.

WARREN, OHIO.—The Warren Electric Light & Power Company furnishes 238 arcs of various kinds and 6,000 incandescent lights and power for 40 motors. The rates for power by meter on the 500-volt circuit are as follows: Less than 200-kw per month four cents per kilowatt; more than 200-kw and less than 375-kw, 3¾ cents per kilowatt; more than 375-kw and less than 750-kw, 3½ cents per kilowatt; more than 750-kw and less than 1,865-kw, 3 cents per kilowatt; more than 1,865-kw per month, 2¾ cents per kilowatt.

PUT-IN-BAY, OHIO.—Russel K. Ramsey, of Sandusky, is stated to have secured a franchise for the construction of an electric light plant for Put-in-Bay.

GUTHRIE, OKLA.—The New Electric & Gas Light Company has $50,000 capital stock. E. Cook is president. It operates 50 arc lights and 3,706 16-cp incandescents, also electric fans at flat rates.

SUMPTER, ORE.—The Sumpter Light & Power Company has 20 arc lamps and 1,800 incandescents.

EUGENE, ORE.—The Lane County Electric Company has sold out to a large company, which is now putting in a transmission plant and perfecting the plant.

SUMPTER, ORE.—It is reported that all the plans of the Great Eastern Power & Light Company have been completed, and that preliminary work will commence immediately. The first electrical plant to be installed will be on John Day River, at the head of John Day Valley, and will generate 6,000-hp, which will be utilized immediately. The company has water power rights capable of generating 23,000-hp. To utilize this power will involve the erection of plants at three separate points.

TROY, PA.—The Troy electric light plant is not now in operation, but a new one is in contemplation.

LYKENS, PA.—The Williams Valley Light & Power Company operates three arcs and 3,900 incandescent lights.

AVOCA, PA.—The Standard Electric Light Company operates 177 enclosed arcs and 6,000 incandescents. General supplies are needed.

ST. CLAIR, PA.—This is a municipal plant under the management of J. W. Reese. It operates 58 arcs and 2,579 incandescent lights.

JERMYN, PA.—It is proposed to construct an electric light plant here to cost from $12,000 to $15,000. C. F. Baker and C. A. Battenberg are interested.

MASONTOWN, PA.—It is proposed to construct an electric light plant here to cost from $12,000 to $15,000. C. F. Baker and C. A. Battenberg are interested.

MOUNT HOLLY SPRINGS, PA.—The Mount Holly Paper Company has two electric light plants in its mills and furnishes free light for the town, churches and public library.

DANVILLE, PA.—The Standard Electric Light Company shows quite an increase in the number of lights, having 120 2,000-cp. arc lights and 1400 incandescents.

WEST CHESTER, PA.—The Edison Electric Illuminating Company operates 250 enclosed arcs, 7,000 16-cp incandescent lights, and 30 motors at three to eight cents per kw-hour. It also runs four cars.

HARRISBURG, PA.—The Harrisburg Light, Heat & Power Company has secured the contract for lighting the city for five years at $47 per 2,000-cp arc light per year. The Paxtang Electric Company bid $49.50 a year for five-year contract, and the United Electric Company $64 per year for five years.

ABERDEEN, S. D.—The Aberdeen Gas Company runs an arc circuit and supplies 19 lamps.

MADISON, S. D.—Mr. Rae, of the municipal light plants, informs us that they are asking for bids on a 125-hp boiler, 125-hp engine direct connected to a 110-kw machine of same size.

DEADWOOD, S. D.—The Cascade Water Power & Electric Transmission Company owns claims along the Spearfish River for which about 4,500-hp will be developed at no distant date. Mr. R. N. Ogden is the president.

COVINGTON, TENN.—The corporation purchased the electric light plant this year from Mr. J. Craig. It supplies 1,600 incandescent lights.

SPRINGFIELD, TENN.—The Ice, Light & Laundry Company supplies 15 arc and 500 incandescent lights. There is some question of the municipality erecting a plant of its own.

CHATTANOOGA, TENN.—Samuel Jenkins, of Chattanooga, is reported organizing a company, with a capital of $500,000, to build an electric power plant for operating street railway, lighting the city and furnishing manufacturing enterprises with power, etc.

MADISONVILLE, TEX.—A. S. & H. J. Allen will soon begin the construction of an electric light plant at this place.

MT. PLEASANT, TEX.—Mt. Pleasant Electric Company, organized in 1903 with $10,000 capital, has 9 arc and 900 incandescent lights.

CLEBURNE, TEX.—The Cleburne Light & Power Company runs motors, the charges for which are from 15 cents to 8 cents per kw-hour. A gas plant is to be installed.

NACOGDOCHES, TEX.—The Nacogdoches Light & Power Company, organized in 1902, is just about putting in a new boiler. It operates 1,250 incandescent lights, also about 100 fans.

EAGLE PASS, TEX.—The Texas-Mexican Electric Light & Power Company. P. De Bona, president, would like to receive bids on one 37½-kw 16,000 alternations, 1,040 volt alternator and one 75 and one 100-kw, 16,000 alternations, 1,040 volts.

HOUSTON, TEX.—The Houston Lighting & Power Company, organized in 1902, has $750,000 capital and $750,000 bonds. W. H. Chapman is general manager. The city is supplied with 433 street and 400 commercial arcs, and there are 16,000 incandescent lights. The rates for motor power are 6 cents per kw-hour up to 20-hp and 5 cents per kw-hour over 20-hp.

PAYSON, UTAH.—The electric light plant (municipal) requires one 100-kw 5,000 volt 60-cycle exciter and switchboard complete; also 150-hp Corliss engine and boilers all complete.

WARRENTON, VA.—The Warrenton Electric Company, organized in 1901 with $25,000 capital, has 28 arc lamps and 800 incandescents. We are informed that there is an opening for an electric light and power plant at Culpepper on the main line of the Southern R. R.

TEKOA, WASH.—The Mahoney Electric & Plumbing Company, Mahoney Bros., proprietors, operates 15 arc and 650 incandescent lights. The company is in need of transformers.

OLYMPIA, WASH.—The Olympia Light & Power Company has $165,000 capital, operates 50 arc lights, 300 incandescents, about 15 motors, at from two cents to seven cents, and a few street cars.

BALLARD, WASH.—The Ballard Electric Company just organized, has $150,000 capital stock and $50,000 bonds. W. G. Clark is president. It has 1,000 16-cp incandescent lights and expects to increase its capacity within the year.

ANACORTES, WASH.—The Anacortes Water Company, formed in 1892, was re-organized in 1901, when an electric plant was added. The capital stock is $100,000. Douglass Allmond is president. There are 12 arcs and 14 incandescent lights.

TACOMA, WASH.—The Syndicate Heat & Power Company is owned by five owners of five office buildings for furnishing light, heat and elevator service. There is a good opening for another car line with plenty of water power for a generating plant.

WHEELING, W. VA.—The Wheeling Electric Company operates 259 arc and 21,000 incandescent lights.

WELCH, W. VA.—The Welch Water, Light & Power Company proposes during the coming summer to double the capacity of its electric light plant by the addition of new boilers, engines and generators. The company will issue about $25,000 bonds to cover the above and other improvements. D. J. Howell is manager and treasurer, 605 12th St., N. W., Washington, D. C.

CASHTON, WIS.—The Cashton Milling Company has two arc and 700 incandescent lights.

WAUPUN, WIS.—The municipal plant furnishes forty-six 1,200-cp arc lights and 3,500 16-cp incandescents.

PRINCETON, WIS.—The Citizens' Electric Light & Power Company has $7,500 capital and supplies 20 arc lights and 1,000 incandescents.

GRANTSBURG, WIS.—Bids are now being received for erecting a village electric light plant, cost not to exceed $8,000. Oscar Clausen, St. Paul, Minn., is engineer.

WAUKESHA, WIS.—The Waukesha Gas & Electric Company, of Waukesha, has been incorporated, capital $100,000. Incorporators: T. W. Haight, H. M. Buck and F. H. Putney.

WAUPACA, WIS.—The Waupaca Light & Railway Company is just putting in new rope transmission at a cost of $1,800. Besides running several cars it supplies forty-seven 2,000-cp arcs and 1,500 incandescent lights. I. P. Lord is manager.

SUPERIOR, WIS.—The Great Northern Railway Company has completed its electric lighting plant at Allouez, and the immense ore docks are now lighted at night with 130 arc lamps. The new plant has a capacity for about 200 lamps. The new system cost about $35,000.

ROCK SPRINGS, WYO.—The plant of the Union Pacific Coal Company, of Omaha, Neb., is situated at this place. It operates a General Electric system and has twenty-seven arc and 2,000 incandescent lights .

ENCAMPMENT, WYO.—The Emerson Electric Light Company, T. C. Dobbins, superintendent, uses the General Electric system and furnishes fifteen 2,000-cp aro lights, 650 incandescents, and operates fourteen electric motors.

SARATOGA, WYO.—The Saratoga Light, Heat & Power Company was incorporated in 1902 with $25,000 capital. It employs a General Electric alternating system, has 7 arcs and 700 16-cp incandescent lights. W. J. Barker is general manager.

THE ELECTRIC RAILWAY.

MOBILE, ALA.—The Mobile Light & Railroad Company is running 75 motor cars and 25 trailers.

MARTINEZ, CAL.—An application has been filed by Robert N. Fick for an electric railway franchise to the top of Mt. Diablo. The proposed line is to pass through various towns between Martinez and Mt. Diablo.

LOS ANGELES, CAL.—The Los Angeles & Glendale Electric Railway Company has been incorporated, with a capital stock of $1,000,000. The directors are R. H. Howell, E. T. Simpson, W. H. Holliday, George I. Cope and L. C. Brand.

WINDSOR, CONN.—The Rockville, Broad Brook & East Windsor Street Railway Company has organized as follows: Frank Grant, of Rockville, president; H. C. Wells, of East Windsor, vice-president; C. F. Harwood, of Rockville, secretary and treasurer. This company is capitalized at $100,000.

WALLINGFORD, CONN.—The Wallingford Tramway Company, which was recently incorporated to build a street railway between this city and New Haven, has begun surveys. The road will connect with the Wallingford terminus of the Meriden Electric Company's system, and will run to Montowese, where it will join the Fairhaven & Westville Railroad Company's lines. The road will be the connecting link of a continuous electric railway between Boston and New York, about 8 miles of line are to be built, and six double truck cars are to be operated. A power station is to be built, and a feature of its equipment will be two steam turbines. Two 500-kw generators and three 300-hp water tube boilers will also make up part of the station equipment.

BELLEVILLE, ILL.—The Illinois Transit Company has filed a certificate of incorporation. The capital is $1,000,000. The incorporators are Charles E. Thomas, B. H. Portuondo, Charles W. Thomas, Lilburn G. McNair and Fletcher R. Harris.

BELLEVILLE, ILL.—The Belleville & Smithton Electric Railway Company has filed certificate of incorporation. The capital is $300,000 and the incorporators are G. G. Bock, Charles E. Thomas, Fred L. Geissler, G. A. Koerner, Jr., and Lilburn G. McNair.

SHELBYVILLE, ILL.—Articles of incorporation of the Rock Island, Keithsburg & Southern Railway Company have been filed. The incorporators and members of the first board of directors are Hal. B. Allen, Van S. Allen and Charles F. Lathe, of Erie; Howard N. Ogden and John O. Allen, of Chicago. The capital stock is $25,000.

INDIANAPOLIS, IND.—Interests identified with the Indianapolis & Martinsville Traction Company plan to build an electric railway from Martinsville to Bloomington, a distance of 23 miles.

INDIANAPOLIS, IND.—George F. McCulloch, president of the Union Traction Company, has verified the report of the purchase by Union Traction interests of the two interurban lines connecting Peru and Wabash, and Peru and Logansport. Mr. McCulloch refused to state the consideration, but it is understood to be $800,000.

INDIANAPOLIS, IND.—The Indianapolis, Shelbyville & Southeastern Interurban Company has passed to the ownership and control of R. C. Light and Fletcher Hines, Indianapolis capitalists. The road cost the two men nearly $600,000. The company has reorganized and the following directors chosen: R. C. Light, Fletcher Hines, M. B. Wilson, Howard Cole and M. B. Dawson. Mr. Light is president and Mr. Dawson, secretary. The new officials say the new company will carry out the plans of the old and extend the line to Cincinnati, by way of Greensburg.

IOLA, KAN.—The Southern Kansas Electric Railway Company has been chartered under the laws of New Jersey to build an electric railway between Iola and Pittsburg. The capital stock is $325,000, and the officers are F. M. Hyde, president; Charles B. Ebert, vice-president; L. L. Northrup, treasurer; E. S. Slough, attorney; L. P. Stover, engineer.

OWENSBORO, KY.—It is stated that the proposed electric railway between Owensboro and Hartford has been financed. The road will be fifty-three miles long, and will run from Owensboro to Hartford. The power house will be located at Curdsville, 13 miles from Owensboro. Both passenger and freight trains will be operated. E. Rice, of Louisville, and Wade Cushing, of Cincinnati, are interested.

PASCAGOULA, MISS.—The Pascagoula Railroad & Power Company has been organized at Louisville, Ky., with a capital stock of $400,000. The company will build an interurban electric railway in Mississippi and control the utilities of Pascagoula, Scranton, East Side and Moss Point. Electric light and power plants, water works and ice factories are included. The officers are Charles T. Ballard, president; L. S. Anderson, of Moss Point, Miss., vice-president; V. Spratt Bridges, secretary; the Columbia Finance & Trust Company, of Louisville, treasurer; S. S. Boyd, general manager.

KANSAS CITY, MO.—It is said that the Topeka, Lawrence and Kansas City Electric Railway Company, of which T. S. Salathiel is president, has been financed and that the contract for building the road has been let. The company was organized Nov. 8, 1901.

JEFFERSON CITY, MO.—Articles of incorporation have been issued to the St. Louis & St. Paul Railroad Company of Kansas City. The company is capitalized at $1,000,000, and proposes to build a railway 100 miles in length. Among the incorporators are Samuel F. Scott, Thomas S. Ridge, W. C. Picking, R. D. Kathrens and A. C. Kinneard. The St. Joseph, Parkville and Kansas City Railway was also chartered. Capital $5,000,000. The incorporators are L. W. Prior, Geo. W. York, Joseph R. Nutt, of Cleveland, Ohio; M. A. Devitt and A. W. Howard, of Chicago; John J. Tootle, C. F. Enright, R. M. Davis and A. B. Weakley, of St. Joseph; J. L. Brown, of Kansas City; E. B. Snider, of Leavenworth, and H. B. McAfee, of Parkville, Mo.

WASHINGTON, N. J.—The Easton & Washington Traction Company has filed articles in the office of the Secretary of State at Trenton, increasing the capital stock of the company from $100,000 to $1,250,000. The company will build an electric railway from Easton to Hackettstown and from Belvidere to Clinton, a system 40 miles long, with Washington as the center. The officers of the company are Robert M. Petty, of Washington, president; W. O. Hay, of Easton, Pa., secretary; R. M. Eilenberger, of Washington, treasurer.

ROME, N. Y.—The Utica & Mohawk Valley Railroad, which has purchased the Rome City Street Railway, will begin at once to equip it with electricity, making it a part of the system which the Utica & Mohawk Company operates throughout Central New York. The Rome road has been operated by compressed air.

NEW YORK, N. Y.—The plans of the New York Central Railroad for the change of motive power in the Park Avenue tunnel from steam to electricity, the addition of ten stories to the present Grand Central Station, the construction of an annex and the other improvements to the Forty-second Street terminal have been completed. These plans will be submitted to the Board of Estimate, and when the city's approval is secured work will be undertaken at once.

NEW YORK, N. Y.—The last obstacle in the way of beginning work on the Pennsylvania's great underground terminal project in this city has been removed. The Appellate Division of the Supreme Court has announced a decision confirming the finding of the commissioners appointed to report whether the tunnel across Manhattan Island under and between Thirty-second Street and Thirty-third Street ought to be constructed and operated. The commissioners had reported that the tunnel railroad as planned ought to be constructed and operated, and the decision winds up the court proceedings. The Board of Aldermen has approved the enterprise, and it is understood the work may now begin.

NEW LEXINGTON, OHIO.—The Perry County Electric Railway & Light Company has been incorporated with a capital of $10,000 by M. H. Donahue, A. Bringardner, C. A. Donahue, William E. Fink and W. S. Bartlet.

COLUMBUS, OHIO.—The Youngstown & Salem Railroad Company and the Youngstown & Southern Railway Company have been incorporated by Ashabel W. Jones, R. L. Andrews, John H. Ruhlman, Jonah R. Long, W. S. Anderson and Jasper W. Long. The former has $300,000 and the latter $1,500,000 capital stock. The latter is to run from Youngstown to East Liverpool and the former makes a connection near Leetonia and runs to Salem. Both are to be electric lines.

PITTSTON, PA.—The Wilkesbarre-Wyoming Valley Traction Company is contemplating the erection of a large power house in this city.

PHILADELPHIA, PA.—It is stated that the American Railways Company has purchased the entire capital stock and all the bonds of the Tyrone Electric Railway and the Tyrone Electric Light & Heat Company, of Tyrone, Pa.

PHILADELPHIA, PA.—President James D. Callery of the Pittsburg Railways Company and other capitalists associated with the Widener-Elkins syndicate are interested in a new company which will shortly be incorporated with $100,000 capital to build a through trolley road between Pittsburg and St. Louis.

GREENVILLE, PA.—The Borough Council has granted a street railway franchise to Congressman Ernest Acheson and Hon. J. V. Clark, of Washington, Pa., and W. I. Berryman and J. W. Taylor, of Pittsburg, who recently purchased the plant of the Greenville Water Company. The road is to be called the Greenville & Westside Street Railway.

HARRISBURG, PA.—At the meeting of the directors of the Harrisburg Traction Company to consider the reorganization plan adopted at the recent special stockholders' meeting, it was decided to call the new corporation the Central Pennsylvania Traction Company. An application for a charter will be made. The capital stock of the new corporation will be $2,100,000, and it will take over the lines of the Harrisburg Traction Company July 1, 1903. The officials and directors of the present company will continue in the same capacity with the new company.

PITTSBURG, PA.—The Pittsburg Railways Company has its new sub-power station at Coraopolis in operation. The station contains one 400-kw. rotary converter and a storage battery equipment of about the same capacity. It will be used to supply power for the Coraopolis division. The new power house of the Pittsburg, McKeesport & Connellsville Railway Company, near the latter named place, is now in operation. The equipment includes six 1,500-kw Westinghouse generators operated by three Westinghouse steam turbines and three Allis-Chalmers engines. This plant will supply the power for the entire system. It cost approximately $1,000,000.

TIVERTON, R. I.—The Legislature has passed an act incorporating the Tiverton & Sakonnet Beach Railway Company, in Tiverton and Little Compton, R. I. The capital stock is fixed at $200,000. Among those interested in the company are William H. Briggs, Abel B. Simmons, Clarence C. Wordwell, Charles R. Wilbur and F. F. Grinnell.

SALT LAKE CITY, UTAH.—Plans are being laid for the construction of an electric railway system between this city and Ogden, a distance of 35 miles. The project is being pushed by Mr. Simon Bamberger, a wealthy business man of Salt Lake.

CHARLESTON, W. VA.—The Luke, Westport & Keyser Electric Railway Company, of Keyser, has been incorporated, with a capital of $5,000. Incorporators: Max Wineland, Robert Amau, Frostburg, Md.; Hugh Scott, Macuny, Md., and John Mackle, Westernport, Md.

FAIRMONT, W. VA.—The Fairmont & Clarksburg Traction Company, of Fairmont, is to construct an electric railway from Burnsville to Clarksburg. The capital is $2,000,000, and the incorporators are S. L. Watson, L. L. Malone, C. Powell, Walton Miller, M. L. Hutchinson, of Fairmont.

NEW INDUSTRIAL COMPANIES.

THE NEW YORK AUTO-CAR COMPANY, of New York, has been incorporated, capital $30,000. Directors: Bernard Uhren, John Lurie and J. J. Head, New York.

THE LEE ELECTRIC INSOLE COMPANY, of Jersey City, has been incorporated with a capital of $100,000. Incorporators: Frederick S. Van Vleck, Charles M. Coburn and Frank B. Lee.

THE ELECTRIC CHAIR COMPANY has been incorporated at St. Louis with a capital stock of $75,000 all paid up. The stockholders are Semple S. Scott, Gustavus A. Brecht, Edward A. Faust, Henry Koehler, Jr., Joseph S. Dobyns and Charles Erd.

THE CINCINNATI CONSTRUCTION COMPANY, Cincinnati, Ohio, has been incorporated with $10,000 capital, by W. P. Deppe, Willard Stone, C. H. Deppe and C. C. Clark. It will construct steam and electric railways and engage in mechanical engineering.

MESSRS. BARTZ, WYANT & BROWN have incorporated at Hornellsville, N. Y., to manufacture and deal in electric motors and appliances. The capital is $60,000. The directors are Frank Bartz, Frederick A. Wygant and Alfred E. Brown, of Hornellsville.

THE VIDEX AUTOMOBILE COMPANY has been incorporated in New Jersey, to make and sell steam, electric and gasoline automobiles. The allowed capital is $1,000,000. Incorporators: Charles A. Greene, James B. Richardson and Gerald A. Griffen.

THE IDEAL ELECTRIC MANUFACTURING COMPANY, Mansfield, Ohio, capital stock, $50,000, has been organized to make electrical supplies and novelties. C. H. Voegele, John Krause, J. F. Stone, M. L. Branyon, S. E. Huenerfauth and others are interested. The company will erect a factory.

THE MATHIS BROS. COMPANY has been incorporated at Indianapolis, Ind., to manufacture ventilating apparatus and all kinds of electrical and mechanical devices. The capital stock is $130,000. The company's plant will be located at Hammond. The directors are Julien W. August, George Mathias and Andrew Swickel.

THE MUSIC DUPLEX TYPEWRITING WIRELESS TELEGRAPH COMPANY, of Portland, Me., has been incorporated to make and deal in telegraph and telephone instruments. The capital stock is $1,000,000, of which nothing is paid in. The officers are: President, J. T. Fagan; treasurer, G. F. Gould, both of Portland, Me.

THE HEAWATH ELECTRIC COMPANY, of Detroit, Mich., has been incorporated with a capital stock of $60,000. The company will make incandescent lamps and handle other electrical specialties. It is now negotiating for a site for its plant. The names of the incorporators are Hoyt Post, S. C. Mumford, Lucien S. Moore, W. S. Reynolds and others.

GOULD STORAGE INTERESTS.—The Gould Coupler Company and Gould Storage Battery Company have been incorporated with the New York Secretary of State, each capitalized at $5,000,000. The companies are to take over the business of the Gould Storage Battery Company and the Gould Coupler Company, West Virginia corporations. The directors are Charles A. Gould, Charles M. Gould, William S. Gould and Frederick P. Hawley, of New York City.

LEGAL.

STORAGE BATTERIES.—In the suit of the Hopedale Electric Company against the Electric Storage Battery Company of Philadelphia, for $750,000 and patent rights, the New York Supreme Court has decided that the Storage Battery Company not only owns the Hopedale system and the patents covering it, but rejects the Hopedale Company's claim of $750,000.

THOWLESS VS. NERNST INTERFERENCE.—The United States Patent Office, through Commissioner of Patents Allen, has confirmed the decision of the examiners-in-chief, awarding priority of invention to Nernst over Thowless. In this decision considerable doubt and discredit is thrown upon the evidence put forward by Thowless to show that he anticipated Nernst in the principle of the practical glower lamp. In addition "Even if it is conceded that Thowless did this in 1896, it must be regarded as an abandoned experiment. The evidence indicates that it was not regarded as a successful demonstration of the practicability of the invention. The lamps are said to have burned from 10 to 20 minutes; but when in 1900 Thowless attempted to repeat these experiments to show how they occurred, most of his tests were total failures. . . . Even if the early abandoned experiments by Thowless be regarded as showing a conception of the invention, the decision must be against him, because of his lack of diligence." The action was on the Nernst Patent No. 623,811 of April 25, 1899, and was conducted by Mr. H. C. Messimer for Thowless and by Mr. Charles A. Terry for Nernst.

NEW YORK INDEPENDENT TELEPHONE.—The Independent Telephone Company has obtained from New York Supreme Court Justice Clark a writ, returnable before him in a few days directing Commissioner Monroe of the Department of Water Supply, Gas and Electricity, to show cause why a peremptory mandamus should not issue compelling him to grant to the company the permit to open the streets. The company was organized and incorporated in 1899, with a capital of $100,000, with the privilege of increasing it to $20,000,000. It proposes to install 100,000 telephones in Manhattan, to run a line over Long Island to Montauk Point, and north in the State to Rouses' Point, besides in the various boroughs comprising Greater New York. It proposes also to pay the city $1 for each telephone installed. The necessary franchise the officers of the company say they have, having obtained it under Articles 5 of the New York State transportation laws. When, however, they applied to Commissioner Monroe for the necessary permit he refused it, on the ground that the new city charter had repealed the law and vested the granting of franchises in the Board of Aldermen. This is denied by the company, which maintains that its franchise gives it the power to put in its poles and wires, subject only to a permit from Commissioner Monroe which requires the ordinary precautions in such work. The officers of the company state that they had the utmost confidence in Commissioner Monroe and knew his attitude to be sincere, but that they feared in other ways efforts were being exerted to balk them in securing their permit, and that they had for that reason applied to the Supreme Court. Among some of the promises of the company are these: Single calls, 5 cents; an unlimited service in the Borough of Manhattan for $125 a year; 600 calls for $45; 800 calls for $55; 1,000 calls for $60. In the Borough of Brooklyn it intends, according to its promise, to give unlimited service for $75.

EDUCATIONAL.

WORCESTER POLYTECHNIC INSTITUTE.—The annual commencement lecture before the Washburn Engineering Society of the Worcester Polytechnic Institute, was delivered this year by Professor Harold B. Smith, of the electrical engineering department of the Institute on the evening of June 9. The lecture was given in the electrical engineering lecture room of the Salisbury laboratories at 8 o'clock, and was illustrated by about one hundred lantern slides and an experimental demonstration of high potential power transmission. The subject "The Relation of the Electrical Engineer to Modern Social and Industrial Progress" was treated from a standpoint of general interest rather than from a purely technical point of view, and the lecture was of considerable interest to the commencement guests and Worcester friends of the Institute.

MICHIGAN COLLEGE OF MINES.—The Legislature of Michigan has passed a bill appropriating $171,900 for the Michigan College of Mines at Houghton for the biennium beginning July next. The most important item of this appropriation is that of $45,000 for the construction of a metallurgical laboratory. The college intends to erect a substantial building for this purpose and to equip it thoroughly for experimental work and instruction in the different classes of metallurgical processes. Cyaniding and other wet methods of concentration will be exemplified in the equipment, and electrometallurgy will receive special attention. It is intended to instal furnaces of larger capacity than is usual in college laboratories. The board of control of the college is taking steps to create a separate department of ore dressing and metallurgy. The equipment for this department will be housed in the new metallurgical building and in the ore dressing mill now possessed by the college. A man to fill the new chair has not been selected. Beside the amount for a metallurgical laboratory, the bill referred to carries an appropriation of $9,000 for extending the equipment of the department of mining engineering, which now occupies its new building erected last year; $4,000 for completing the equipment of the chemistry building also erected last year; $2,000 for providing additional cases for the mineralogical museum, and $1,000 for increasing the equipment of the department of mechanical engineers.

PERSONAL.

CHARLES BRANDEIS.

MR. CHARLES BRANDEIS.—A young electrical engineer who has been doing excellent work in Canada is Mr. Charles Brandeis, who has now established himself as a consulting, electrical and mechanical engineer with offices at 112 St. James Street, Montreal. Mr. Brandeis was born in London, England, graduated from the City and Guilds of London Central Institute at the age of twenty and was awarded the diploma and associateship of that institution. He obtained subsequently a large experience with leading electrical companies on the continent of Europe in the design and operation of electric light, power and railroad plants. In 1898 he came to the United States and worked for a couple of years with the General Electric and Westinghouse companies. In 1900 he went to Canada as designing engineer of the Lachine Rapids Hydraulic and Land Company, where he has done some excellent work. When the Lachine Company was absorbed recently by the Montreal Light, Heat & Power Company, he resigned his position to take up consultation work. Mr. Brandeis now has on hand electric light plants for three provincial towns and is also interested with a number of capitalists in the development of a large water power for manufacturing purposes. Mr. Brandeis is well-known personally in the electrical field in the United States and also through the columns of this journal, to which he has been a frequent contributor.

MR. H. S. COLLETTE, of the electrical engineering and contracting firm of J. G. White & Co., 29 Broadway, New York, has sailed for a trip to Europe.

MR. FRANCIS BLOSSOM, of the electrical engineering and contracting firm of Sanderson & Porter, New York City, has returned from an extended trip to the Southern States.

MR. CHARLES A. MOORE, of Manning, Maxwell & Moore, and president of the Shaw Electric Crane Company, of Muskegon, Mich., has returned from a seven months' trip abroad.

MR. G. F. BREITENSTEIN, superintendent of fire alarm telegraphs, of Utica, N. Y., died on June [illegible] of typhoid fever. He was a member of the International Association of Municipal Electricians.

MR. H. WARD LEONARD has been asked by the British Navy to tender bids for equipping H. M. S. *Terrible* with electric turret turning devices, with which such excellent results have been obtained on American men of war.

MR. HEINRICH JAEGER, one of the managers of Escher Wyss & Co., of Zurich, the turbine builders, is in the United States for a short stay and may be addressed, care Mr. Clemens Herschel, the hydraulic engineer, [illegible] Wall St., N. Y. City.

MR. JACOB CLOOS, of Milwaukee, has been appointed consulting engineer by the city council of Sheboygan, Wis., for the proposed municipal electric light plant for street and commercial lighting in conjunction with the new water works system.

MR. ROBERT C. CLOWRY, president of the Western Union Telegraph Company, has accepted an invitation to become a Director of the Kansas City, Mexico and Orient Railway Company, with which road the Western Union has a twenty-five-year contract.

MR. E. H. ABADIE.—Mrs. Ida Force Bolling, of Louisville, Ky., announces the engagement of her daughter, Miss Alice G. Bolling, to Mr. Eugene H. Abadie, of St. Louis, and general manager in New York of the Elblight Company of America. It is said they will be married in the fall.

MR. ISAAC L. RICE, president of the Consolidated Railway Electric Lighting & Equipment Company, has sailed for Europe. According to present arrangements he will be on the other side for about four months in the interest of the various concerns with which he is connected on this side.

MR. LOUIS E. MASSA, C. E., secretary of the A. D. Granger Company, contracting engineers, of 95 Liberty Street, New York, sailed on the S. S. *Minneapolis*, Saturday, June 6, for an extended tour abroad. Mr. C. C. Tomkinson, M. E., has been appointed assistant secretary of the Granger Company, and Mr. L. A. Camacho, manager of the sales department.

MR. F. P. MATHERS, F. G. S., F. R. G. S., who is interested in the electrical utilization of the falls of the Zambesi, South Africa, is reported in this country to study the conditions at Niagara, etc. The average estimated horse-power of the Victoria falls is 35,000,000-hp and the transmission distances figured on are from three to five hundred miles.

PROF. J. J. THOMSON, of the Cavendish Laboratories, Cambridge University, England, is to receive an honorary degree this week at Columbia University, New York, in recognition of his work in molecular and electrical physics. He is now in this country and was offered the physics chair of Prof. Rood at Columbia, upon the latter's death, but declined.

MR. CHARLES ALDEN, of Dorchester, Mass., has just completed a series of experiments by which he is enabled to control all the movements of a boat in mid-stream while sitting on the banks. The scene of his operations is at Milton, on the Neponset River. He is now at work on a model of a lifeboat to be similarly managed, which he believes he can imitate in bigger boats. There is nothing new whatever about the general idea, at which Tesla and others have worked.

MR. GEORGE HERBERT CONDICT, of New York, a well-known electrical engineer, has been elected vice-president and general manager of the old established Electro-Dynamic Company, of Philadelphia, to whose affairs he will now give part of his time. The company has won a well deserved reputation for its specialties, and will, it is understood, add shortly to its lines of production. Mr. Condict's predecessor in office, Mr. Paul, will, it is understood, remain on the directorate.

MR. W. J. McMANIGAL resigned recently his position as general manager of the New Omaha Thomson-Houston Electric Light Company, of Omaha, Neb., and the duties of general manager have been assigned to the president of the company, Fred A. Nash. R. A. McLaughlin has been made general superintendent and W. B. Whitehorn, purchasing agent. The New Omaha Thomson-Houston Electric Light Company now controls the light and power situation in Omaha and South Omaha, Neb., and in Council Bluffs, Iowa.

MR. J. C. HOBART. The deserved compliment of a complimentary dinner was recently tendered to J. C. Hobart, of the Triumph Electric & Ice Machine Company, at the Business Men's Club of Cincinnati by participants of the Business Men's Excursion to New Orleans and other Southern points during the recent convention of the National Association of Manufacturers. Mr. Hobart was also presented with a silver loving cup as a token of appreciation of his services rendered as the chairman of the general excursion committee.

DAVIS-BARRETT.—We are happy to record the marriage at Saratoga, N. Y., on June 3, of Grace Inez, daughter of Mr. and Mrs. J. M. F. Barrett to Mr. Harold McGill Davis, well-known in the electrical field and for some years past advertising manager for the Sprague Electric Company. The wedding took place at the home of the bride's parents, the ceremony being performed by Rev. Milton T. Littlefield, cousin of the groom. Only the relatives and a few intimate friends were invited. The bride wore gray crepe de chine. Mr. and Mrs. Davis will spend part of the month traveling through the New York Lake District and along the New England coast, and will then make their residence on the upper West side of New York City.

LORD KELVIN is one of the subjects selected for portraiture in the *Booklover's Magazine* for June. Prof. A. W. Goodspeed says: "It seems to be the delight of some biographers to lay great stress upon the desirability, if not necessity, that a man to be really great in any walk of life should start with nothing but a shoe-blacking outfit, or perhaps with the borrowed price of a first batch of newspapers. For the encouragement of those whose parents possess more than average intelligence and education and who may even be supplied with some of the comforts of life, let it be borne in mind that Lord Kelvin, the man of genius and learning, was born of highly educated parents and has ever lived surrounded by an atmosphere of culture and refinement."

MR. EDWARD F. SCHURIG, for the past six years city electrician of Omaha, Neb., has resigned his position to accept one as manager of the Beatrice Electric Company, of Beatrice, Neb. Mr. Schurig succeeds Mr. L. J. Sullivan, who has recently entered business in Omaha as general manager of the Nebraska Electric & Fixture Company. Mr. Schurig is one of the best known electrical men in Nebraska and his record as city electrician has been an excellent one. His work in Beatrice will include the general improvement and extension of the company's plant and system. Paul H. Patton succeeds Mr. Schurig as city electrician of Omaha. Mr. Patton is an experienced telephone man having been with the Nebraska Telephone Company in Omaha for nearly ten years, and before that with the Western Electric Company, in Chicago, and the Colorado Telephone Company, in Denver. At the time of his appointment, he was in the engineering department of the Nebraska company and acting as superintendent of equipment.

Trade Notes.

THE WOODHILL & HULSE ELECTRICAL COMPANY, Los Angeles, Cal., has purchased the Western & Southern Electrical Works. This will give the former concern control of most of the electrical business of Los Angeles.

AUTOMOBILE AND CYCLE MATERIAL. Mr. Chas. E. Miller, 97 Reade Street, New York, has issued a very complete catalogue showing a new line of automobile parts, fittings, and sundries and many European novelties. The catalogue covers the ground very thoroughly and a copy will be mailed to any one interested on application.

THE PLUNGER ELEVATOR COMPANY, of Worcester, Mass., has sold, through its New York office, 156 Fifth Ave., an elevator with a lifting capacity of 14,000 lbs. to the MacAndrews & Forbes Licorice Co., Camden, N. J. The elevator will carry loaded cars from one floor to another, the total travel being 24 feet. No counter weights or cables will be used in this installation.

REYNOLDS CORLISS ENGINES.—A trade publication somewhat unique in character has been issued by the Allis-Chalmers Company, which consists entirely of the names and addresses of users of Reynolds Corliss engines, classified according to lines of manufacture. No less than 189 pages are necessary to contain the list, electric railway and lighting plants alone taking up 31 pages.

THE BENJAMIN ELECTRIC MFG. COMPANY, of Chicago, has opened an Eastern office at 27 Thomas St., New York, where it will keep on hand a large stock of its regular manufactures among which is the Benjamin wireless cluster that has attained an enviable reputation in electrical circles. The stock in the East will enable the company to fill orders promptly either from New York or Chicago.

PUMPING MACHINERY. The Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, in a recently issued catalogue (No. 53), describes and illustrates its full line of pumping machinery ranging from small single pumps to triple-expansion pumping engines, and including vacuum hydraulic pumps, triplex power pumps, air compressors, etc. The extent of the line may be surmised by the fact that the catalogue contains 114 pages and almost 100 illustrations.

OPENING-DIE.—The Ideal Opening Die Company, 24 West Street, New York City, in a recently issued pamphlet describes briefly and illustrates its "Ideal" opening-die, which is designed for use in connection with either hand of automatic turret machines. The advantages derived from the use of the device are briefly pointed out, and the two-page illustration at the center of the booklet shows its construction very clearly. This opening-die is at present made in four sizes, that is, ¼ in., ½ in., ¾ in., and 1 in., and larger sizes will be manufactured.

THE F. BISSELL COMPANY, Toledo, Ohio, has just issued two booklets upon the subjects of switchboards and specialties for electric lighting, power and railway construction, and specialties for telephone construction. The former illustrates and gives prices of pole ladders, seats and platforms; alley braces for side arms; cable and messenger cars; manhole tops; conduit rods; and a line of tablet boards. Views of three switchboards constructed by this company are also given. The telephone pamphlet covers a full line of articles used in telephone work and construction.

TELEPHONE EQUIPMENT.—The Conn. Telephone and Electric Company, Meriden, Conn., is sending out a new catalogue which shows a large number of improvements, and new styles of telephone apparatus. Among the latter are noticed the company's solid back transmitter, which has a new resonating chamber; a new self-contained receiver and switch hook; a new style of switchboard, etc. The company has moved into a larger factory which gives a greater producing capacity, and it reports that it has a large number of big contracts on hand and that the business prospects are exceedingly bright.

TELEPHONE APPARATUS.—The De Veau Telephone Manufacturing Company, 27 Rose St., New York, introduces to the trade from time to time new telephone apparatus, and has built up a large business and an excellent reputation for the quality and efficiency of its goods. The extent of its line of products may be appreciated by an examination of its latest catalogue, which has 128 pages, and includes descriptions and illustrations of its telephone apparatus and supplies. The interior telephones made by this company are well shown. Every one concerned in telephone work will find much matter of interest in this catalogue.

BULLOCK BULLETINS.—The latest bulletins of the Bullock Electric Mfg. Company have for their subjects, Bullock engine type generators for direct current (No. 1008), and Bullock Type B motors (No. 1021). Both bulletins are printed on an excellent quality of paper and we have seen very few machinery half tones equal to those printed in these pages. In the first mentioned bulletin, every constructional detail down to the smallest is well illustrated, and a large number of plants are shown where the generators are installed. The second bulletin includes an interesting efficiency curve of 2½-hp and 5-hp moderate speed motors.

DIRECT-CONNECTED EXHAUST FANS.—The Emerson Electric Mfg. Co., St. Louis, Mo., has just issued a bulletin (No. 3040) on direct connected exhaust fans for alternating and direct current. It presents an extended list of fans of this class, of design similar to those now so well-known in the trade. They were brought out to meet the demand for very quiet running fans, and are fitted with Davidson blades in order to insure quiet operation. The company continues to supply Parker blades for exhaust fans where a slight noise is not objectionable. The two styles throw an equal volume of air, the choice being largely determined by the matter of slight noise or no noise.

DIRECT-CURRENT GENERATORS.—Bulletin No. 30 of the Northern Electrical Manufacturing Company, Madison, Wis., is a profusely-illustrated pamphlet of 32 pages, devoted to a description in detail of direct-current generators. There are no less than 50 half-tone illustrations, which are so excellent in execution that we cannot forbear mentioning the name of the engraver—Franklin Engraving Company, Chicago. The minutest details of construction are illustrated and machines are shown direct-connected to almost every modern type of steam engine. An interesting section of the catalogue is devoted to describing and illustrating a twin type of generator that has been designed for use with the steam turbine.

VENICE IN AMERICA.—One of the splendid pieces of illumination in New York City is "Venice in America" at the Madison Square Garden. The incandescent lights in the ceiling are in general blue. The Duss orchestra is placed in a court of honor staging, surrounded by high pillars resembling marble, wreathed with vines and ropes of incandescent lamps of greenish tinge. At the foot of the Rialto Bridge are two immense pillars, one entwined with red incandescents and the other with blue, while over the entire canal hang Venetian lanterns lit by incandescent lamps an odd mixture of ancient and modern illuminating effects. The lamps used in this production were furnished by the Germania Electric Co., Harrison, N. J.

SCIENCE IN THE MAGAZINES.—Conclusions so startling as those reached by Dr. Wallace's *Fortnightly* article on "Man's Place in the Universe," could not go long unchallenged, and the April number of the *Fortnightly* brings a prompt reply from no less an authority than the Savilian Professor of Astronomy at Oxford. Professor Turner's article is reprinted in *The Living Age* for May 9, which is full of timely articles. Professor Harnack comments on "The Kaiser's Letter on Christ and Revelation;" there is a review of Mr. Chamberlain's career from *Blackwood's Magazine;* and a discussion of "The Unrest in the Balkans," by the Roumanian ex-Minister of Public Instruction, the vice-president of the Central Macedonian Committee and the President of the Cretan Chamber of Deputies.

BUFFERS AND GRINDERS. The Storey Motor and Electric Company, 135 Broadway, New York, devotes a recent catalogue entirely to the subject of buffers and grinders. The various types of these machines are illustrated by excellent half-tones and the dimensions are given in tables for use in connection with diagrams of the machines. The pamphlet is of extraordinary value by reason of the practical information it gives at the back on the subject of silver polishing, gold polishing, copper and brass finishing. These buffers and grinders are designed expressly for this service and may be set up on a bench or table at any convenient point. They may be run from an ordinary lighting or power circuit at either 110 or 220 volts. A substantial column is furnished with the machine if desired.

BOOKLOVERS' MAGAZINE.—The new *Booklovers' Magazine* is already famous for its pictures. In the May number, among other illustrations, there are fifteen full-page pictures of scenery and figures reproduced in natural colors by the three-color process, six full-page portraits in tints, and ten full page half-tones in black and white. These pictures illustrate articles by Talcott Williams, W. R. Hotchkin and Cyrus Townsend Brady on Department Stores, having full-page portraits of the great leaders; the vacation-travel articles by Lilian Bell, Julian Hawthorne, Jeannette L. Gilder and Mary Bacon, with many European views; and the critiques by Oscar Fay Adams, Agnes Repplier, Mary E. Wilkins, and Katharine Lee Bates on the immortal women novelists—Jane Austen, George Eliot, George Sand, and the Brontës.

EWING-MERKLE ELECTRIC COMPANY.—The Ewing-Merkle Electric Company, St. Louis, Mo., formally opened its new store at 1106 Pine Street, that city, May 25, a large and representative gathering being in attendance to inspect the new quarters. On the first floor there are specially designed show cases containing samples of nearly all the small material needed in the lighting and telephone industries. Beyond the city counter is the exhibit room, in which are contained motors, dynamos, arc lamps, switchboards, electric fans, telephone and electric fixtures, and the larger articles used by contractors in electric lighting and telephone companies. The shipping and receiving departments are also favorably located on these floors. The basement contains large stocks of Roebling's telephone wire, cross-arms, glass insulators, and iron conduit. The general offices of the company are located on the second floor and are handsomely fitted up and so arranged as to afford the greatest convenience in the transaction of business. On the third floor the lighting supplies are kept, and the fourth floor contains all the copper wire—rubber-covered, water-proof, magnet annunciators and cables, of all of which the stock is very complete and excellently arranged. On this floor also shelving is provided for glass shades, reflectors and incandescent lamps. On the fifth floor are kept in standard packages goods that are not unpacked on the premises, such as electric fans, arc lamps, sockets, cut-outs, etc., etc. in fact, everything ordered out in original packages. Brackets, pins, construction tools, etc., are kept in large stocks on the sixth floor. During the reception refreshments were served, and all present extended cordial wishes for the prosperity of the company.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 2, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

728,309. COIN-COLLECTOR FOR TELEPHONE PAY-STATIONS; Charles E. Scribner, Chicago, Ill. App. filed July 29, 1901. (See page 1015.)

728,478. TELEPHONE-LOCK; Edward G. Lewis, St. Louis, Mo. App. filed June 20, 1902. (See page 1015.)

728,833. SIGNAL DEVICE FOR TELEPHONE SYSTEMS; Edward P. Baird, Evanston, Ill. App. filed April 14, 1902. (See page 1015.)

728,964. TELEPHONE-TOLL SLOT-MACHINE; William S. Paca, Erie, Pa. App. filed Aug. 26, 1902. (See page 1015.)

728,994. TELEPHONE-LOCK; William H. Scott, St. Louis, Mo. App. filed June 25, 1902. (See page 1015.)

729,184. TRANSMITTER-ARM; William Kaisling, Chicago, Ill. App. filed Dec. 8, 1902. (See page 1016.)

729,267. TELEPHONE-RECEIVER HOLDER; Arthur J. Briggs, Allegheny, Pa. App. filed Sept. 6, 1902. (See page 1016.)

729,523. SAFETY GUARD FOR TROLLEY WIRES AT RAILROAD CROSSINGS; Charles D. Austin, Amsterdam, N. Y. App. filed April 10, 1903. Energized guards are arranged adjacent to the trolley wire, so that in case the trolley leaves the wire while crossing the track, it will strike a guard and receive current therefrom to carry the car over the crossing.

729,550. BATTERY JAR; George H. Condict, New York, N. Y. App. filed Dec. 16, 1898. The exterior walls of the cells have ribs which come together when the cells are nested, and thus support the walls and furnish intervening spaces for carrying away spilled solution.

729,560. SIGNALING-JACK FOR MULTIPLE-TELEPHONE EXCHANGES; Lars Magnus Ericsson, Stockholm, Sweden. App. filed Feb. 12, 1901. (See page 1016.)

729,614. PROCESS OF TREATING MATERIALS BY RADIATED HEAT IN ELECTRIC FURNACES; Carl G. P. De Laval, Stockholm, Sweden. App. filed March 19, 1902. The material is piled up in the furnace chamber and presents an inclined side to the heat of an arc. As the material is decomposed, it runs downward into a receptacle.

729,620. TROLLEY STAND; William Magner, Lockport, N. Y. App. filed Nov. 6, 1902. Details.

729,640. BRAKE FOR ELEVATORS; John P. McCurdy, Chicago, Ill. App. filed June 9, 1902. The momentum of the armature of the hoisting motor, after the current is shut off, is used to generate current to operate a brake magnet.

729,655. WINDING OR REVOLVING MAGNETS; Charles A. Parsons, Newcastle-upon-Tyne, England. App. filed Oct. 7, 1902. Non-magnetic bridge pieces are inserted between the pole pieces of a rotary field magnet and serve as supports for the conductors to prevent their displacement by centrifugal force.

729,657. TROLLEY CATCHER; William E. Pettee, Newton, Mass. App. filed Feb. 21, 1901. Details of a spring drum retriever.

729,658. BRAKE FOR CARS; Bertil Von Philip, Philadelphia, Pa. App. filed Jan. 22, 1903. Alternate friction disks are clamped and separated by an electro-magnet and a spring.

729,662. ELECTRIC IGNITION GENERATOR; Benjamin P. Remy, Anderson, Ind. App. filed April 17, 1902. The machine is mounted to slide on rails, but is held by a spring to maintain a proper tension on the belt.

729,664. ELECTRIC MOTOR; Edgar G. Richards, Madison, Wis. App. filed June 30, 1897. A counter shaft with which the armature is geared, is mounted in brackets extending from the heads of the motor which are adjustable at any angular position around the motor axis.

729,703. MEANS FOR INDICATING THE IMPACT OF BODIES AT A DISTANCE; Juna U. Y. Motta, Getafe, Madrid, Spain. App. filed Oct. 28, 1901. A pivoted plate mounted on a target vibrates a number of times depending upon the distance from the pivot at which it is struck by the bullet; the vibrations operate an indicator.

729,716. MEANS FOR ELECTRICALLY OPERATING COUNTER SHAFTS; Norman C. Bassett, Lynn, Mass. App. filed Feb. 27, 1902. An arrangement for throwing a friction pinion into contact with either one of two concentric surfaces on a pulley, to change the speed and direction of rotation.

729,729. FUSIBLE ELECTRIC CUT OUT; William P. Burke, Fethard, Ireland. App. filed Feb. 24, 1903. The fuse wire is stretched over a bridge like a violin string, the bridge preventing the formation of an arc.

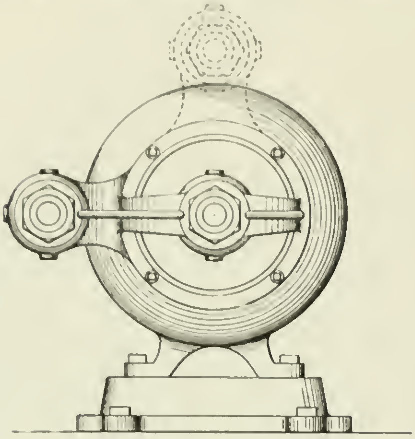
729,730. INCANDESCENT LAMP; William R. Burrows, Newark, N. J. App. filed Jan. 30, 1901. Means for preserving the seal of an incandescent lamp, comprising heat radiators of large area compared to the leading-in wires and surrounding each wire below the filament-joint.

729,734. BRAKING SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed Feb. 18, 1901. The brakes on the rear trucks are set with less force than those on the forward trucks, to prevent skidding of the rear truck wheels due to the lifting of the car body from the rear truck when the brakes are applied.

729,641. SNAP SWITCH; Frank E. Frum, Schenectady, N. Y. App. filed March 1, 1902. Details.

729,648. ALTERNATING CURRENT TRANSFORMER; John J. Frank, Schenectady, N. Y. App. filed Feb. 2, 1903. An arrangement of transformer coils such that connections may be made to three-wire systems of different voltages and the coils connected so as to give any one of a number of different voltages.

729,662. STARTING RHEOSTAT; Charles E. Harthan, Lynn, Mass. App. filed March 8, 1902. A thermostat in series with the line provides for a given interval of overload before opening the circuit breaker.



729,664.—Electric Motor.

729,731. ELECTRIC HEATER; Thomas J. Johnston, Schenectady, N. Y. App. filed Feb. 11, 1899. The heaters have coils of different capacities and by means of a suitable switch the heaters and coils can be connected in parallel or series to obtain various heating effects.

729,772. PUSH BUTTON SWITCH; Edwin G. Kasterhuber, Schenectady, N. Y. App. filed March 3, 1902. Details.

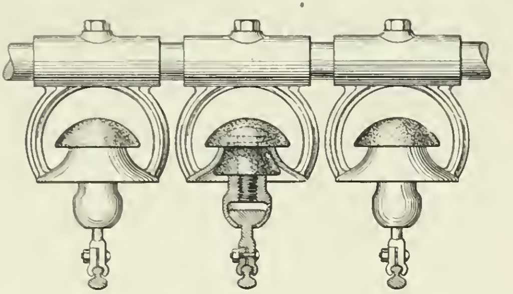
729,801. TELEPHONE-EXCHANGE SYSTEM; Charles B. Smith, New York, N. Y. App. filed June 25, 1901 (See page 1015.)

729,826. OVERHEAD STRUCTURE FOR ELECTRIC RAILWAYS; Ben Willard, New Orleans, La. App. filed Feb. 25, 1899. The ear that holds the wire is connected by a ball and socket joint with the insulator.

729,827. BATTERY; David H. Wilson, Chicago, Ill. App. filed April 30, 1902. The connection from the carbon cup leads from the bottom upward through the walls of the cell, so that creeping salts cannot reach the binding post.

729,828. LAMP RECEPTACLE; Herbert C. Wirt, Schenectady, N. Y. App. filed Dec. 19, 1900. A base having two grooves for the wires and a lamp socket attached thereto whose terminals extend into the groove, in combination with a cover.

729,833. SOLUTION FOR PRIMARY BATTERIES; Harry S. Amwake, Camden, N. J. App. filed May 22, 1900. A solution of sodium hydrate on one side of a partition and of sodium bichromate and sulphuric acid on the other side.



729,826. Overhead Structure for Electric Railways.

729,862. ELECTRIC HEATER; Joseph F. Hewitt and Charles W. Spatig, Allegheny, Pa. App. filed Dec. 30, 1901. A combined water tank and electric heater.

729,873. TYPEWRITING OR SIMILAR MACHINE AND APPARATUS FOR USE IN CONNECTION THEREWITH; Jules Lagarde, Clermont-Ferrand, France. App. filed July 27, 1901. Electro-magnets controlling the type bars are so arranged in connection with circuits and switching apparatus that the operator, by touching a given letter space on the keyboard, can cause either a small letter or a capital to be printed.

729,878. BRUSH HOLDER AND BRUSH FOR DYNAMO ELECTRIC MACHINES; Robert Lundell, New York, N. Y. App. filed Nov. 26, 1902. The brush holder contains a wedge-shaped central portion with brushes on the opposite sides of the same, which are pressed against the commutator and against the wedge portion at the same time.

729,879. FIELD MAGNET FOR DYNAMO ELECTRIC MACHINES OR ELECTRIC MOTORS; Robert Lundell, New York, N. Y. App. filed Dec. 26, 1902. The laminated yoke and pole pieces are supported upon the frame by devices which do not pass through the laminations.

729,882. ELECTRIC TRACTION; Auguste Megroz, Clarens, Switzerland. App. filed Nov. 25, 1902. A metallic conduit covered with suitable insulating material at all parts except an interior portion with which the current collector makes contact.

729,906. ELECTRIC LAMP; George Stein, New York, N. Y. App. filed Aug. 12, 1902. A lamp and holder for the use of physicians and dentists.

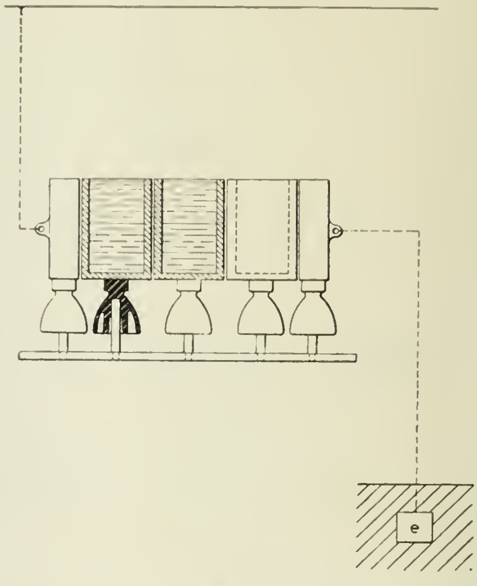
729,911. AUTOMATIC PARALLELLING DEVICE; Eli M. Hemphill, Avalon, and Edward Reber, Pittsburg, Pa. App. filed Dec. 24, 1902. A solenoid is arranged in circuit with the "synchronizing lamps" to automatically throw the generators into parallel as soon as they are in synchronism.

729,952. ELECTRIC BURGLAR ALARM FOR VAULTS, SAFES, OR THE LIKE; Chas. O. Miller, Esterville, Iowa. App. filed March 29, 1902. Details.

729,957. TROLLEY; Miles McBride, Braddock, Pa. App. filed April 3, 1903. The pole carries two wheels, one on each side, and the spring gives it a downward tendency; it may therefore be lifted and reversed, one wheel being used for one direction of travel and the other for the opposite direction, the wheels making top contact.

730,014. PRIMARY BATTERY; James W. Gladstone, West Orange, N. J. App. filed Dec. 17, 1902. Details.

730,058. CONDUCTOR; George E. Tinker, New York, N. Y. App. filed Jan. 9, 1903. A third-rail inclosed in a rectangular box having a narrow slot in the side for the arm of the collector.



730,211.—Lightning Arrester for Electrical Plants.

730,061. REFLECTING GALVANOMETER; Edward Weston, Newark, N. J. App. filed July 9, 1902. The parts are secured to the lid of the case in such a manner that the axis of the magnetizable core, the movable coil and the support for the latter, are coincident when the instrument is levelled.

730,069. ELECTRIC LAMP; Alexander J. Wurts, Pittsburg, Pa. App. filed Sept. 28, 1901. Details of an automatic cut out for the heater of a Nernst lamp.

730,098. ELECTRIC SELF-PLAYING PIANO ATTACHMENT; George H. Davis, New York, N. Y. App. filed Dec. 23, 1898. Details.

7730,101. VOCAL GUARD FOR TELEPHONES; William J. Donihue, Jamestown, N. Y. App. filed June 9, 1902. (See page 1016.)

730,116. TROLLEY POLE; George W. Hamilton, Philadelphia, Pa. App. filed March 23, 1903. Two sets of arms pivoted together, two sets of links connected to the arms and a spring connecting the sets of links, the arrangement affording an extended movement of the arms with a limited amount of expansion and contraction of the springs.

730,181. ELECTRIC AUTOMATIC OVERFLOW ALARM; Robert J. Walker, Holland, Mich. App. filed May 21, 1902. Details of an apparatus involving contacts operated by a float.

730,186. CONDUIT AND SEWER ROD COUPLING; Albert W. Case, Brookline, Mass. App. filed May 31, 1902. Details.

730,211. LIGHTNING ARRESTER FOR ELECTRICAL PLANTS; Georg Honsberg, Nuremberg, Germany. App. filed Dec. 16, 1902. In the space between the electrodes are interposed vessels containing liquid and having porous walls slightly separated from each other.

730,216. ELECTRIC LAMP; Henry Noel Potter, Pittsburg, Pa. App. filed April 27, 1900. A Nernst lamp capable of operation in any position.

Electrical World and Engineer

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CONTENTS.

Editorial ... 1039
Degrees for Cooper Hewitt and J. J. Thomson ... 1042
Programme of the Institute Niagara Meeting ... 1042
The Training of Telephone Operators. By Herbert Laws Webb ... 1043
Collins Wireless Telephone System. By Dr. T. Byard Collins ... 1046
A Contribution to the Subject of Aging of Sheet Steel. By Thos. S. Allen 1048
Electrical Engineers in the Modern City ... 1049
Another Telephone Central in New York City ... 1049
Simultaneous Telegraphy and Telephony. By Charles C. Duvall ... 1050
Telephone Exchanges—IV. By Arthur V. Abbott, C. E. ... 1051
Recent Progress in Wireless Telegraphy ... 1052
The Gruhn Telechirograph for Transmission of Handwriting ... 1054
Thirteenth Annual Meeting of the Canadian Electrical Association ... 1056
The Chicago Independent Telephone Convention ... 1057
A Note on Artificial Fluorescence of Living Human Tissue. By William James Morton, M. D. ... 1058
Western Union Earnings ... 1058
Recent Electrochemical Developments. By Clinton Paul Townsend ... 1058
Boston Edison Company Hearing ... 1059
New Telephone Patents ... 1059
Independent Telephony in New York State ... 1060
Annual Meeting of the New York Electrical Society ... 1060
Current News and Notes ... 1060
Letter to the Editors:
  Absolute Measurements in Electricity. By Henry S. Carhart ... 1063
Digest of Current Electrical Literature ... 1064
Electrical Apparatus in Coal Mining. By S. B. Belden ... 1068
Nernst Lighting Plant for a Circus ... 1070
Status of the Kellogg Telephone Interests ... 1070
Power Plant for the Philadelphia Subway ... 1071
Ventilating Equipment for a Turkish Cruiser ... 1071
Efficiency Tests of Tangential Water-Wheels under 1912 feet Effective Head ... 1071
News of the Week ... 1072

Telephonic Finality.

The meeting of the National Independent Telephone Association next week in Chicago calls attention once more to the steady and rapid growth of the independent telephone cause in this country. In spite of the activity and vigor of some of the sectional or state telephone associations, the national body necessarily remains that which has or should have the most representative character; and we should not be surprised if some steps were taken at the present meeting to harmonize and consolidate some of the work which has been done by bodies hitherto coming more or less into clash and rivalry. There is no doubt that frequent meetings are found necessary in the earlier stages of any social or industrial movement, and that a great deal of stimulus and benefit is derived from them; but after a time the charm or glamor wears off to some extent; the great fundamental questions are settled; the expense of frequent meetings is felt to be somewhat of a burden; and, usually, the people who are most interested settle down to a régime of at best one or two meetings a year. In the electrical field this has been the case with regard to the street railway and electric lighting companies and their associations, the two national bodies of which each meet only once a year; while relatively few of the state organizations maintain even yearly meetings to which the word "convention" might be fairly applied. It is perhaps early in the independent telephone movement to expect a settling down to such routine periodicity, but it is evident to anyone who has watched the course of events during the last few years that even in the telephone field a great deal of the foundation and constructional work of organization necessitating constant conference has already been accomplished.

As one looks back over the record of a year, it is seen that there is much good work in the past twelve months upon which the independents are to be congratulated. The standpoint of their maintenance and operation has visibly and markedly improved; their line construction is much better; and money is spent more willingly on the apparatus for both the exchange and the subscriber's station. More efficient service is given, the principles of the work are better understood, and it would indeed be difficult to find a higher class of telephonic service than is furnished by some of the independent exchanges. What is perhaps most important of all is that a great many of these exchanges have found that in order to give good service, better rates must be paid to the exchange by the subscriber, and there has been a gradual toning up, therefore, all along the line. Indeed, one of the noticeable features of independent work in the larger exchanges during the past year has been the drift toward the measured rate system. The advocates of this are increasing in number, and while there are still a great many intelligent independent telephone managers who fight for the flat rate method, we believe that in due time most, if not all of them, will be converted to the scientific basis of operation which is beginning to apply so generally throughout the Bell system, and which to-day obtains more and more in the electric lighting field, as well as in the street railway field—for a five-cent fare is, after all, a measured service, and the "transfer" issued might be compared to the free trunking done for the subscriber from one exchange in a city to another exchange in a remote part of it.

There are, of course, many indications that telephony is very far from finality in this country, from whatever point of view it may be regarded. No one has yet discovered how many telephones can be installed in any given community, nor how frequently the subscriber can be induced to use his telephone and pay for each call. If there is any one direction in which possibly finality might have seemed to be reached, it is that with regard to the evolution of the familiar type of multiple switchboard exchange. We do not know whether this subject will come up for consideration during the next week at Chicago, but we note that at a meeting in London of the English Institution of Electrical Engineers, the only telephone paper lately brought before that body dealt with the multiple switchboard problem, Mr. Aitken, the author of it, advocating a further development of the divided board, which has found its first exemplification in this country, as for example, in St. Louis. Mr. Aitken has gone even further than Mr. Kellogg in this departure, and has virtually proposed, as Mr. Kempster B. Miller has done, that extremely large exchanges shall be adapted each to serve areas, say, five miles in diameter, each exchange including several large multiple switchboards under the one roof and the subscriber's apparatus being provided with means for calling up at will any one of the switchboards in the wholesale exchange to which he is thus connected. This, it will be observed, is the very antithesis of such a system as that in New York, where considerably over a hundred thousand subscribers are now divided up into well-nigh two-score exchange groups and branch offices. While such a method would obviously get rid of a great deal of trunking, the remedy or new plan proposed itself bristles with many dangers and difficulties, and we note that English opinion on the subject is by no means favorable. The clash between these two ideas of centralization and de-centralization in multiple exchange work seems to provide at least one technical battleground of the future in telephonic development; and while public conventions are hardly the bodies in which such issues can be satisfactorily determined, there is no doubt as to the ample room for discussion of this and many other kindred topics at such a gathering as that at Chicago. We trust that the National Independent body will be encouraged by the success of its annual convention and go forward in its work; that it will enlist new and enthusiastic support, and that it will come to be altogether a power for good in the wondeful electrical industry for a large part of which it assumes to speak.

Oscilligrams and Resonance.

An interesting paper by Mr. M. B. Field has recently been read before the Glasgow section of the British Institution of Electrical Engineers. It covered a number of experimental observations, made with the oscillograph, on voltage and current waves over actual transmission circuits, and it elicited an extended discussion. The results emphasize the importance of using the oscillograph to detect the behavior of pressure or current in a circuit at the particular moment when a sudden change of any kind is to be expected. This behavior can, in many instances, be computed; but there is nothing which will record it and enable it to be studied accurately in detail, except the oscillograph.

The general outcome of the investigation was to show that in a high-pressure polyphase system of cables, aggregating about fifty miles, and operated at about 6,500 volts pressure, there was no resonant effect of any practical importance. The frequency in this case was 25 cycles per second. A distinct ripple of the twelfth-frequency harmonic was, however, to be detected in the currents due to the pulsating action of the armature teeth.

A part of the paper was devoted to the subject of free oscillations, produced in a circuit containing inductance and capacity by a sudden disturbance of the circuit, as by switching it on or off. These effects, as is well known, differ from those attending the steady operation of alternating current circuits, in being rapidly damped out, and in having a natural, or self-imposed, frequency as distinguished from the frequency impressed by the alternator.

Mr. Duddell, in the discussion of the paper, contributed some useful oscillograms and data observed by him under practical conditions. Among other things it was mentioned that the power factor of high pressure cables varied in general from 1.5 to 3 per cent. That is to say, the ratio of the watts to the volt ampères delivered to a cable disconnected from its load varied between 0.015 and 0.03. Cases had been observed, however, in which the power-factor of a cable appeared to be over 10 per cent. In view of the relatively large charging current of high pressure distribution systems, it is evident that even with a power-factor of no more than 2 per cent., the total annual loss of energy in dielectric losses must be considerable.

If the ratio of the cyclic maximum to the effective value of an alternating current or pressure be termed the stress ratio, oscillographs were adduced to show that the stress ratio on a cable might be increased by resonance from 1.41, the pure sinusoidal value, to 2.0. This was in the case of a tooth-cored 5 kilovolt alternator charging cables. When the alternator was running free, at normal speed and voltage, its e.m.f. wave showed distinctly the ripples due to the armature teeth. The stress-ratio was, however, only 1.45, or but little greater than that for a pure sine wave.

When the alternator was connected to the high-pressure cables, the terminal pressure and speed remaining normal, the shape of the e.m.f. wave became so modified by the resonance of the tooth-frequency, that the stress-ratio increased to 1.67. If the speed and frequency of the alternator was increased 8 per cent., an increased resonance was attained due to the action of the seventh harmonic; and the stress-ratio increased to 1.74, with a visibly different shape of wave. Moreover, when the speed and frequency of the alternator fell 26 per cent. below normal, the fifteenth harmonic came into action, and the stress-ratio increased to 1.94. This observation indicates that the electrical stress on a cable may happen to be considerably increased by allowing a single alternator connected with the cable to slow down under excitation. That is to say, it should be de-excited before being allowed to slow down, and, better still, it should be disconnected from the circuit, then de-excited, and then shut down. Otherwise all the e.m.f. harmonics, due to deviations from the simple sine wave form, will experiment with unerring purpose to excite resonance in the cable at some particular frequency during retardation.

The Institute Niagara Meeting.

Elsewhere in this issue we print the details of the programme for the Niagara Falls meeting of the American Institute of Electrical Engineers. It is an excellent menu, and we believe that it will attract a very large attendance of members, even though a great many of them have become rather tired of going to Niagara for conventions, and hardly care to see the Falls in the midst of the devastation wrought by preparatory work for power plants on the Canadian shore. There would, indeed, be greater eagerness among electrical engineers to visit the great Cataract if more of the electrochemical and electrometallurgical establishments using the current generated by it were open to the public. In fact, as there are so many other points of interest in this country where an Institute meeting could be held, outside great cities, we think it might be well to take them in, and subject Niagara to a prolonged "closed season.'

Experiments on Synchronous Converters.

The last number of the Journal of the British Institution of Electrical Engineers contains a paper by D. W. M. Thornton, read at the Newcastle local section, on experiments connected with the operation of a pair of small converters running under laboratory conditions. One converter was driven, inverted, from a storage battery, and supplied either single-phase or multiphase currents to the other converter, which, in its turn, was connected to an adjustable load on its direct-current side. By inserting the coils of an oscillograph in the alternating-current circuit between the two machines, the waves of pressure and current could be recorded and studied under a great variety of conditions.

One of the main results of the investigation was that the efficiency of the combination was a maximum in the neighborhood of the condition of non-inductive operation, or unit power-factor. The power-factor was, of course, susceptible of adjustment within a fairly wide range by varying the field excitation of the two machines. This condition of nearly highest efficiency at highest power-factor is one which might have been expected on theoretical grounds.

Another salient result obtained was the prominence of armature-reaction magnetic alternating fluxes. The magnetic flux in the field magnetic circuit of a synchronous alternator is constant at no load. When the machine runs under load, however, the armature reaction tends to make the magnetic flux pulsate. This is especially the case when there is any electric oscillation or phase-swinging.

By employing an exploring coil on the magnetic circuit, a very appreciable alternating-voltage was observed therein, generated by armature reaction and phase-swinging. The author examined these induced alternating voltages by the aid of the oscillograph. He shows that they may be accompanied by a relatively large eddy-current loss in the mass of the magnetic circuit, and he also points out that the method is capable of general application to dynamos and motors for the detection of irregularities of operation due to any cause. The wave-forms, curves and tabular matter show that a large amount of work has entered into the preparation of the paper; but the results must be interpreted as specially applicable to laboratory conditions rather than as indicating the relations found under industrial conditions.

As to Radio-Activity.

We abstracted in the Digest lately a paper on radio-activity which has awakened so much interest that it seems to call for some comment. It was a continuation in logical form of the work which is already familiar on the material emanations from radium and its allies. The burden of the investigation is to show that radium must inevitably disappear or be converted into simpler forms of matter after a few thousand years of life. In plain words, radium must have been created within historic times if the estimates of Rutherford and Soddy are correct. The radium in a chunk of pitchblende, therefore, has been spontaneously formed within a measurable period, and the process is inferentially still going on, the rate of formation being much greater of course than the rate of dissipation as radio-active material in order to account for the present existence of the substance. To a less degree, the same statements apply to uranium and thorium and other radio-active substances. All this is highly interesting if true. To follow up the matter a little further, the experiments of Curie on the spontaneous emission of heat from radium have been interpreted as showing on the electron theory, that radium is a tremendous store of spontaneously emitted energy. The most careful estimates yet made show it to be endothermic to a degree inconceivably greater than any substance heretofore known. If the energy thus stored could be instantaneously liberated, radium would become an explosive of such tremendous energy as to dispense wholesale annihilation.

Now the two statements here collocated are singly sufficiently startling, but taken together, the conception of the continuous spontaneous formation in solid rock of a definite chemical substance inconceivably endothermic and steadily undergoing spontaneous decomposition comes as near to being dynamical "tommy-rot" as anything suggested since the demise of the lamented Professor Keeley. For it should be remembered that radium has been shown to have a perfectly definite and characteristic emission spectrum with definite mathematical relations to the spectra of allied elements, and its atomic weight has been determined by ordinary chemical methods as accurate as that of many other rare elements. It can be separated from other substances by ordinary chemical methods, forms salts with haloids and acids in an entirely regular manner, and behaves in general as it ought to behave from its approximate place in the periodic series. All the chemical facts about it give it a systematic place as a regular chemical substance not set apart from other elements by any remarkably unique peculiarities. It is rare, to be sure, but so are many other elements found in small proportions in unusual minerals. Uranium and thorium, its near neighbors, are fairly well known substances, both possessing the same property of radio-activity under certain circumstances, but in a slightly different way and to a much less degree. Polonium, another allied substance, has far greater radio-activity, but in it the emanations allied to cathode rays of projected matter cut relatively a very small figure, while it also now appears to have a definite chemical identity.

Again, with respect to thorium and uranium, it has been pretty clearly shown by chemical research that radio-activity is not a regular and invariable property under all circumstances, but appears under certain reproducible conditions and may disappear and again be reproduced. It seems to belong to them in much the same way as the phenomenon of phosphorescence belongs to calcium sulphide prepared in certain particular ways. Radio-activity may or may not be allied directly to phosphorescence, but it has already been shown to pertain to altogether too many kinds of matter to allow of a highly specialized explanation applicable to radium and its allies and yet not holding for commoner substances. As we have several times taken occasion to remark, the main trouble with investigations of radio-activity is a tendency to rely blindly on electrical evidence for the explanation of these apparently very complicated but widely generalized physical properties. To look at the matter without professional bias, the electrical evidence as to the facts recited at the beginning of this comment, by itself and uncorroborated by independent sources of information, is "not worth the powder to blow it up," if taken alone. The electrical effects of radio-active material are valuable means of investigation, but they tell only a part, and perhaps a rather small part of the whole story. Moreover, many of the conclusions drawn from them rest on the perhaps current, but as yet unproved, assumption that the values of electrical functions are continuous through so profound a change of state as that which may separate matter from non-matter—using the terms in their chemical sense. Until the electrical evidence is backed up by direct evidence not based on this assumption, one should be very cautious in drawing sensational conclusions from it. In the particular instance under consideration, the trend of general chemical and physical evidence is decidedly against the conclusions advanced, and whether they are ultimately proved sound or not, they should at the present stage of affairs be accepted only tentatively and cautiously while awaiting further information.

Degrees for Cooper Hewitt and J. J. Thomson.

Special interest was given to the commencement exercises at Columbia University, New York, last week, by the fact that degrees were conferred on Prof. J. J. Thomson, of England, and on Mr. Peter Cooper Hewitt. The former was presented to President Butler by Prof. W. H. Hallock, who said: "Just a century ago no less a man than Lord Brougham, in the *Edinburgh Review*, held up Young and his classic work to ridicule, and his friend and fellow student, Sir David Brewster, more than a score of years later said that 'his chief objection to the undulatory theory of light was that he could not think the Creator guilty of so clumsy a contrivance as the filling of space with ether in order to produce light.' Almost simultaneous with the death of Brewster appeared that most beautiful generalization of Maxwell, which at a stroke converted the ether into the all-important factor of the material universe, and from that day the study of this subtle medium has progressed until it is safe to say that we know much more about it than about matter. The most important physical investigations of the day deal with the connection between what, for the lack of a better term, we call matter, and the ether, and no one has contributed so much to the solution of this question as this candidate. The human mind may recoil from the contemplation of limitless space and numberless worlds, but still more must it hesitate and acknowledge its impotence when called upon to penetrate the secrets of the atom, a million times too small to be seen even under most powerful magnification. Faraday read the ridicule of electromagnetic induction, Maxwell and Hertz set light and electric waves in the same class, Röntgen added the x-rays, and Becquerel the new radiations. Whose task has it been to co-ordinate these widely varied phenomena and show them as applications of simple fundamental laws rather than marvellous exceptions? Who, relying upon the simple laws of the elastic ether, has penetrated the structure of the atom and revealed its secrets? Who has taught and inspired a host of the ablest investigators in physical science? None to an extent comparable with Joseph John Thomson, Cavendish professor of experimental physics in the University of Cambridge, England, whom I have the honor to present, and respectfully request that the Degree of Doctor of Science be now conferred upon him."

In conferring the degree of Doctor of Science, President Butler welcomed Prof. Thomson as "comrade of Maxwell, Helmholtz and Kelvin in the mastery of Nature's intimate secrets, standing as they stood on the outermost edge of the boundary of knowledge."

Mr. Hewitt was felicitously presented by his friend, Prof. M. I. Pupin, and in conferring the degree of Doctor of Science, President Butler said: "Peter Cooper Hewitt, distinguished son of a distinguished father, whom this university will always delight to honor, scientist and inventor of exceptional insight and skill, I gladly admit you to the degree of Doctor of Science in this university, and confer upon you all the rights and privileges that belong thereto."

The degree of LL.D. was also conferred on President Humphreys, of Stevens Institute, who graduated from the mechanical engineering course of Columbia in 1881. In introducing President Humphreys, Dean Hutton, of the faculty of applied science, said, in part: "A graduate from the mechanical engineering course in 1881, he has shown that this education can fit a man to carry the most exacting burdens of industrial administration and affairs. From modest beginnings he became the founder of important business enterprises which are monuments of his professional ability and his faculty for organization and control. We honor him because of the love and loyalty which he has manifested to his alma mater when at her call and in her need he laid aside the lucrative and expanding opportunities of his chosen path to assume the burden and responsibilities of the presidency of Stevens Institute. We honor him for the energy, the ability, the tact, the courage, the self-sacrificing enthusiasm with which he has assumed these duties and is now discharging them."

At a luncheon which followed in the Alumni Memorial Hall, Prof. Thomson spoke. He stated that he had been greatly impressed by American universities and still more by the magnificent benevolence showered upon them. "I envy American liberality," he said. "Cambridge University sorely is straitened for funds. It took years of hard work to raise $350,000. It is difficult to interest rich Englishmen in education, while here it seems to be the first interest of the wealthy man. I regret, though, that your enormous gifts for university buildings are not accompanied by corresponding gifts for endowment. A peculiar danger is constituted here by the fact that salaries received by teachers are lower than in any other country in the world. The greatest pleasure is in solving the things which seem to be most obscure, but scientists are kept away from investigation by lack of material reward."

Programme of the Institute Niagara Meeting.

The following is the programme in detail of the meeting of the American Institute of Electrical Engineers at the Cataract House, Niagara Falls, on Monday, June 29, and following days:

Monday, June 29. Institute and President's day, 9:30 to 1. Address, President Scott. Institute Branch Meetings, their Organization, Development and Influence, by Calvin W. Rice. The Energy Transformation in the Synchronous Converter, by W. S. Franklin. Commercial Alternator Design, by W. L. Waters. Afternoon—Visits to local points of interest. No prearranged programme. Evening—An Exhibition of the Hewitt Converter and the Mercury Vapor Lamp, by P. H. Thomas.

Tuesday, June 30. Electrical Day, 9:30 to 1. Railroad papers: High Speed Electric Railway Problems, by A. H. Armstrong. Storage Battery Industrial Locomotives, by Frank L. Sessions. Predetermination in Railway Work, by F. W. Carter. Car Run Tests, by W. E. Goldsborough and P. E. Fansler. Some Recommendations Concerning Electrical and Mechanical Specifications for Trolley Line Insulators, by Samuel Sheldon and J. D. Keiley. The Storage Battery in Substations, by W. E. Goldsborough and P. E. Fansler. Notes on the Operation of Railway Motors in Service, by Clarence Renshaw. Afternoon, 2:15.—Technical tour of inspection of electrochemical and other electrical installations operated by Niagara Falls Power, and the Power Houses of the Niagara Falls Power Company. Reception by Niagara Falls Power Company on Terrace of Power House No. 2. Evening—Dance under the auspices of Local Committee at Cataract House.

Wednesday, July 1, Niagara Day, 9:30 to 1.—Power Transmission Papers: On the Testing of Electrical Apparatus for Dielectric Strength, by P. H. Thomas. Choice of Frequency for Very Long Lines, by P. M. Lincoln. Methods of Bringing High-Tension Conductors into Buildings, by C. E. Skinner. Y or Δ Connection of Transformers, by F. O. Blackwell. The Grounded Wire as a Protection against Lightning, by Ralph D. Mershon. The Operation and Maintenance of High Tension Underground Systems, by Philip Torchio. Electric Cables for High Voltage Service, by Henry W. Fisher. The Use of Automatic Means for Disconnecting Disabled Apparatus, by H. G. Stott. Afternoon—Trolley trips to Niagara Gorge, Fort Niagara, Brock's Monument, Chippewa. Technical visits to following plants: Niagara Falls Hydraulic Power and Manufacturing Company; Canadian Niagara Power Company; Natural Food Company. Evening—Entertainment, Cataract House, under auspices Local Committee and General Committee.

Thursday, July 2, Excursion Day, 9:30 to 1.—Miscellaneous papers: The Factors which Affect the Energy Losses in Armature Cores, by J. Walter Esterline and Clarence E. Reid. Central Station Economies, by W. E. Goldsborough and P. E. Fansler. The Electrical Equipment of a Gold Dredge, by R. L. Montague. The International Electrical Congress of 1904, by Elihu Thomson. The Legalized Standard of Electromotive Force, by H. S. Carhart. Symbols and Nomenclature, by Carl Hering. A Universal Telegraphic Code, by G. C. Squier. The Magnetic Units, by A. E. Kennelly. The Cathode Ray Alternating Current Wave Indicator, by Harris J. Ryan. Some Notes on Certain Underground Hoisting Problems on the Witwatersrand, by A. W. K. Pierce. Afternoon—Technical excursions to Olcott Beach, St. Catharines, Lockport, Tonawanda Substation. Evening—Illumination of Gorge Route.

Friday, July 3, Buffalo Day, 9:30 to 1.—Joint meeting with the Society for the Promotion of Engineering Education. Papers will be presented by the following members of the Institute: The Teaching of Physics to Electrical Engineering Students, by W. S. Franklin. The Problems that are Facing the Electrical Engineer of To-Day and the Qualities of Mind and Character which are Neededed to Meet them, by J. G. White. The Proper Qualifications of Electrical Engineering School Graduates, from the Telephone Engineer's Standpoint, by Bancroft Gherardi, Jr. The Proper Qualifications of Electrical Engineering School Graduates, from the Manufacturer's Standpoint, by L. A. Osborne. The Education of the Artist in the Forces of Nature, by E. H. Mullin. Engineering English, by T. J. Johnston. Lunch 1 to 2. Afternoon—Technical trips to Buffalo, Buffalo General Electric Company, Buffalo Terminal House. Adjournment of convention.

The Training of Telephone Operators.

THE OPERATOR'S TRAINING SCHOOL OF THE NEW YORK TELEPHONE COMPANY.

By Herbert Laws Webb.

A NEW YORK daily newspaper of this date—a date that shall be nameless, for no one shall know how long it has taken me to complete this article—contains a dispatch from an unknown place in the interior of the country, which rejoices in a name suggestive of a heroine of a romantic novel, stating that a wealthy banker of the place "fell in love with a telephone girl who always answered his calls promptly, and they were married this afternoon." Doubtless there is a wealth of romance concealed behind that succinct statement, and it was probably hardly the intention of the industrious reporter who discovered, or invented, the event to lead us to believe that the wealthy banker married the telephone girl simply because she answered his calls promptly. A telephone girl who answers calls promptly is not really a *rara avis,* and, if she were, the average wealthy banker is not so lacking in intelligence as incontinently to marry the first quick operator he meets and so reduce the efficiency of the telephone service. If he really appreciates quick telephone service he would be acting contrary to his own interests in removing from the switchboard to his fireside the giver of it. However, let the story stand for what it is worth; it may result in a marked acceleration of the rapidity of the telephone service furnished to wealthy bankers the country over, and it may help to increase the general efficiency of telephone operators, since none can tell when she may be entertaining an "angel" unawares.

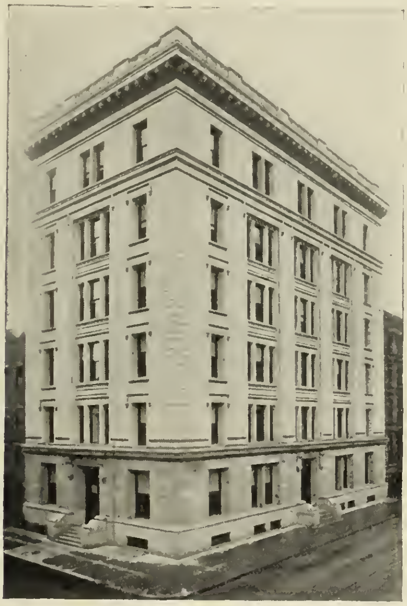

FIG. 1.—EIGHTEENTH STREET TELEPHONE EXCHANGE AND SCHOOL.

The making of an expert telephone operator is by no means the simple matter that many suppose it to be, and there is far more in telephone operating than the quick answers that captivated the wealthy banker of Muscatine. At its simplest, the operation of a telephone switchboard so as to give a thoroughly efficient and satisfactory service demands an intelligence somewhat above the average, trained and guided by careful tuition and suprvision. But in a large city telephone system of to-day there is such a great variety of possible calls that may be made—local, suburban and long-distance, direct-line, party-line, public station, private branch exchange, and so on—and this great and ever-increasing variety involves the use of so many different signals and tests, each having its proper place in the general scheme for the rapid and accurate handling of the traffic, that the demands made on the capacity of the expert operator are far more exacting than anyone not familiar with the inside working of a telephone system would readily believe. With the growing complication of the modern city telephone system and its traffic there has arisen a necessity for giving the operators a regular course of preliminary training and tuition before entrusting them with any part of the actual work of operating subscribers' lines.

The method of teaching telephone operators their work formerly followed was to allow the learner to "listen in" at a working operator's position and to watch the handling of the plugs and keys and the display of signals, picking up what explanation she could of the meaning of these movements from the orders and answers she overheard in her head telephone. After a period of this learning by looking on, with a certain amount of instruction from supervisors and chief operators to aid her in acquiring a working knowledge of the switchboard, the learner was placed at a light position, under the wing of an expert operator, and so gradually acquired by sheer practice the confidence and quickness of the full-fledged operator, working up from an assisted position, through night work when calls are few, to an easy day position, until finally judged sufficiently expert to handle a fully loaded position at the busiest time of day. To reach this point usually took the average girl about nine months; as the telephone operator does not, on the average, remain a telephone operator for longer than three years, it follows that a quarter of the total time the operator remained in the telephone company's employ was occupied in teaching her to do her work efficiently.

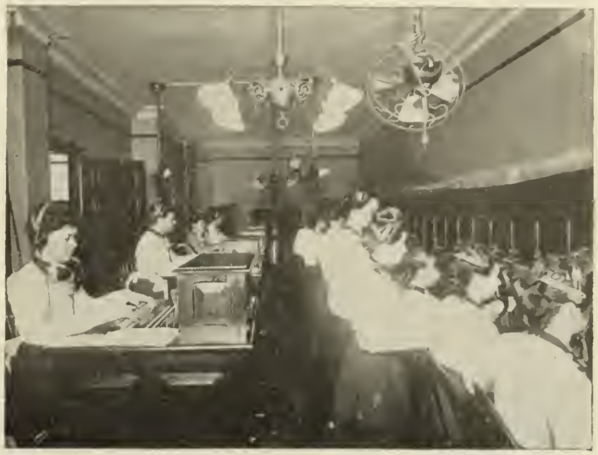

FIG. 2.—SWITCHBOARD PRACTICE.

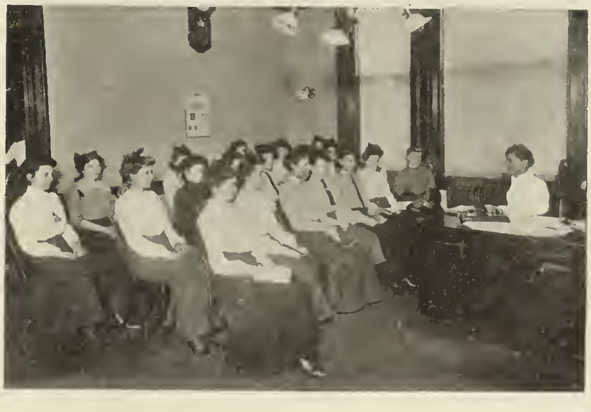

FIG. 3.—LECTURE ROOM.

All these operators have to be taught their work, as telephone operators rarely travel and do not go from one telephone company to another, so that there is no supply of experienced applicants. Nowadays there is, in addition to the demand due to the rapid expansion of the telephone system, a steady demand for trained operators for private branch exchanges in business houses, but even before this demand arose to reduce the telephone company's force the average time that a girl remained an operator was not more than three years. After three years' service at the switchboard she left to get married, to take up other work, because she was wanted at home, and probably for a variety of other reasons; but anyhow, she left, and her place had to be filled by the laborious process of training a learner in the manner described

The new method of training operators is as great an advance over the old as the common battery switchboard is over the magneto system It consists in passing them through a thoroughly equipped and officered training school, where they are taught how to handle the various parts of a telephone switchboard, how to answer calls, how to complete all the many different kinds of connections that they may be called upon to make, even how to handle an abusive or argumentative or flirtatious subscriber. And as in any other good school these things are not taught simply by rule of thumb, but a good groundwork of theory and underlying principles is given on which to build more firmly the working knowledge of the apparatus that comes by actual manipulation.

The training school for operators of the New York Telephone Company is established in the new Eighteenth Street telephone building, where it has been in active operation for nearly eighteen months, having started in January, 1902, with four students. The school is now arranged to accommodate about 60 learners at a time, and up to the present it has supplied the working exchanges with no less than 825 graduates from its very thorough course of tuition in the science and art of telephone exchange working. The school has a total teaching staff of nine, under the very able management of Miss Katharine Schmitt, one of the company's most experienced exchange employees, who is undoubtedly one of the smartest telephone women in the country. Miss Schmitt has the great advantage for her position of being what no mere man could pretend to be, a very actute judge of womankind; and any young woman who passes her preliminary examinations and tests and then completes the course of training in the school has the best possible certificate of being fit for the work of telephone operating under the stress of New York conditions. Not by any means all, not even a very large percentage of the applicants survive the ordeal. Of the applicants, who often number forty to fifty in a day, not more than about half are found to have the requisite qualifications to justify even beginning to teach them the inner mysteries of the telephone system; and of those who pass the preliminary examination as to character, education, physical and mental fitness, from thirty to forty per cent. drop out in the sifting process that goes on in the first week or two of tuition. On a broader scale, it is much the same as with the fire horses; either a girl shows from the beginning that she has an aptitude for the work, or she shows within a week or so that she has none, or so little that it is not worth while to expend time and labor on teaching her work at which she will never become expert.

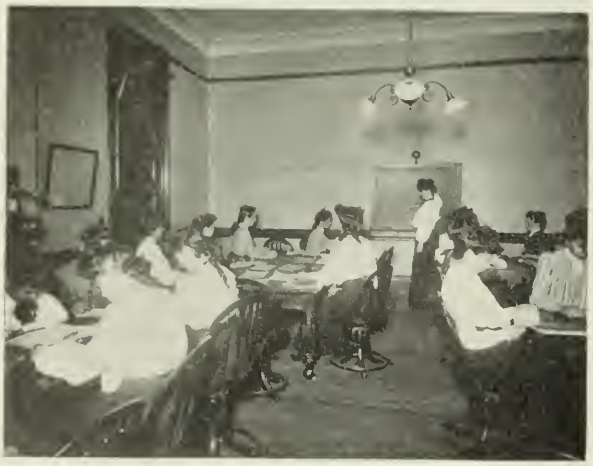

FIG. 4.—STUDY ROOM.

From this point of view alone the school has an enormous value, as it eliminates entirely from the exchanges the raw student element, which previously made a serious draft on the time and attention of the supervisors and chief operators, and also constituted more or less of a clog on the service. Further, the school provides means of testing a beginner's capabilities and general aptitude for the work very much more effectively and quickly than was possible under the old system of training learners in the exchanges. The general result of the school system is this: After a month's training in the school the graduate is a more efficient operator than was formerly obtained after three or four months of the "listen in and look on" method; and the training school graduate after about four months in the exchange is a full-fledged expert operator. So that in about five months' time the new system produces the result that formerly was estimated to take about nine months, and produces it with much less trouble and friction both inside the exchanges and between operator and subscriber. Nor does this tell the whole story. It was reckoned that nine months' training were necessary to produce an expert operator a few years ago, when the system was smaller and simpler and the standard of service somewhat lower than it is to-day. The tremendous development of the system has brought with it a corresponding increase in the variety of calls that may be made, and this, coupled with the steady raising of the standard of efficiency of service—implying both an increase of smartness and an increase of accuracy—makes a greater demand on the intelligence and capacity of the operator than was made a few years ago. So that the expert operator of to-day is a bit more of an expert than she of a lustre ago. She does more work and quicker work and more accurate work, and, thanks, to the school, she learns to do it in not much more than half the time that was formerly necessary.

The first step in dealing with applicants is to test their general fitness for learning the work. The usual applicant is a young girl of between seventeen and twenty, living with her parents or relatives, and of whose character or general conduct there is practically no question. In dealing with recruits to a force of young women numbering close on to two thousand and working in groups of between one and two hundred, this is naturally a question that must be put beyond doubt. Many applicants come direct from school with recommendations from their teachers, and the question of a sufficient elementary education—the ability to write, read and understand, quickly, clearly and correctly—is easily settled. The physical and mental qualifications are the next points—a fair height, good hearing and eyesight, and a good voice production and pronunciation are the chief physical requisites, and a quick intelligence and alertness of mind are the mental qualities required, and are easily recognized when present. Unfortunately, they by no means always are present. All these points are pretty thoroughly tested, and those who fail to pass the test may be pretty sure that they have not been superficially or carelessly judged. Miss Schmitt detects those who fall below the standard as unerringly as the automatic balance at the mint rejects light-weight coin.

The successful applicant then immediately begins to learn the routine of work in a modern telephone exchange, and from an applicant passes to the stage of a student. To each student is assigned a locker and a number, by means of which her work may be identified at any time in the future. In this respect it will be seen that the telephone company is consistent, as it gives the operators' numbers as well as the subscribers. The first lecture to a class of learners begins with instructions regarding the hours of duty, the deportment expected of operators when in the exchange quarters and the care of their lockers; it then plunges *in medias res* with a description of the telephone; that is, of the subscriber's station, of the manner in which it is connected to the exchange and of the functions of the exchange switchboard and of the operators who serve it. The description of the telephone system and of the multiple switchboard and its various parts is illustrated by means of admirably executed diagrams and drawings, some of which are reproduced here. Each part of the switchboad is explained point by point, and the students learn how each subscriber's line terminates in its answering jack and signal, how each line may be reached at any part of the board by means of its multiple jacks, and what the various jacks and signals mean. The interest of the students is retained, and at the same time an idea is got of their intelligence and receptiveness, by asking them questions as the lecture goes along, getting them to point out which are the answering jacks and which the multiple and giving them practice in picking out jacks on the diagrams by their numbers.

After this preliminary canter the students are taken to the switchboard and are shown the actual apparatus, the use and nature of each part of the equipment being thoroughly explained. Very careful instruction is given in the handling of the cords and plugs, and the students are specially cautioned against the vicious practice —the cause of so many cord troubles—of pushing plugs in and pulling them out by the cords. The use and proper manipulation of the combined listening and ringing key is explained and illustrated by the instructor, and the function of the supervisory lamps and their relations to the cords made clear. After this object lesson, the impression it has made on the students is tested by asking them to name the different parts of the keyboard equipment and to describe their use.

At the next lesson, the students enter upon the science and art of telephone operating, and learn how to answer calls and how to check the number asked for by subscribers. Particular attention is given to teaching the students to answer in a brisk and business-like manner, and this important little detail is illustrated by the instructor, who makes very plain the difference between the tired and lackadaisical manner that makes the subscriber's heart sink and the clear, brisk tones that inspire the subscriber with confidence in the efficiency of the operator. It is just such points as this that illustrate the thoroughness and intelligence of the system of tuition. The actual operation of the switchboard is then gone into more fully and the meaning of the supervisory lamps is thoroughly explained and illustrated by practical demonstration. The students are taught to supervise entirely by means of the lamp signals, and thus it will be seen that New York is in course of acquiring a race of telephone operators who will never have learned to use that distressing phrase, "Are you through?"

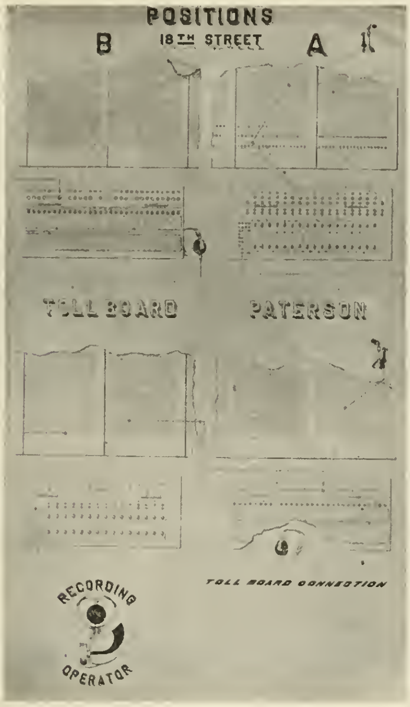

FIG. 5.—DIAGRAM OF A TOLL CONNECTION.

From this point on the student gets daily deeper into the mysteries of a large telephone system. The succeeding lectures of the course deal with the various signals on the line lamps, indicating different classes of service, with the recording and checking of messages, with the "busy" test and all the troubles and embarrassments liable to arise from it if it is disregarded or if the calling subscriber is incredulous and persistent—not an unknown occurrence. Next the students are made acquainted with the methods of trunk working, and with the various signals on the multiple jacks indicating private branch exchanges, numbers changed or discontinued, and so forth. Were I to set out in detail the extent and variety of the information which a telephone operator in a modern and extensive system is required to absorb in order to fit her for her work, it would make quite a formidable list of items. And to become thoroughly efficient and useful she must not acquire this knowledge merely superficially, but must get it accurately and firmly fixed in her mind, every detail thoroughly mastered so as to be ready for any of the thousand and one different demands that may be made on her in the course of a day. If a mechanical operator could take a tour through some of the New York exchanges and observe the immense variety of calls that are made, it would throw itself on the nearest scrap-heap in despair.

In the course of tuition the lectures illustrated by diagrams alternate with practical work at the switchboard. The lectures cover all the general principles of the work of exchange operating and management and organization; the districts into which the city and neighboring territories are divided are described and illustrated in dealing with trunk working; the organization of the exchanges is fully shown in explaining to the operators their relations with the supervisors, monitors, chief operators and managers and the assistance they are to expect from them in the course of their work; the methods of reaching out-of-town points and of dealing with the various special calls and difficult connections are all duly explained and illustrated by precept and example.

The working part of the school consists of a fully equipped common battery switchboard of twelve *A* positions and two *B* positions. This switchboard is fitted with every variety of appliance and signal that is to be found in the regular exchanges and is capable of dealing with every variety of call likely to be originated in the actual working of the general system. The subscribers are represented by a number of supervisors, seated at desks overlooking the switchboard. These desks are equipped with telephones and with a number of lines connected to the switchboard. These representatives of the public pour in upon the students a steady stream of calls of all kinds, and they enjoy the highly original experience of making telephone calls and actually watching the handling of them. And let it not be imagined that these supervisor subscribers make merely perfunctory calls that are always easily handled. By no means. They test and try the learners in every possible way, even to the extent of trying to make them lose their tempers by arguing with them and by affecting to disbelieve "busy" reports! Being experienced operators themselves, they know well the little difficulties that telephone users sometimes create, and all of these they practice on the learners—to prepare them for the "real thing." Patrolling the switchboard itself are other supervisors, in their own parts, watching the work of

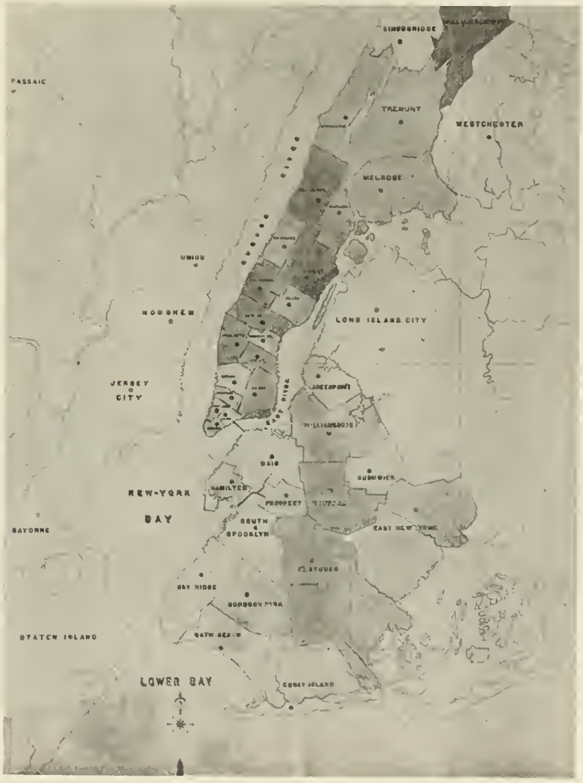

FIG. 6.—MAP OF NEW YORK TELEPHONE DISTRICTS.

the student operators, helping them with difficult connections, correcting their errors and instructing them in each new detail as it comes up. It can readily be imagined that after a few weeks of such very practical practice as this, a student who has any real aptitude for the work is in a fair way of becoming a well informed telephone operator, with a certain amount of confidence in herself and with a good working knowledge of the apparatus she has to deal with in the actual exchanges.

When she graduates from the school to the exchange she finds exactly the same apparatus as that which she has been handling in practice, the same methods, the same discipline, the same accommodations and general surroundings, only all on a larger scale and doing real business for the great and exacting public. She is like a sailor boy transferred from a training ship to a man-o'-war in commission that sails the deep blue sea and meets fair weather and foul, and has to be worked and trimmed and tended and navigated at all hours of the day and night. In either case, if the right training has been given to the right material, she or he soon "shakes down" and takes up the real work in a workmanlike way.

In dealing with a class of work where so much depends on scrupulous and accurate attention to almost innumerable details it is difficult to give a fair description without going into detail to an extent that would threaten to be tiresome. However, I think I have said enough to show that the organization and conduct of the school are throughout characterized by the motto of the New York Telephone Company, "Thorough." The combination of theoretical instruction and explanations in lectures and by diagrams with the actual practical working of a switchboard of exactly similar type to those used in the exchanges is most happily and judiciously carried out. To a large extent, the girls are led to teach themselves, by arousing their interest in the work and encouraging them to ask questions on all points where they feel any doubt. As a general result a course of four or five weeks' training in the school puts the student operator on a rather surer and more stable footing of efficiency than four or five months' training in the exchanges under the old method. The school-trained operator is not only just as expert in the manipulation of the apparatus after four or five weeks in the school as the learner in the exchange formerly was after four or five months, but she is better grounded in the general conduct of the company's business and in the broad principles of the big system with which she has to deal. She has somewhat the advantage of the man who has been to college, as compared with the man who has just picked up his training as he went along. Moreover, as Mr. Sherwood pointed out in the recent Institute discussion on telephony, the training school course provides the exchanges with a staff of operators who have acquired a uniform method of working, and this is a noticeable advantage in the conduct of the service as a whole.

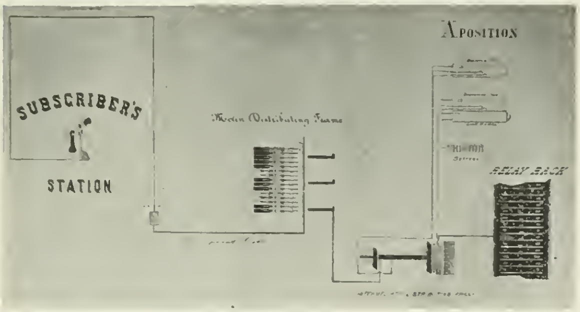

FIG. 7.—DIAGRAM OF SUBSCRIBER'S LINE.

In Mr. Sherwood's recent contribution to the Institute discussion on telephony, he summed up admirably the advance that has been made in the operating efficiency of the New York telephone service by the general adoption of the relay system, and also summarized the advantages gained by the institution of the training school. In one very interesting remark he answered the question that might be asked as to why, if a training school is so beneficial, was it not established before. Until the end of 1901 the switchboards of the New York system were not of uniform design or method of working. So rapid has been the progress of telephone engineering that there have always been two or three different styles of exchange equipment in use at New York at the same time. The Eighteenth Street exchange, for instance, has been rebuilt three times in less than 12 years—in 1889, in 1894, and in 1901. Since 1898, when the first relay exchange was put in service, there have been distinct styles of switchboard in use, the relay system, the magneto with self-restoring drops, and the magneto with manually restored drops, and an operator accustomed to any one of these would be more or less a stranger to either of the others. Consequently a central training school would have had a somewhat complicated job to cope with, involving a course in "classics," an intermediate course, and a modern course. The complete reconstruction of the plant on the relay system, finished at the end of 1901, gave the whole service of Manhattan Island—for the first time in its history, I believe—a uniform method of working throughout. It then became possible to establish a training school to teach a uniform method of operating, and the school started its course at the beginning of 1902.

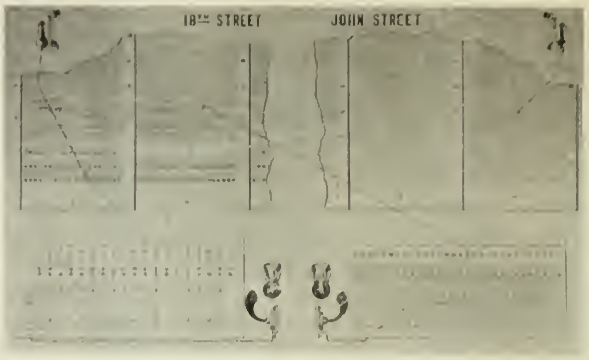

FIG. 8.—SECTIONS OF MULTIPLE SWITCHBOARD.

Collins Wireless Telephone System.

By Dr. T. Byard Collins.

THE electrical equipment employed by A. Frederick Collins in his recent tests of wireless telephony between moving ferry-boats on the Hudson River is shown in the accompanying illustrations. The instruments are the ones used at his Rockland Lake proving grounds the preceding summer, and by which he was enabled to transmit and reproduce articulate speech to a distance of a mile without wires.

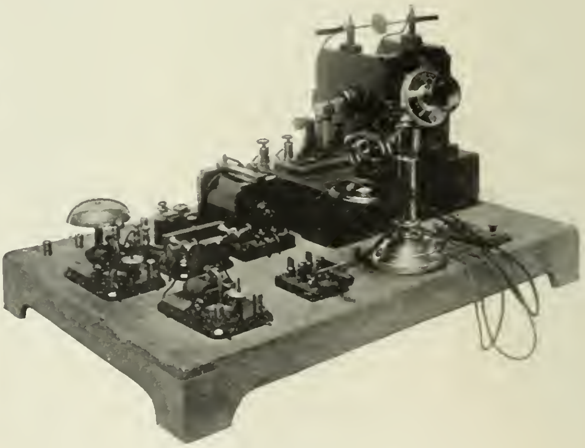

FIG. 1.—TRANSMITTING AND RECEIVING APPARATUS.

The apparatus is complete in every detail, being arranged to send and receive telephone messages and with calling and indicating appliances as in the case with the regulation telephone. The wireless telephone partakes of the nature of both the wire telephone and the wireless telegraph and the apparatus is similar to a combination of these prototypes, if we make one or two exceptions.

In assembling these parts the arrangement is such that alternating currents are set up in the system which describe pure sine wave curves, and are, therefore, opposed to and eliminate the obstacles that have prevented the adoption of high-frequency currents with maxima decreasing in geometric progression as produced by the disruptive discharge. An objection to this method of compromising low-frequency alternations of the ordinary telephone and the high-frequency oscillations of the wireless telegraph by introducing a mechanically high-frequency current in the wireless telephone may be made on the ground that its carrying capacity is limited when compared with telegraphy without wires, and this will have to be admitted for the present, but an increase in distance is only a matter of evolution, just as it has always been with devices for the transmission of intelligence.

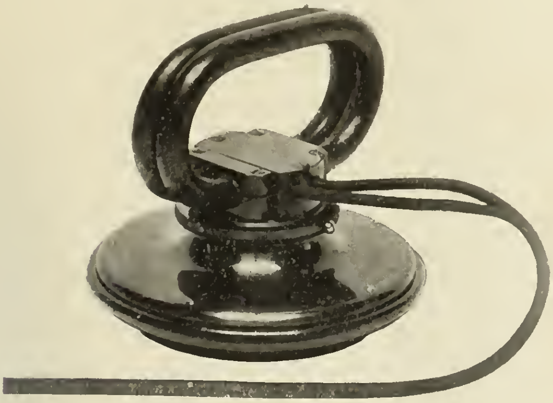

FIG. 2.—RECEIVER.

There are some inherent difficulties in this extension of distance in wireless telephony not found in wireless telegraphy, for in the former the ordinary transmitter will only carry a current of a certain critical value which, if increased, will burn out, whilst in wireless telegraphy there is practically no limit to the amount of energy that may be radiated.

The experimental researches of Mr. Collins in seeking the best means for the transmission of speech without wires are interesting, since he began with the conductivity and has run the whole gamut up to the Hertzian wave method. In this way he became familiar with the merits and limitations of all the different means to the end of wireless telephony. In his investigation of Hertzian wave phenomena he slowed down the high-frequency oscillations until they registered a periodicity of only a thousand per second, when the emitted waves were of correspondingly greater length, so long in fact, that it was indeed difficult to determine whether they were transverse vibrations in the ether or longitudinal current thrusts.

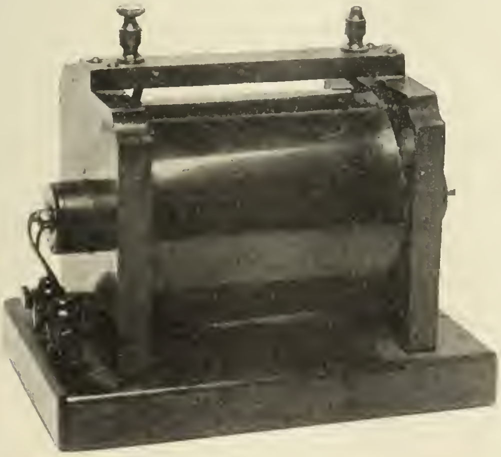

FIG. 3.—TRANSFORMER.

In producing these phenomena Mr. Collins damped down the oscillator circuit by the addition of capacity using a battery of Leyden jars for the purpose and sustaining the relation of the coefficients by adding inductance formed of coils of fine wire; as the frequency of oscillation slowed down to a period equal to mechanical vibration, the telephone receiver responded and without the intervention of a coherer or other wave-detecting device, and the period of alternation at which it operated the best was between one and two thousand.

In these experiments a closed circuit oscillator and resonator was employed so that the oscillations would be rendered as persistent as possible; now what with the damping factor, the low-frequency and the closed circuit, it is evident that distance could not be bridged to any great extent, yet sufficient to show that there was a germ for a system of wireless telephony which, properly cultured, would be of service for places where a few thousand feet would suffice.

Another line of research by Mr. Collins and one that not only interests in its new phases, but which gave evidence of long-distance wireless telephony, was carried out by causing the discharge to take place in the earth instead of in the air, thus eliminating some of the disadvantageous features of very rapid oscillations such as occur when a high-potential circuit is discharged across an air-gap.

In this case two terminals were earthed, but it must not be inferred that the method is that or similar to that employed in conductivity experiments—in fact, there is as much difference between the two as there is in obtaining electric oscillations by a disruptive discharge and low-frequency, high-potential currents by separating the spark balls to a point beyond the sparking capacity of a coil. In the experiments above referred to the terminal plates or spheres were placed very closely to each other; that is to say, from one to three feet. The energy propagated is of course in the nature of current impulses, but the distance attained with the telephone was far greater than when plates were used in rectangles separated a half of the distance over which indications are to be received, besides possessing the absolutely necessary feature demanded by commercial requirements. The apparatus operates experimentally in free air, but to no effective distance, and in this it follows the analogue of sound; i. e., if a bell sending out its waves can be heard a distance of a mile in free air, it can be heard a distance of twelve miles if struck under water, since water is the denser medium, and similarly with the discharge in the earth. It may be accounted for by the fact that the ether, when closely identified with gross matter, apparently assumes a greater density than in air, and greater in air than in vacuum. To this paradoxical condition the name of *bound ether* has been given, and bound ether has the property of propagating impulses of this nature to much greater distances than ether associated with free air.

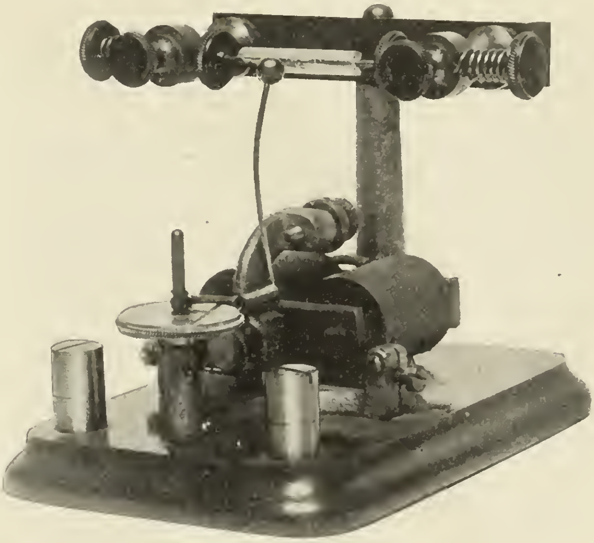

FIG. 4.—COHERER AND TAPPER.

As in every other method for the electrical transmission of energy without artificial connection, the impulses are radiated in every direction, but for the purpose Mr. Collins intends using his wireless telephone, namely, on harbor craft, this feature is far from objectionable, since every vessel within a given radius should be made aware of the presence of every other vessel.

It will be even more difficult to syntonize wireless telephone apparatus than that employed in wireless telegraphy, but in the former secrecy is not a necessity and the first boat that comes into the field of force is the one the wireless telephone is to serve first, just as the first train to enter a block in which there is already a train is the one to receive the signal.

At his Rockland Lake experimental stations Mr. Collins had equipped the first complete wireless telephone system ever operated; it included at either end a sending and receiving apparatus, together with wireless bells for signalling in both directions. Mr. Collins' recent test on the Erie Railroad ferryboats was the first attempt to improve the signalling service of harbor craft.

It seems passing strange, but it is nevertheless true that until Mr. Collins' application of wireless telephony between moving boats there had not been a single improvement for signalling between vessels in harbors since the invention of the steam whistle.

Mr. Collins' wireless telephone is evidently not designed to supplant the wire telephone, even as the wireless telegraph will never take the place of the wire telegraph, but the field of the wireless telephone is enormously large, its usefulness unquestioned, its practicability assured, and its immediate adoption certain.

A Contribution to the Subject of Aging of Sheet Steel.

By Thomas S. Allen.

It is not the writer's intention to go into detail or bring forth any new theory on the above subject, but only to place before the public the results of a few experiments performed along this line at the works of the Bullock Electric Manufacturing Company. As far as can be ascertained from the many recent publications on this subject, aging of sheet steel is supposed to be caused only by heating, and not by magnetic reversals, as was formerly believed to be the case. With this point in view, the following tests were made to see if heating would cause any appreciable increase in the hysteresis loss of commercial sheet steel for armature construction.

The hysteresis of the samples tested was measured with a Ewing hysteresis tester. This tester was not used to measure the hysteresis loss direct, but only to compare the loss of the samples under test with the known loss of two standard samples; this loss is termed the "hysteresis constant," and will hereafter be expressed by that term. The samples tested were each composed of several strips ⅝ in. wide and 3 in. long. Three different readings were made on each sample, six strips being taken for each reading, and the hysteresis constant was deduced from the average of these readings, thus reducing the error of the readings to a minimum. The strips were punched from the sheet with a special punch and die, thus insuring the same shape and size for each strip, and, by taking the same number of strips for each reading, it was possible to get a constant weight and section of iron for every reading on any particular gauge.

The first test was made on six samples, each of which was selected from a different shipment of commercial steel, by this means securing samples that were as widely variable with respect to composition as was possible for us to obtain. The samples were also selected with the object of covering a wide range of hysteresis constant. The hysteresis constant of each sample was very carefully measured, after which they were placed in a drying oven with the temperature varying from about 67° to 125° C. Every few days the samples were taken out and tested. This operation was repeated fifteen times during the complete test, which extended over a period of 180 days. The temperature of the oven was also taken at twenty-five different times, giving an average of 93° C.

The results of these tests were plotted in the form of curves, shown in Fig. 1, with the hysteresis constant as ordinates, and the time the samples were in the oven in days as abscissæ. Each sample was composed of eighteen strips of steel .014 in. thick except sample No. 5, which consisted of twelve strips of steel .025 in. thick. This sample shows an increase of hysteresis constant from .47 before it was placed in the oven, to .863 after it had been in for 150 days, then decreased to .84 in the next thirty days. Sample No. 92, which had a very high constant before it was placed in the oven, did not change any great amount, as it had practically the same constant at the end of 180 days as it had at the start. Sample No. 105 nearly doubled the value of its constant in 110 days, then decreased a slight amount in the next 70 days. It is interesting to note that the constant of sample No. 101 increased very rapidly for the first ten days, and, at the end of 180 days, it had decreased to nearly the original value.

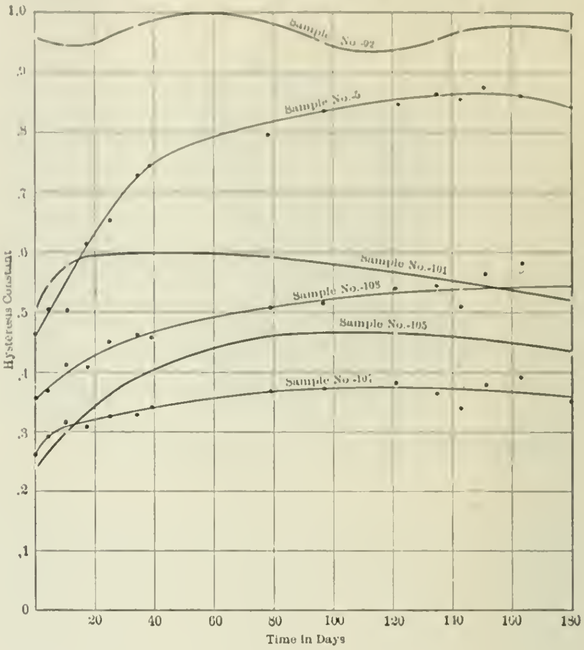

FIG. 1.—CURVES SHOWING RESULTS OF TESTS.

The results of the second test on six other samples are shown in Fig. 2. This test was conducted in the same manner as the first, and as this set of samples was selected from altogether different shipments than the first, a comparison of the two tests shows the aging of different samples to be rather variable.

These tests, although not very extensive, show, as far as they go, that aging is likely to take place in all sheet steel subject to a variable temperature and especially with steel having a low hysteresis constant to begin with. Therefore, if aging takes place at lower temperatures, say about 50° or 60° C., it would seem rather absurd for the dynamo manufacturer to spend his time and money in annealing armature iron.

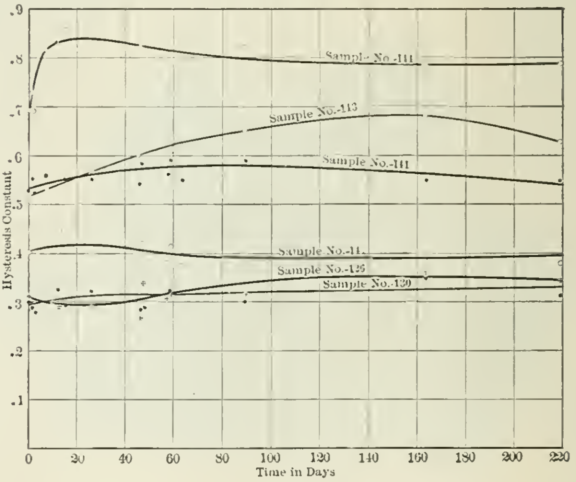

FIG. 2.—RESULTS OF SECOND TEST.

With the present advancement in the manufacture of electrical machinery, and the rigid guarantees which the manufacturer has to meet, it is of the utmost importance that he should know the true quality and composition of the steel to be used. Taking for an example, the ponderous generating units of from 5,000 to 10,000-kw capacity, the magnetic circuits of which contain thousands of pounds of sheet steel, and on which the guarantees for efficiency are drawn up to the fraction of one per cent., it will at once be seen that the manufacturer is placed in a rather unpleasant position as he has no means of ascertaining whether the iron to be used will or will not increase 200 per cent. in hysteresis loss. There are many cases where machines of the best and latest design are running to-day with a temperature rise of double the amount obtained from the tests made on them at the makers' shops. From these facts it will be seen that no matter how much skill is employed in the design of a generator, this peculiar phenomenon (aging) may creep in to mar all the good points of the design.

The time is rapidly approaching when this matter will have to be settled, for a non-aging iron is absolutely essential for the design of first-class electrical machinery. It is hoped that this paper will help to convince its readers of the vital importance of this subject to electrical manufacturers.

In conclusion, the reader's attention is directed to a paper by Mr. S. R. Roget, B. A., entitled "Effect of Prolonged Heating on the Magnetic Properties of Iron," which was read before the Royal Society on May 12th, 1898. This paper gives the results of very extensive and interesting tests, the method of obtaining the hysteresis loss being the same as was used in the tests explained in this article. From the title of this paper it would be inferred that these tests extended over a very long stretch of time, but, as a matter of fact, twenty-five days was the longest test on any one sample. These tests were also made with steady temperatures, the lowest being 50° C., at which temperature the sample tested aged but little in twenty-five days. The results may have been true for those conditions of temperatures and time, but which we could not compare with the conditions met with in practice. As electrical machinery is called on for wide variations in load, we may expect wide variations of temperature.

Electrical Engineers in the Modern City.

Prof. Harold B. Smith, in charge of the electrical engineering department at Worcester Polytechnic Institute, Worcester, Mass., gave the annual commencement address, last week, in the electrical laboratories, before the members of the Engineering Society and a number of interested friends of the institute, including many women.

Prof. Smith's topic was "The Relation of the Electrical Engineer to Modern Social and Industrial Progress," and his treatment of the theme was at once popular and comprehensive. Few lectures upon electrical subjects ever given in Worcester have been so thoroughly understood and generally interesting to those not directly connected with electricity or electrical development, as was Prof. Smith's talk.

Supplementing the lecture itself, Prof. Smith threw upon a screen a large number of stereopticon views, showing the methods of power development and transmission, as well as the buildings and machines connected therewith. With the aid of the electrical equipment at the institute, Prof. Smith also gave a practical demonstration of power transmission. This was in fact a most interesting and significant experiment. The high-potential laboratory is located about 1,000 ft. from the lecture room in the Salisbury laboratories. In the former is located Prof. Smith's 500,000-volt transformer, and from it he transmitted current at 120,000 volts, 60 cycles, to his 175,000-volt transformer in the lecture room; while to the secondary of this transformer he synchronized a 10-kw rotary converter on the lecture table, and applied load to the secondary of the rotary. The above voltages were effective values, and the night was damp and rainy. It is said that this is the first time that power for actual work has been transmitted at so high a potential.

With regard to power transmission, Prof. Smith said: "Of the electrical engineering developments of the past 10 years, there are two which are most important in their effect upon social and manufacturing interests, and to which we may devote most of our attention in order that the full significance of their relation to mankind may be fully realized. The first is the long-distance transmission of power, which on the Pacific coast has already wrought an industrial revolution, as it is quietly doing in many of the industrial centers of the world.

"In San Francisco a few years ago the cost of electric current for power and light was 15 cents for 1 hp per hour, while to-day the published price is almost exactly one-seventh of this amount, and it is possible to deliver at the factory on the coast, from the melting snows and glaciers of the Rockies, power for the machinery at a smaller cost than that at which it is possible to produce that power by steam, even though the fuel were to be delivered at the factory boiler without cost to the power producer.

"The power transmission systems of the Pacific coast are developing at a rate which is the best possible demonstration of the accuracy of this statement, as the discovery of fuel oil in large quantities on that coast has caused no decrease in plants for, and actual installation of, plants for the electrical transmission of power to points where such fuel can be had for little more than the bare cost of feeding it to the boiler from an adjacent oil well."

Prof. Smith also remarked: "It has been estimated that the quantity of carbonic acid annually exhaled by the population of New York City is about 450,000 tons, and that this amount is less than three per cent. of that produced by the fuel combustion of that city, so we may expect that, with the removal of this great source of contamination of the atmosphere, even the air of our greater cities will be practically as pure as that of the country.

"This fact, with many others pointing in the same direction, together with the entire possibility of such power transmission from a purely engineering standpoint, make it no unsafe prediction that in the near future many of the large cities of the world will not see coal except in their mineralogical collections.

"The second and more important development to which particular attention should be given, is largely dependent upon this already successful accomplishment of electric power transmission, but has for its field of application the highly important service of railway transportation. The service of our steam railways, contributing so largely to our rapid development as a nation is meeting a new element which has already wrought great changes in methods of transportation in some localities, and is rapidly extending its influences throughout the world. Many of the existing steam railways have failed to recognize the significance of the possibilities of electric railway transportation, and have met its development at every point with vigorous and determined opposition, which in the end can only react upon those maintaining such opposition."

As to what electric roads have done, Prof. Smith said: "During the past year the electric roads of Massachusetts, because of dense city traffic, carried four times as many passengers as did our steam roads, but while we have locally a remarkable development of urban and suburban traffic, a far more significant development has taken place in the States of the Middle West. There electrically operated express trains at high speed span entire States and carry passengers at an average of about 1 cent per mile for each passenger, while paying dividends comparing favorably with those of steam roads operated at a passenger rate of from 2 to over 3 cents per mile. These roads of the Middle West are common carriers and do a thriving freight and express business."

Another Telephone Central in New York City.

Last week the New York Telephone Company opened a new exchange in a new three-story fire-proof brick building at No. 126 Orchard Street, located between Rivington and Delancey. The first floor is occupied by the terminal room. The second floor is used as operators' quarters, consisting of locker room, dining room, reading room, infirmary, clerks' room, toilet room and men's quarters. The third floor is occupied as the operating room. The switchboard statistics of the new exchange are:

Ultimate capacity of switchboard	9,600 lines.
Ultimate number of "A" positions	60 lines.
Ultimate number of "B" positions	28 lines.
Ultimate number of operators to be employed	175 lines.
Present equipment	4,000 lines.
Present number of "A" positions	28 lines.
Present number of "B" positions	14 lines.
Present number of working lines	2,051 lines.
Present number of working stations	2,524 lines.
Present number of employees	71 lines.

The district takes parts of the Franklin, Spring and Eighteenth Street districts, and consists of the block bounded by New Chambers Street, the Bowery, Third Avenue, Thirteenth Street, Second Avenue, Fourteenth Street and the East River. The new exchange will be known as "Orchard."

Simultaneous Telegraphy and Telephony

By Charles C. Duvall

THE following is a method which the writer has found very convenient and simple to install, whereby a toll telephone line may be utilized for telegraphic service without in any manner interfering with telephone communication.

In Fig. 1 the telegraph station, *A*, is shown at the end of a telephone line, the station being installed in the telephone exchange or at a distance therefrom. Two repeating coils, P_1 and P_2, are placed in the telephone circuit, one on each side of the telephone switchboard; these coils will naturally be located within the telephone station building. A single wire, *W*, connects the middle point of one side of one repeating coil with the middle of one side of the other repeating coil, the connection being with the outside coil in each instance. The resistance of the repeating coil is fixed by the constants of the circuits. Connected with the outer repeating coil to the left is a telegraphic circuit which contains two resistances, *R C*, in parallel, and the usual telegraphic apparatus; that is, *R*, a relay; *K* the key; *M B* the main battery, and *E* being the earth. The connections of line and bridge are shown more in detail in Fig. 2.

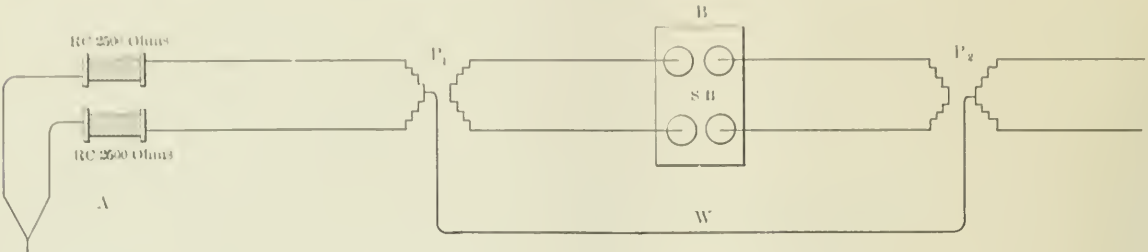
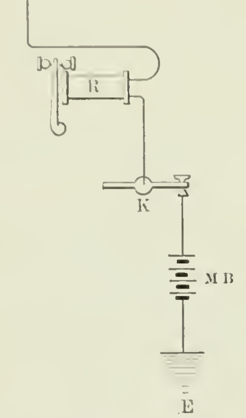

Fig. 1.—Diagram of Station Connections.

Assume a toll line including four exchanges with the wires dead ended at the switchboard in each exchange; and that it is desired to use the circuits for telegraphic purposes, working between points beyond the two extreme telephone exchanges, as shown in Fig. 3. By connecting around each exchange as above explained, the entire toll line can be used continuously for telegraphic purposes without interfering with the telephonic service.

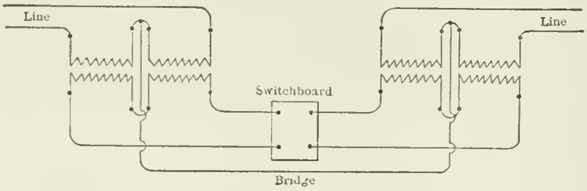

FIG. 2.—DIAGRAM OF CONNECTIONS OF LINE AND BRIDGE.

I am now using a line of 45 miles length connected in this manner. The telephonic service is not interfered with in the slightest, the telephone ringer drops act as usual, and there is no ground noise whatever nor any disturbance from the telegraph signals. It would be an easy matter to cut in four additional telegraph offices in the circuit of Fig. 3, simply by placing a set of Morse instruments in the bridging circuits around the telephone exchanges.

Fig. 4 shows a line I have had in operation for some time, and which is about 60 miles long, and includes three telegraph offices and five telephone stations. The method of connecting is similar to that of Fig. 1, except that in this case the line is used as a party line and the stations are rung up by magnetos, there being a certain number of rings for each station. The circuit is in constant use as a telegraph circuit from 9 o'clock in the morning until 6 o'clock at night, and without the slightest disturbance to the telephonic service, notwithstanding the presence of the magneto ringers.

In conclusion, I wish to say that a great part of the credit for the results obtained with the above arrangement is due to my able assistant, Mr. E. W. Campbell, manager at Pittsburg of the telegraph and telephone service of the American Tin Plate Company and the American Sheet Steel Company. Mr. Campbell has rendered me great assistance in obtaining the excellent results in practical work with the method described above.

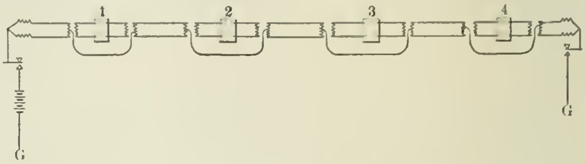

FIG. 3.—DIAGRAM OF LINE CONNECTIONS.

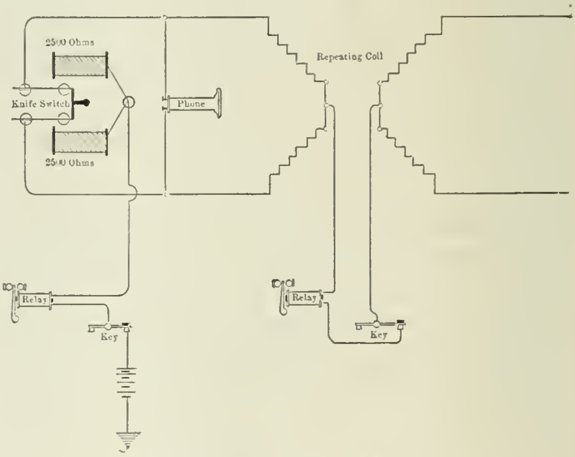

FIG. 4.—DIAGRAM OF OFFICE CONNECTIONS.

Contractors' Exhibitions.

In connection with the Electrical Contractors' Association convention, which will be held at Detroit, Mich., on July 14, 15 and 16, and under the auspices of the local association, it is proposed to make an exhibit of electrical apparatus in the Light Guard Armory there, a rental of $50 per booth being charged. Mr. Frank J. Miner is the chairman of the exhibition committee, 207 Jefferson avenue, Detroit, from whom forms can be obtained.

Telephone Exchanges—IV.

By ARTHUR V. ABBOTT, C. E.

THE second noteworthy point of difference between electricity and magnetism is the fact that there is no such thing as a magnetic *insulator*. Strictly speaking, this statement is true of electricity, for there is no substance that will not allow some electricity to leak, but as the difference between the ordinary conductor and ordinary insulator is many million fold, electrical leakage is too small in most cases to be of serious consideration. With magnetic circuits on the other hand, the curves of Fig. 13 (last issue) show that even under the most favorable conditions the resistance of one of the best insulators (air) is less than 3,000 times as great as that of the best conductor (iron), and as magnetic mechanisms are usually designed, the difference is only a very few hundred fold. With any magnetic circuit, therefore, there is comparatively an enormous amount of leakage, which interferes materially with both the operation and the efficiency of the apparatus.

The tractive effort which a magnet is able to exert is an important consideration in the design of a receiver system. According to Maxwell, the law of magnetic traction may be stated as follows:

$$P = \frac{\mathfrak{B}^2 A}{24{,}642}$$

in which P is the pull in grammes, $\mathfrak{B}$ the flux in gausses, and A the area of one pole piece in square centimetres. In Fig. 13 this relation is plotted in curves E and E'. For curve E the value of B is to be found by scale 1 on the left-hand side of the sheet, while the corresponding tractive effort in grammes per square centimetre is shown by the horizontal scale marked E, commencing at the left hand on the bottom of the sheet and reading from left to right. For example: A flux of 10,000 gausses gives a tractive effort of 4 kilos per sq. cm. As it is difficult to read a lower portion of this curve with accuracy, curve E' is plotted at the top right-hand corner and gives the values of the beginning of curve E somewhat magnified. For this curve the $\mathfrak{B}$ scale is given on the right-hand side of the sheet and designated E', while the corresponding tractive efforts are shown upon the top of the sheet and similarly labeled.

Consider now this theory of the magnetic circuit as applied to the design of the magnetic system of a receiver. For ease in analysis it is convenient to imagine the receiver magnet as an electromagnet, as was actually the case in the older forms; and after the calculations are made, the electromagnet may be replaced by an equivalent permanent magnet without changing the results. Fig. 14 is a diagrammatic representation of such a receiver system, in which $A B$ is the diaphragm of soft iron, d d the air-gap, or space between the diaphragm and the soft iron bar, c c, that forms the magnet; n n the wire coils on the end of the U-shaped bar, each coil having two windings, one connected to the line, L L, and the other to the battery, E, which may be supposed to be variable, so that any desired degree of magnetic excitation may be produced in c c. From the curves E and E' (Fig. 13) it is seen that the tractive force which is exercised on the diaphragm $A B$ will vary as the square of the intensity of magnetism in c c, and at first sight *strength of field* would seem to be the prime requirement. But a little consideration will show that mere pull avails nothing. The office of the diaphragm is to *vibrate* with *changes* in the magnetic field in which it is placed. These changes are caused by the line current which traverses the coils n n, therefore, the condition of the magnet c c must be such that the smallest impulse from the line will produce the greatest change in the magnetism of c c, and thus the greatest effect on the diaphragm. Further the condition of the diaphragm must be such that the smallest change produced by c c in the field or air space, d d, will be followed by the greatest possible change in the magnetism induced in the diaphragm, in order to secure the greatest sensitiveness. Now referring to the curves A and A' (Fig. 13), it is seen that soft iron is most sensitive to changes in magnetism when it is placed in a field having an intensity of from three to five gausses. This is the keynote to the design of the magnetic system, for we know that we must create a field of an intensity of 3 to 5 gausses in which to place the diaphragm, and that the bar, c c (assuming it to be of soft iron), must be so proportioned that *when* it creates such a field it will itself be magnetized to such a pitch as to be the most sensitive to the line current changes, or in other words, both magnet and diaphragm must be in unstable magnetic equilibrium. From the curve this intensity, it is seen, must not exceed 10,000 gausses. Let us now take some dimensions, say such as resemble those found in practice, and calculate what the magnetic system should be. Assume the diaphragm to be 2¼ in. (5.72 cm) in diameter, and .014 in. (.03 cm) thick. Suppose the air space to be 3/64 in. (.12 cm) wide and the magnet to be .25 in. thick x .625 in. wide, with a length of 9 in., measured around the bar from d to d. The cross-section of the magnet will then be .156 sq. in. (1.01 sq. cm, say 1 sq. cm) and the length 23 cm. If the distance between the centers of the pole pieces be taken at ½ in. (1.27 cm), the portion of the diaphragm in front of the magnet that acts as an armature and is included in the magnetic circuit will be 1.59 x .03 = .048 sq. cm. This is on the assumption that there is no spread of the magnetic induction between the ends of the pole pieces and the diaphragm, but the magnetic flux will fan outwards, in all directions, particularly across so wide an air-gap, so that it is conservative to assume that practically the theoretical cross-section will be much increased, say 50 per cent. The diaphragm, then, must be credited with a section of say .075 sq. cm and a length of 1.27 cm between centers of the pole pieces. To secure maximum sensitiveness the magnetization must not exceed 10,000 gausses. Hence the flux in the diaphragm will be 10,000 × .075 = 750 maxwells. As the magnet is a long U-shaped bar, whose adjacent sides are close together, leakage will be very great. A rough estimate of probable leakage may be made by considering the relative resistances of the path through the air-gap and diaphragm, and that offered by the air space between the parallel sides of the magnet. These sides are 1.56 cm wide, 11.5 cm long (the mean distance around the magnet through its center) and .95 cm apart; then the area of the flat sides of the magnet between which leakage will take place is 1.56 × 11.5 = 18 sq. cm. The resistance of this path will be $\frac{.95}{18} = .053$ oersteds. Between the poles and the diaphragm there are two air-gaps, each of which may be regarded as having the same area (1 sq. cm) as the pole opposite to it, and a length of .12 cm. The resistance of the air-gap will then be $\frac{2 \times .12}{1} = .24$ oersteds. Therefore, the resistance of the path through the air-gaps is to the resistance of the leakage path as .24 is to .053; or, in other words, but 20 per cent. of the flux through the magnet will reach and traverse the diaphragm. Consequently, the total flux through the magnet will be $\frac{750 \times 100}{20} =$ 3,750 maxwells. From the curve A' (Fig. 13) it is seen that when $\mathfrak{B}$ equals 3,750 $\mathfrak{H}$ is 1.44 gilberts per centimetre of length. As the magnet is 23 cm long, and 1 gilbert is equivalent to 1.257 ampere-turns, or 1 ampere-turn = .796 gilberts, the total required ampere-turns to produce this flux is 1.44 × 23 × .796 = 26.4. As the air-gap is relatively large considerable leakage will take place across the gap.

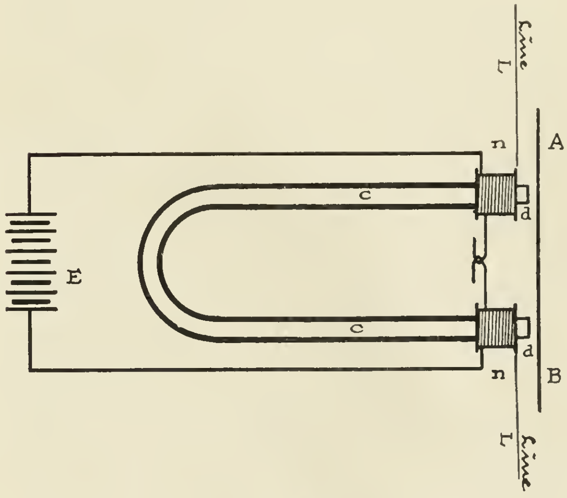

FIG. 14.—DIAGRAM OF RECEIVER MAGNETIC SYSTEM.

and it will not be far out of the way to assume that the mean flux through the air gap to produce 750 maxwells in the diaphragm must be a thousand maxwells. To force 1,000 maxwells through 1 cm air requires a magnetomotive force of 1,000 gausses. The resistance of the air gap has already been shown to be .24 oersteds, and hence the ampere turns necessary to drive the desired flux through air gap will be 1,000 × .24 × 796 = 191. In the diaphragm the flux is 750 maxwells, the area is .075 sq. cm and the length 1.27, so the flux density is 10,000 gausses, to produce which curve *A* (Fig. 13) shows that 5 gausses per linear centimetre must be provided, hence the amp-turns to produce the flux in the diaphragm will be 5 × 1.27 × .796 = 5. The magnetomotive force then required for such a magnetic system will stand as follows:

	Gausses.	Ampere turns
Magnet	33.2	26.4
Air Gap	240	191
Diaphragm	6.4	5
	279.6	222.4

From curve *E'* (Fig. 13) it is seen that a flux of 3,750 maxwells per sq. cm will produce a tractive effort of 580 grammes per sq. cm. As the total area of the poles is 2 sq. cm, the tractive effort will be 2 × 580 = 1,160 grammes (about 2.3 pounds), and it is a common specification to require telephone receiver magnets to lift a two-pound weight.

In order to facilitate the interconversion of gilberts and ampere-turns, two lines are drawn on Fig. 13 to the top corners of the sheet. These lines are designated "ampere-turn curves," *Z* and *Z'*. The curve *Z* is to be used with the ℋ scale on the bottom of the sheet at the left hand, and scale 2 as a vertical scale. For line *Z* this scale 2 reads directly, but for *Z'* it must be divided by ten. For example, to find the ampere-turns equal to 30 gilberts follow a vertical from 30 as the lower left-hand scale to the curve *Z*, thence a horizontal to scale 2, finding 24. Also to find ampere-turns equivalent to 8 gilberts, follow a vertical from .8 on theright-hand lower scale to curve *Z'*, thence a horizontal to scale 3, finding 6.5; divide by ten, obtaining .65.

In the hypothetical magnetic system of this example a battery has been imagined as furnishing the exciting magnetomotive force, because the calculation of the necessary quantity of magnetomotive force was by this artifice rendered more simple. The only other source of magnetomotive force now at our disposal is that of a permanent magnet. As we are utterly in the dark as to the mechanism whereby a magnet is able to act in this fashion, the estimation of a magnet to emit a definite quantity of magnetomotive force is correspondingly obscure. By measurement it is possible to determine the amount of flux any magnet emits, and it is perhaps justifiable to assume that if the magnet produces this flux it can in some mysterious way develop the magnetomotive force necessary to create and maintain the ether stream represented thereby. Experiment can show how much flux can be developed in steel magnets per unit of area.* Hence the proper size magnet is determined by dividing the desired flux by the unit flux thus ascertained. The chief practical material so far discovered from which it is desirable to make permanent magnets is steel, and experiment shows that average specimens can rarely be depended upon to develop a flux of more than 3,000 to 5,000 gausses. The preceding calculation has shown that it is necessary to obtain a flux of 3,750 maxwells for this system, and that 224 ampere-turns were required for the purpose. If, therefore, for the soft iron bar, coil and battery of Fig. 14 a permanent magnet be substituted that contains 3,750 maxwells, the same effect should be produced, and the rest of the system will remain as previously calculated. On the basis of 3,000 gausses a magnet of 1.25 sq. cm would be needed.

Traction in South Africa.

A correspondent or the *Iron Age* says that electric operation of railways seems to be the *mot d'ordre* in South Africa just now. Sir Percy Girouard foreshadows a new departure in the electrification of the Transvaal railroad system. An initial scheme is to electrify the east and west railroad services for passengers only, coal being obtained for generating purposes alongside the line, and a suitable site for the power station being naturally indicated at the colliery. If electric trains are adopted it is possible that the present trains of seven or eight carriages running every hour will be changed into short electric trains with a half hour or 20 minutes' service. The population of this portion of the Rand is increasing at such a rate that the innovation should pay for itself even at low fares.

Recent Progress in Wireless Telegraphy.

On June 9 a number of interesting patents were granted for improvements in wireless telegraphy, one to Reginald A. Fessenden and three to Lee de Forest.

Prof. Fessenden's patent relates to an apparatus by which he is enabled to obtain from a direct current source any desired number of discharges per second across a discharge gap used in the production of electromagnetic waves. Heretofore when direct current has been used for producing electromagnetic waves for wireless telegraphy, the practice has been to use an induction coil together with a mechanical break or a Wehnelt interrupter; but for mechanical and other reasons neither break enables one to get any desired number of discharges per second; moreover, in the case of the Wehnelt interrupter the action is not uniform. For these reasons it has been difficult to obtain a continuous stream of electromagnetic radiation, such as is adapted to be used with a cumulatively acting receiver or with a telephone transmitter. In addition the lack of ability to produce any desired number of discharges per second has rendered it difficult to carry out the method of tuning in which groups of waves of predetermined group frequency are sent out and a receiver is thereby operated which is tuned mechanically or electrically to the group frequency. The important feature of Fessenden's new wave generating apparatus is that no break is used, so that there is no necessary appreciable interval of time between the acts of charging and discharging.

Fessenden's apparatus consists essentially of a direct-current dynamo giving constant voltage (or a storage battery), and in series with it a variable high resistance, a condenser and a variable self-inductance. In shunt with the condenser and the self-inductance there is a spark gap, one terminal being connected to the vertical wire, the other to earth. The drawing which accompanies the patent shows more devices in the circuit, but the elements mentioned above are the essential ones. In operation the dynamo charges the condenser and when its potential has risen sufficiently a discharge across the spark-gap will occur, discharging the condenser and setting up oscillations in the sending conductor. On account of the high resistance in the circuit some time is required to recharge the condenser to sparking potential. Hence the discharge is intermittent and may be made to occur as many times per second as desired by cutting off more or less of the resistance, so that any desired number of discharges per second may be obtained.

The inventions of Lee de Forest may be briefly characterized as an application of the "Lecher system of wires" to the methods of wireless telegraphy. To fully understand this application it is necessary to give a brief outline of the characteristic features of the Lecher system, called so after a German scientist, E. Lecher, who studied this special arrangement of wires for a purely scientific purpose.

The Lecher system (Fig. 1) consists essentially of two parallel wires of equal length *AB* and *CD*, connected each at one end (*AC*) to an apparatus producing electrical oscillations of high frequency. If the length of these wires is one-quarter or any multiple thereof of the wave length of the electrical oscillations impressed on the system, stationary or standing electromagnetic waves are set up along the wires, which thus divide up into quarter or half wave lengths with nodes and loops symmetrically situated on each wire. In Fig. 1 the distances *AE* and *EF* are one-half wave-length, *FB* one-quarter wave-length; at *E* and *F* the wave of electrostatic energy forms nodes, at *B* it forms a loop. At the nodes *E* and *F* a conducting body, as a wire bridge, may be placed across both wires, without interfering with the waves; on the contrary, the use of such bridges has the advantage, that if grounded, they lead off waves of another wave-length than that to which the system is adjusted or tuned. At the loop *B* all the energy of the system is electrostatic; therefore, a sensitive device used for detecting the electrostatic wave, such as a coherer, may be placed most advantageously at the static loop *B*.

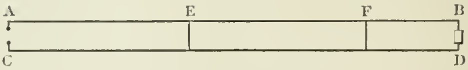

FIG. 1.—DIAGRAM OF LECHER SYSTEM.

The electromagnetic wave differs in phase from the electrostatic wave by a quarter wave length, so that the loops of the electrostatic wave are nodes of the electromagnetic wave and the nodes of the electrostatic wave are loops of the electromagnetic wave. A device for detecting electromagnetic waves such as a bolometer, is placed most advantageously at the loop of the electromagnetic wave.

In such a system of wires the period of vibration is independent of the distance between the two wires and of their diameters; such a system is what is called a "distortionless" circuit. The velocity of propagation thereon for high frequency oscillations is approximately that of light. The Lecher system has been studied thoroughly by various scientists, as it is simple in its mathematical and theoretical aspects; its constants are easily calculated and regulated, so that the dimensions of the system for securing definite results may be readily predetermined.

The most important characteristic features of the Lecher system may be summed up as follows: It is to a high degree a resonant vibrator, that is, it has a very marked period of its own and is very little responsive to oscillations of any other frequency than its own. It is a poor radiator, and consequently a persistent vibrator, persisting for some time in its vibrations once they are set up, therefore producing a long wave-train and damping slowly. By reason of the stationary waves set up higher potentials are obtained than are otherwise possible. The nodes and loops of these stationary waves are fixedly located, thus enabling connections to be made with the wires at any phase of the wave desired. The system may be easily and accurately tuned to any frequency desired. These are the features which make the Lecher system of wires especially suitable for application in wireless telegraphy; on the transmitting station it is possible to obtain with its aid for each signal a longer and better sustained series of waves, while on the receiving end it has other marked advantages.

If the system of Figure 1 is to be used at the receiving station, the coherer is inserted between *B* and *D*, *C* is connected to earth, and *A* to the vertical conductor or antenna, the equivalent length of which is one-quarter of the wave-length of the natural oscillation to which the system is tuned.

For use at the transmitting station, the Lecher system may be arranged as shown in Fig. 2, which represents a "static method of charging." The Lecher wires are shown as of one-half wave-length. Inserted in the bridge across their ends is a condenser. In shunt around this condenser are a spark-gap *S* and the secondary coil of a transformer *T*. When the condenser is charged to the breaking-down point of the spark-gap *S*, a discharge occurs at this point, and this serves as a connecting bridge between the parallel wires, and these wires are set in vibration as a Lecher system. Part of the energy is reflected back at *A* and *B*, forming stationary waves with nodes at *A* and *B*. A part goes into the upright conductor or antenna *AD* and is radiated outward.

A great many modifications are of course possible with the Lecher system in the receiving and transmitting apparatus. For instance, instead of the two parallel wires, the "wire and sheath" arrangement may be used, which consists of a wire surrounded by a coaxial tubular conductor insulated therefrom.

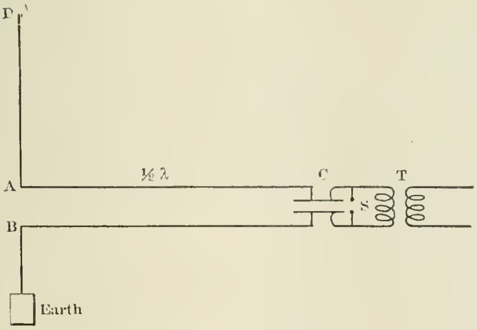

FIG. 2.—DE FOREST TRANSMITTING STATION.

In Fig. 3 the wires *C* and *D* are the simple conductors of the Lecher system, one of them being earthed; the single antenna, however, is replaced by two plates *A* and *B* which may be considered simply as an extension of the Lecher conductors. If the planes of these two plates be parallel and adjacent, the greater part of the energy is concentrated in the field between them. The region of the strongest wave propagation is outward of *A*, and as the plate *B* tends to absorb the lines of force which proceed in its approximate direction, the direction of strongest propagation is perpendicular to its plane. This feature enables the direction of propagation of the effective energizing or signalling waves to be in a measure controlled or directed, or, in other words, provides for the maintenance of a neutral zone or zones. If these plates be mounted so as to be rotatable upon a common axis, the position of these neutral zones may be controlled, and the same apparatus may thus be utilized for signalling in any direction desired, while approximately ineffective in other directions.

It would, of course, be very inconvenient in practice to use the Lecher system in form of two long parallel wires. De Forest has found that the following convenient arrangement is equivalent to the Lecher system. He twists together the two wires which are insulated, so that they form a twisted pair, the distance between them being regulated by the thickness of the insulation. It is desirable that the pitch of the twist be not too steep. The twisted pair is well adapted to use upon a spool or coiled in any other manner which may be desirable to economize space or to secure portability. In practice the inventor has successfully used such wires with a pitch equal to three turns to the inch wound upon a spool about three inches in diameter with successive turns about an eighth of an inch.

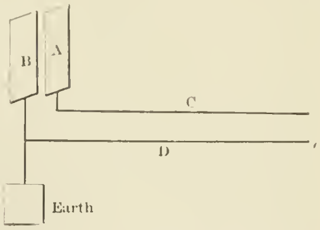

FIG. 3.—DE FOREST METHOD FOR DIRECTING WAVES.

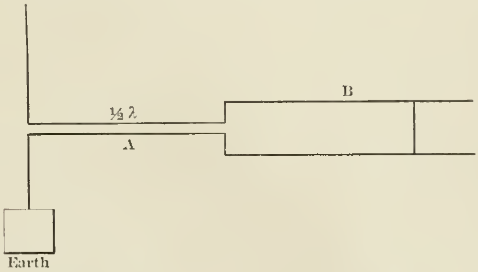

FIG. 4.—METHOD OF TRANSFORMATION OF POTENTIAL.

The Lecher system finally enables one to raise or lower the potential by simple and effective methods. It is well known that the mutual induction of the Lecher wires decreases as the two parallel wires are brought closer together and that conversely the capacity of the system is increased at the same time. Consequently if one system of such parallel wires, as *A* in Fig. 4, of a length equivalent to one-half wave length of the vibration transmitted be added to another system, as *B*, of the same period of electrical vibrations, but having its two parallel wires farther apart, then this second system *B* may take up the impulse transmitted from the first system unaffected as to its period of vibration, yet transformed to a wave of higher potential, but of correspondingly diminished magnetic energy or current. Instead of using different distances between the wires in the two systems, one may use the same distance, but embed the wires in one system in a different dielectric from the other; or both methods—change of distance between wires and change of dielectric—may be combined. When desirable to still further increase the self-induction of one of such systems of parallel wires one may insert at corresponding points in each of the two wires inductive or momentum coils of suitable impedance. Each section of the Lecher wires should be of a length corresponding to one-half of the length of the wave of the period to which the system is timed.

A Novel Trolley Pass.

In a recent publication it is reported that President Charles V. Darcy, of the Hoboken (N. J.) Commissioners of Public Instruction, has received a silver match safe, upon which is carved a perpetual pass on all tramway lines in London. The box is one of a number which the Duke of Marlborough had made as souvenirs of his visit to this country several years ago. All the lines in London, however, are not under one management; nor is it quite understood where the Duke gets his power to issue dead-head passes over them.

The Gruhn Telechirograph for Transmission of Handwriting.

On page 501 of vol. 39 (March 29, 1902) of Electrical World and Engineer, we gave a brief description of a new form of telautograph, invented by Mr. F. Karl Gruhn, of Dresden, Germany. In the following we give a full illustrated account of the construction and operation of this interesting instrument which we recently inspected at the office of Mr. Thomas F. Fitzhugh Lee, of Brooklyn, who, together with the inventor and Mr. M. Herzka, is interested in the introduction of the instrument in the United States.

The instrument is called the "telechirograph" and is a device for transmitting hand-written messages and reproducing them at the receiving station in the hand writing of the sender; it is to be used in connection with the telephone, and it is stated that apparatus now being built will enable one to telephone and transit a written message simultaneously over the same wire. The device is expected to find great favor with stock brokers and with the business world in general. While the instruments exhibited at the Brooklyn office are placed there for exhibition only and transmission takes place from one room to another room on the same floor, the method has been used in Germany for transmitting messages from Dresden to Berlin (a distance of about 200 km) and is said to have given entire satisfaction.

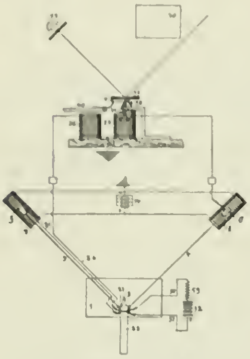
FIG. 1.—TRANSMITTING AND RECEIVING APPARATUS.

The first telautograph was invented by Elisha Gray[1] and the fundamental principle employed by Gray has been adopted by those who followed after him. It is to resolve the motion of the pencil in the transmitting station into two rectangular components, to transmit over two circuits electric effects which are proportional to these two components, and to recompose the two component effects again at the receiving station. The resultant is then a facsimile of the message or design, written at the transmitting station. Gray used current pulsations for transmission. Ritchie, an Englishman, devised a telautograph[2] similar to that of Gray in its fundamental principle. The pen is fixed at the extremities of two links which are fixed to the arms of two otherwise independent rheostats. Each of these is connected through a battery to one of two transmission lines. Currents varying in intensity in accordance with the movement of the pencil on the transmitting station, are sent over the lines. The receiving instruments are virtually two powerful d'Arsonval galvanometers or instruments of the Weston type with locally excited electro magnets. A telephone is employed in connection with the instrument. When the telephone is on its hook, the writing telegraph is connected to the lines; and on removing the telephone the writing telegraph is disconnected and the ordinary telephone connections are substituted. From the reports published as to this instrument, it appears that it is only applicable to comparatively short lines.

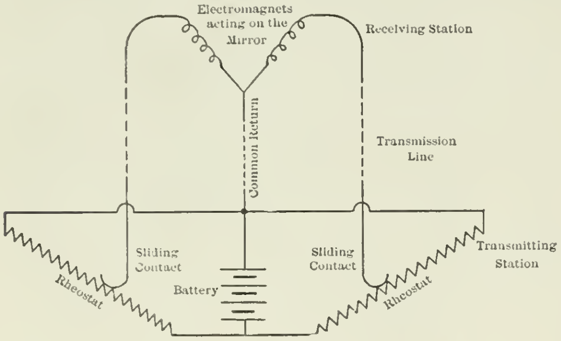

FIG. 2.—DIAGRAM SHOWING CONNECTIONS DURING TRANSMISSION.

The Gruhn telechirograph is in its transmitting devices quite similar to the Ritchie telautograph, but differs essentially from it in the receiving apparatus, in which an arrangement is employed which was used before in the Pollak and Virag high speed telegraph system[3]. The transmitted currents influence two electromagnets which in turn cause a small concave mirror to move; a light ray from a small incandescent lamp falls upon the mirror which reflects it on a sensitized piece of paper.

Fig. 1 shows the whole arrrangement of both transmitting and receiving apparatus, the former being shown at the bottom, the latter at the top. 1 is the paper on which the sender writes the message, 30 the photographic paper on which the received message is recorded. On the transmitting station the message is written down by means of the pencil 2, and while the pencil moves, the rods 3 and 4 also move and the contacts 5 and 6 at their ends slide on the rheostats 7 and 8, so that parts of these resistances are cut in or out, in conformity with the motions of the pencil. Fig. 2 shows diagramatically the connections while a message is transmitted, each transmission line forms a shunt on the local circuit of the battery. It will be seen from this diagram that when the contacts slide on the rheostat, the currents in the two transmission lines vary; and these are the currents which influence the electromagnets that act on the mirror in the receiving station.

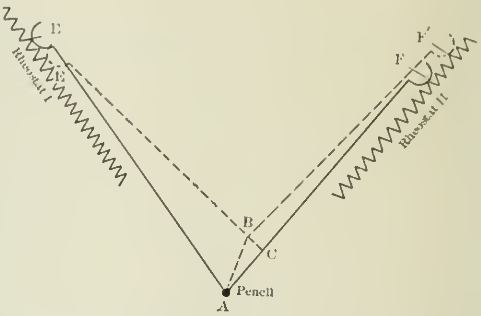

FIG. 3.—DECOMPOSITION OF MOVEMENT OF PENCIL INTO TWO RECTANGULAR COMPONENTS.

Fig. 3 shows how the motion of the pencil is resolved into two components, and how electrical effects are produced which are proportional to these two components. The pencil may first be placed at A, and may then be moved to point B. The sliding contacts move in the same time from E to E^1 and from F to F^1; therefore, the part EE^1 of the rheostat I is cut out of the one transmission circuit, and the part $F F^1$ of the rheostat is inserted in the other transmission circuit. We may now assume that the arms AE and AF are very long; if instead of moving the pencil in a straight line from A to B, we first move it from A to C and then from C to B, the lines AC and BC being perpendicular upon each other, it will be seen that $AC = FF^1$ and $BC = EE^1$. In other words, we have resolved the motion AB into two components AC and BC, and the amounts of resistance which are cut in or out from the transmission circuits, are directly proportional to the two rectangular components of the motion of the pencil. Of course, this is exactly correct only if, as supposed above, the rods AE and AF in Fig. 3 (the rods 3 and 4 in Fig. 1) are very long. If they are small, the above argument will not hold good, and there will be considerable distortion of the transmitted signs or letters. It is, of course, important that for practical use the instrument should be of small size, and for this reason the rods 3 and 4 in Fig. 1 should be short. In order to accomplish this, it is necessary to employ some device counteracting the distortion which otherwise would result. The inventor states that he uses such a device, but does not want it to be described at present, as the patent for it has not yet been granted.

The rheostats in the transmitting apparatus are constructed by winding insulated wire in the narrowest possible windings in contact with each other upon a non-conducting core, while the insulation in the path of the sliding contacts is removed from the surface of the spools, but in such a way that it remains between the single windings of the latter. Each winding therefore forms an element of resistance. In Fig. 2 a common metallic return is shown for the two circuits, while in Fig. 1 the earth is used as a return; the inventor proposes to use the lead sheathing of telephone cables for his return circuit. 14 in Fig. 1 is a battery, as is more clearly shown in Fig. 2.

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[1] A full illustrated description of the Gray telautograph is to be found in Electrical World, vol. 21, 1893, page 220.

[2] A full illustrated description of the Ritchie telautograph was given in Electrical World and Engineer, 1900, vol. 36, page 886.

[3] See Electrical World and Engineer, vol. 34, 1899, page 34.

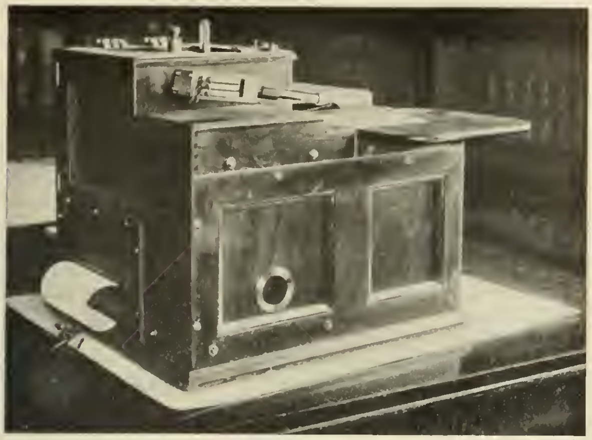


FIG. 4.—TELECHIROGRAPH (PENCIL IN ITS REST).

The receiving apparatus as shown at the top of Fig. 1, contains a small electric incandescent lamp 33 which throws its light through a small slit upon a concave mirror, 35, which reflects the light ray to the sensitive paper 30. The mirror is attached by means of cement to a small iron plate 36 in form of a triangle; one corner of the latter rests upon the set-screw 37, upon which the mirror can oscillate. Beneath the two other corners extend two armatures which are subjected to the attraction of the electromagnets 26 and 25; only the armature 40 which belongs to the coil 26, is shown in Fig. 1; the coil 25 must be thought to be behind the set screw 37 in the figure and the armature which belongs to it cannot be seen therefore. These armatures undergo oscillations corresponding to the component movements of the transmitting pencil; they are carried by flat springs, not shown in the figure. For the armatures, permanent magnets are used, and the iron cores of the electromagnets 25 and 26 are short and do not fill the hollow space of the coils up to the top. A large air space is therefore formed between core and armature, and this fact is said to assure that the oscillations of the armatures are directly proportional to the currents in the magnetizing coils. To lessen the oscillations, oil damping is employed.

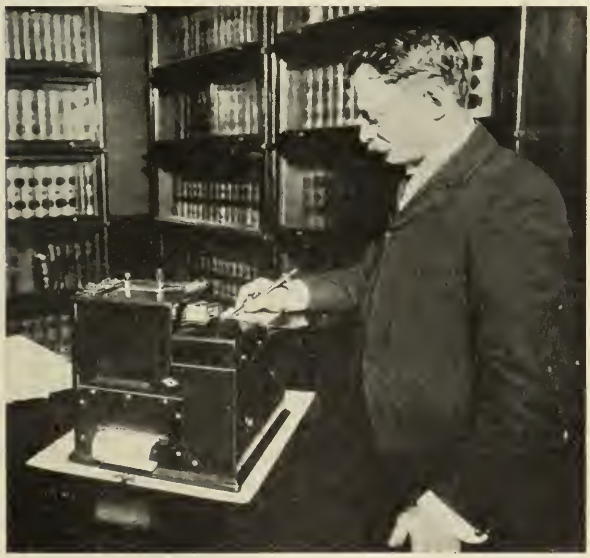
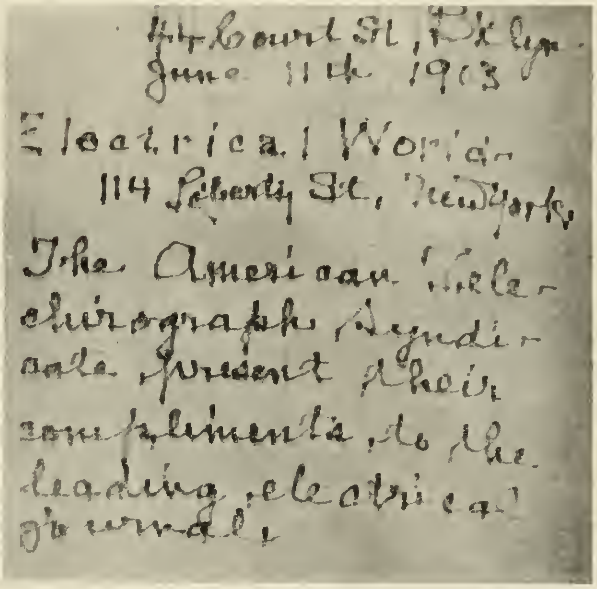


FIG. 5.—TELECHIROGRAPH IN OPERATION.

The following arrangement is used to deviate the light ray from the sensitive paper when no message is transmitted. Upon the pencil 2 in the transmitting station (Fig. 1) is mounted a sleeve 22, under the influence of a spring adjacent to which a second sleeve 23 is arranged. The sleeve 22 is connected through a wire 21 with the sliding contact 5, while the sleeve 23 is connected through 24 with the transmitting circuit. The pencil is held by means of the socket 22 and guided over the paper. If placed in position to write, the point of the pencil touches the paper first, whereupon the sleeve 22 moves downward and makes contact with the sleeve 23, so that an electrical connection between the wires 21 and 24 is effected; the connections are then those shown in Fig. 2. In lifting the pencil this contact is broken, and the ray immediately oscillates in the direction influenced by the corresponding branch distant circuit to the extreme extent, so that the point of light leaves the sensitive paper. The deviation of the point of light, however, is effected more quickly if the branch distant circuit is not interrupted, but if a relatively strong current in the opposite direction is sent through. For this purpose the battery 52 is provided, whose action is easily understood; when writing, the contact between 22 and 23 is closed and the battery 52 does not come into action; 53 is a resistance in series with this battery.



44 Court St, B'klyn.
June 11th 1903

Electrical World
114 Liberty St, New York

The American Telechirograph Syndicate present their compliments to the leading electrical journal.

FIG. 6.—SPECIMEN OF HANDWRITING AS RECEIVED.

In practice, of course, each instrument contains both a receiving and a transmitting apparatus. When a message is completed, a small electric motor operated by an independent battery in the receiving device is set in motion. This motor operates a train of wheels or rollers which draw the portion of the film written upon by the light ray through a developing bath and out again through a pair of rubber drying rolls so that the completed message is delivered about 35 seconds after the sender has replaced the metallic pencil in its rest. In improved instruments which are now being built, this time is expected to be shortened.

Fig. 4 shows the instrument in its present form. It is of the size of an ordinary typewriter box. The parts of interest which can be seen are the pencil and the piece of paper on which the sender writes his message. When the instrument is used at the receiving end, the paper with the photographic record of the message is delivered through an opening near the bottom of the box. The message, reproduced in Fig. 6, was transmitted and received in the presence of our representative. It shows that the characteristic features of the handwriting of the sender are well reproduced by the instrument.

In Fig. 4 the pencil is seen in its rest in the foreground of the upper part of the cabinet; Fig. 5 illustrates an operator transmitting a message. In both illustrations the sheet of paper, seen at the lower corner of the left side, contains the transmitted message when the instrument is used as a receiver.

Thirteenth Annual Meeting of the Canadian Electrical Association.

The Thirteenth Annual Convention of the Canadian Electrical Association was held in the city of Toronto, with headquarters at the King Edward Hotel, on Wednesday, Thursday and Friday, June 10, 11 and 12. The attendance was one of the largest in the history of the Association, and the interest taken in the discussion of the various papers brought before the Convention augurs well for the future of the Association. Aldermen Starr and Ward, on behalf of the city, extended a hearty welcome to the delegates and their friends, which was ably responded to by Mr. A. A. Dion, of Ottawa.

Mr. H. F. Reesor, manager Electric Light and Power Company, Lindsay, Ont., occupied the chair, and at the opening of the Convention on Wednesday morning delivered the President's annual address, in which he bespoke for the papers which were to be read a free and thorough discussion so that the salient points in each might be brought out or criticised and in this way the members present would get the benefit of the knowledge imparted to the fullest degree. This year a new feature, at least to this Association, had been inaugurated, namely, the establishing of a question drawer from which he felt confident, if properly followed up, much benefit would accrue; and following along the lines of the National Electric Association he suggested that a new officer should be elected to be named "Question Box Editor," whose duty it would be to look after questions pertinent to the interests of light and power companies and electricity generally.

During the course of the address he said that during the year just passed the question of long distance power transmission had engrossed the minds of capitalists to a greater degree, perhaps, than at any previous period in the history of this country. Rapid strides had been made in development in this direction and at the present time some very extensive plants were contemplated and under construction, notably around the Niagara Peninsula, and when completed Canada could boast of having some of the largest and best equipped electrical installations in the world. He referred to the progress in connection with wireless telegraphy and said, "Truly electricity has passed its 'infancy' stage"; let the use of electricity be suspended for one day, yes, even for one hour, and our whole commercial, if not our domestic system, would be paralyzed."

He referred to the fact that the tide of municipal ownership was in full flow. Millions of money had been invested in Canada by individuals and companies in lighting and power development, sanctioned, and in many instances induced by the very municipal corporations that were now clamoring or looking with longing and covetous eyes at a business that had been carried from an experimental stage until it had become to all appearances a factor of considerable importance in every day commercial life. He characterized it as a case of "Municipalities gone mad." He thought the experiences of the past in connection with this matter should be an incentive to every person interested in electricity to join the Association and bear a quota of the burden in connection with combatting this movement.

He acknowledged with thanks the cordial invitation extended by the National Electric Light Association to the officers of the Association to attend their annual Convention which had been held a few weeks ago in the city of Chicago, and he was pleased to say several had availed themselves of this pleasure.

The report of the Secretary-Treasurer, Mr. C. H. Mortimer, showed a total membership of 375, a large increase over last year. The report also showed a handsome balance to the credit of the Association.

Professor Owens, of McGill University, Montreal, gave a brief address, during which in the name of the Mayor and Business Men's League of St. Louis, Mo., he invited the Association to co-operate with the American Institute of Electrical Engineers and other similar societies in making a success of the International Electrical Convention to be held there during the Louisiana Purchase Exposition in 1904

Mr. John Yule, of Guelph, presented the report of the Committee on Legislation, which stated that the Committee had met and agreed upon a plan of campaign for defence of the Conmee Amendments which were threatened by a bill which had been introduced in the Legislature by Mr. Downey, M.P.P., for their total repeal, and the Committee were pleased to report that they had been successful in opposing this bill. The committee asked for better financial support from those who were reaping the benefit of the work done, as by the efforts of this committee millions of dollars had been saved to the companies interested.

The question box was conducted by Messrs. Hunt and Dion and proved a valuable source of information to the members.

On Wednesday afternoon a paper on the training of the high tension engineer, prepared by Mr. Paul Lincoln, of Pittsburg, was read by Mr. Charles S. Scott, chief electrician of the Westinghouse Electric Company, Pittsburg, Pa., and president of the American Institute of Electrical Engineers. The paper pointed out that there were two schools in which the electrical engineer could receive his training, but only one in which he must receive a course before he could be called a high tension engineer. Those things which were learned in the schools equipped with professors and laboratories and mathematical text books must be supplemented by the things which could only be learned in the school of experience.

Professor Owen, in discussing Mr Lincoln's paper, said: "Both Mr Lincoln and Mr. Scott have outlined the relations which should and in the main do exist between the college and practical work so clearly that remarks by me are hardly necessary. However, it may be said that within comparatively few years there did not exist as complete and satisfactory an understanding between the college people and the outside world as now I am glad to say does exist, due in large part to the interest in college work shown by such men as Mr. Scott, Mr. Lincoln and the officers of the Westinghouse, General Electric, the Bullock and other large manufacturing companies. They now perfectly well understand, I think, that a college does all that it can be expected to do when it, in the short time it has to give to the student, gives him some knowledge of the fundamental principles of engineering which underlie all his future work. The tendency in engineering education now, as far as I am able to observe, is to instruct in the principles. No university that I know of can operate a manufacturing establishment and give to the students a knowledge of manufacturing details. It is quite out of the question. It is most significant, however, that the majority of the larger electric manufacturing companies select their young men almost entirely from college graduates, saying at the same time to me that they do not expect that every man who comes from the college will make an engineer, but that it is the best material from which to draw their men. Now, I believe that there are men going out from the colleges to-day perhaps better trained than they were years ago. To me, as a man connected with an engineering school, I must say, if it is so, it is largely due to the interest and assistance of the outside man. I remember very perfectly the difficulty ten or twelve years ago I experienced in obtaining permission to visit the works of any one of the larger companies. I was fortunate enough to know Mr. Scott, and I got into the Westinghouse Company, where I spent one summer. If you, gentlemen, who own and operate lighting plants desire your engineer to further inform himself about high tension work or some special form of new apparatus that any of the larger companies is manufacturing, you may send him to such a factory and he will be kindly received and be shown everything; and he will go away with very much more information than he had when he came. In line with what Mr. Scott had said you might also send your men on trips of inspection for the purpose of studying local conditions which are similar perhaps to those which obtain in your own plant. If the college education is supplemented by this sort of training you will then have or should have an engineer. The college does not make you an engineer. The college man is not in any sense an engineer, but he is a man who is much more likely to become quickly an engineer than a man who has not had the college training. It is only the beginning of the work. Nothing in the world can take the place of experience."

Mr. Scott and Prof. Owen, who had spoken with reference to the educational and manufacturing end of the subject, were followed by Mr. Black, who spoke with regard to the operating end of a transmission plant. He said he had been very much struck with one remark to the effect that when things were designed and everything planned out so that you would naturally expect it to work perfectly, it did not always work that way. He thought that had been the experience of almost everybody who had had to do with operating electrical machinery. He was very much pleased to notice what Mr. Scott had said about engineers getting together and trying to work together for the benefit of electrical engineers at large. It was certainly gratifying to younger engineers to find men of large experience who were willing to give them the advantage of their experience.

On Thursday morning a very valuable paper was read by Mr. R. T.

E. Lozier on "Variable Speed Motors and Their Relation to New Shop Methods," which was amplified by Mr. Lozier and afterwards discussed very fully by Messrs. Hynes, Gossler, Leonard, Higman and others.

In the afternoon of the same day two papers were read, one by Mr. G. U. G. Holman, of Quebec, on "Some Points Relating to Submarine Electric Power Cables," and another by Mr. J. W. Farley entitled "High-Tension Transformers."

In answer to questions on his paper, Mr. Holman stated that he though it was inadvisable to use lead with a rubber covered cable, inasmuch as it was an extra precaution which their experience had shown was not worthy of being paid for. In answer to a question as to the cable versus aerial lines, he said that if the conditions were favorable, the aerial line was by all means preferable.

A paper was also read by Mr. R. J. Russell, of St. Louis, Mo., on "Single Phase Motors as a Means of Increasing Station Earnings."

Amongst those noticed as being in attendance were J. F. Thorne, Pittsburg, Pa.; H. B. Kirkland, Chelsea, Mass.; J. M. Leamy, Buffalo; J. W. Pitcher, Halifax, N. S.; R. J. Russell, St. Louis, Mo.; F. G. Bolles, Cincinnati, O.; G. A. Patterson, Brandon, Manitoba; A. Warren, New York City; P. H. Hover, New York City; A. P. Manning, New York City; C. F. Scott, Pittsburg, Pa.; Dr. R. B. Owen, McGill University, Montreal, together with representatives of the various companies in the many towns and cities in Canada.

The Canadian Bullock Electric Manufacturing Company of Montreal presented each person in attendance with a white button containing a number, and each day issued a neat booklet containing a list of those in attendance with a number opposite each name corresponding with the numbers on the buttons, which provided a means of identification for the members and their friends.

The social features of the Convention consisted of a tally-ho drive to points of interest in the city by courtesy of the Canadian General Electric Company; an excursion by special steamer and band concert at Toronto Island; a visit by special cars to the works of the Canada Foundry Company, by courtesy of the company, and the annual Association dinner.

Invitations were also extended by the De Forest Wireless Telegraph Company of Canada to inspect their station where messages were continually being sent to and received from Hamilton, a distance of forty miles; also by the Metropolitan Electric Railway.

In connection with the Question Box some of the questions asked and answers given were as follows: Question: Is it advisable to "ground" secondaries at the transformer or in the building supplied? Answer: At the transformer.

Answer (No. 2): To ground secondaries at the transformer would seem to be the more preferable method. It would ensure all consumers lines being protected; whereas grounding in the building would often be found inconvenient and too often would be neglected altogether.

Question: Should meters be tested in place or should they be returned to the station for that purpose?

Ans.: (1) In some cases in place, in others taken to the station.

Ans.: (2) Government regulations require that meters should be presented to the Inspector for inspection. To test *in situ* is extremely inconvenient and sometimes impossible. An extra fee is charged for meters so tested.

Question: What has been the experience of water power plants with the maximum demand flat rate, controlled by a Lacey controller, or similar device?

Ans.: (1) Systematic inspection, while not having been shown to be absolutely necessary so far, would seem to us to be very advisable and a convenient method of testing controllers in places desirable.

Ans.: (2) An experience of about six months with the Lacey controller would indicate that it furnishes the best means so far put on the market to deal with flat rates. Common sense would dictate that this instrument, the same as any other device for measuring current, should not be allowed to go for an indefinite time without inspection and test. A testing box equipped with standard lamps or some other suitable load, with an indicating wattmeter or an ammeter and voltmeter attached, and a connecting device which would admit of the outfit being quickly attached to the circuit near the controller would probably fill the bill. In setting the controller, it must be adjusted to carry the load contracted for at the extreme voltage which the circuit is subjected to, otherwise the controller will trip when the voltage rises, without having more than the rated number of lamps in circuit.

Ans.: (3) The maximum demand rate by a Lacey controller suits quite a large class of customers, knowing the amount payable each month regardless of the hours burning. The contractor has the benefit of the load to put on a transformer; no meter readings and fewer inspections.

On Friday morning the officers and members of the various committees were elected for the ensuing year and resulted as follows: Mr. J. J. Wright (Toronto), President; J. B. Thornton (Montreal), 1st Vice-President; A. A. Wright, M. P. (Renfrew), 2d Vice-President; C. H. Mortimer (Toronto), Secretary-Treasurer.

Executive Committee: Messrs. John Yule, A. B. Smith, P. G. Gossler, A. A. Dion, Gordon Henderson, B. F. Reesor, C. K. Greene, C. B. Hunt, J. A. Kammerer and H. O. Fiske.

Committee on Statistics: Messrs. A. A. Wright, D. R. Street and J. W. Purcell.

Committee to confer with Underwriters: Messrs. P. G. Gossler, A. A. Dion, J. J. Wright, G. U. G. Holman and Mr. Wight.

Committee on Legislation (Ontario): Messrs. Hunt, A. A. Wright, Reesor, Dion, Breithaupt, McCullouch, J. J. Wright and J. W. Purcell, with power to add to their numbers.

(Quebec): Messrs. E. A. Evans, J. McCarthy, P. G. Gossler, Sangster and Holman, with power to add to their numbers, the first named in each case to be the convenor.

After considerable discussion as to the respective claims of Hamilton and Montreal as the place for holding the next Convention, on a vote having been taken, Hamilton was selected.

On the recommendation of the Committee on a standard system of accounting for electric lighting companies and on motion of Mr. A. A. Dion, seconded by Mr. A. Williams, the report of the Committee on standardization of accounts made to the last annual meeting of the Association, was received and adopted, and the standard system of accounts for Electric Lighting Companies recommended for adoption by the National Electric Light Association of the United States, was recommended by this Committee for adoption by the Canadian Electrical Association.

On motion of Mr. C. B. Hunt, the Association approved of the appointment of a Question Box editor, the appointment being left in the hands of the Executive Committee, an appropriation to be made from the Nicholls Fund to be made towards paying for prizes to be given for the best answers to questions submitted, and to defray the necessary expenses in connection with this department.

After some further discussion and the passing of votes of thanks to those who had contributed to the success of the Convention, the meeting adjourned to meet in Hamilton, Ont., in 1904.

The Chicago Independent Telephone Convention.

It is hoped and believed that the annual meeting in Chicago next week, at the Auditorium Hotel, of the Independent Telephone Association of the United States, will be of unusual interest, and will secure a large attendance. Mr. J. G. Ihmsen is chairman of the local committee in Chicago which has been putting in a lot of hard work.

The programme as announced by Mr. J. B. Ware, the secretary, is as follows: June 24, 2 P. M.—Address of welcome by Hon. Carter H. Harrison, Mayor of Chicago; response by Hon. S. P. Sheerin, of Indianapolis, Ind.; annual address of President James M. Thomas; roll call of States, ten-minute reports; "Advantages of Association," by Hon. C. E. Hull, of Salem, Ill., president Interstate Telephone Association: "The Telephone and the Technical School," J. C. Kelsey, professor of telephony, Purdue University, Lafayette, Ind.; "Modern Exchange Construction," W. H. Johnson, general superintendent Frontier Telephone Company, Buffalo, N. Y.; "Independent Telephone Development in the South," by C. E. Stinson, president Memphis Telephone Company, Memphis, Tenn.; "Western Telephone Development," J. S. Bellamy, Knoxville, Iowa. 6 P. M., concert in Auditorium Hotel. 8 P. M., special train to San Souci Park; programme of entertainment there to be given later. June 25, 10 A. M.—Patent Litigation Committee report, Hon. Hugh Dougherty, of Bluffton, Ind., chairman; "Telephone Discipline," by C. E. Tarte, general manager Citizens' Telephone Company, Grand Rapids, Mich.; "Eastern Telephone Development," F. A. Demarest, general superintendent Interstate Telephone nd Telegraph Company, Trenton, N. J.; "Present and Future," Frank L. Beam, Columbus, Ohio; General business; election of officers.

Note on Artificial Fluorescence of Living Human Tissue.

By William James Morton, M. D.

If a solution of bisulphate of quinine or of the alkaloid quinine, of the strength of one gram to eight ounces, contained in an ordinary glass bottle, is subjected to x-radiation in the dark, these solutions will be seen to glow with the fine, opalescent violet ray fluorescence of quinine solutions.

Calculating the amount of blood in a human body to be one-thirteenth part in weight of the entire body, we may estimate that a person weighing 130 pounds will contain ten pounds of blood. This is equivalent to ten pints or equivalent to the above given ratio of one gram to eight ounces of water. We may, therefore, without doubt, conclude that the fluids of a person to whom twenty grams of quinine has been administered represent a solution of quinine equivalent to that mentioned in the bottles; and equally when such a person is exposed to the x ray, that the person's tissue will be rendered fluorescent in the same manner.

The quinine may be administered about one hour before the x-ray treatment and in a dosage of from five to twenty grams.

It is recognized that the radiations of substances exhibiting a violet color possess curative properties in disease. We have thus presented to us by this new procedure, a method of producing fluorescence in more intimate relation to the tissue elements than can be gained by any method from the exterior. In this manner I have been treating cancer now for over a year, and with, I believe, results which could not be attained by the x-ray alone, though this is purely a clinical deduction. I have also treated cases of pseudo-leukæmia, chronic malaria, and many other diseases, not necessary here to mention, in this manner. It is only desired in this communication to present briefly the method and the possibilities of this new form of application of fluorescent radiations.

Among other fluorescent liquids, some of which may be used medically, Mr. W. J. Hammer, in a recent publication, enumerates the following: Petroleum, quinine, Magdala red, eosine, uranine, saffronine, paviine, æsculine, amidophthalic acid, fluoresceine, rhodamin, thalleen, resorcorufin, and resorcin blue.

Western Union Earnings.

The Western Union Telegraph Company issues the following statement for the quarter ended June 30, 1903, the figures for the current year being partly estimated, while those for 1902 are actual:

	1903.	1902.	Changes.
Net revenue	$2,000,000	$1,892,476	Inc. $107,524
Bond interest	286,300	254,770	Inc. 31,530
Balance	$1,713,700	$1,637,706	Inc. $75,994
Dividends	$1,217,014	$1,217,009	Inc. $5
Surplus	$496,686	$420,697	Inc. $75,989
Previous surplus	$12,515,341	$10,330,306	Inc. $2,185,035
Total surplus	$13,012,027	$10,751,003	Inc. $2,261,024

The above statement, partly estimated, yields the approximate figures for the twelve months ending June 30, 1903 as follows:

	1903.	1902.	Changes.
Net revenue	$8,206,773	$7,292,328	Inc. $914,445
Bond interest	1,077,700	992,580	Inc. 85,120
Balance	$7,129,073	$6,299,748	Inc. $829,325
Dividends	4,868,050	4,868,031	Inc. 19
Surplus	$2,261,023	$1,431,717	Inc. $829,306
Previous surplus	10,751,003	9,319,286	Inc. 1,431,717

The actual returns for the March 31, 1903, quarter were: Net revenue, $1,842,269; bond interest, $286,300; balance, $1,555,969; dividends, $1,217,014; surplus, $338,955; previous surplus, $12,176,386. Total surplus, $12,515,341.

Telephone War in Sweden.

Great public inconvenience has, according to a despatch from Stockholm, Sweden, resulted from the war between the Swedish state telephone system and the Stockholm private telephone company. The private company's wires are confined to the city and its suburbs. The government having broken off communication between the two systems, patrons of the private company cannot talk with the provinces where the State system is in control. The alleged cause of the trouble between the two interests, as presented by the government authorities, is the arbitrary methods pursued by the private company, which are stated to be inimical to the interests of people of all classes who use the telephone. Possibly it is the other way around.

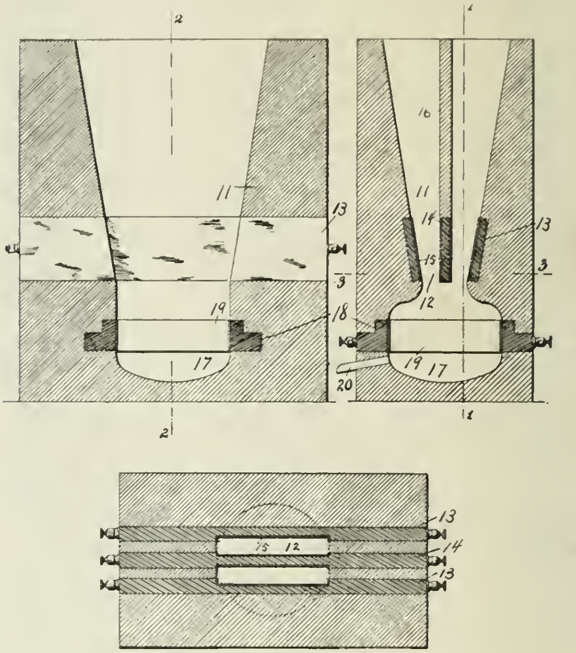
Recent Electrochemical Developments.

By Clinton Paul Townsend

REDUCTION OF IRON ORES

The accompanying cuts illustrate in vertical and horizontal section a form of electric resistance furnace recently patented to Michael R. Conley, and assigned to the Electric Furnace Company, of New York. Mr. Conley's purpose here as in the constructions heretofore described is the reduction of iron ores and the direct production therefrom of steel; to this end the furnace is fitted with two sets of superposed resistance bands, of which the upper accomplishes the reduction of the ore, and the lower maintains the metal at such temperature as will permit it to be run or cast direct from the furnace.

The furnace comprises a fire-clay or fire brick stack 11, the shaft of which converges downwardly to a neck 12, below which is an enlarged hearth 17 for the reception of the metal. Within the neck of the furnace and protected from the weight of the charge by embedding in the furnace walls, are two resistance pieces 13, composed of graphite and fire-clay in proportion to one to three. A central resistance plate 14 of similar composition extends across the furnace midway between the plates 13, and is protected from the superincumbent charge by a fire-brick partition 16. All of these plates are reduced in cross section in their central portions in order to increase the heat development, and are protected from the oxidizing influence of the ore by a coating of magnesite 15. Midway of the hearth, and encompassing it, is the lower resistance band 18, sheathed by a magnesite coating 19. The taphole 20 is situated below this band.



SECTIONS OF ELECTRIC FURNACE.

The advantages of the electric furnace for the particular purpose in view are the application of the heat to the interior of the charge, the close regulation of the temperature to the necessities of the reaction, and the fact that the reduced metal comes into contact with no carbon surfaces other than the carbon mixed with the charge and that this carbon can therefore, in theory at least, be accurately gauged to reduce the ore and carburize the metal to the extent desired. A further advantage claimed is the feasibility of the reduction of fine oxids and concentrates without previous briquetting.

Boston Edison Company Hearing.

Considerable information of interest in regard to the business of the Edison Electric Illuminating Company of Boston was brought out on June 9 at a hearing held before the Massachusetts Gas & Electric Light Commission, on the question of issuing 20,000 new shares of stock, amounting to $4,000,000, to pay for the various suburban electric light companies which have recently been acquired, new plant, cables, tubes, etc. President C. L. Edgar submitted a large number of detailed figures in regard to the proposed expenditure.

These showed in brief that on December 31, 1902, the company had notes payable amounting to $683,000, and that appropriations for the year amounted to $97,000, making a gross debt of $780,000. Deducting $384,000, the balance due on capital stock left a net debt of $396,000 at the beginning of 1903. This balance on capital stock is to be paid in August. The 1903 budget of the company, as settled upon by the officers, amounts to $2,510,000, with an additional 5 per cent. for contingencies, a total of $2,635,000. Of this amount the largest item is for the new L street station in South Boston, which is now under construction; and it is hoped that it will be completed by December 1 of the present year. The station is to have 4 units instead of 3, and will cost, exclusive of the coal plant on the harbor, $1,347,000. The estimated cost of the coal plant is $103,000. The expense for tubes and cables this year is set at about $329,000.

The suburban electric light companies which have been acquired and the cost of each are the Milton Light & Power Company, $71,000; Dedham Electric Company, $135,000; Blue Hill Electric Company, $76,000; Natick Gas & Electric Company, $188,000; Framingham Electric Company, $134,000; Woburn Light, Heat & Power Company, $269,000; Somerville Electric Light Company, $627,000; Needham Company, $30,000; Chelsea Gas Light Company, $287,000, and Newton and Watertown Electric Company, $412,000, a total expenditure of $2,229,000. All but the Chelsea and Newton companies have been purchased, and options are to be taken up on these last two.

The total stock of the companies to be cancelled by the Edison Company, when it gets the new stock asked for, is $723,000; total bonds, $239,000, and total debts outside, $280,000; in coupon bonds, etc., $330,000; a total of $1,292,000. For this amount the Edison Company is to devote the proceeds of its sale of stock to the extent of $1,500,000. A part of the premium received will be used towards paying for the Chelsea and the Newton Companies.

The net debt of December 31, 1902, the 1903 budget and the cost of securing the outside companies amount to $5,260,000. Of this amount, $300,000 in undivided profits is to be deducted, and also $1,730,000 of capital stock that has been authorized, but not issued, leaving a debt of $3,230,000. Expenditures for 1904 are estimated at $1,610,000, covering the cost of lamps, service meters, a new unit in the power station and general extensions. These include possible new sub-stations or extensions in the north and west ends, and in Roxbury. The estimated debt on December 31, 1904, is thus $4,490,000. Of this amount the company wishes to fund $4,000,000 in the additional stock asked for at the present time.

The debt of the Edison Company is largely held by corporations and individuals. The amounts required for the purchase of the suburban companies were fixed by the selling price of the stockholders. The Massachusetts Gas Companies are to take the gas business of the Newton Company. The Edison Company intends to run the electric plant at Chelsea and supply Chelsea and Somerville. It will close practically all the stations to the south and west of Boston and supply the districts from that city. The system of contracts in use in Boston will eventually be adopted throughout the system. One advantage of the consolidation will be the supplying of 24-hour service to all the cities, a privilege which they do not all possess at present. There was no opposition at the hearing.

Philadelphia Meeting A. I. E. E.

The fourth regular meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held Monday day evening, June 8. The meeting was very well attended, there being over three hundred visitors and members present. Mr. William J. Hammer gave his lecture on "Radium and other Radio-active Substances," which was freely illustrated by experiments and lantern slides. Mr. Joseph Menchen, of New York, through his representative, Mr. Eckhardt, gave some examples of the way in which electricity is made use of on the stage. He showed various scenic effects, the one which pleased the meeting most being a combination of the rising moon playing upon dashing waters, showing the reflection of the moonlight on the water ripples, while the wind is driving clouds across the sky. He also showed waterfalls, snow storms, and sand storms. His apparatus was inspected by the members with much interest after the meeting. This was the last meeting of the Branch for this season. The next meeting will be held in September

New Telephone Patents.

"LOADING" TELEPHONE LINES.

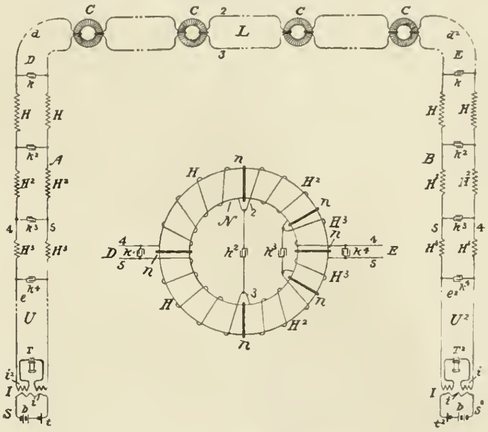


FIG. 1.—WARREN AND CAMPBELL LOADED CIRCUIT.

Attention is again called to loading of telephone lines by a patent issued to H. S. Warren and G. A. Campbell for what may be termed a "terminal taper," in contradistinction to the "terminal transformer." With any wave motion it is universal experience that when there is an abrupt change in the character of this medium through which that wave is progressing, a reflection more or less complete takes place at the point of contact of the two dissimilar media. This is clearly recognized in the reflection of light at the surface of water, or the echo or reflection of sound from a solid body. So is it with electric wave motions progressing in conducting media such as a line circuit. If such a circuit be composed of a series of sections, adjacent sections being of widely different electrical characteristics, that is, having combinations of resistance, inductance and capacity such that their resultant effect in the different sections is markedly different, then a very considerable reflection will take place at each change point. With loaded telephone working where long toll lines only are loaded with inserted series of impedance coils, if a local unloaded subscriber's loop or local trunk line, with its low inductance, be connected as an extension, the reflection loss at the junction of the toll and local lines becomes prohibitive. The terminal transformer was the first suggestion to overcome this difficulty, the primary and secondary windings being suitably proportioned, respectively, to the unloaded and loaded circuits. Such a transformer is not, however, a practical success, as it divides the circuits into two distinct conductive parts, and therefore prohibits the use of through lines for direct currents; for example, their use for a composite or simultaneous telegraphic and telephonic communication. Furthermore, it has been found difficult to design a transformer which will not introduce losses of a magnitude comparable with the reflection losses to be overcome.

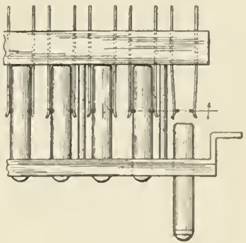


FIG. 2—M'CORMICK SWITCHBOARD

The terminal taper, which to all intents is a series of auto-transformers, serves to not only maintain the conductive continuity of the wires, but at the same time to avoid reflection losses. This device is represented in Fig. 1 by the windings H, H^2, H^3. C C C are the loading coils of the main toll line, while I, I, are the telephone instruments at the ends of the unloaded local circuits U, U^2. The two coils H, H are balanced, as also are H^2, H^2 and H^3, H^3 and these series of coils are so proportioned as to number of turns and resistance lost taken with the capacity of the condensers K, K^2, etc. bridged between them a gradual tapering of the impedance of the circuit takes place in passing through them. Thus, the H, H part of the circuit is relatively like that of the loaded portion of the line in characteristic, while the H^1, H^2 end is similar to the unloaded end, a sufficient number of intermediate steps being used to reduce the individual reflections to a point such that their sum is practically small. Messrs. Warren and Campbell have assigned their patent to the Bell Company, the holder of the fundamental loading patents.

LAMP JACK.

Mr. W. E. McCormick, of Chicago, has patented a new lamp jack and assigned his patent to the International Telephone Manufacturing Company. This lamp jack, shown in Fig. 2, is a sort of companion piece to the same inventor's strip jack patented some time ago. As will be seen, all strain is thrown directly on the front supporting strip, the lamp jack being in skeleton form. An insulating fibrous sleeve surrounds the lamp, guides it into position and isolates its illumination to its own bull's-eye. It will be interesting to know just what fiber will be selected, for experience has shown such material in the thin sheet necessary for this work, to warp almost out off recognition in the immediate presence of a source of heat, and hard rubber has been found to be nearly as bad.

A ONE-WIRE CENTRAL ENERGY BOARD.

A third telephone patent is that for a one-wire central energy switchboard. We have all seen the three-wire switchboard of the Western Electric Company, followed by the two-wire switchboard of the Kellogg Company. Now the Western Electric Company tries to go one better in the production of this switchboard, the patent for which is granted to J. J. O'Connell and assigned to them. As will be noted from Fig. 3, which shows the general circuit together with a sketch of how it is proposed to avoid cross-talk, the connecting cords form a local grounded or common return system, only connected with the subscriber's line system by the agency of repeating coils. It will thus be understood that each subscriber's line must contain primarily such a repeating coil. One side of this coil serves to send battery to the subscriber's line and repeat the voice currents to the other side of the coil, which is connected between the jack and ground. All that it is necessary therefore to complete the talking connection is to provide a single conductor between the spring jacks of the two lines in question. This simplicity of cord circuit banishes the supervisory lamp from the cord circuit, and this lamp has therefore been associated with the answering jack, one for each subscriber, and has been colored red to be distinguishable from the line lamp. Thus red lamps will flash at various points of the switchboard, which will have no significance, as the disconnection can only be made by the operator of the calling party. The system is therefore a one-light supervision system with the added precaution of an indication of "hang-ups" at a portion of the switchboard other than that where the "hang-up" exists. The exact operation of the signals and the combined ringing and listening key is easily traceable and need not therefore be further discussed.

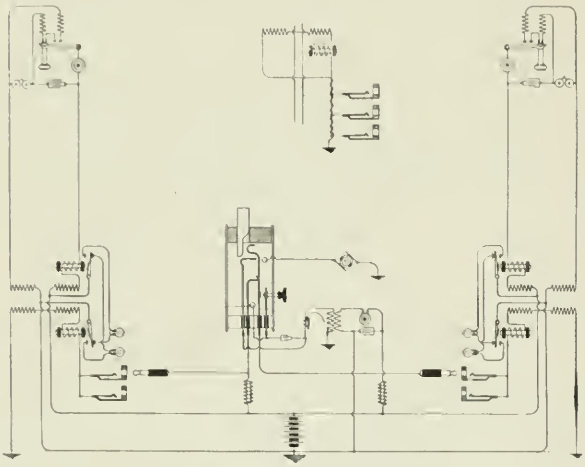


FIG. 3.—O'CONNELL EXCHANGE SYSTEM.

Independent Telephony in New York State.

It would appear from the meeting held in Utica on June 10, that the differences existing in the independent telephone field in New York State have been adjusted so that the New York State Independent Telephone Association may be said to represent the interests characterized by its title. The meeting was called to order by President George R. Fuller, of Rochester, N. Y., who discussed the conditions under which the meeting was held and named the various points in the State at which Independent exchanges had been established. With regard to membership in the Association, he proposed certain changes based on $2 for the first 100 telephones and $1 for each additional 100 telephones up to 500. From 500 up to 1,000, 50 cents for each additional 100. Above 1,000, 25 cents for each 100, extra assessments for any one year being limited to 25 per cent of the annual dues. He also proposed liberal treatment of the supply trade.

Mr. C. O. Harris read a paper on the Growth of Independent Telephony in the State of New York, and Mr. Potter, of Syracuse, read a paper on Uniformity in Telephone Service.

Officers for the ensuing year were elected as follows: President, George R. Fuller, of Rochester; first vice-president, Howard Hendrickson, of Albany; second vice-president, J. H. Scofield, of New York City; secretary and treasurer, J. B. Ware, of Buffalo. Executive Committee: H. H. Persons, of Buffalo; B. G. Hubbell, of Buffalo; S. B. Rawson, of Niagara Falls; Edward Davis, of Binghamton; T. H. Ferris, of Utica; J. S. G. Edwards, of Gloversville; J. S. Brailey, Jr., of Herkimer, and T. S. Lane, of Jamestown. Inspectors: C. H. Poole, of Utica, and C. O. Harris, of Rochester.

During the evening a reception was held at the Home Telephone Company's Exchange of Utica, the equipment of which was installed by the Stromberg-Carlson Company, including a 10-section central energy board.

Among the manufacturing interests represented at the Convention were the Sterling Electric Company, Lafayette, Ind.; Kellogg Switchboard and Supply Company; American Electric Telephone Company; North Electric Company; American Novelty and Manufacturing Company, New York City, and the Stromberg-Carlson Telephone Company.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society for the election of officers was held at the Café Boulevard, New York City, June 10. The officers elected were: President, J. J. Carty; Vice-Presidents, W. I. Donshea, Hobart D. Betts, W. S. Barstow, Douglass Burnett, H. C. Townsend, F. C. Bates; Secretary, George H. Guy; Treasurer, Henry A. Sinclair. The reports of the secretary and treasurer showed the society to be in a more flourishing condition than ever. One hundred and eighty-six members were elected during the year; there were 26 resignations and 3 deaths, and 51 were struck off the rolls for non-payment of dues. The net gain in membership is 106, the present membership numbering 619. The quality of the papers presented at the season's meeting, a matter of supreme importance in this organization, has been fully up to the exacting standard of late years, and there is a feeling of confidence among the members that the society is pressing on at a sure and steady gait towards the 1,000-member mark. An excellent dinner was served and a carefully selected musical programme was rendered by the Hungarian Band. The vocal part of the evening's entertainment was provided by Mr. Charles Stuart Phillips, whose rich and powerful tenor voice rang out to fine advantage in several beautiful compositions.

Trolley New York to Boston.

At New Haven, Conn., on June 16, in the Superior Court, Judge William T. Elmer granted permission for the construction of the last link of trolley line necessary for a complete electric road between New York and Boston, paralleling the New York and New Haven from the Hub to the Grand Central Station. The new road, upon which work will be begun at once, will connect New Haven with Wallingford and is about six miles long.

CURRENT NEWS AND NOTES.

UTILITY OF TELEPHONE.—The New York and New Jersey Telephone Company has just removed the telephones from all suburban public schools and municipal courts because of the failure of the fusion administration to pay tolls for the last two years. By the use of the telephone much time was saved by both the courts and the lawyers, cases being called to suit the convenience of both sides and promptly disposed of. In the public schools the telephone was used by the principals to summon substitute teachers and to report to the board rooms, saving many hours to the scholars in cases where teachers failed to report and enabling the principals to remain at their posts.

PROPOSED PATENT LAWS IN MEXICO.—Under date of May 16, 1903, Consul W. W. Canada, of Vera Cruz, says: "A bill has been laid before the Congress of Mexico providing that trademarks shall be registered and patents for inventions granted without previous investigations respecting their novelty or originality. Petitions for registrations of trade-marks and applications for patent rights are to receive prompt attention, and measures shall be taken to effect a reduction in the charges made for such service. A special code of penal laws for the prevention of fraudulent uses of trademarks, etc., and violation of patent rights is to be prepared. The law to be enacted shall be in accordance with the convention of Paris, March 20, 1883, that there may be no impediment to Mexico joining the International Union for the Protection of Industrial Rights."

ELECTRICITY IN SURGERY.—Surgery without the use of ligatures was advocated in Europe recently by Dr. Andrew J. Downes, of Philadelphia, who has just returned from Madrid, whither he went to attend the International Medical Congress. Dr. Downes read a paper on "Electro-Thermic Haemostasis in Abdominal Surgery." Practical demonstrations of this method of performing surgical operations without employing ligatures were given by Dr. Downes at clinics in several cities in Europe. In all surgical operations, as usually performed, hemorrhage is controlled by the use of ligatures. The new method consist of the use of various sized pressure forceps, of special design, in the blades of which is an insulated piece of platinum, which is heated by the passage of a suitable electrical current through it. It cooks the tissue under pressure, obliterating its blood vessels. The process is an absolutely aseptic one.

CUTTING WESTERN UNION WIRES.—At Philadelphia, on June 11, in a decree by Judge Acheson in the United States Circuit Court of Appeals, the order of the Circuit Court of New Jersey, on January 21 last, directing that the Pennsylvania Railroad and the United New Jersey Railroad and Canal Company be restrained from in any manner interfering with the use and operation of the telegraph lines of the Western Union Telegraph Company until the right of way dispute is finally decided by the Supreme Court of the United States, was reversed. This decree practically declares that the demolition of the telegraph company's poles and wires by the railroad company was justified legally and is a flat refusal by the court of the order for stay of proceedings petitioned for recently by counsel for the telegraph company. Should any poles or wires still remain untouched they may now be torn down. The Appellate Court's decree covers less than one-half of a typewritten page, and sets forth no grounds for the reversal of the lower court's injunction.

CHEMICAL ELECTRIC SIGN.—A patent was granted on June 9 to Mr. Harry B. Wren, of Washington, D. C., for an electric sign. It is composed of parts of suitable form made of a conducing material and embedded in a foundation of non-conducting material; they are connected in a suitable manner by wires to the electric supply circuit. The principal point of the invention is that these conducting elements are covered or permeated with a chemical compound which changes color with change of temperature or other change of state. The following prescription is given for such a compound: mix one part of powdered cobalt and four parts of aqua regia, add one part of sodium chloride and sixteen parts of water, filter and mix with gum to the consistency of paint. When the electric current is turned on, the temperature of the conducting elements changes and the outline of the design appears in a color different from that at normal temperature. Similar effects may be produced by means of electromagnets, which attract metallic filings of various colors and produce the outline of the letter or character desired.

THE UNION ENGINEERING BUILDING.—At the meeting at Asheville, N. C., last week of the American Society of Civil Engineers, action was taken in regard to the participation of the Society in the million-dollar building presented lately by Mr. Andrew Carnegie to such of the national bodies as wished to share in it, and the Engineers' Club, of New York City. It resolved that the Board of Direction be authorized to ascertain whether suitable accommodations can be obtained for the Society in the proposed new building, with provisions for future needs, and also to make such investigations and hold such conferences as may be necessary on the advisability of the acceptance of Mr. Carnegie's gift by the Society. It was also resolved that the Board of Direction be authorized to co-operate to this end with the other organizations concerned, and that it be requested, provided it is satisfied that suitable accommodations can be obtained and that acceptance of the gift is otherwise practicable, to send members of the Society a letter ballot, by means of which direct expression of the wishes of the Society in the matter may be secured, and to accompany such ballot by statement of the reasons for and against uniting in the scheme with the other organizations. It was resolved that the Board of Direction, in case a majority of the members, as shown by the letter ballot, are in favor of uniting with the other organizations, is authorized to proceed in behalf of the Society in carrying out the project. It was also voted that the letter ballot provided in the foregoing resolution should be presented to the Society with the usual sixty days' notice, and an opportunity for discussion at the next annual meeting. The Boston chapter has recently voted overwhelmingly in favor of accepting Mr. Carnegie's generous offer.

MAGNETIC SUSPENSION FOR INSTRUMENTS.—Two patents for magnetic suspension devices were granted on June 9, the one to Mr. Frank P. Cox, of Lynn, Mass., the other to Mr. William H. Pratt, of Lynn, Mass., both assigned to the General Electric Company. Mr. Cox annuls or diminished the mechanical friction due to the weight of the shaft of an electric meter in the following way: The shaft is held in position by two bearing rings at the upper and lower ends and the magnetic suspension device is placed at its upper end. It consist of an iron body of, a form which may perhaps be best described by assuming an ᗰ being revolved around its middle axle which is in direction of the shaft; it consists, therefore, of an outside ring and an axle in the center, the ring being closed by a circular iron plate at the top, and polar projections being provided at the bottom; the magnetising coil is wound around the axle in the center. In this way a strong magnetic flux is produced, the lines of force being radial and horizontal. In the annular space through which the flux passes, an annular mass of soft iron is placed so as to nearly fill this space, small air-gaps only being left. This iron ring is supported on a number of arms of non-magnetic material, connected to the upper end of the shaft of the instrument. The magnetic flux holds the iron ring in such a position that the weight of the shaft and armature is supported wholly independent of any mechanical bearings. The patent, granted to Mr. William H. Pratt, is for a similar arrangement; the magnet is also assumed to have one of its poles annularly shaped and surrounding the other; the flux passes between the poles in horizontal radial lines, and in this space the annular armature is placed which bears the shaft of the instrument. So far the arrangement is exactly the same as in the above patent of Mr. Cox. But Mr. Pratt points out that this arrangement in general has the disadvantages that if the annular armature has a comparatively small circumferential reluctance, whenever it is displaced sidewise there is a tendency for the flux, or part of it, to enter the armature at one side, flow half way around the armature, and go out at the other side. This flux then tends to hold the armature permanently displaced. To reduce this tendency, Mr. Pratt arranges the magnetic circuit of the armature in such a manner as to oppose but little reluctance to the passage of a radial flux, and considerable reluctance to the passage of a circumferential flux. This is accomplished by the use of an armature formed of blocks of magnetic material separated by air-gaps. He thus overcomes the tendency to hold the armature permanently displaced when once accidentally displaced.

FIRE IN A NIAGARA PLANT.—According to a press dispatch, a fire in the works of the Oldbury Chemical Works, at Niagara Falls, destroyed ten transformers and six rotary converters a few days ago. The damage is given as $100,000. The works are located on the lands of the Niagara Power Company and produce yellow phosphorus and potassium chlorate.

RADIUM AND EYESIGHT.—A cable dispatch from Berlin, Germany, of June 7, says: "Dr. Lunden, a German scientist, says he has proved by experiments that rays reflected from radium enable the blind to see more or less clearly. He instances the cases of two Russian blind boys who permanently regained their sight through the use of these rays."

MUNICIPAL ELECTRICIANS.—The Eighth Annual Convention of the International Association of Municipal Electricians will be held in the banquet hall of the Hotel Rudolf, Atlantic City, N. J., Wednesday, Thursday and Friday, September 2, 3 and 4, 1903. The following rates have been secured from the hotel: $3 each, one or two persons in one room; $2.50 each, three or four persons in one room and two beds; with bath, $4.50 one person and $7.50 for two persons. Those desiring rooms should write to Mr. William Cochran, manager, Hotel Rudolf. The following papers have been promised: "The Best Methods for Lighting Small Cities," "Classifying of Records of Electrical Departments, and Standard Specifications for Supplies and Contracts," "Importance of the Fire and Police Telegraph Systems." There will also be a "topical discussion" of Line Construction, which is expected to bring out all the different ideas of the several members in relation to this important question. An exhibit will also be made of apparatus.

WESTINGHOUSE IN CANADA.—For some years past the Westinghouse people have had air-brake works at Hamilton. It is now proposed to amalgamate the Canadian air-brake business with that of a new Canadian Westinghouse Electric Company. A meeting of the organization committee was held recently at Hamilton when the following gentlemen were present: Mr. H. H. Westinghouse, vice-president of the Westinghouse Air-Brake Company of Pittsburg; Mr. J. F. Miller, secretary of the same company; Mr. L. A. Osborne, fourth vice-president of the Westinghouse Electric and Manufacturing Company of Pittsburg; Mr. Warren Y. Soper, of Ottawa, and Mr. Paul J. Myles, of Hamilton. It is understood that a number of influential Canadians will be financially interested in the new undertaking. The importance of this addition to Canadian industry cannot be overestimated. The business in Canada of late years has grown to such proportions that it warrants the establishment of a domestic factory to be devoted to the demands and interests of the Dominion. The capital will be $2,500,000.

WIRELESS AT SEA.—A new application of wireless telegraphy is noted by the captain of the *Kaiser Wilhelm II* of the North German Lloyd Steamship Company. On a recent voyage across the Atlantic to New York he had been unable to obtain an observation throughout the entire voyage, but approaching the British Isles he became convinced that he was nearing land and was unable to ascertain his exact location. He directed the Marconi operator to send out a message, and received a response from the Crookhaven station. This did not betray the location of the ship to the captain any more definitely than his dead reckoning had done. A second message was sent to the Crookhaven station, requesting that a sharp lookout be kept, and that when the fog whistle was first heard a dispatch be immediately sent to the ship notifying them to that effect. Several hours later a message was received on board the vessel saying: "We have just distinguished your fog whistle." Crookhaven was then requested to sound its fog signal at stated intervals, and by this means the *Kaiser Wilhelm* was able to definitely ascertain its location. On the return voyage, the same ship, when 350 miles out from Nantucket light, reported her approach to this coast by means of relaying from the steamship *Minnehaha*, which was 150 miles nearer the lightship than the German vessel. It was thus enabled to report its arrival twelve hours earlier than it would otherwise have been able to do.

REPEATING BREAK FOR ELECTRIC CIRCUITS.—A patent was granted on June 9 to Mr. Leo Daft, of Ealing, the electric railway pioneer, and Mr. Alfred Williams, of Wimbledon, England, for a repeating break for electric circuits. The chief advantages of this break are said to be that the frequency can within wide limits be regulated to any desired degree; the fraction of the period during which contact occurs before break can be regulated, the rapidity of the severance of the surface at the desired moment is a maximum. The two surfaces when in contact are caused to move relatively to one another; this has the effect of displacing any impurities between the surfaces and allows them to come into more intimate contact. The points of the two surfaces which mutually part company when the break occurs are changed in each successive break, so that the condition of the surfaces is rendered more permanent on account of the distribution of the unavoidable wear and tear, due to sparking over the whole area of contact uniformly. An electric motor drives the break, and a rheostat is used for regulating the speed. Several forms of the apparatus are described. In one form the surfaces of contact are two parallel concentric circular plane areas. One is caused to turn in its plane about its center through a small angle in each contact, the other not rotating. The contact surfaces are of platinum and immersed in a bath of non-conducting fluid, such as alcohol, petroleum, or other hydrocarbon; the fluid serves to quench the spark and the beaker collects the platinum dust so that it may be recovered. In a modification of this form of apparatus, the contact surfaces are eccentric to one another and both surfaces are caused to revolve. In another modification one of the surfaces consists of the rim of a circular disk which is caused to rotate on its axis and the other surface is concave, of the same shape as a portion of the rim of the disk. The fork which carries the revolving disk is part of a pivoted lever which is caused to make angular reciprocations. In another modification, the fork which carries the revolving disk is mounted so as to make linear reciprocations, and the other electrode is adapted to have its constant surface changed at intervals when the surface in use has become unduly worn.

VENTILATING DYNAMO ARMATURES.—The improvement of the ventilation or cooling of high speed dynamo electric machinery is of importance and recent developments tend to make it more of a consideration than ever. The means for ventilation at present employed are of two kinds. The most usual consists in forming radial gaps in the sheet-iron assemblage in such a manner that the assemblage is formed of annular blocks separated from each other by small spaces. By reason of the increase of the cooling-surface a certain improvement in the ventilation of the machine ensues; but the ventilation nevertheless remains very insufficient, the insulations of the sheet-iron opposing great difficulty to the passage of the air from one piece of sheet-iron to the other. The second process, less employed, but nevertheless more efficacious, consists in causing the air to circulate in the interior of the moving portion and around the fixed portion by means of fans directly mounted upon the shaft of the machine. In a method of ventilation just devised by Mr. A. C. E. Rateau, of Paris, France, an auxiliary fan is employed; but the system is distinguished from the prior arrangements in that the air fed by the fan is forced to circulate in inner channels formed in the fixed portion of the machine, such channels being arranged in such a manner than not only is the fixed portion cooled, but at the same time also (and this is most important) the periphery of the moving portion. In a general manner the invention consists, therefore, in forming channels through the fixed sheet-iron assemblage or in forming between them suitably arranged channels, in which air is caused to circulate by means of a fan. In this manner the air licks the face of all the sheet-iron pieces, as well as the periphery of the moving portion, quite near to where heat is evolved. The surface of contact between the air and the masses to be cooled is, on the other hand, very extended, because the channels may have a superficial area as large as desired. The channels are formed either of holes pierced by a punching-machine in the sheet-iron assemblage in the same manner that the notches for receiving the windings are formed or by gaps of suitable length formed in the succession of sheet-iron assemblages. Of course, there is left between the different channels enough metal to insure the passage of the magnetic flux. This arrangement is also applicable to machines having a rotating field the fixed portion of which is continuous and to all other electrical machines in which the poles are insulated.

ALTERNATING CURRENT MOTOR.—Mr. Alex J. Churchward, well known as an American designer of dynamo electric apparatus, has taken out a patent on a new form of alternating current motor of the self-starting type, and brought to synchronous speed. In one form he organizes the motor as a continuous or direct current motor, which, as is well known, will start and under the action of (single-phase) alternating currents fed to armature and field, will, if not too much loaded, come to synchronous speed. In its self-starting condition the motor has a field-coil in series with the armature. When brought to synchronism, a switch changes the connections, so that alternating current is fed direct to the armature by means of rings or continuous contact devices, and the field is excited by continuous current fed thereto over a circuit which is provided with regulating appliances controlled automatically in a manner to cause the field to increase in strength with the load. This continuous current may operate in any suitable coils upon the field-magnet; but when such coils are in a circuit formed as a shunt to the armature, so as to take their direct current from it, they are made as high-resistance coils and independent of those used in the non-synchronous operation.

ELECTRIC COOKING APPLIANCE.—Mr. Edward E. Gold, of New York City, who has already done a great deal of successful work in the electric heating field, has just been granted a patent on an adjustable or flexible cooking device, the application for which was made as long ago as July 16, 1896. It is based upon the use of his heating coils or spirals enclosed within the cooking chamber, associated with portable heater trays in which the coils are grouped between plates. For utilizing these electric trays or heaters Mr. Gold provides an oven or stove consisting of a casing into which the trays are inserted, so as to serve as shelves on which to place the articles to be cooked. The sides of the oven are provided with ledges or cleats for upholding the tray and so that any tray can be placed on any pair of cleats, and thereby set in the oven at any desired height. Removable grids or gratings are provided as shelves between the electric trays or upon ledges not occupied by the latter. The top of the stove is provided with stove-holes, as usual, under each of which is provided a special electric tray or heater. For introducing the electric heaters in circuit they are provided with circuit-terminals connected to the coils, adapted for connection with exterior conductors connecting with the respective circuit-leads; one or both of the connections consisting of a metallic socket in the heater connected with the coils and adapted to receive a metal pin or plug connected by a wire or cable with the stationary circuit-lead.

HIGH SPEED ELECTRIC TRAINS.—A cable dispatch from London of June 13 says: The Prussian State railways between Hamburg, Hanover and Berlin will shortly conduct an interesting competition between steam and electrically hauled trains. The leading locomotive builders and electrical firms of Germany have been invited by the State to submit designs and specifications for steam or electric locomotives or motor cars capable of making 100 miles an hour with a light load, and 90 miles an hour on ordinary traffic. The tests will be a continuation of the trials of high speed electric trains on the Prussian standard gauge military line between Berlin and Zossen, and have been arranged on account of the decision to increase the speed of trains between Hamburg, Hanover and Berlin. The *Times* expresses the opinion that even then no particular light will be shed on the question of express passenger traffic. Bearing in mind the nature of the Berlin-Zossen line, the *Times* goes on to say: "Engineers are agreed that mean speeds of over sixty to sixty-five miles an hour are practically commercially impossible on the present two-rail tracks. Owing to the existing curves and the mixture of speeds, a critical stage has been reached in railway locomotion. The liveliest interest will therefore be taken in the working of the monorail system, which is to be built between Manchester and Liverpool, on which a speed of 110 miles an hour is promised without fear of derailment. Doubtless some special form of track is the true solution of the problem of high speed."

PHASE INDICATOR.—Mr. Otto Holz, of Schenectady, has assigned to the General Electric Company a patent issued to him on a phase indicator. The instrument comprises two relatively rotatable members, one of which is charged electrostatically in accordance with the voltage of an alternating-current system and the other in accordance with the current flowing in said system. The two members are free to move relatively to each other and to assume various relative positions depending upon the phase relations between the current and electromotive force of the system, or, in other words, upon the power factor. The member responsive to potentials corresponding to current is movable and the member responsive to voltages of the alternating-current system fixed, or the reverse. In either case there will be produced in each of the members a rotating electrostatic field, so that if the two members were to be placed at random with respect to each other a torque would be exerted between the two members. The movable member being preferably free to rotate without restraint would then turn under the influence of this torque until it has assumed a position where the torque became zero. If under these conditions the currents of the alternating-current system should be in phase with the electromotive forces, this position of the movable element of the instrument would indicate unity power factor. In case the currents of the system were to shift in phase relatively to the electromotive forces the electrostatic field in the element of the power-factor indicator corresponding thereto would shift correspondingly, thereby disturbing the balance of the torques existing between the two elements of the instrument, and thereby causing the movable element to assume a new position of equilibrium corresponding to a new value of power factor. The varying values of power factor are thus indicated by the positions assumed by the movable member as an index to which a pointer movable over a scale is employed.

INDUCTION MOTOR ARMATURES.—Mr. Charles P. Steinmetz has patented an improvement in the armatures of induction motors. As is well known, these are ordinarily designed so as to have low resistance, and thus secure close speed regulation and high efficiency. When thus designed, however, the torque of the motor at starting is comparatively small and the machine therefore unsuitable for use in cases where it is required to start under load. Various expedients have been resorted to in order to secure large starting torque and at the same time to obtain high efficiency under normal load. The invention now made accomplishes this result by providing the armature or induced member with a plurality of windings, one at least of which is of the squirrel-cage type and of comparatively high resistance. At starting all of the windings of the induced member of the motor are open except the squirrel-cage winding. As soon as the motor gathers speed, however, the other winding or windings of the induced member are successively closed. The particular form of short circuiting switch is immaterial and may conveniently consist of a suitable contact-piece sliding longitudinally upon the shaft of the motor and co-operating with suitable terminals connected to the distributed winding. In starting the motor the distributed winding is open-circuited, thus rendering the same inactive, and so making use only of the squirrel-cage winding, which is usually of comparatively high resistance. After the motor has been started from rest the sections of the distributed winding are cut in one after another, thus increasing the amount of active copper in the induced member, and consequently increasing the ampere-turns, and so approaching the conditions of high efficiency and close speed regulation. When all of the windings have been cut into circuit and all of the copper on the armature becomes active in carrying current, the result secured is equivalent to that which would be obtained by the use of a single winding having the same amount of copper in cross-section, and if the amount of copper employed is sufficient the desired regulation and efficiency may be secured.

LETTER TO THE EDITORS.

Absolute Measurements in Electricity.

To the Editors of Electrical World and Engineer.

Sirs.—We are not at all responsible for the telegraphic despatches that have been sent out regarding what we are doing in my laboratory at the University of Michigan in absolute measurements in electricity. The facts are these: Two papers have already been published in the *Physical Review* in which we described an absolute electro-dynamometer of our own design and construction. The first one was by Professors Patterson and Guthe on "A Redetermination of the Electrochemical Equivalent of Silver," Phys. Rev., Vol. VII, No. 39. The second paper was by myself and Professor Guthe on "An Absolute Determination of the E.M.F. of the Clark Cell," Phys. Rev., Vol. IX, No. 5, 1890.

We found that the large and small coils of our former electrodynamometer were not sufficiently stable in form, and we did not get their dimensions with as great accuracy as we desire. Hence we are rebuilding the instrument entirely and are measuring every part with the greatest accuracy. The large coil, wound on a plaster of Paris cylinder 47 cm. in diameter, is now done, and the porcelain cylinder, made at the Royal Porcelain Works in Berlin, is nearly ready for winding. Methods and instruments for measuring these coils have had to be invented, but the difficulties are now apparently overcome.

A large number of Weston cells, with excess of cadmium sulphate crystals, have been made and they have been under comparison for several weeks. More will be made soon. We shall first measure the E.M.F. of the cadmium cell, and subsequently shall redetermine the silver equivalent. On account of the extreme care given to all details, the work has progressed slowly; but we hope to have some preliminary measurements of the E.M.F. of the cadmium cell made before the coming meeting of the American Institute of Electrical Engineers at Niagara Falls. In both these determinations we get, of course, an absolute measure of the ampere. We have standard resistances with Reichsanstalt certificates, and these we assume to agree with the certificates. HENRY S. CARHART.

ANN ARBOR, MICH.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

An Interesting Phenomenon in Compensated Motors.—HEYLAND.—An article illustrated by diagrams. The author had repeatedly observed in experiments with compensated motors, that the rotor losses, that is, the copper losses in the short-circuited armature, after connecting the compensator, did not become greater, but were even less than in the ordinary motor. If the same motor worked first with a simply short-circuited rotor and then with a compensated rotor at the same load, the heating and the losses measured in the rotor were less in the compensated than in the normal motor. This seemed very surprising, for while for the stator a decrease of the losses on account of the improvement of the power factor was self-evident, it should have been supposed that the losses in the rotor would increase, because the induction currents in the rotor are increased in the compensated motor by the magnetizing currents which are introduced through the commutator. Experiments were made with motors which carried collector rings, and the short-circuited armature was connected with an amperemeter, which was introduced into the circuit of the collector rings. It was then found that the rotor current in the compensated motor was only greater for small loads, but at normal load and from ⅓ of the load upwards, was smaller in the compensated motor than in the ordinary motor with short-circuited armature. The phenomenon was investigated graphically and the explanation was found in the negative leakage of the compensated motors. It is well known that in such motors the field of the rotor is greater than that of the stator. The tractive power is quite generally determined by the product: common field × induction currents, and as in the compensated motor the field common to the stator and rotor becomes larger than in the ordinary motor, therefore, for a given tractive force the induction currents will become proportionately smaller. This difference is so considerable that beginning with a certain load the total current resulting from induction current plus magnetizing current in the rotor is smaller in the compensated motor than the induction currents alone in the ordinary motor. The author states that this result is of great practical significance, as it shows that it is not necessary, as was stated formerly, to increase the winding space in the rotor. On the contrary, the rotor with the same copper can be considerably more loaded, without passing the heat limit. In the stator, in consequence of the absence of the wattless component, the heating becomes the same, if the power is increased in inverse proportion of the power factor. The iron losses remain the same. In the rotor it is possible, if desired, to go still higher, for the iron losses can be neglected altogether. The heat limit of the copper will generally not be reached on account of the better ventilation in the rotor, and the slip in any case becomes less in the compensated motor, because it is proportional to the losses by the induction currents. A 5-hp motor, therefore, furnishes about 7 hp with the same heating, when running as a compensated motor. The efficiency of the same motor increased from 78 to 81 per cent.—*Elect. Zeit.*, May 28.

Ageing of Iron Sheets.—STERN.—A long article with a number of tables and diagrams. The tests of the sheets covered a period of 5 years, from 1897 to 1902. Immediately measurements were made with 7 rings, composed of 32 sheets, each 0.35 mm thick. Each ring received two windings, such as are necessary for ballistic investigations. The windings were of such dimensions that the rings could be connected to a 52-volt alternating current, of a frequency of 125, when the saturation of the iron was about 8,000. Three rings were exposed to a dry heat of about 100° C, 3 rings were connected to an alternating current and an incandescent lamp, so that the average temperature of the rings was 45° C. The seventh ring was kept at the temperature of the room for control measurements. The examination of the rings was for the purpose of investigating a statement made by Mordey and Blathy, that the reversal of magnetization has no influence on the ageing, which at high temperatures would take place also without demagnetization. Therefore, it was expected that the first three rings would age considerably, but no ageing would take place with the other three rings, as they were only heated to 45°, and the change of magnetization should not have any influence. The percentage of ageing, that is, increase in hysteresis loss, of the first three rings, was found after 40 days' heating, as 56 per cent., 45 per cent. and 31 per cent., respectively, but the hysteresis loss in the other three rings had also increased after 15 to 17 months by 20 per cent., 15 per cent. and 8.5 per cent. The greatest surprise, however, was furnished by a measurement of the seventh ring, which should have served as control. This had only been exposed to the ordinary room temperature, but it was found that an average increase of hysteresis loss of 12 per cent. had taken place after 17 months, and from $B = 4{,}000$ to 10,000 quite evenly; the magnetization curve had also received another form. Other observations on the same line cause the author to make the following statement: "It must be regarded as an incontestable fact that iron at the temperature of the room can also show in time a not inconsiderable increase of losses by hysteresis." The conclusions drawn from a long series of measurements are the following: 1. Ageing of sheets of iron can take place at every temperature. 2. A sheet with a small coefficient of hysteresis has in general a greater inclination to ageing than a sheet with a large one. 3. In an ageing sheet this coefficient grows for small inductions in a greater degree than for high ones. 4. Consequently, the permeability decreases at small inductions with the ageing more than at high inductions. 5. An annealing of the sheets after punching (or cutting) is at best without value, mostly detrimental. 6. There is iron, which shows between room temperature and 100° none at all or an inconsiderable increase of losses. 7. A number of German rolling mills, after having formerly manufactured a strongly ageing material, is to-day in a position to furnish sheets which do not age at all or only to a small degree. 8. As there are still manufactured to-day strongly ageing sheets, continuous control measurements are to be advised. 9. A limiting clause in regard to the temperature of cyclically magnetized iron in machines and transformers cannot be recommended in view of 6 and 7.—*Elect. Zeit.*, May 28.

REFERENCE.

Induction Motors with Commutator.—BRAGSTAD.—The conclusion of his long theoretical article on polyphase induction motors, with commutator and shunt excitation, previously noted in the Digest.—*Elec. Zeit.*, May 28.

POWER.

Electric Driving in Machine Shops, Engineering and Shipbuilding Works.—The continuation and conclusion of the article previously noted in the Digest. The paper by Williamson deals entirely with the work carried out in the various establishments of Vickers Sons & Maxim, Limited, in which the aggregate horse-power of generators and motors amounts to about 22,500 B.hp. The whole of the generating plant is of the continuous-current type, delivering current at 220 volts, and all the dynamos are shunt wound. The fact that there are some 1,300 motors in daily use, switched on and off by the workmen in charge of the various machines, and that in spite of the rough usage they are subjected to, they take care of themselves remarkably well, speaks well for continuous-current motor driving. A table is given showing the summary of generating costs for one year, from which it appears that at North Sheffield, with 640 kw-capacity and a fuel cost of $2.42 per ton, the total cost per unit was 1.43 cents, while at South Sheffield, with 1,325-kw capacity and fuel at $1.80 per ton, the total cost per unit was 1.35 cents. The capital outlay on plant and buildings at North Sheffield was $99.05 per kw, and at South Sheffield $125 per kw. A detailed analysis of the cost of generating at the two Sheffield works is given. The day load is 5,150 amp. and the night load 4,500 amp. The application of the motor drive to a vertical portable planer or slotting machine is described, where the novelty of the application lies in the insertion and short-circuiting of a shunt resistance, which takes place when the motor is reversed at the end of the down stroke of the tool, so that the return stroke is made at the rate of 900 r.p.m., while on the cutting stroke the motor runs at 300 revolutions. The reversion of the motor and the insertion and cutting out of the shunt resistance take place automatically. A number of valuable data are given to the actual power consumed by a large number of various tools when doing specific work, and the amount of metal removed per B.hp-hour. Among the tools mentioned are large gun-goring lathes, heavy armor plate planers and other heavy machinery. On a Wellman charging machine for steel furnaces three 25-hp tramway motors are used, one each for the traveling, traversing and lifting motions, and a 5-hp motor for the turning gear. The power taken varies from 7 to 70 B.hp. The tubs hold three tons, and a 40-ton furnace is charged in half an hour, as against four hours by manual labor. The advantages over manual charging are a reduction of 50 per cent. in wages, an increased output of 25 per cent. and a reduction in the cost of repairs. The power for line shafting in the works varies from about 5½ to 13 B.hp per 100 ft. of 3 to 3½-in. shafting, the average being 9.1.—Lond. *Elec. Rev.*, May 22 and 29.

Electric Drive in Rolling Mills.—ANDREEN.—The author first discusses the question of speed regulation as required in rolling mills and comes to the conclusion that continuous-current motors are best suited for the peculiar conditions met with. A recent installation at a rolling mill in Sweden is then described. In the generating station there are two 170-kw dynamos, driven each by a water turbine of about 250 hp. The generators are of the compound type and run at 550 volts and 310 amp. at full load. The motor is directly coupled to the rolls and furnishes normally 400 hp. It has two commutators, which can be connected in series or parallel, and is compounded, but less than the generators. The speed can be varied from 140 to 500 revolutions, and the motor runs sparklessly at a constant position of the brushes and at all loads. The load conditions are very difficult, diagrams showing that it rises and falls during a few seconds from a maximum to nothing. As the motor is built for constant speed, there is no fly wheel necessary on the rolls and the important advantage is obtained that the rolls can work at a uniform speed, by which means the production is enlarged, the work simplified and the percentage of scrap considerably decreased.—*Teknisk Tidskrift*, translated in *Elek. Anz.*, May 17, 24.

Equipment of Machine Shops.—HORNER.—A discussion of the questions that come up in this connection. In regard to the question of electricity versus compressed air the author states that they are rivals to a certain extent, but only within a comparatively limited area. "The latter agency scarcely touches the driving of machine tools outside of the portable types, nor is it used much for hoisting tackle, excepting in the lighter class of traveling crabs and hoists. It is not a serious rival to electricity in the heavier cranes, whether they are of the fixed or traveling types. . . . The elasticity of the electric system as well as its potential economies, explains and justifies its phenomenal growth." The article is well illustrated.—*Cass. Mag.*, June.

Tests of Electrically-Driven Shop Equipment.—MOORE.—An article giving a table of tests of the power required for various tools, such as drills, planers, punches, rail benders, under actual working conditions. Among the data given for the various tools is the voltage and amperage of the starting current, the time required to start, voltage and amperage of the current while the tool was running, the average developed horse-power, and the revolutions of the various motors per minute. Alternating current is used in the plant. The tests occupied a period of one hour, the machines during this time running under ordinary service.—*Eng. News*, May 28.

Oiling System for Power Plants.—MOOCK.—An illustrated description of an oiling system which supplies sight-feed nozzles with oil under a constant head, regardless of whether the supply tank is full or almost empty. The main supply tank has upper and lower gauges, showing the level of the oil, a supply pipe running to the engine. Tapped into this pipe is a stand pipe having a hole in the side near its upper end, which end is closed to keep out the dirt; a valve is situated at the top of the tank for filling purposes. When the tank is first filled the oil rises in the stand pipe to the same height as in the tank; the valve at the top of the tank is then closed, and the oil in the stand pipe will feed to a point where a little air will force its way into the bottom of the tank, thereby allowing more oil to run out, and this point will be the constant oil level. The sight-feed nozzles are all on the same level and when once properly set, need never be shut off, a valve being placed in the main feed pipe for that purpose.—*Amer. Elec.*, May.

REFERENCES.

Size of Motors Required to Drive Presses.—FLADD.—An article giving a compilation of a number of presses of different kinds in actual operation and the horse-power of the motors required to drive them.—*Amer. Mach.*, May 28.

The Electric Motor in the Machine Shop.—KIMBALL.—A long, well-illustrated article. The author discusses the speed requirements for the various tools at considerable length.—*Eng'ing Mag*,. May.

Power Test of Group Drive Motors.—LEWIS.—An article, illustrated by tables and diagrams, on an elaborate series of tests recently made at the Roanoke shops of the Norfolk & Western Railway, to determine the power required by the various group drive motors for machine driving.—*Am. Eng. & Railr. Jour.*, June.

Motor-Driven Shafting Lathe.—An illustrated description of a recently-designed machine.—*Am. Mach.*, May 28.

Motor-Driven Machine Tools.—An illustrated article giving examples of individual drives applied to boring mills.—*Am. Eng. & Railr. Jour.*, June.

Electricity in French Slate Quarries.—A description of the electrical equipment for lighting and power of the Société Ardoisière d'Anjou.—*Eng'ing*, May 22.

Mechanical Draft.—HUBBARD.—An illustrated article in which the author enumerates the advantages of mechanical draft over natural draft. Both the forced and induced draft systems are described.—*Amer. Elec.*, May.

Pipe Coverings.—STROHM.—An illustrated article giving the various requisites of a good steam pipe covering and describing many of the more efficient forms.—*Amer. Elec.*, May.

TRACTION.

Electricity for Railway Purposes.—An abstract of a report on recent progress in railway engineering, published by the Union of German Railway Companies, to which 65 companies in Germany, Austria, Luxemburg, Bosnia, and the Netherlands belong. Electric lighting of passenger cars by the systems of Stone and Dick is tried in a few cases, but sufficient experience has not yet been obtained. Electric lighting with accumulators alone is tried by various companies, and is in regular use in a considerable number of cars; the results are said to be generally good, but the cost is higher than with oil gas lighting. For signals, electric light is used in only a few cases. From the experience of the Würtemberg, Palatia and Arad-Csanad Railways it appears that an automobile service on rails either with benzine, steam or accumulators, is practicable; the choice of the one or the other system depends upon local conditions, and the grades of the road. Grades limit the use of the accumulator car in a higher degree than the use of benzine or steam cars. Whether accumulator cars are commercially successful, depends greatly upon the cost of the current. Simplicity of operation and lack of noise and smell are advantages of the accumulator car over the benzine and steam cars. Electric power is used for various purposes; devices for setting switches and signals, operated by electric current, have been used by eleven railways for several years, and it appears that if properly and carefully maintained, these devices are reliable and successful. One railway company states that these electric devices are more reliable than mechanical devices; whether the signals and switches have been really set correctly, is at once evident in the setting device, for large distances the accuracy of setting the switches and signals is the same as for near distances. It seems that for greater installations less attendance is required with electric devices, but their cost is higher, and for this reason their introduction is recommended only where electric current is already available for lighting and power. A setting device with 10 switches and three signals, operated by compressed air in conjunction with electric current, is in use on the Bavarian railways, and has proved reliable. Electric block systems have been found to be successful.—*Elek. Zeit.*, May 21.

Electrical Traction on the Northeastern Railway (England).—An illustrated article descriptive of the adaptation of several suburban lines of the above railroad to electric motive power, which is in progress. The trams will be operated by continuous current, obtained from a single collector rail placed in the 6-ft. way, with a return circuit through the running rails, but the position of this rail has been so fixed that a return collector rail can be installed between the rails if required in the future. Three-phase current at 5,500 volts and a frequency of 40 per second will be transmitted to substations, where it will be transformed by stationary transformers and rotary converters into continuous current of 600 volts. Fourteen 800-kw rotary converters will be distributed among the sub-stations, and in order to meet the excessive fluctuations of the load, they have been designed to operate without serious sparking at an overload of 100 per cent. for 10 minutes, and at an overload of 200 per cent. momentarily. The main transformers are of the single-phase, oil-insulated, self-cooling type. To each rotary converter is coupled a small induction motor, fed by a special transformer, which will run the rotary up to synchronous speed. The high-tension switches will be of the oil-break type, the feeder switches being provided with an automatic reverse-current release, all being operated electrically by low-tension continuous current, for which small batteries are provided. The unit train will be composed of two motor coaches, with one trailer coach between them. For collecting current from the live rail each motor car carries four contact shoes, connected together so as to maintain contact at junctions, etc. The generating plant in the station is to consist of Parsons steam turbo-generators, each of 3,500-kw capacity, with an overload capacity of 5,000 kw for two hours.—Lond. *Elec.*, May 29.

Recent Developments in High-Speed Electric Traction in Germany.—Reichel.—A synopsis of a recent paper referring to results on the Berlin-Zossen line and the elevated railway of Berlin. On the latter line 800-volt, direct-current motors have been used with good results, and the Siemens & Halske Company has recently built 1,000-volt, direct-current motors. The author states that 3-phase motors can be built for 10,000 volts. A wiring diagram for a two-motor locomotive and a plan and elevation of a four-motor locomotive are shown. In the latter there are two 1,000-hp motors and two smaller motors, which can be connected in cascade to the larger motors when low speeds are desired. A table is given showing comparison between steam and electric trains at speeds of 160 km per hour.—*St. R'y Jour.*, May 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charlottenburg.—Collischonn.—A well-illustrated description of the electric central station of Charlottenburg, near Berlin, Germany, supplying current for lighting the town and various railroad stations in the neighborhood, and for the tramway lines in the same town. The company is said to be very successful, 85,000 lamps being connected at the present time, which is only two and a half years after commencement of operation. The station contains one 3,200-volt, three-phase generator of 1,160 kw normal and 1,430 kw maximum non-inductive capacity, two 440-kw, 3,200-volt, three-phase generators, one 220-kw, 3,200-volt, three-phase generator, and two 440-kw, 600-volt, direct-current generators, all machines running at 94 r.p.m. Each of the two direct-current dynamos is coupled with a 440-kw, three-phase machine, driven by a 500 to 650-hp steam engine, while the other generators each have their own steam engine. Two synchronous converters, each of 75 kw, running at 1,000 r.p.m., give the exciting current for the three-phase machines, for lighting the station and for driving the motors for condensation. These converters are operated in parallel with a battery giving 810 amp hours when discharged in three hours. The three-phase currents are transformed from 3,000 volts in two 85-kw transformers to the primary voltage of 70 of the converters, which give direct current at 110 volts. The switchboard is so arranged that all measurements are made on low-potential circuits, there being only several switches for the high potential lines on the board, but these are about 9 ft. high, so that they are not readily accessible and do not constitute a source of danger for the attendants. The measuring coils taken from the high potential coils of the alternators have a potential of 50 volts, and are so arranged that each phase may be measured. Static voltmeters are used on the high potential circuits to detect grounds. When a feeder has been grounded it can be used as return wire and the former return is then connected as feeder. High and low potential circuits are connected by 105 transformer stations, in which the voltage is transformed from 3,000 to 120 or 225 volts. The transformers have three vertical cores, which are united into one magnetic circuit by sheets at the top and bottom. The primary and secondary are arranged concentrically above each other and are separated by an insulating ring. A number of tables and diagrams are given.—*Elec. Zeit.*, May 21, 29.

ELECTRO-PHYSICS AND MAGNETISM.

Condensation of Radio-Active Emanations.—Rutherford and Soddy.—A long, illustrated paper containing the announcement of a very interesting discovery, namely that it is possible to condense the so-called emanations from thorium and radium, and that they behave just like vapors. The emanations are passed through an apparatus consisting of a double copper spiral, immersed in a glass cylinder filled with liquified ethylene, which in its turn is immersed in a copper vessel filled with liquid air. If the emanation from either of the above elements is conveyed by means of a slow current of hydrogen, oxygen or air, through the apparatus, the conditions can be so regulated that no trace of the emanation can be found in the gases issuing at the outlet of the apparatus. The spiral copper tube in which the emanations condensed was employed as its own thermometer, by determining its electrical resistance. The apparatus is shown in the accompanying diagram. *A* represents the entrance of the gas. The radium emanation mixed with air is stored in *B*; *D* is a drying tube containing calcium chloride. The ammeter is in circuit with voltameters serving for the generation of the conveying gas, and the current indicated by it furnishes a measure for the quantity of the gas. *T* is a testing cylinder in connection with an electrometer, *E*, by which the presence or absence of emanations in the issuing gases is detected. The radium emanation condenses at a temperature of 150° C. and the thorium emanation at 120° C. The condensed emanations can be volatilized again by suddenly removing the spiral from the bath of liquid air. The conclusion reached by the authors is that the emanations possess the usual properties possessed by ordinary gaseous matter, in so far as the phenomena of volatilization and condensation are concerned. These new properties, taken in conjunction with the earlier discovered diffusion phenomena, characteristic of the radio-active emanations, leave no doubt that the latter must consist of matter in the gaseous state.—*Phil. Mag.*, May.

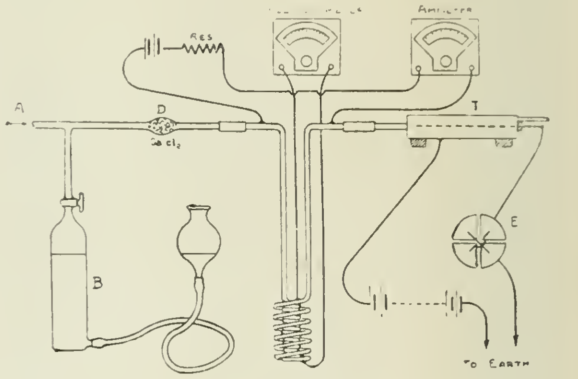


DIAGRAM OF APPARATUS.

On the "Emanation Substance" from Pitchblende.—GIESEL.—An article under the above heading by the well-known investigator on the subject of radio-activity, giving the steps by which he succeeded in separating a new radio-active substance from pitchblende. Experiments on the physical properties of the emanation proceeding from the above substances, are also detailed. The author arrives at the conclusion that the emanation experiences in the electric field an acceleration in the direction from the positive to the negative electrode, and that it must itself possess a positive charge. The emanation of the substance is very different from that of radium. The name "E-rays" is suggested for the new rays.—*Berichte der Deutsch. Chem. Gesellschaft* 35, 3608; translated in *Scien. Am. Suppl.*, May 16.

Magnetism and Thermal Conductivity.—BLYTH.—An account of an experimental investigation of the influence of a magnetic field on thermal conductivity. The change in the thermal conductivity of bismuth produced by a magnetic field is very small; for a transverse field of 3,550 C. G. S. units it is considerably less than ½ per cent., and it is scarcely measurable even in higher fields by any of the methods used. As tested by the bridge method, mild steel suffered a reduction of its conductivity of 3.3 per cent. for an increase of transverse field of 7,500, and a reduction of 2.1 per cent. for an increase of 6,700. The reduction, 3.1 per cent., was observed for the same material by the method of direct measurement on application of a transverse field of 6,500. The effect of a longitudinal field of 51 C. G. S. on the conductivity of mild steel was to diminish it by about 4 per cent. In the case of soft iron, as tested by direct measurement, a longitudinal field producing a magnetic induction of 16,000 per sq. cm., diminished the conductivity about 10.6 per cent., while the effect of a transverse field is comparatively small, about 1 per cent. for a field of 7,850; by the bridge method the effect of a longitudinal induction of 17,500 was found to be a diminution of conductivity of 10.2 per cent.—*Phil. Mag.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Nickel Cathodes.—BROWNE.—An account of experiments on depositing nickel sheets of some thickness. The difficulty is the tendency of electrodeposited nickel to crack and curl off in rolls, like wood shavings; the wood shavings curl into a helix because they are compressed on one side or expanded on the other, and a similar difference in surface tension causes the curling of nickel deposits. The author discusses the results of the fact that the solution near the cathode becomes poor in nickel ions during the process of electroplating; any condition which aids the replacement of the ions helps the deposit to remain flat; circulation is, in this respect, most efficient. With a difficultly soluble salt no replacement, however fast, is certain to prevent local irregularities; hence the use of well-soluble salts, as nickel chloride, is of great benefit; heat is also useful by giving mobility to the liquid and by causing eddies therein; but better than all, is the employment of a steady current density. The entire art of the production of solid nickel deposits of almost any desired thickness consists in maintaining initially good conditions to the end. He gives the results of experiments made on the deposition of nickel sheets on graphited cathodes of rolled block tin, with varying densities of a solution of nickel chloride and common salt, with varying temperature, current density and acidity. The best results were obtained with a neutral solution of about 70 g. nickel chloride and 180 g. sodium chloride per liter, a current density of 100 to 200 amp. per square meter with efficient circulation; heat increases the flexibility. All cathodes made in this way have, however, a slight outward curl, which curl increases with the current density. The curling is always toward the anode and around the longer axis of the rectangular cathode, irrespective of the way in which the cathode hung in the bath. A test was made to determine the extent of curvature given by a certain current; this being established, an anode was curved to the same radius, and a cathode was fastened to a backing of the same, but with reversed curvature; the plating was then performed in exactly the same manner as before; when the cathode had attained the desired thickness it was stripped from the backing and then sprang into a perfect plane surface. The author suggests the use of a curved cathode to measure the intensity of surface tension of deposits under varying conditions.—*Electrochem. Ind.*, June.

Electrolytic Synthesis of Sugars.—An article on experiments by Walther on the synthesis of fruit and grape sugar by electrolysis, with an electrolyte charged with carbonic acid and with or without the addition of ammonium sulphate or phosphate and vegetable albuminoids. The products of the electrolysis are oxalic, tartaric and citric acids, fruit sugar and grape sugar in the order named. Careful control of current, e.m.f., concentration, temperature, etc., are necessary. Brushes of platinum wire are used as anode, while for cathodes various metals, such as platinum, silver, etc., or clay mixed with magnetic oxide of iron or carbon, are employed.—*Chemiker Zeitung*, August 16 and October 18, 1902; *Eng'ing*, May 1.

The Dissociation Theory in Medicine and Biology.—BANCROFT.—A paper on some applications of the electrolytic dissociation theory to medicine and biology. He first discusses the hypothesis that certain ions give a certain color to a solution and the hypothesis that certain ions have a toxic action on certain plants or animals. On the other hand there are other factors to be taken into account besides that of electrolytic dissociation. The properties of a substance are a function of the degree of saturation as well as of concentration. The dissociation theory is useful in the field of reaction velocity. He offers an explanation of the way that hydrochloric acid gets into the stomach. He refers to the acceleration of the reaction velocity by colloidal metals, platinum, silver, etc., or so-called ferments. In conclusion he discusses the importance of the behavior of semi-permeable membranes in plant life.—*Electrochem. Ind.*, May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Thermostat Heated and Regulated by Electricity.—MARIE AND MARQUIS.—A paper presented to the French Academy of Sciences. The thermostat consists of a receptacle of glazed stoneware of about 15 litres capacity. The heating is done by a platinum wire, which is transversed by a current, and the liquid is agitated by a stirrer, driven by a small electric motor. The regulation of the temperature is effected by acetone, arranged in a glass vessel above a layer of mercury, which is in contact with a platinum point. The expansion of the acetone forces the mercury away from the platinum point, and this breaks another circuit, which, through connection with a relay, interrupts the heating current. The apparatus is stated to keep the temperature constant within 2° or 3° C. The description is illustrated.—*La Revue Technique*, May 25.

Construction and Attachment of Galvanometer Mirrors.—WATSON.—An abstract of a Phys. Soc. paper. To overcome the difficulties arising from the attachment of the fibre to glass mirrors and the necessity of varnishing the mirrors, the author uses disks of fused quartz instead of glass. A small tag of quartz is fused to the edge for the attachment of the fibre. A reflecting surface of platinum is deposited on the quartz disks by coating them with a platinum solution and exposing them to red heat, when platinum is deposited.—Lond. *Elec.*, May 22.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Automatic Telephone Systems.—O'BRIEN.—An illustrated article describing the Ness automatic intercommunicating telephone system, which system is applicable to all installations of private telephones where a number of instruments are to be connected in an intercommunicating relation, the standard switches having 10, 16, 20 and 24 points. The system may be connected so as to use one central ringing and talking battery, or may be installed to use central ringing batteries and individual talking batteries located at each station. The automatic switch is intended not only to enable the user of the telephone to signal and obtain connection with any other station on the system, but also to bring the instrument into its normal connection with the line when the conversation is finished and to restore the bell connections so that the instrument may be signalled by any other station. This result is obtained by the action of the user in replacing the telephone receiver upon the hook.—*Amer. Elec.*, May.

REFERENCES.

Wireless Telegraphy and Railroading.—SCHMIDT.—The first part of an illustrated article on the application of wireless telegraphy to railways.—*Elek. Anz.*, May. 14.

Wireless Telegraphy.—GUARINO.—An illustrated article on the development of Marconi's system of wireless telegraphy.—*Sc. Am., Sup.*, May 9.

Submarine Telegraphy.—Fournier.—A popular illustrated description of the Pierre Picard system, in use in three French cables.—*Cosmos*, May 16.

New Installations for the Safety of Trains on Railroads.—A description, illustrated by diagrams, of the Rudolf Bartelmus automatic electric block signal and Miller's block system, giving signals on the locomotives.—*Dingler's Poly. Journ.*, May 23.

System for Prevention of Collisions Between Trains.—A short description of the Rasanta system, which uses a wire running along the rail of the track, connected with a telephone and alarm bell in the cab of the engine. The invention works somewhat like the block system and the bell rings automatically, when two trains are in the same block.—*Scien. Am.*, May 16.

New Telegraph Installation in Brussels.—A long illustrated article containing a detailed description of the arrangement and switchboard, to put the different lines in connection with each other.—*Journ. Telegraphique*, May 25.

Telephone Engineering.—Dommerque.—Another article of the series on telephone engineering; it treats of wire. The author gives various tables for the resistance, weight, strength, etc., of the various standard wires, with temperature coefficients and formulæ for making temperature corrections.—*Amer. Elec.*, May.

New Books.

Telephony. By Arthur V. Abbott, C. E. New York: McGraw Publishing Company. Six Volumes. Part I.—The Location of Central Offices, 170 pages, 33 illustrations. Part II.—The Construction of Underground Conduits, 190 pages, 62 illustrations. Part III.—The Cable Plant, 153 pages, 41 illustrations. Price, per volume separately, $1.50; Set of six, $6.

These three neat and compact volumes are the first of a series of six manuals which have been prepared by Mr. Abbott, the well-known electrical engineer, who was at one time connected with the Chicago Telephone Company, and who has given special attention to the subject of telephony for several years past. These volumes now issued are based upon the valuable series of articles which Mr. Abbott has contributed to the pages of Electrical World and Engineer. In bringing the matter into book form, Mr. Abbott seized the opportunity to revise his text and to embody various corrections and suggestions which have been required, or put forward by readers and critics. There is nothing exactly like these volumes now before the electrical public, and in view of the tremendous extension that is now being given to the telephonic art, they should undoubtedly be of great utility and enjoy a wide circulation. Most of the books available on the subject of telephony have been written from the standard of describing apparatus in the shape of switchboards, receivers, transmitters, etc., as well as aerial lines and underground cables sometimes. But Mr. Abbott has pushed much further afield than this, and in Part I. has discussed the location of the central office of an exchange system or district, and has presented a great variety of interesting considerations with regard to the determination of the telephonic center and the effect of displacing it or of subdividing the territory.

Parts II. and III., while dealing with matter which is more familiar, namely, underground conduits and the cable plant, are also fuller than usual of what one may call the theory of the subject, although the practical aspects are in no wise neglected. The opening chapter of the second part, for example, deals with the principles of circuit design, and the second chapter with questions of mechanical properties. Incidental to all these volumes is the use of a large number of diagrams and curves of great practical value in figuring out questions of cost as well as in determining certain physical qualities in connection with the work. Another unusual and unique feature is the inclusion in Parts II. and III. of elaborate specifications profusely illustrated with cuts, and entering into all the details of the work, so that they can be used as regular contract and specification forms.

In these books the main point which impresses the reader is that Mr. Abbott brings the central station manager face to face with the questions and problems of cost, which, as he intimates, are always vital; and we believe that the information thus rendered available will be appreciated by all those who are now engaged in the development of the industry, particularly as it is to them a somewhat new field of which the difficulties and elements have to be mastered. It is possible that to some of our telephone readers connected with smaller exchanges, portions of the discussions in Part I. may appear rather verbose and recondite, but the points which Mr. Abbott raises are an essential feature of telephonic engineering, and so far as we are aware they have never been discussed before in public. Hence it was high time that a treatment of the subject was available, and while all to whom the discussion appeals may not agree with Mr. Abbott in his conclusions, they will find it suggestive and illuminating to study his thoughtful pages.

The books are simply and substantially got up with good type, and are profusely illustrated by a large number of new cuts made specially to accompany this text. The remaining three parts, which are to appear in due course, will deal with open wire lines, the sub-station, switchboards, and the central office.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. General meeting, Niagara Falls, June 29, July 3.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Atlantic City, N. J., September 2, 3 and 4, 1903.

National Electrical Contractors' Association of the United States. Annual Convention, Detroit, Mich., July 14, 15 and 16. Frank J. Miner, chairman Exhibition Committee, 207 Jefferson Ave., Detroit.

National Independent Telephone Association. Secretary, J. B. Ware, Ellicott Sq. Building, Buffalo, N. Y. Next meeting, Chicago, June 24 and 25.

Electrical Apparatus in Coal Mining.

By S. B. Belden.

In regard to the utilization of electricity in mining, some interesting data is given by the Jeffrey Manufacturing Company, of Columbus, Ohio, with respect to new apparatus it is now introducing. Miners are now well disposed towards such machinery, but it is said that the public will probably never know the trials and expense attendant upon the introduction of the first chain machines by Mr. J. H. Jeffrey, president of the company. The height of the first machines precluded the possibility of operating them in thin coal, and for several years no attempt was made to build a machine designed for this work. Even after the chain machine was an established success, neither the coal operators nor the manufacturers of the machines believed that a machine weighing over one ton could be operated in coal ranging from 32 in. to 36 in. The standard machine having proven so successful in thick veins, these large machines began to be used in lower coal until finally the minimum vein, so far as these machines were concerned, was reached. One fact, however, was clearly demonstrated, which was that the weight of the machine was not such a serious obstacle. The designers were given the problem and a smaller and lighter machine was brought out by the Jeffrey Manufacturing Company. Its height over all is only 18 in., but as a truck is essential for moving it from room to room, it is necessary to allow for a height of 28 in. when so mounted. The total weight of this machine is in the neighborhood of 2,500 pounds, and as it has been designed to have a wide flat shoe board to rest on, it can be moved along the face of the coal by the machine runner and his helper with ease.

The parts are made as light as possible consistent with the work to be performed, but in no instance was a pound of metal sacrificed which would affect either the durability or the strength of the machine. Two steel channel bars and two angle irons riveted to steel cross ties form the outside frame, in which rests an inside sliding frame consisting of a heavy channel, or center rail, to which is bolted the cutterhead. This cutterhead is made entirely of two milled steel plates, which, bolted together, form the front guide for the cutter chain. The chain, which is made of cast-steel solid links connected by drop-forged straps, passes around idlers, or sprockets, located at each side of the cutterhead, and then along the chain guides to the rear of the machine, where it receives its power from a third sprocket located under the motor. The motor is of the iron-clad multipolar type and was designed especially for this low-vein machine. The motor rests upon a steel carriage which forms the bearing for the main shaft. A feature, which is essential to the successful operation of low coal, is that the thin-vein machine is equipped with a self-propelling truck. Where the grades are heavy this truck operated by the mining machine motor is of extraordinary advantage, and where the room lies to the dip it obviates the necessity of brushing down the roof for the mules.

Many mines now having only 28 in. to 30 in. of coal are being operated entirely by the thin-vein machine. While the data received from these different mines varies, owing to the local conditions, it is safe to say that a fair average will show these machines to be capable of under cutting at least 50 tons of coal per shift. Nearly all of these plants work two eight-hour shifts, so the output of a machine working in such a vein can be considered as 100 tons per day. Four hundred tons represents the daily output of many small mines and it might not be amiss to show the approximate cost of an electric plant of this capacity.

The average amount of power required by each machine has been estimated to be about 15 kw, so a 75-kw dynamo would furnish sufficient power for the simultaneous operation of four machines and still have excess power for electric lights or for small motors, which might be added for pumping or ventilation. In order to have at all times sufficient boiler power I would recommend a 72 x 18 150-hp return tubular boiler. At first glance this would seem to be too great an excess of boiler power, but actual experience has demonstrated that this proportion is more economical in the end. The following machinery then would be necessary for a plant to produce 400 tons of coal per day in a 3-ft. vein of coal: One 72 x 18 return tubular boiler, one duplex boiler feed pump, one feed water heater, one injector, one set of steam fittings, one 13 x 14 simple automatic engine, one double leather dynamo belt, one 75-kw generator, one marble switchboard and instruments, one complete station equipment, four low-vein machines, four self-propelling trucks for the same. Approximate prices: Plant, $4,100; four machines, $4,000; four self-propelling trucks, $400; total, $8,500.

To this price would be added the cost of the foundation, the cost of installing the machinery, and the cost of the necessary copper wire to conduct the electric current from the power house into the mines. It is safe to figure on $10,000 covering the necessary expenditures for this plant.

It is difficult to say exactly what the depreciation of an electric plant is, and it is even more difficult to say what the depreciation of a chain machine is, for the first Jeffrey mining machines put on the market over 25 years ago are still in daily operation. A large amount of data received from various mining sections bearing on the cost of mining machine maintenance per ton of coal cut gives figures ranging from one-tenth of a cent to two cents per ton. One can easily appreciate the variation of these figures by considering first the quality of the coal being mined, and second the care which is taken of the machinery. It is only natural that a hard coal full of sulphur in the "bearing in," will cost considerably more per ton to mine than a soft pure coal. It is also true that two machines working in the same territory or even in adjoining rooms, will show a difference in the cost of repairs, which can be traced to the different attention or care which they have received from their respective runners.

I have before me the mining scale recently adopted in number eight vein of Ohio coal. This scale gives: Pick mining in rooms, 90 cents; machine mining in rooms, 11 cents; loading after machine in rooms, 52½ cents.

This shows a difference between the two methods amounting to 26½ cents per ton. The four-machine plant figured on should produce at least 75,000 tons per year. If we allow a depreciation charge on the plant of 10 per cent. of its cost per year and 6 per cent. for the interest on the investment, and add to this the cost of producing the power (which our data sheets give as 1 9-10 cent to 2 1-10 cent per ton) and the largest cost of repair parts which we have ever known we still have a net saving of over 13 cents per ton. In other words, a plant of this kind will practically pay for itself within one year, by the net savings of the difference between the cost of the chain machine mining and the pick mining.

The Jeffrey Manufacturing Company builds electric locomotives in weights ranging from two to thirty tons, and, as with its mining machines it has designed special locomotives for operating in low coal. The dead work in the entries necessary to get sufficient height for mules in low coal mines, often adds no small amount to the cost of the production. The special low-vein locomotives were designed with a view of saving this roof brushing. The local conditions in the different districts govern the amount paid for such yardage, so it is difficult to name any definite amount which can be saved. However, I am familiar with one mine where the amount was $2.80 saved for every yard of entry driven. In this particular mine the strata instead of being level was rolling, and grades were encountered on the butt entries ranging from 2 per cent. to 7 per cent. By the introduction of a low-vein locomotive the operators were able to displace eight mules and four drivers. Counting each mule as costing 35 cents per day and the drivers $2.25 apiece, and deducting the pro rata share of the plant expense for the locomotive, they figured that they saved $8 per day by its use. Locomotives weighing four tons have been built by the Jeffrey Company, having a height over all of only 29 in. These are fitted with wheels outside of the frame and have a small enough wheel base to admit of their operating on any curve around which a pit car will pass.

The heavier locomotives have a greater total height. One has the following dimensions—it weighs 24,000 pounds and has a total height excluding the trolley of 39", the length over all is 9' 4" and the wheel base is 40". It is designed to have an operating speed of from six to ten miles per hour, and will handle a gross train load of 150 tons on a level track at this speed. The Jeffrey Company has recently put out a locomotive which is fitted with a new device. The object is to enable the locomotive to reach the face of the coal in the rooms without using a trolley wire. As the rooms are continually being advanced the cost of wiring them and of keeping the wires within working distance of the face, would be considerable. This new locomotive receives current through a cable, one end of which is connected to a junction-box on the entry outside of the room neck. The cable is wound on a reel which is mounted on one end of the locomotive, and the current passing through the cable is conducted to the motors. As the locomotive leaves the entry on its way into the room the cable unwinds from the reel. When the locomotive starts out of the room with the loaded car, the cable automatically rewinds itself on the reel. At the junction-box in the entry it will be entirely rewound, and the locomotive can again proceed with the current taken from the trolley wire.

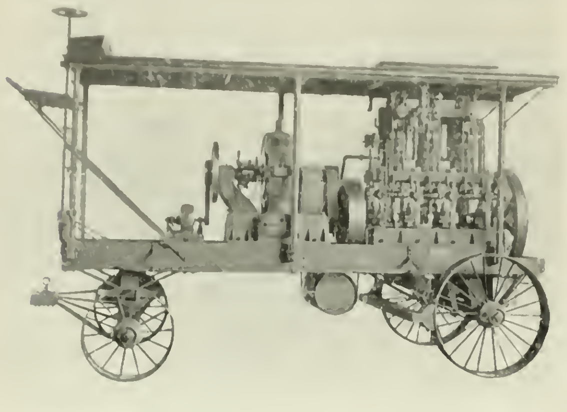
The cost of adding a locomotive to an electric mining plant already in operation is but very slight, as compared with the result which can be obtained. It is therefore advisable when installing a machine plant to provide for excess power if there is any possibility of using electric haulage in the future. The hauling being all done during the day shift, when a new plant is being installed it is considered economical to design it on the basis of operating more machines during the night shift and thus give the locomotive and a few machines the power during the day. Such an arrangement cuts down the initial cost of the power plant and seems to give absolute satisfaction. For instance, to consider a plant capable of cutting and hauling 1,000 tons of coal per day from a 4-foot vein of coal. The cost would be about $15,000.00 F. O. B. cars factory. Six of the machines would be worked during the night shift and four of them could alternate on the day shift. In this manner they would give the output required. A locomotive such as specified above, would be capable of hauling 117 tons gross train load on a level track at 8 miles per hour, and unless the grades were unusually heavy in the mine it could have sufficient power to produce the output figured on.

Equipment for D. L. & W. Shops.

The award has been made for the generators and engines for the new shops at Hoboken, N. J., and Scranton, Pa., of the Delaware, Lackawanna & Western Railroad. The generator contract, which was secured by the General Electric Company, calls for 1,050 kilowatts. There will be two 3-phase, 60 cycle machines, of 250-kw capacity each; a similar number of 200-kw capacity each, and one generator having a capacity of 150 kilowatts. They will be direct-connected to Ball & Wood cross compound engines, which will operate at 225 r.p.m. The engine contract calls for two of 375-hp; the same number of 300-hp capacity each, and one capable of developing 225 horse-power. These equipments will be used for both light and power purposes.

Nernst Lighting Plant for a Circus.

Reference was made recently in these pages to the fact that Ringling Bros., circus managers, had equipped a traveling lighting plant to supply Nernst lighting for one of their big circus tents. We are now able to illustrate this interesting little plant. The engraving herewith shows a Fort Wayne alternating current generator connected to a Walrath 30-hp, three cylinder gas engine, of the open-base type, built by the Marinette Iron Works of Marinette, Wis.



PORTABLE LIGHTING PLANT FOR CIRCUS.

The engine is connected to the dynamo by a Chicago Link Belt drive and the outfit is mounted on steel trucks. As a matter of fact, the outfit has been furnished in duplicate. In other words, there are two of these complete equipments which are being used for lighting the Ringling circus and animal tents, and the proprietors of the show express themselves as well pleased with the results obtained from these plants, which, of course, have to sustain a good deal of rough-and-tumble usage, and are transported from one end of the country to the other.

Status of the Kellogg Telephone Interests.

From one of the officials and minority stockholders of the Kellogg Switchboard and Supply Company we have received the subjoined statement in regard to the situation that has developed in the affairs of that company, as noted in these pages last week:

The Kellogg Switchboard and Supply Company was organized in 1897 with Mr. Milo G. Kellogg, of Chicago, its president and principal stockholder. In the fall of 1901, Mr. Kellogg's health broke down, and about November 1 of that year he was obliged to give up all business matters entirely, and left Chicago for California for an indefinite absence. Mr. Kellogg left the management of the company in the hands of Mr. Wallace L. DeWolf, of Chicago, who was then vice-president of the company, and entrusted Mr. DeWolf with a power of attorney for his entire personal property so as to provide for any financial emergency which might arise in his affairs and those of the Kellogg Company during his absence. Prior to Mr. Kellogg's departure a large amount of money had been expended in the increase of the plant of the company and an increase in the capital stock of the company to meet the expenditure was in progress, and a certain large customer and debtor of the company was in a precarious financial condition.

Shortly after Mr. Kellogg's departure, or about January, 1902, Mr. DeWolf sold Mr. Kellogg's entire interest in the company, amounting to about two-thirds of the entire capital stock, to Mr. Enos M. Barton, of Chicago, president of the Western Electric Company, and representing, it is understood, the Bell telephone interest. This sale was made without Mr. Kellogg's knowledge or consent and Mr. Kellogg was not advised of the sale of his stock until six months thereafter. At the same time, Mr. DeWolf sold his own stock, amounting to 202 shares, in the Kellogg Company, and effected the sale also to the same party, of the stock owned by Mr. Clarence Buckingham, of Chicago, a director in the Kellogg Company. No other director, officer, employee or stockholder of the Kellogg Company, save the secretary, was advised of the sale, and none of them knew of the sale until more than a year thereafter. No record of the transfer of stock was made on the books of the Kellogg Company, and all employees, and particularly those connected with the sales and engineering departments, were given the most postive assurance that there was no truth in the rumors that the Kellogg Company was controlled by the Western Electric interest.

On July 4, 1902, six months subsequent to the sale of his stock, Mr. Kellogg, having sufficiently recovered his health to inquire into the affairs of the Kellogg Company, was advised by Mr. DeWolf that his stock had been sold to Mr. Barton. Acting upon the advice of his counsel, Judge R. S. Taylor, Mr. Kellogg, as soon as his health permitted, began negotiations through his counsel with Mr. Barton, and with Mr. Frederick P. Fish, president of the American Telephone and Telegraph Company, for the repurchase of this stock. These negotiations have continued without interruption since the first of October, 1902, to the present time. Up to about the first of this year there was every prospect of these negotiations being successful, and that Mr. Kellogg would again obtain possession of his stock and the controlling interest in the Kellogg Switchboard and Supply Company so that he could again control the management of the Kellogg Company and could assure his friends and its customers that their interests would be protected and all of the obligations assumed by the Kellogg Company fulfilled to the letter. About the first of the year, however, Mr. Barton advised Mr. Kellogg and his counsel that it had been definitely decided to reject all propositions for the repurchase of his stock and that an additional price which Mr. Kellogg might offer for said stock would not affect the decision in this matter. Mr. Kellogg had already offered to repurchase his stock at a price which would net a large profit to the original purchaser.

Mr. Kellogg then appealed to the Bell interest to reconsider the matter from an ethical standpoint, that is, from the standpoint of the damage which would result to his friends and customers and employees of the Kellogg Company who had been placed in a false light by the action of both parties concerned in the sale of his stock. To this appeal the Bell interest also turned a deaf ear.

March 11, 1903, Judge R. S. Taylor, informed Mr. F. W. Dunbar of the condition of the Kellogg Company and its relation to the Bell interest. Mr. Dunbar was the first employee of the Kellogg Company to be informed of the existing situation and he took up the matter immediately with Mr. Kellogg, who placed the entire correspondence and records of the negotiations at his disposal, and explained all the details. The situation was discussed and examined with the object of finding some way to insure the protection of the customers of the Kellogg Company in the future as they had been protected in the past. Legal advice was again sought and it appeared that the minority stockholders of the Kellogg Company could secure legal redress and by so doing could insure the protection of the customers of the Kellogg Company, and the fulfilling of its obligations to the independent telephone business.

On May 19, 1903, Mr. Kempster B. Miller and Mr. F. J. Dommerque, of the Kellogg Company, were for the first time made acquainted with the situation and, with Mr. Dunbar, decided to bring suit against Mr. DeWolf, Mr. Barton, Mr. Fish, the American Telephone and Telegraph Company and the Western Electric Company for the recovery by Mr. Kellogg of his stock and to restrain the Bell interests from disposing of the stock until it could be returned to its rightful owner and from voting said stock to control or influence the management of the Kellogg Company or from influencing in any manner the management of said company, or from interfering with any of the patent suits pending against the Kellogg Company and its customers.

The suit was brought in the Circuit Court of the State of Illinois on Friday, June 5, 1903, by Henry S. Robbins, attorney for the minority stockholders, and on that day Judge Tuley of that court granted a preliminary injunction to the above effect. Mr. W. W. Dean, of the Kellogg Company, and other minority stockholders joined in the suit.

The suit brought by the minority stockholders of the Kellogg Company is not only in the interest of these stockholders, but, it is stated, is primarily in the interest of the customers of the Kellogg Company. The minority stockholders are confident in the successful issue of the legal steps which they have taken, as thus detailed.

Power Plant for the Philadelphia Subway.

One of the largest contracts for steam turbine and electrical power machinery recorded has just been closed by Westinghouse, Church, Kerr & Co., with the Philadelphia Rapid Transit Company, covering 15,000-kw of steam turbine and approximately 50,000-kw of electrical generating and converting machinery, for the new rapid transit subway and elevated system, now under construction in Philadelphia. The most interesting feature of the equipment to be installed, is that steam turbines are to be used exclusively for power generation in the central station now under construction. There will be three turbines, each of 5,000-kw normal capacity, which will be of the type now being built by the Westinghouse Machine Company for large powers. The turbines will be direct connected to Westinghouse 3-phase, 25-cycle, generators, and the units will run at 750 r.p.m. with 175 lbs. of steam, 27½" vacuum and possibly 100° to 150° of superheat. The three units will operate in multiple upon a common bus bar, and power will be distributed directly at a nominal potential of 13,000 volts from the station without the use of any intermediate transformers. For this purpose, the generators are wound for high potential.

The new power station is located upon the Delaware River, near the foot of Green street, and is laid out for an ultimate capacity of 50,000-kw, it being the idea of the designers to concentrate at this point the entire power generating equipment at present distributed among a number of smaller stations. The location of the new station upon the river bank secures excellent coaling facilities and an inexhaustible supply of water for condensing purposes. The present equipment will furnish power for the subway, and some reserve power for the surface traction system pending the execution of proposed plans for centralizing the entire power system.

The contract also comprises a large amount of transforming and converting machinery, to be installed in the several sub-stations, which will be built at various points in the district covered by the transit system. This machinery will be used for converting the high tension alternating current received from the power station into low potential direct current for use directly upon the third rail of the traction system. The first installation will comprise fourteen 1,000-kw and two 500-kw rotary converters. Each of the 1,000-kw rotaries will be furnished with three 375-kw step-down transformers, and each of the 500-kw rotaries with three 175-kw transformers of similar design. The electrical equipment will be built by the Westinghouse Electric and Manufacturing Company.

The new rapid transit system, now under construction, will cover the entire business district of Philadelphia, and includes a two and four track subway about 1¼ miles in length, extending from the Delaware River along Market street, to a point near Twenty-third Street, a short distance from the Schuylkill River. At Broad Street an appropriate central terminal station will be erected. The enterprise is one of the most important in the history of American railway development and the introduction of the steam turbine in such large sizes is particularly impressive by reason of the confidence shown in this comparatively new type of prime mover.

Ventilating Equipment for a Turkish Cruiser.

The recent disturbances in the Orient have directed much attention to the fighting resources of the Turkish Government. While the Turkish army appears to be courageous and fairly well equipped and drilled, it is a matter of common knowledge that the Turkish navy is practically non-existent, the few vessels in commission being old and out of repair. However, the Sultan is taking active steps to remedy this deficiency, and Messrs. Wm. Cramp & Sons, of Philadelphia, are now building for the Ottoman empire a large cruiser, to be named the *Medjidia*. This vessel will embody the latest improvements in naval construction, and will be an effective fighting machine in every way. One feature which has been looked after with particular care is the ventilation, which is of very great importance in a vessel serving in tropical or sub-tropical waters. Nine electrically-driven centrifugal fans are provided to ventilate the hull of the *Medjidia*. Fan No. 1 is a 40-in. steel-plate "exhauster," which will supply air above the protected deck, forward, while No. 2 of the same size will supply air below the protected deck forward. Fan No. 3 is an exact duplicate of fan No. 1 and will supply air between frames 65 and 66 aft. No. 4, of the same size, will furnish air aft of frame 66. No. 5, which is a 50-in. steel-plate "exhauster," will supply air to the dynamo and evaporating rooms. No. 6, a "Monogram exhauster," having a cast-iron housing, will supply air to the crew's quarters between frames 10 and 24. This fan is bolted to the ceiling and is driven by an electric motor supported on the side of the fan. Fan No. 7, which furnishes air to the crew's quarters between frames 24 and 34, is similar to fan No. 2. Fan No. 8 for the crew's quarters between frames 34 and 35, is a duplicate of fan No. 6, and fan No. 9, of the same size and character, furnishes air to the officers' quarters between frames 55 and 83. The 40-in. fans are capable of supplying 4,260 cubic ft. of air at 1 ounce of pressure when running at 822 r.p.m., and 1½ ounces when running at 1,010 revolutions. The 50-in. fan will supply 3,690 cubic ft. at 1 ounce pressure at 660 revolutions, and 1½ ounces at 808 revolutions. The four "Monogram" fans can supply 2,110 cubic ft. of air at 1 ounce pressure running at 822 r.p.m., or at 1½ ounces when running at 1,030 r.p.m. The entire ventilating equipment above described was furnished by the B. F. Sturtevant Co., of Boston.

Efficiency Tests of Tangential Water-Wheels Under 1912 ft. Effective Head.

Recent development in hydraulic practice on the Pacific coast has been toward the utilization of higher heads. In the minds of a number of engineers the question has arisen as to the wisdom of developing these high heads, utilizing the totality of fall in one station, as against dividing the fall up and passing the water through two or more stations in series, in this way utilizing the same water under lower heads in two or more power plants. The Edison Electric Company, of Los Angeles, Cal., had this problem to consider when it was proposed by them to install their new power plant, which has been known as Mill Creek No. 3, it being located in the Mill Creek Canyon near Redlands, Cal., the effective head on this plant being 1,912 ft. After carefully considering the matter, the Edison Company decided that it would be better engineering to utilize the total available head in one power station. They also concluded that, as they had several other power plants to build, this would be an excellent opportunity to test the relative merits of the different water wheels on the market.

The plant to be installed by them was to consist of four water wheel generating units of 750 kw each, designed for a 25 per cent. overload, at a turning speed of 430 r.p.m. They therefore decided to install at first but two units, the rest of the plant to be placed with the engineering firm furnishing the most efficient and satisfactory wheel unit. Accordingly they placed two orders, that for the second unit being placed with the Abner Doble Company, San Francisco, makers of the "Ellipsoidal Tangential Water Wheel"; at the same time taking an option from each firm for two additional wheel units under certain agreements.

The initial wheel units have been installed and tested, and have been in operation for several months, and it is interesting to note that, based on the results secured the Power Company has exercised its option, placing the order for the rest of the wheel units with the Abner Doble Company on account of the high efficiency over a wide range of load shown by its wheel, its capacity to carry a very heavy overload, and the maintenance of this high efficiency over a wide range of load. At loads from one-half load to over 25 per cent. overload the Doble wheel showed an efficiency on the preliminary tests of from 80 per cent. to 84 per cent. The generators in this plant were furnished by the General Electric Company.

This installation is of value in confirming the wisdom of the Power Company in utilizing its total head in a single station, as against dividing it up over several stations, as has been carried out by several of the other power companies. The nozzle used on this machine is of the Doble patented needle regulating type, which gives an excellent efficiency curve with variable load, the water consumption of the unit being almost strictly proportional to the power output of the generator.

Another important point demonstrated by this installation is that the efficiency to be secured under these very high heads is exceedingly favorable, clearly demonstrating that it is better engineering to utilize the total available power value in one station than to divide it up into two or more, excepting in most exceptional cases, where other conditions may exist, such as for instance excessive length of pipe line or reservoir and storage facilities. These tests make a very interesting comparison with the work of one of the famous Swiss builders in the Vouvry Plant, where the efficiency secured was 56 per cent.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a good demand for time money for the long dates and considerable business was done, the lenders being largely banks and trust companies. The closing rates were 4 per cent for 60 days, and 4½ to 6 per cent for 90 days to seven and eight months. The stock market, after a violent fall in values, rallied materially on short covering, support from large interests and some further buying for long account. While the entire market felt the weight of an early selling pressure, the heaviest declines were in stocks which were attacked in force by the bear operators. Among the latter were Brooklyn Rapid Transit and Amalgamated Copper. The later improvement, however, extended throughout the whole list, and was especially pronounced in Amalgamated Copper. There was some activity in General Electric, which became very strong after the improvement commenced. The other industrials were not particularly prominent. General Electric made a net gain of 3¼ points, the closing price being 180½, which was 1 point below the highest of the week, the lowest quotation being 172½. The latter figure also represents the lowest quotation of the year. Westinghouse common touched 178 as the lowest point and 196 the highest, closing at 195, this being a gain of 13 points, the lowest figure of this week also being the lowest figure of the year. Westinghouse rights closed at 2¼, being ¾ of a point lower than the last quotation. Brooklyn Rapid Transit closed at 58½, a gain of 1 point, the lowest figure of the week and of the year being 54. Metropolitan Street Railway made a net gain of ¼ point, closing at 127¾, after touching 121½, which was also the lowest recorded figure of the year. Western Union made a net gain of 1¾, the closing quotation being 85½. American District Telegraph dropped to 20½, thereby losing 3½ points net. The following are closing quotations of June 16:

NEW YORK

	June 9	June 16		June 9.	June 16
American Tel. & Cable......	75	77½	General Electric	175	177½
American Tel. & Tel........	140	142	Hudson River Tel...........	..	..
American Dist. Tel	25	27	Metropolitan St. Ry........	122¾	124½
Brooklyn Rapid Transit ..	56¼	56⅝	N. E. Elec. Veh. Trns.......	.	⅛
Commercial Cable.	..		N. Y. & N. J. Tel..........	.	..
Electric Boat	20	18	N. Y. E. V. T. Co..........	5½	5¾
Electric Boat pfd	38	37	Tel. & Tel. Co. Am.........	..	..
Electric Lead Reduction .	1¼	1¼	Western Union Tel..........	83½	85
Electric Vehicle	6½	7	Westinghouse com.	178	189
Electric Vehicle pfd ..	12½	13½	Westinghouse pfd	175	..

BOSTON.

	June 9	June 16		June 9	June 16
American Tel. & Tel ...	145¾	143	Western Tel. & Tel. pfd....	91	92
Cumberland Telephone....	.	..	Mexican Telephone	1¼	1¾
Edison Elec. Illum........	251	246	New England Telephone ..	133*	125
General Electric...........	175	179	Westinghouse	.	..
Western Tel. & Tel	13	13	Westinghouse pfd.........	..	.

PHILADELPHIA.

	June 9.	June 16		June 9.	June 16
American Railways	..	..	Phila. Traction	96½	96½
Elec. Storage Battery	63	..	Phila. Electric	6⅛	6¼
Elec. Storage Battery pfd.			Pa. Electric Vehicle........	..	..
Elec. Co. of America	8½	8¾	Pa. Electric Vehicle pfd ...	..	..

CHICAGO.

	June 9	June 16		June 9.	June 16
Central Union Tel		..	National Carbon pfd........	94	94
Chicago Edison	154	154	Northwest Elev. com........	..	..
Chicago City Ry..........	190	190	Union Traction	3½	3
Chicago Tel. Co	135½	..	Union Traction pfd.	30	30
National Carbon	23¾	23¾			

*Asked.

DIVIDENDS.—The Western Union executive committee has recommended the declaration of the regular quarterly dividend of 1¼ per cent. Manhattan Elevated directors have declared a quarterly dividend of 1½ per cent., payable July 1. The Otis Elevator Company has declared the regular quarterly dividend of 1½ per cent. on the preferred stock. U. C. I. Company, Philadelphia, has declared the regular quarterly dividend of $1 per share, payable July 15. The directors of the American Telephone and Telegraph Company have declared a regular quarterly dividend of 1½ per cent. and ¾ per cent. extra, payable July 15. The directors of the Chicago Telephone have declared the quarterly dividend of 2½ per cent., payable June 30, to stockholders of record on June 25. The United Traction & Electric Company of New Jersey have declared the regular quarterly dividend of 1¼ per cent., payable July 1. Directors of the Rochester Passenger Railway have declared a dividend of 1¼ per cent. on the preferred stock, payable July 1. The West Philadelphia Passenger Railway Company have declared a dividend of $5 per share, payable July 1. The Union Passenger Railway Company, of Philadelphia, have declared a dividend of $4.75, payable July 1. Twin City Rapid Transit directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock payable July 1. A dividend rental of $2 per share will be paid to the holders of the preferred stock of the West End Street Railway Co. July 1.

ST. LOUIS UNITED RAILWAYS.—At a special stockholders' meeting of the United Railways Company the proposition to guarantee the proposed issue by the St. Louis Transit Company of $20,000,000 refunding and improvement bonds was almost unanimously carried. Three-fourths of the stock was voted, and only ninety shares voted against it. The financial plan involved looks into the future of the properties, and places the transit system in an unusually strong position. It is not likely that all the bonds will be issued, but it was deemed wise by the management to make ample provision for contingencies which may arise. The application of the $20,000,000 in bonds to be issued by the St. Louis Transit Company is as follows: During the year 1903:

Payment of the directors' loan and other indebtedness of the company	$2,995,425
Improvements, betterments, etc., on the property of the United Railways of St. Louis, approximately..........	2,222,600
During years 1904 and 1905:	
Collateral trust notes (due November 1, 1904)..........	$5,776,000
Improvements, betterments, ets., on the property of the United Railways Company of St. Louis, approximately..	2,280,000

The balance of the bonds will remain in the treasury of the company for future additions, acquisitions, betterments and improvements.

CHICAGO CITY RAILWAY COMPANY.—The terms on which the Chicago City Railway Company will agree to waive its claims under the so-called ninety-nine-year act have been reported by the subcommittee on franchises to the council committee on local transportation. The railway company declares, however, that there can be no waiver unless full remuneration for its tangible property be assured by contract, such payment to be based upon an impartial appraisement of the property at the termination of the new grant. The coincident proposition unalterably linked with the above is that if the municipality does not purchase, license may be granted to a new company to purchase at the same figure. Furthermore, the proposed contract specifies that in case the municipality neither purchases of itself nor licenses another corporation to purchase, "it will make a new grant to the company upon terms then to be agreed upon, it being understood that the then fair cash value of the tangible property comprising the street railway system of the company, and reasonably required for its operation (exclusive of any earning power or franchise value) shall be the basis of a new grant."

ELECTRIC STORAGE BATTERY.—Stock of the Electric Storage Battery Company to the amount of $15,795,700, all common, has been added to the trading list of the New York Stock Exchange. Its stock has been largely dealt in on the Philadelphia Exchange and on the local curb market. It is controlled by the Whitney-Ryan-Widener group of capitalists. In the application there is given a list of companies, eleven in number, whose patents are controlled by the Storage Battery Company. The total net earnings for the year ended December 31, 1902, according to the report, were $1,113,199, from which were deducted dividends of $812,427. It is stated that there is an undivided surplus of $2,323,354. The company estimates the value of its patents and franchises at $13,523,796. It has a total of quick assets of $2,147,467.

LOUISVILLE RAILWAY REORGANIZATION.—The directors of the Louisville Railway Company have agreed on a plan of reorganization, thus setting aside the differences between the common and preferred stockholders which threatened to terminate in litigation over the future policy of the company. The plan agreed upon is to increase the capitalization from $12,000,000 to $21,299,300. This new capitalization will be placed in the hands of a holding company to be chartered under New Jersey laws. The holding company will have $12,000,000 common stock, $2,500,000 preferred stock and $6,799,300 bonded indebtedness. The plan provides for paying for $3,000,000 worth of improvements and the purchase of $2,500,000 preferred and $3,500,000 common stock of the old company by issues of stock in the holding company.

NEW WESTINGHOUSE STOCK.—It is officially stated that the $4,500,000 of new stock offered to the stockholders of the Westinghouse Electric and Manufacturing Company has all been subscribed for. The willingness with which stockholders subscribed for the new stock is a source of gratification.

ELECTRIC LIGHTING IN NEW YORK.—There will be a hearing this week by the New York Aldermanic Committee on Water, Gas and Electricity on the application made by the Long Acre Electric Light and Power Company for a franchise, "right or privilege to lay, erect, construct and maintain suitable wires or other conductors, with the necessary poles, pipes, conduits, and appliances, in, on, over, across and under certain streets, avenues, public parks and places in the Borough of Manhattan." The application for a franchise was introduced in the board on May 19 by Alderman John T. McCall, "by request." The statement given is that the franchise is desired for the purpose of carrying on a general business of lighting, heating and supplying power. The territory in which the right is desired is between Fifth Avenue and the Hudson River, Thirty-third and Fifty-ninth Streets, and the term desired is twenty-five years, with permission of renewal at revaluation made by a committee of three. This is the company organized and to be run in the interests of the big theatrical managers for the purpose of supplying the theatres which they control. W. W. Walters, one of the managers of the Garrick Theatre, is quoted as saying that just as soon as the franchise was given the electric plant would be built at a probable cost of several million dollars. "We have not decided just where the plant is to be installed, and will not decide on anything until after we get the franchise. The Long Acre Electric Light and Power Company will not only be able to supply electric light at half the price the big electric light companies are charging, but at an even lower price. The plan of the company is to supply electric light to any place in need of it." The following are the officers of the company: President, William Harris; first vice-president, Frank McKee; second vice-president, Al Hayman; secretary, W. W. Walters, and treasurer, H. B. Harris.

THE MONTREAL LIGHT, HEAT AND POWER COMPANY'S second annual statement has been issued. It shows that the gross earnings of the company for the past year amounted to $1,937,560, and the net profits to $718,667. Out of the profits there have been declared four quarterly dividends of 1 per cent. each, amounting to $679,354, leaving a balance og $39,333, which has been placed to the credit of surplus account. The dividends paid show an increase over last year of $91,365, and, in addition, there was an increase in the interest on bonds and loans of $90,709. The company is now supplying all the gas and electricity used in the city of Montreal and suburbs, and the directors expect that the company will realize a considerable benefit from the economical operation of all the several companies, which comprise the Montreal Company, under one management. Owing to the break in the Chambly dam, the company suffered a loss in revenue, and an increased operating expense, estimated at $153,351 net earnings. During the year 17,806 incandescent lamps and motors, equivalent to 5,093 horse-power, were added to the circuits. At the meeting of the directors Mr. H. S. Holt was re-elected president, Hon. R. Forget, vice-president, and Mr. H. H. Henshaw, secretary-treasurer.

KINLOCH TELEPHONE, ST. LOUIS.—The report of the Kinloch Telephone Company of St. Louis, which has just been issued, shows an enormous increase in the amount of the telephone service in this city, and monthly net profits of over $11,000. The company's showing for the two fiscal years closed and the first four months of 1903 is given below:

Year ended December 31:

	1902.	1901.	Changes.
Gross	$472,137	$376,221	Inc. $95,916
Operation and maintenance	201,874	190,731	Inc. 11,143
Interest, taxes, etc.	157,226	135,832	Inc. 21,394
Net earnings	$113,037	$49,658	Inc. $63,379

First four months in 1903: Gross, $178,334; operating and maintenances, $77,729; interest, taxes and other charges, $56,080; net, $44,524.

BELL TELEPHONE STOCK INCREASE.—The directors of the American Telephone and Telegraph Company met this week and voted to issue $21,943,200 of new stock. On March 31 last the stockholders authorized an increase in the amount of capital stock from $150,000,000 to $250,000,000, the new stock to be issued from time to time as required for additions and improvements. Stockholders of record of June 30 will be entitled to subscribe to the new stock issue arranged for this week at par on the basis of one share of new stock for every five shares now held. There will be five payments as follows: September 22, 1903; November 21, 1903; January 22, 1904; March 22, 1904, and May 6, 1904. The new stock will not carry dividends until July, 1904, except in case of prepayment of the entire amount.

BULLOCK STOCK INCREASE.—The stockholders of the Bullock Electric Company, Cincinnati, O., have voted to increase the 6 per cent. preferred stock from $1,000,000 to $1,500,000. The money thus derived is to be used for the purpose of erecting more buildings and carrying a larger stock of material on hand.

Commercial Intelligence.

THE WEEK IN TRADE.—An improvement is noted in weather, crop and labor conditions, and the feeling prevails that damage from these sources has been overestimated. Seasonable quiet continues in wholesale business generally, and there is an improvement in tone as a result of the better crop outlook. Iron production is at the highest point ever recorded, but the old weakness in quotations has given way to a rather firmer tone, though advance buying is still the exception. Stocks of iron are not accumulating very much. Railroad earnings are good on the whole, though the western floods have curtailed the June gross receipts somewhat. May gross receipts show a gain of 12 per cent. as against a gain of 14.3 in April, but follow a gain of 9 per cent. in May, 1902, over 1901. The prediction that the winter wheat yield would be 485,000,000 bushels has been confirmed in the government report showing conditions still above the average and far above 1902. Spring wheat, though 2 per cent. smaller in area than last year, is in good condition and it is estimated that the crop will yield 300,000,000 bushels. The business failures for the week ending June 11, as reported by *Bradstreet's*, numbered 181 against 157 the week previous and 165 the corresponding week last year.

BATTERY FOR ST. LOUIS TRANSIT.—Mr. A. B. Du Pont, vice-president of the St. Louis Transit Company, has recently executed a contract with the Electric Storage Battery Company, of Philadelphia, manufacturer of the Chloride accumulator, for the installation of a 3,000-kw storage battery to be used in a rotary sub-station with rotaries having a capacity of 6,000 kw. The battery will regulate on the fluctuations and assist in caring for the morning and evening peaks. The sub-station is in the center of the city, and this installation is one of the extensions being made for the purpose of caring for the increase of traffic. It is interesting to note that this contract represents the largest individual installation of storage batteries in the world for railway service.

ELECTRICITY ON THE COMSTOCK.—It is stated that after a long series of vicissitudes, by the Fourth of July all the mines on the Comstock lode will be running again for the first time in fifteen years. By that time the lower levels of the Consolidated California and Virginia mine will be unwatered, and it is expected that good paying ore will be found on the lower levels. In nearly all the old mines electric hoists have been put in and the mines are all using electric power, which will greatly lessen the expenses of operating. It is now fifteen years since a small bonanza was found in Consolidated, California and Virginia which yielded $6,000,000.

BALL ENGINE ORDERS.—The Windsor Sugar Company, Windsor, Colo., will have an electric plant consisting of two engines of 150 hp direct-connected to Crocker-Wheeler generators. The Ball Engine Company, Erie, Pa., furnishes the engines, which are of the self-oiling type. The Longmont Beet Sugar Company, Longmont, Colo., will install an electric plant, consisting of three engines of 725 hp, direct-connected to Crocker-Wheeler generators. The Ball Engine Company furnishes the engines of the self-oiling type.

EQUIPMENT FOR STANDARD STEEL COMPANY.—The American Engine Company, of Bound Brook, N. J., with New York offices, Edwin S. Boyer, manager, White Building, has just been awarded a contract by the Standard Steel Company, of Burnham, Pa., for a 800-hp engine for direct connection to a Crocker-Wheeler generator of 600-kw capacity. The equipment is to be used for both light and power purposes at the Burnham plant.

SPRAGUE ELEVATORS FOR AUSTRALIA.—The Sprague Elevator Company, 52 Broadway, New York, has secured a contract for electric elevators to be installed in the new Adelaide Savings Bank Building, Adelaide, South Australia. The contract was obtained through Unbehaun & Johnstone of that city. The ventilating apparatus for the same building will be driven by a Western Electric motor.

GERMAN TELEPHONES FOR BOMBAY HOTEL.—The $2,000,000 hotel which J. N. Tata, the founder of the British Indian house of Tata & Co., New York offices, 88 Wall Street, is building in Bombay, is to be equipped with German telephones, our Teutonic rivals securing the contract on the points of both prices and delivery. Each of the 600 bedrooms of the hotel will have a telephone.

LIGHTNING ARRESTERS FOR CHINA.—Fearon, Daniel & Co., of China, 96 Wall Street, which concern purchases considerable quantities of electrical supplies, etc., for shipment to the Far East, has secured a substantial order for lightning arresters from the Shanghai Municipal Council for the electric lighting system of the foreign settlement.

COPPER WIRE FOR ENGLAND.—The John A. Roeblings' Sons Company, 117-119 Liberty Street, New York, is shipping considerable copper wire to England.

THE SWEDISH AMERICAN TELEPHONE COMPANY, West Jackson Boulevard, Chicago has recently closed contracts with the following named telephone companies for their complete equipment. The Rural Union Telephone Company, at Livermore, Iowa, with exchanges at Livermore, Humbolt, Bode, Harding, Rutland and Pioneer, Iowa; Dedham Telephone Company, Dedham, Iowa; People's Mutual Telephone Company, Latimer, Iowa; Golden Rod Telephone Company, Osceola, Neb.; M. L. Reynolds Telephone Company, Delton, Wis.; J. A. Murray, North Freedom, Wis.; Farmers' & Merchants' Telephone Company, Rumells, Iowa; Rowan Rural Telephone Company, Rowan, Iowa; Auburn Telephone Company, Auburn, Neb.; West Lawn Telephone Company, Leeton, Mo.; Interstate Telephone Company, Modale, Iowa; Peet & Co., Swea City, Iowa; Brown Supply Company, Coffeyville, Kan.; Farmers' Mutual Telephone Company, Hepburn, Iowa; Armstrong Telephone Company, Yatesboro, Pa.; Butternut Valley Telephone Company, New Berlin, N. Y.; D. H. Holt, Bronson, Kan.; Judson Milling Company, Judson, Ind.; Wilsonville Telephone Company, Stockport, Iowa; Epworth Rural Telephone Company, Cleghorn, Iowa; Arion Telephone Company, Arion, Iowa; Osmond Telephone Company, Osmond, Neb.; Potosi Telephone Company, Potosi, Mo.; Landesville Mutual Telephone Company, Landesville, Ind.; Kilbourne Telephone Company, Kilbourne, Wis.; Pierson Telephone Company, Pierson, Iowa; Rector Co-Operative Telephone Company, Rector, Ark.; La Fontaine Telephone Company, La Fontaine, Ind.; Orange Mutual Telephone Company, Orange, Ind.; Viborg & Centerpoint Telephone Company, Viborg, S. D.; Tracy Telephone Company, Bussey, Iowa; New Richmond Telephone Company, New Richmond, Ind.; Sharpesville Telephone Company, Sharpesville, Ind.; Lincoln Mutual Telephone Company, Stuart, Iowa; Cherokee Mill & Elevator Company, Cherokee, Kan.; Deer Creek Co-Operative Telephone Company, Deer Creek, Ind.; Camden Telephone Company, Camden, Ind.; Burrows Telephone Association, Burrows, Ind.; Seymour Telephone Company, Seymour, Ill.; Roseville Telephone Company, Roseville, Ill.; Teton Telephone Company, St. Anthony, Idaho; West Bend Telephone Company, West Bend, Iowa; Arlington Telephone Company, Arlington, Ind.; Citizens' Telephone Company, Murrayville, W. Va.; Prairie City Telephone Company, Prairie City, Iowa; Mitchellville Telephone Company, Mitchellville, Iowa; Bedford County Telephone Company, Bedford, Pa.

POWER IN CALIFORNIA.—Because of the increase in the consumption of power and the present and bright prospective demand for a continuity of service for the mines and smelters in the northern part of the State, the Northern California Power Company has inaugurated a plan for the improvement of its great power system, which when completed will give it the most flexible and one of the finest systems of electrical generation and transmission in California or the West. A large amount of machinery has arrived from the East for new generating plant. The new transmission line from the company's sub-station at Keswick to the Balaklala mines on Squaw Creek, now being surveyed, will be constructed with a view to permanency. It will have a potential equal to that of the main line from the present power plant, viz., 20,000 volts. It will parallel the railroad from Keswick to Copley, and will then lead across the lower foothills to a junction with the wagon road recently constructed from Kennet to the Balaklala and Shasta King mines by the Balaklala Mining Company and the Trinity Copper Company. It will be fifteen miles in length. In the perfection of its entire system, the Northern California Power Company will run several tying-in lines to connect either or both of its power plants with all branches of the entire system.

AUTOMATIC TELEPHONY IN NEW ENGLAND.—Mr. J. L. Putnam, the energetic general manager of the Clark Automatic Telephone Switchboard Company, of Providence, R. I., reports that the Automatic Telephone Construction Company, recently organized in that city for the purpose of erecting small town plants, is at present engaged in building an exchange at Hope Valley, R. I., where it proposes to install the Clark system. He also mentions that the Clark Company has recently furnished a 48-point plant for the Société Alsacienne de Constructions Mechaniques Company's works at Belfort, France. Among recent work at home is a 48-point Clark plant in the factory of the Eagle Lock Company, at Terryville, Conn., and a 30-point plant in the Boston Store at Providence, R. I.

WORK IN THE YOSEMITE.—The proposed Yosemite Valley Railway, it appears, will materialize in a short time. The company have received all the encouragement they could ask. They are just about ready to take steps preliminary to construction. The terminus at either end of the line has not been decided on yet. At the lower end it will probably be Merced or Modesto. The company owns valuable water sites along the river, an excellent one being in the park. If this cannot be utilized the one at McCabe's flat, a few miles above Bagby, will be the site of a big plant. One of the main features of the enterprise will be furnishing power to the mining industry. It will prove a boon to many localities where fuel is much higher than electric power would be.

ELECTRIC TRACTION FOR SAN LUIS POTOSI.—An electric traction system is to be constructed in San Luis Potosi, Mexico, by American interests. The Potosina Electric Company, which recently acquired the interests of the San Luis Electric Company, will build the road. Sanderson & Porter, 52 William Street, New York, act as consulting engineers for the company, which at present lights San Luis Potosi. Additional lighting equipment has been ordered from Westinghouse, Church, Kerr & Company, three 250 hp Westinghouse gas engines, to operate on the Loomis-Pettibone system having recently been ordered. There is a horse tramway—the Tranvias de San Luis Potosi—at present operating in that place. It is 13 miles in length.

COMBINATION IN AUSTRIA.—An electrical manufacturing consolidation scheme for Austria is said to include the Austrian Union Electricity Company (a promotion of the Union Company, of Berlin), the Austrian Schuckert Company, and the branch establishment of the Siemens & Halske Company. The prospect of the creation of more intimate relations between the external off shoots of the Siemens & Halske Company and the Schuckert Company has already been foreshadowed in the official communications issued by the latter two companies in connection with their scheme of amalgamation, but no mention has previously been made of the inclusion of the Austrian Union Company in this direction.

MOTORS ON ERIE.—With regard to the work going on upon the Erie Canal, a telegram from Albany, of June 5, says: It is announced that a test of electric motor cars for hauling canal boats is to be made shortly on the Erie Canal near Schenectady. At the Schenectady works of the General Electric Company two cars are being built for this electric motor system, and the test is to be made with the consent of the State Superintendent of Public Works. Poles will be erected for a stretch of a mile and a half along the canal, and when the test is made the cables will be stretched from the towing-boat to the cars, which are to run on rails to be placed on the outer side of the towpath.

ALLIS-CHALMERS ENGINE SALES.—In a long list of Allis-Chalmers engine sales for May, 1903, the following are noted: Northwestern Elevated Railway Company, Chicago, Ill., 34-in. and 70-in. x 60-in. heavy duty, horizontal cross-compound direct-coupled Reynolds Corliss engine. Takata & Co., 15-in. x 36-in. heavy duty, horizontal direct-coupled Reynolds Corliss engine. St. Louis Exposition, 44-in. and 94-in. x 60-in. combined vertical and horizontal direct-coupled Reynolds Corliss engine. National Tube Company, Pittsburg, Pa., three vertical, triple-expansion pumping engines, fifteen million gallons capacity each.

THE NORTON COAL COMPANY, of Norton, Va., is opening new operations and adding coke ovens, for which extension to its plant it has recently purchased from the Westinghouse Electric & Manufacturing Company two additional generators with larry equipment, etc. This company already has in use two 100-kw, belted, 250-volt, Westinghouse generators, together with two Baldwin-Westinghouse mining locomotives, switchboard and other auxiliary apparatus, making a complete electrical installation for mine haulage purposes.

ELECTRICAL SUPPLIES IN UTAH.—The Inter-Mountain Electric Company, of Salt Lake City, Utah, has been organized to do all kinds of electrical work and sell all lines of electrical supplies. The new company is the old firm of the same name, of which Mr. S. F. Fenton was the sole proprietor, he now being president and manager of the new concern. The other officers are E. A. Tripp, vice-president; L. H. Farnsworth, treasurer, and G. C. Fenton, secretary and assistant manager.

ELECTRICAL SUGAR REFINERY FOR PORTO RICO.—A large sugar refinery is to be built in Porto Rico, which will be equipped with considerable electrical machinery. The capacity of the plant will be 1,000 tons per day. The power plant will be capable of developing 1,200 hp. The pumps will be driven by electric motors. The Smokeless Combustion Company, 1 Broadway, New York, will let the contracts for equipment.

STROMBERG-CARLSON TELEPHONE OUTFITS.—The Consolidated Telephone Company, of Gridley, Ill., has purchased a switchboard and equipment from the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, Ill., and Rochester, N. Y., which has also recently sold switchboard and telephones to the Concord Telephone Company, Concord, Ill.

THE SAUQUOIT SILK MILLS, of Philadelphia, have recently purchased from the Westinghouse Electric & Manufacturing Company two 125-kw, three-phase, engine-type generators, and 300 ½-hp, three-phase induction motors, each of these motors to be direct-connected to a silk loom.

THE OTIS ELEVATOR COMPANY will next week remove its present offices in the Empire Building to more commodious premises in the Battery Place Building, where two complete floors—the fifth and sixth—have been secured.

'PHONO-WIRE FOR ENGLAND.—The Bridgeport (Conn.) Brass Company recently secured a contract for some 20 miles of 'phono wire for shipment to England, for street railway purposes.

General News.

THE TELEPHONE.

HARRISON, ARK. The Reich Telephone Company has been incorporated here with a capital stock of $10,000. Mr. J. L. Reich is president.

TEXARKANA, ARK.—The Texarkana Telephone Company operates a 1,000-drop board and has 800 subscribers. The apparatus is American; 2 wire common battery. The company is now building toll lines. The rates are $36 and $24 per year. This is a fine system, having 16 miles of cable and all the wires in the downtown district underground. The company expects a large increase of subscribers.

CORONA, CAL. The City Council has granted a twenty-five-year franchise to Henry A. Coit to operate a telephone system.

EUREKA, CAL. It is stated that the Sunset Telephone & Telegraph Company is negotiating for the purchase of the Humboldt Telephone Company.

GREELEY, COL. The Morgan County Independent Telephone Company was incorporated January, 1903, with $35,000 capital. The apparatus of Kellogg Switchboard Company is used a 300-drop board. There are 275 subscribers and 47 miles of toll line. Besides this 80 miles more are being built and other connections made.

NEW BRITAIN, CONN.—The Farmington Valley Telephone Company has 150 subscribers at $12 and $15, and 30 miles of toll line.

WOODBURY, CONN.—The Woodbury Telephone Exchange furnishes telephone service to Southbury, Oxford and Roxbury as well as this place, the number of subscribers gradually increasing. A 100-drop board of Swedish American make furnishes service to 160 subscribers at $15 for residences and $20 for business houses.

SANFORD, FLA.—The Sanford Telephone Company has only been in operation six months and finds prospects very bright. It operates a 200-drop board and has 118 subscribers at $1.50 for residences and $2 for business houses. A line to De Land is contemplated, 21 miles in length.

COVINGTON, GA.—The Covington Telephone Company has a 200-drop board, 202 subscribers and has made an excellent showing in less than two years. It connects with ten farmers' lines and is steadily increasing. Rates are $1 for residences, $2 for business houses.

WAYCROSS, GA.—The Southern Bell Telephone & Telegraph Company will spend $15,000 in reconstructing the telephone exchange in this place. All of the old wires in the business section of the city are being taken down and cables substituted. New apparatus will be installed in the exchange.

PEKIN, ILL. The Citizens' Telephone Company has increased its capital stock from $50,000 to $200,000.

JOSLIN, ILL.—The Crescent Telephone Company operates four switchboards of 100 drops each. It has 350 subscribers and 60 miles of toll line. Messages are 10 cents.

STEWARDSON, ILL.—The Stewardson Telephone Company operates a 100-drop board with 100 subscribers and 15 miles of toll line. The rates are $1, $1.25 and $1.50.

CHICAGO, ILL.—The Western Telephone & Telegraph Company has been incorporated with a capital stock of $2,500 by F. W. Pringle, H. Hallett Johnson and H. S. Pringle.

WAPELLA, ILL.—The Long Point Mutual Telephone Company has a switchboard capacity of 100 and 190 subscribers. There are 120 miles of toll line. Three companies are doing business in the same territory.

MT. OLIVE, ILL.—The Mt. Olive Telephone & Electric Company is at present engaged in installing its system—the Strowger. It has an automatic switchboard of 999 drops, and 100 subscribers. Operations will commence July 1.

IVESDALE, ILL.—The Farmers Mutual Telephone Association has a 40-drop board; 70 subscribers and 40 miles of line. An increase of 200 subscribers is expected within the year. Connection is made with other towns and cities at a small rate.

STREATOR, ILL.—The Streator Independent Telephone Company will extend and improve its lines at an expenditure of about $30,000. A toll line will be built to Ransom where connections will be secured with 150 farmers' instruments.

ROCKFORD, ILL.—The Rockford Home Telephone Company has a switchboard with 1,600 lines installed, 4,000 being the ultimate capacity. It has 1,700 subscribers and growth has been rapid and demand greater than can be cared for. Toll lines are projected.

DANVILLE, ILL. The Vermillion County Telephone Company has completed plans for improvements to its system, which will cost in the aggregate about $61,000. The present capacity of the exchange is about 2,000 telephones, but this will be increased to about 8,000.

RUSHVILLE, ILL. The Grange Telephone Company uses "Standard" telephones; has a 30-drop board and 240 subscribers. The rates are from $8 to $15 per year and 20 cents for toll messages. Another, a mutual telephone company has been incorporated in Rushville, but is not yet in operation.

DAHLGREN, ILL. The Dahlgren Peoples' Telephone Company operates Stromberg-Carlson apparatus and has a 25-drop switchboard. It has 150 subscribers. There are 200 miles of toll line and the rates are 10 cents per message. Recent growth has been rapid and an increase in plant is projected in the near future.

PEORIA, ILL. The annual meeting of the stockholders of the Citizens' Telephone Company was held here recently. The company, which started last February, now has 850 telephones. The stock was increased to $200,000. Directors were elected and they will meet to elect officers. It is probable that the present officers will be re-elected.

GALESBURG, ILL.—We are informed by the manager of the Galesburg Union Telephone Company that business is increasing with remarkable rapidity. He operates apparatus of the Sterling Electric Company, has a 1,350-drop board and 1,050 subscribers. The company has 50 miles of toll line of its own and hundreds in co-operation. Rates are $1 to $2.50 per month. Farmers' connections are being made daily.

CHICAGO, ILL. Two wireless telegraph stations have been established at Chicago and Milwaukee. These have been erected by the Marconi Company, and will probably be used for the transmission of ordinary paid messages. A station will be built at South Haven within a short time, and it is said that the system will be gradually expanded until every port on the great lakes has a station. It is also intended to install Marconi instruments on some of the larger lake vessels.

EL PASO, ILL.—The El Paso Telephone Company has a switchboard capacity of 300 series; 50 bridging drops for rural lines on the Stromberg-Carlson system. It has 255 city subscribers, 320 rural party lines, built by the farmers themselves to the city limits, whence they can run into the office. The farmers therefore own the telephones and pay $3 per year switching fees. The company has doubled its growth in eight months and claims to have the largest exchange in the world for the number of inhabitants within the city limits.

CHICAGO, ILL.—Charges have been made before the council committee on gas, oil and electric light that the ordinance anxiously sought by the United Telegraph, Telephone and Electric Company, now operating in Hyde Park, but seeking to extend its lines to all portions of the city, is a measure from which the Chicago Telephone Company hopes to benefit when its present franchise expires in 1909. The ordinance giving the company the right to use all of the streets of the city for the system, bases the telephone rates on the following schedule: Direct lines, 600 calls, $60; excess 5c.; 1,200 calls, $88; excess 4c.; 1,800 calls, $109, excess, 4c.; 2,100 calls, $118, excess 3c. Two-party lines: 600 calls, $44, excess 5c.; 1,200 calls, $70, excess 4c.; 1,500 calls, $80, excess, 5c. Four-party lines: 600 calls, $28, excess 5c.; 1,200 calls, $56, excess 4c.; 1,500 calls, $68, excess 3c.

WINCHESTER, IND.—The Pleasant Hill Telephone Company has just been organized in this place.

FRENCH LICK, IND.—The Star Telephone Company has increased its capital stock from $2,000 to $15,000.

WARSAW, IND.—The Commercial Telephone Company has increased its capital stock from $30,000 to $50,000.

BUNKER HILL, IND.—The Miami County Telephone Company operates a 150-drop board and has 150 subscribers. The outlook is good.

PARKER CITY, IND.—The Parker Telephone Company operates a 200-drop board, has 250 subscribers and 18 miles of toll line. Extensions are projected.

LUTHER, IND. The Luther Telephone Company operates a 300-drop board and has over 200 subscribers. Extensions are projected, and the outlook is very bright.

BROWNSBURG, IND. The Brownsburg Telephone Company operates a 200-drop board, and has 117 subscribers at $1 per month. A large increase in the system is in contemplation.

ROANOKE, IND. The Roanoke Telephone Company operates a 99-drop board and has 60 subscribers. The rates are $1, $1.50 and $1.25 for residences, business houses and farmers, respectively.

FRENCH LICK, IND.—The Star Telephone Company, of French Lick, has increased its capital stock from $2,000 to $15,000. The company will make improvements and extend the lines to meet the demands for service.

MONROEVILLE, IND. The Monroeville Home Telephone Company uses Stromberg-Carlson apparatus, has a 100-drop board and 200 subscribers. The rates are $1 and $2 per month. The company is building rural lines.

MOHAWK, IND.—The Mohawk Telephone Company uses apparatus of the Modern Telephone Company and has 170 subscribers. There are rural and party lines at $1 per month. This is a farmers' mutual company.

PORTLAND, IND.—The Home Telephone Company operates an American express board with 450 subscribers. An increase of 100 telephones is projected. The rates are $2 and $1 for business houses and dwellings respectively.

SARATOGA, IND.—The Branch Independent Telephone Company has a 30-drop board of Stromberg-Carlson make. There are 26 subscribers and 22 miles of toll line. The rate is $1 per month. The situation and outlook are good.

DUNLAPS, IND.—The Dunlaps Telephone Company operates a 25-drop board and has 100 subscribers. There are 10 miles of toll line. The rates are $12 per annum. A large increase in the number of telephones is expected in the near future.

LEBANON, IND.—The Lebanon Telephone Company operates a 600-drop "Sterling" switchboard and has 700 subscribers at $1.25 and $1.75 and $1.00 for party line service. The company will increase the number from 1,200 to 1,500. It has 50 miles of toll line.

WEST SONORA, IND. The Deer Creek Co-operative Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $3,000. The incorporators are A. A. Cook, A. A. Newer, Samuel Mitchell, Perry Johnson and James T. Zartman.

WHITESTOWN, IND.—The Whitestown Citizens Telephone Company operates a 50-drop board and has 149 subscribers, which number will probably be doubled within another year. The system is co-operative, each owner paying his share of all expenses. There are no other charges.

PORTLAND, IND.—The City Council has granted a franchise to the Hoosier Telephone Company, an organization of local men, with $100,000 capital.

The company will put in a telephone plant here to compete with the Home Telephone Company, which now has a monopoly of the business.

CAMDEN, IND.—Representatives of all the telephone exchanges in Carroll County, at a meeting in this city, decided to encourage connection with county seat exchanges, but bound themselves not to pay a cent for such connection. This will apply to Delphi, Logansport and Frankfort.

WINCHESTER, IND.—The Winchester Telephone Company, operating a plant here for the past five years and the Eastern Indiana Telephone Company with 200 miles of line in Randolph County, have consolidated and will reincorporate under the name of Winchester Telephone Company.

CHERUBUSCO, IND.—The Gogar Telephone Company is now putting up a new building and will buy a new board, cable, etc., as soon as it is completed. It now has a 300-drop board with 200 city and 150 farmer subscribers. These will be probably doubled later. The rates are $18 for business, $12 for private houses.

LEBANON, IND.—The New Long Distance Company, of Indianapolis, has bought a controlling interest in the Lebanon Telephone Company. This is thought to be the initial step toward securing the controlling interest in all the county seat telephone plants through which the Long Distance Company's line runs.

COVINGTON, IND.—The Covington & Coal Creek Co-operative Telephone Company uses apparatus of the Eureka Electric Company, and has a 100-drop board with 23 subscribers and 25 miles of toll line. There are only farmer subscribers at present, but a material increase in number will probably soon occur. Rates are 70 cents.

NEW ALBANY, IND.—The Home Telephone Company's system has been connected at Fredericksburg with an independent long-distance telephone which has been extended from Martinsburg. The company's lines are being extended in every direction and in a short time many farm houses in southern Indiana will be connected with the city exchanges.

MODOC, IND.—The Modoc Telephone Company uses Kokomo apparatus, has a 100-drop board and 125 subscribers. There are 37 miles of toll line and 350 miles of wire, most of which is of recent growth. The company is about to install a switchboard at Economy, Ind.; and branch lines will be built from there. Rates are $1.00 for private and $1.50 for business telephones.

ROCKPORT, IND.—The Luce and Ohio Township Telephone Company operates a 900-drop board and has 700 subscribers. Rates are $1 and $2 for dwellings and business houses respectively. A plant in Warwick County is projected. The company cannot build fast enough to supply the demand and has already declared a dividend of 6 per cent., besides using receipts for construction work.

GREENFIELD, IND.—The Allentown Telephone Company, of Hancock, has filed articles of incorporation with the Secretary of State. The capital stock is $160, divided into sixteen shares of $10 each. The purpose is to build and operate a rural telephone system, the service to be free to the subscribers. Daniel W. Lonebalk, W. W. Crider, J. W. Bash, Joe A. Smith, R. F. Cook and others are incorporators.

RICHMOND, IND.—The controlling interest in the Richmond Home Telephone Company has been purchased by Colonel Orr and L. M. Flesh, capitalists of Piqua, Ohio, with Edward L. Gates, banker at Richmond. The Home Company is one of the most successful independent companies in the State. The new owners state that additional equipment will be installed and the lines extended to meet the demands.

BEDFORD, IND.—The Bedford Home Telephone Company operates a 480-drop board; with an ultimate capacity of 3,200 Stromberg-Carlson equipment. There are 200 subscribers. This plant was opened for business June 1, 1903, and expects to number 300 subscribers before the month closes. Toll connections are being made with the farmers' local lines in Lawrence County, connecting over 700 subscribers and a long distance line to Seymour, Ind., where still further connections will be made.

WABASH, IND.—The franchise of the Central Union Telephone Company in this city has expired by limitation and the company has not as yet made application for renewal. The council is urged to take steps to have the company's property removed from the streets or to secure more favorable terms for a renewal of the franchise. The stockholders of the Home Telephone Company of this city, which has practically the bulk of the business, and who are active and influential business men are said to be opposing the granting of a new franchise to the Central Union.

PLAINVILLE, IND.—Work has begun on the telephone line from this city to Washington where it will connect with the Home Company's line. A complete system will be put in, connecting Washington, Plainville, Cornettsville, Epsom, Elnora, Sandborn, Bicknell, Roglesville, Newberry and Edwardsport. The rural district will have access to the system throughout the county and it will also give the patrons access to direct connection with Washington, Vincennes, Terre Haute, Indianapolis and the many other cities. W. H. Bunch is president of the new system and B. J. Millis, secretary.

IOWA FALLS, IA.—The Central Iowa Telephone Company has increased its capital stock to $200,000.

BURLINGTON, IA.—The Modern Telephone Company will establish an automatic exchange in this city.

DES MOINES, IA.—The Slater Mutual Telephone Company has been incorporated with a capital stock of $10,000.

FLANDREAU, IA.—The Rural Reciprocal Telephone Company has been incorporated with a capital stock of $10,000.

BOXHOLM, IA.—The Boxholm Telephone Company intends to extend its system, and will also buy a 100-drop switchboard.

BONDURANT, IA.—The Farmers' Mutual Telephone Company has been organized at this place, the capital stock being $20,000.

NICHOLS, IA.—The Nichols Mutual Telephone Company has been incorporated with a capital stock of $2,000. Mr. John Nichols is president.

CRESTON, IA.—The Creston Mutual Telephone Company has increased its capital stock to $100,000, and will expend about $12,000 in improvements and additions to its system.

MUSCATINE, IA.—The Mississippi Valley Telephone Company is preparing to put in a new switchboard, string new cables and make a general overhauling of its system in this city.

COLLINS, IA.—The Collins Telephone Company operates a 200-drop board and has 162 subscribers. It has 50 miles of toll line and expects to add 15 more soon. The rates are $1 per month.

WOOLSTOCK, IA.—The Woolstock Telephone Company operates a 50-drop Kellogg switchboard and has 100 subscribers. It has 85 rural connections at $1 per month. Extensions are projected.

HAWARDEN, IA.—The Hawarden Telephone Exchange has been sold to W. J. Van Allen, of Epworth, Ia., and J. A. Lattner, of Worthing, Ia. New lines will be constructed throughout the county.

GRIMES, IA.—The Farm Mutual Telephone Company has installed Stromberg Carlson apparatus and a 100-drop board. It has 350 subscribers. The company has 115 miles of farm lines all built in the past year.

MODALE, IA.—The Interstate Telephone Company will establish an exchange in this city and otherwise improve its system. It will probably extend the line to Little Sioux and possibly up the Soldier Valley in the near future.

IOWA CITY, IA.—The Sharon Farmers Mutual Telephone Company operates a 25-drop board and has 150 members. Membership costs $30. The company has connection with long distance telephones to Muscatine, Cedar Rapids and other places.

MILFORD, IA.—The Midland Telephone Company which operates Kellogg apparatus has a 100-drop board and 140 subscribers; with 15 miles of toll and 75 of rural lines. Rates are $1 per year. The company is building to Arnolds Park and Spirit Lake.

FOREST CITY, IA.—The Great Northern Telephone Company has four switchboards of 350-drop capacity and 350 subscribers. There are 30 miles of toll line, and one exchange has been put in. Extensions are projected. The rates are: Rural lines, $1.25; business, $2; dwellings, $1.

PRAIRIE CITY, IA.—The Farmers and Merchants Telephone Company operates Swedish-American apparatus; has a 200-drop board and 350 subscribers at $1.50 and $1.00 per month. Prospects are good for 200 more. There are 24 miles of toll line. The company was formed one year ago.

FAIRMONT, IA.—The Consolidated Telephone Company operates a 600-drop board and has 600 subscribers. There are 100 miles of toll line, and a new one to Fairview is projected. Business rates are $30; residences $20. The company operates in five counties and has a total of 2,500 subscribers.

RED OAK, IA.—Mr. J. F. Miller, manager of the Montgomery County Telephone Company gives us some interesting notes of that very prosperous concern. He operates Stromberg Carlson apparatus, having a 500-drop board. Another 100-section is to be installed. There are 425 subscribers, paying $1 per month for residence instruments and $2 per month for business houses. The company commenced business January, 1903, and now has 200 more subscribers in sight. Many improvements are projected.

CLAREMORE, I. T.—The Claremore Telephone Company, owned by Mr. J. G. Rucker, operates a 150-drop board, has 115 subscribers and 95 miles of toll line. The rates are $1.50 for residences and $2 for business houses. The outlook is very favorable.

ALTOONA, KAN.—The Altoona Co-operative Telephone Company uses Eureka apparatus and has a 50-drop board with 65 subscribers and 20 miles of toll line.

CEDAR VALE, KAN.—The Dosbaugh Telephone Company has a 100-drop board at Cedar Vale with 100 subscribers; a 250-drop board at Sedan, with 220 subscribers; 150 at Caney with 115 subscribers and 100 at Peru with 50 subscribers. The apparatus used is Kellogg, Ericsson and Standard. Rates are $1 for residences, $2 for business houses. There are 130 miles of toll line. New buildings are being constructed. Growth has been rapid and in view of the gas and oil development in the section a still greater increase is expected.

BARBOURVILLE, KY.—The Hyden Telephone Company has been organized here to build a line from Manchester to Hyden.

INDEPENDENCE, KY.—Sealed bids will be received by the Kenton Fiscal Court for a local telephone franchise in this city. Charles Durin and Thomas Dunn constitute the committee.

VALLEY CITY, MD.—The Valley City Telephone Exchange operates a Kellogg switchboard of 600 drops, has 430 subscribers and 165 miles of toll line. About 100 miles of farmers' lines is projected. The rates are $2 and each. Business is brisk for almost every farmer wants to subscribe.

HAVERHILL, MASS.—The People's Telephone Company uses Couch & Seeley apparatus, has a 300-drop board and 600 subscribers. Growth has been satisfactory.

NEW BEDFORD, MASS.—The Automatic Telephone Company, of New Bedford, has a switchboard capacity of 10,000 drops, 750 subscribers and 14 miles of toll line. It has increased steadily, having added three switchboards within a month. Toll lines to surrounding towns are projected, and general building up of the system in southeast Massachusetts, where new subscribers are coming in daily.

SAGINAW, MICH.—The Michigan Bell Telephone Company is preparing to make extensive improvements in this city.

SAGINAW, MICH.—The Valley Telephone Company is building new lines to Frankenmuth, Fairgrove, Reese and Vassar.

MENOMINEE, MICH.—The American Electric Telephone Company will ask for a franchise for a telephone exchange here and at Marinette.

LIBERTY, MICH.—The Liberty Telephone Association has a 12-drop board and 175 subscribers. There are 12 miles of toll line and 40 miles more will be built.

MARION, MICH. The Marion Telephone Company has a 70-drop board of the Eureka Electric Company's make and 30 subscribers. Ten miles of toll line are projected.

ROCKLAND, MICH. The Ontonagon County Telephone Company has a switchboard capacity of 200 drops and 140 subscribers. The increase has been good for two years.

HOWELL, MICH. The Livingstone Home Telephone Company employs Eureka and other apparatus, has a 300-drop board and 268 subscribers. It has 140 miles of toll line, its rates being $24 and $12 for business houses and dwellings respectively. Extensions are contemplated.

LITCHFIELD, MICH.—The Litchfield Telephone Exchange commenced operations less than a year ago, but has made good progress and has a promising future. Stromberg-Carlson apparatus is used. It has a 100-drop board and 145 subscribers. There are 9 miles of toll line, the rate being $10 per annum per subscriber.

ROSSEAU, MINN. C. A. Pearson has been granted a franchise for a telephone exchange in this place.

ST. JAMES, MINN. The Madelia Telephone Company has been incorporated with a capital stock of $10,000.

COKATO, MINN. The Cokato Telephone Company is just putting in the Stromberg-Carlson system, with a switchboard capacity of 100 drops. It has 65 subscribers. Rates are 75c. and $1.25 per month.

McINTOSH, MINN.—A telephone line owned by Mr. A. Jensen has a 100-drop board and 60 subscribers. Fifteen miles of toll line are being built. Its rates are $2 for business houses, $1.25 for residences.

GREENWOOD, MISS.—The Yazoo Valley Telephone & Telegraph Company intends adopting the common battery system. Lines are all metallic. It has a 300-drop board; 200 subscribers and 25 miles of toll line. Recent growth has been 100 subscribers and as many more are in sight.

WAHOO, NEB. The Golden Rod Telephone Company has increased its capital stock to $150,000.

EAGLE, NEB.—The Eagle Telephone Company operates a 50-drop board with 33 subscribers and 9 miles of toll line. Farmers' lines are projected. The rates are 50c. per month.

BRADY, NEB. The Maxwell & Brady Telephone Company has a 40-drop board, 35 subscribers and 80 miles of toll line. Rates are $1.50 per month. The outlook is good for doubling the business.

HOOPER, NEB.—The Hooper Telephone Company operates Eureka and Stromberg-Carlson apparatus, has a 100-drop board and 145 subscribers. The company is now preparing to put in 50 more telephones in the country east of this place.

BATTLE CREEK, NEB.—The Battle Creek Telephone Company uses Stromberg-Carlson apparatus and has a 10-drop board with 83 subscribers. Thirteen miles of country lines have been recently built and a large extension is projected. This is a new concern.

BEATRICE, NEB.—The German Telephone Company has filed articles of incorporation. The paid up capital of the company is $2,000. The place of business is in Logan township. The articles are signed by J. M. Shuster, president, and John Bubhoom, secretary.

WISNER, NEB.—At the annual meeting of the Cuming County Independent Telephone Company held recently, the following-named officers were elected: L. Dewald, president; J. E. Albers, vice-president; B. H. Von Seggern, secretary, and Peter Witt, treasurer.

NORTH BEND, NEB.—The Farmers' Telephone Company has switchboards at North Bend, 100 drops; Scribner, 100; Dodge, 100; Webster, 100; Snyder, 50; Pleasant Valley, 50. It has 300 subscribers and 70 miles of toll line. Its rates are business houses, $1.50 per month; dwellings, $1.

LINCOLN, NEB.—The Surprise Independent Telephone Company has filed articles of incorporation. The capital stock is $50,000, and the incorporators are A. L. Sperry, E. E. Miller, S. R. Severns, W. H. Greenslit, G. H. Miller, J. H. Greenslit, J. H. Miller, R. Dudley, R. H. Sperry, B. K. Sperry and J. D. Modlin.

FREMONT, NEB.—At a special meeting of the city council the proposition of the Fremont Independent Telephone Company for an amendment to its franchise to permit the adoption of the sliding scale was rejected. The present rates are $2 for business houses and $1 for residences. The change contemplated an increase of 25 cents when 700 telephones were in operation and a further increase when 1,000 were in operation. The change, however, in no event to take place until January 1, 1905, nor until 100 miles of toll line poles had been constructed.

EAST HAMPTON, N. Y. The East End Telephone Company rents the whole service to two subscribers.

CAMPBELL, N. Y. The Campbell & Risingville Telephone Company uses Eureka apparatus. It has 120 subscribers and 60 miles of toll line.

LOCH SHELDRAKE, N. Y.—The Loch Sheldrake & Hurleyville Telephone Company has five telephones on its line and charges 10 cents per message.

GROTON, N. Y.—The Farm and Village Telephone Company operates a 200-drop Kellogg switchboard with 75 subscribers and 75 farm lines, with 90 subscribers.

CATON, N. Y.—The Caton Telephone Association uses Bell apparatus, has a 4-drop board, 26 subscribers and 19 miles of toll line. The message rate is 10 cents.

MINAVILLE, N. Y.—The Minaville & Amsterdam Telephone Company has four miles of toll line and runs into the office of the Hudson River Telephone Company at Amsterdam.

ITHACA, N. Y.—The Ithaca Telephone Company operates Century apparatus. It has a 600-drop board with 600 subscribers and 126 miles of toll line. An increase of 200 is projected.

BELMONT, N. Y.—The Belmont Citizens' Telephone Company operates Western Electric apparatus, has a 50-drop board and 235 subscribers. It has 40 miles of toll line, its charge being $12 per year.

BAINBRIDGE, N. Y.—The Riverside Telephone Company has been incorporated with a capital stock of $2,000. The incorporators are Joseph J. Waters, H. G. Robbins and Lewis B. Anderson.

COVENTRYVILLE, N. Y.—The Coventry & Oxford Telephone line runs from Coventry to Oxford through a farming district. It uses a 4-drop board of Standard make, has 27 subscribers and 11 miles of toll line.

MASONVILLE, N. Y.—The Masonville Telephone Company has several toll lines running through the rural districts. It operates a 30-drop board and has 50 subscribers. Its rates are $10. A large increase is projected.

ARKPORT, N. Y. The Arkport & Bishopville Telephone Company has a 6-drop board here and 28 subscribers. It has 15 miles of toll line, the rate being $5 per year. It has five lines built connecting 85 subscribers at several other places.

ESSEX, N. Y.—The Essex Mutual Telephone Company, which connects with lines in other towns covering 20 square miles and giving a service of 400 telephones, has a 10-drop board and 25 subscribers. The rates of toll service are $6 per annum.

RICHFIELD SPRINGS, N. Y.—The Richfield Springs Telephone Company operates Stromberg-Carlson apparatus; has a 200-drop board and 150 subscribers. Its rates are $15 and $12—two on a line. Rural lines are now being built and the outlook is very promising.

COOPERSTOWN, N. Y.—The Cooperstown Telephone Company operates a 100-drop board, has 200 subscribers and 50 miles of toll line, at rates of $15 and $12—two on a line. Extensions are projected and connections will be made with several towns and cities north.

WESTPORT, N. Y.—The Westport, Essex & Lewis Telephone Company uses apparatus of the Hipwell Mfg. Company. Its switchboard is of 6-drop capacity. There are 90 subscribers, nearly all within the past year, and 22 miles of toll line. The rate is $6 per year.

WARWICK, N. Y.—The Warwick Valley Telephone Company operates a 100-drop board, has 200 subscribers and 40 miles of toll line. An extension of 30 to 40 lines for farmers is projected. The rates are: farm lines, $12; village lines, $15 to $21; country tolls, $10 to $15.

SCHENECTADY, N. Y.—The Schenectady Home Telephone Company, which commenced operations February, 1903, has a 1,920-drop board of Kellogg make and 800 subscribers. Its rates are $44 for business houses and $22 for dwellings. An increase of several hundred telephones is projected.

NEW YORK, N. Y.—A new telephone exchange, which will be known as "Orchard" and which will take 9,600 subscribers from the overcrowded Spring and Eighteenth Streets exchanges, was opened recently at 126 Orchard Street. The telephone company has just completed a building there. There will be 170 operators at the switchboards. Roughly speaking, the new exchange will take in all telephone subscribers east of Third Avenue, the Bowery and Park Row, from Thirteenth Street to Chambers Street.

ELIZABETH CITY, N. C.—The Elizabeth City Telephone Company is now changing its system to the Bell common battery. The switchboard capacity is 250-drops. There are 200 subscribers at rates of $3 for business houses, $1.50 for residences. Seventy-five miles of extension toll lines are now under construction.

HILLTOP, N. DAK.—The telephone office here has a 200-drop board and 225 subscribers. Rates are $15 per year.

LANGDON, N. DAK.—The Langdon Telephone Exchange Company operates a 120-drop board and has 120 subscribers.

AMENIA, N. DAK. There is a private line here with about 14 instruments which has been in use about ten years.

MANDAN, N. DAK.—The Mandan Telephone Company uses a 200-drop board, has 193 subscribers and 166 miles of toll line. Rates are $1.50 and $2.50. Toll, 25 to 75 cents.

RUSSELLVILLE, OHIO.—The telephone line here is owned by Messrs. Sidwell & Miller, who operate 7 miles of toll line at 15 cents a message.

WOODSTOCK, OHIO. The Mechanicsburg Telephone Company has opened an exchange here and a number of the farmers in the surrounding districts are arranging for connections.

KINSMAN, OHIO.—C. G. Clisby is organizing a mutual telephone company among the farmers in his vicinity. His intention is to supply telephones to all the farmers in the district.

MILFORD CENTER, OHIO. The Home Telephone Company is preparing to build two branch farmer's lines in a northerly direction from town. A new line is being built to Burnham.

OBERLIN, OHIO.—The Oberlin Telephone Company operates North apparatus; has a 399-drop board and 329 subscribers. Rates are $15 for residences and $24 for business houses.

MARBLEHEAD, OHIO.—The Kelley Island & Sandusky Cable Company operates Kellogg telephones, a 100-drop board and has 125 subscribers. Rates, $1 and $1.50 for residences, $1.50 for business houses.

MANCHESTER, OHIO.—The apparatus used by the Manchester Telephone Company is Western Electric. The switchboard capacity is 125 drops and there are 119 subscribers, 77 being the increase of one year.

CONNEAUT, OHIO.—The Conneaut Telephone Company has completed extensive improvements to its exchange and has raised its rates from $1 to $1.50 per month. The company has 700 telephones in operation.

FOREST, OHIO.—The People's Telephone Company, with American Electric apparatus, has a 200-drop board, 195 subscribers and 20 miles of toll line. Rates, $1.25 and $1.50. Several more instruments are to be put in.

COLUMBUS, OHIO.—The South Charleston Home Telephone Company, of South Charleston, has been incorporated with a capital stock of $10,000. The names of the incorporators are S. H. Rankin, Alex. Renick, Edwin R. Sharp, Frank L. Beam and Frank A. Davis.

CUMBERLAND, OHIO.—Mr. H. W. McKee is the owner of the telephone system which has been established two years and is growing rapidly. It has a 300-drop local board, 40 miles of toll line and 350 subscribers. Kellogg apparatus is installed.

NORTH LEWISBURG, OHIO.—The North Lewisburg Telephone Company operates apparatus of various makes. It has a 150-drop board with 125 subscribers and 25 miles of toll line. An increase of three farmers' lines is projected and prospects are very bright.

BERGHOLZ, OHIO.—The Bergholz Telephone Company operates Kellogg switchboards, two of 100 drops each, two of about 40 or 50 and one of 16. It has 50 miles of toll line and about 200 subscribers. A switchboard is about to be placed in Carrollton. Residence rates are $12, business, $15.

WASHINGTON, OHIO.—The Washington Home Telephone Company, which operates "American" equipment, has an 800-drop board and 850 subscribers. Rates are $12 and $24 per year. A further extension of the country pole line is contemplated. There is a growing demand for telephones.

WILLSHIRE, OHIO.—The Willshire Telephone Company operates Stromberg-Carlson apparatus. There are 95 subscribers, the rates being $1.50 for business houses and $1 for residences. Increase is steady. Farm lines are being built and a large increase in the number of subscribers will follow.

MASON, OHIO.—The Valley Telephone Company has been forced to temporarily discontinue its service at Mason. Heretofore the company has used the ground return system, but now that the electric railway has been built through the town, the system is unsatisfactory. Metallic circuits will be installed.

ELIDA, OHIO.—The Elida Mutual Telephone Company uses Eureka and other apparatus, has a 100-drop board and 300 subscribers. There are 125 miles of toll line, the rate being $1 per month. There has been 50 per cent. increase of late and by developing the present area there is every prospect of doubling the number of present subscribers.

PAINESVILLE, OHIO.—The North Electric Company, of Cleveland, has just completed the installation of a new telephone exchange here. The new board will accommodate 1,600 lines. The company is now operating 680 lines. It has just announced a new schedule of rates as follows: Business, independent line, $32; two-party line, $24. Residences, single independent line, $20; two-party line, $18; three-party line, $17.

POTTSVILLE, PA.—The Carbon Telephone Company will extend its lines to Tamaqua and Mauch Chunk. At Tamaqua connections will be made with the United Telephone Company's exchange and at Mauch Chunk with the Consolidated Telephone Company's system.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company informs us, through Manager Brown, that business is very prosperous. Apparatus used is Kellogg, North, and its own make. Switchboard capacity, 21,200; number of subscribers, 17,000. There are 800 miles of toll line and many different rates. The company expects to spend $800,000 in improvements, extensions and new plants within the next 12 months. The present capital is $5,000,000; bonds, $1,400,000.

PITTSBURG, PA.—The new exchange of the Central District & Printing Telegraph Company was connected up on the night of May 30, and the connections of 4,000 lines were changed from the old to the new switchboard in about three minutes' time. The new exchange is at the corner of Fourth Ave. and Cherry Alley. The new switchboard is of the lamp signal relay type with an ultimate capacity of 9,000 lines, and will take care of approximately 14,000 subscribers. The present switchboard equipment has a capacity for 6,000 subscribers.

PITTSBURG, PA.—A group of telephone companies in western Pennsylvania, the stocks of which were held by the United Telephone & Telegraph Company, of New Jersey, which also owned the independent plants in Baltimore and Wilmington, Del., has changed hands, the control having passed from the Baltimore syndicate headed by Br. George R. Webb to the Pittsburg & Allegheny Telephone Company. The latter company has increased its capital stock to $5,000,000, which is made up half and half of preferred and common stock. The consolidation was effected through the Central Trust Company, of Baltimore.

CHESTERFIELD, S. C.—The Chesterfield Telephone Company has enlarged its business considerably this year and is about to extend its toll line. It has a 50-drop board and 86 subscribers.

ST. MATTHEWS, S. C.—The St. Matthews Telephone Company operates a Clark automatic 72-drop board and has 30 subscribers. The rates are $1.50 for business houses, $1 for residences. An extension of 15 or 20 miles of toll line is contemplated.

MILLTOWN, S. DAK.—The Milltown Telephone Company has a 12-drop board and 38 subscribers, 32 miles of toll line at 15c. per message. An increase is projected.

KNOXVILLE, TENN.—The East Tennessee Telephone Company will begin at once to make extensive improvements in its plant on Seventh Street in this city. New switchboards will be installed at a cost of $8,000.

MINERAL WELLS, TEX.—A franchise has been granted by the City Council to the Independent Telephone Company to operate an exchange in this city.

FORT WORTH, TEX.—The Texas Telephone & Supply Company has been incorporated in this city, the capital stock being $10,000. The incorporators are L. J. Taylor, W. G. Liggett, C. C. Houston and Warren E. Martin.

FT. WORTH, TEX.—The Ft. Worth Telephone Company has a 2000-drop board and 1951 subscribers to commence business, but is not yet in operation. The apparatus is of American Electric make. The company will occupy its own building, with everything up-to-date.

SHERMAN, TEX.—The Grayson County Telephone Company is equipped with a 600-drop Kellogg switchboard. It has 500 subscribers in Sherman, 647 in Denison. Between the two cities are 50 miles of toll line, which is free to subscribers. The capital stock has been increased to $340,000 to meet the rapid progress of the company. Mr. G. Holmes is manager.

OGDEN, UTAH.—The City Council has granted a franchise to the Independent Home Telephone company and work on the new system will be commenced in the near future.

SALT LAKE CITY, UTAH.—The Independent Home Telephone Company has notified the city council that work has been commenced on the construction of its exchange and that the company has filed a bond of $25,000 as required by the terms of the franchise.

BRADFORD, VT.—The Bradford Telephone & Telegraph Company furnishes service to 300 subscribers with a 100-drop board. It has 100 miles of toll line, the rates being $12 per year.

VERGENNES, VT.—The Addison & Panton Telephone Company employs Bell apparatus and has a 25-drop board with 150 subscribers and 70 miles of toll line, the charge being $12 per year for toll service.

SPRINGFIELD, VT.—The New England Telephone & Telegraph Company supplies the apparatus of the Springfield Local Telephone Company. A 40-drop board affords service to 175 subscribers at $12 for dwellings and $18 for business houses.

MIDDLEBURG, VT.—The Addison County Telephone Company uses apparatus of Western Telephone Construction Company. The switchboard has a capacity of 350 drops. There are 350 subscribers. The company has 50 miles of toll line, the rates being $1 per month. Extensions are projected.

FAIRLEE, VT.—The Fairlee Telephone Company is a branch line of the New England Telephone & Telegraph Company and connects with the lines of that company, having subscribers into So. Fairlee, Bradford and other places. It operates a 20-drop board and has 100 subscribers in Fairlee. The apparatus used is American Bell.

ESSEX, VT.—The Central Telephone Company operates two switchboards of 100-drop capacity each. It supplies service to 300 subscribers at $12 per year on grounded lines, $18 to $21 on metallic circuit. A large increase is projected. The company furnishes service to the towns of Jerico, Underhill, Westford, Fairfax, Williston, Colchester, Grand Isle and others, as well as to this town.

CHARLESTOWN, W. VA.—C. C. Gaver, of Hillsboro, Va., has been granted a franchise for the Old Dominion Telephone Company to build lines to Harpers Ferry.

ALTO, WIS.—The Alto Telephone Company has been incorporated with a capital stock of $3,000.

OSHKOSH, WIS.—It is stated that the Winnebago Telephone Company will construct an independent telephone system in this place.

MAPLE GROVE, WIS.—There are 120 miles of toll line from this place and a further extension is projected. Rates are 20c. per message.

STEVENS POINT, WIS.—The Stevens Point Mutual Telephone Company has been organized, and the work of constructing its system will be commenced at once.

POYNETTE, WIS.—The Leeds Farmer's Telephone Company has 150 subscribers and 200 miles of toll and party lines which connect with those of five different companies.

ORFORDVILLE, WIS.—The Orfordville Telephone Company has Standard apparatus and a 200-drop board, with 185 subscribers and 20 miles of toll line. Recent growth 75 numbers and 100 more are projected.

REEDSBURG, WIS.—The Reedsburg Telephone Company has 260 subscribers and expects a large increase in the number. It uses Western Telephone Construction Company's apparatus and has a 300-drop switchboard.

MT. HOREB, WIS.—The Mt. Horeb Independent Telephone Company operates a 200-drop board, has 150 subscribers, and 40 miles of toll line. It is branching out in every direction and makes a fine showing for its one year of existence.

BELLEVILLE, WIS.—The Belleville Telephone Company operates a 100-drop board, has 65 subscribers and five miles of toll line. Stromberg-Carlson apparatus is used. Rates are $1 for residences, $1.50 for business houses.

GRAND RAPIDS, WIS.—The Wood County Telephone Company operates a Stromberg-Carlson full metallic system. It has a 400-drop board and another 100-drop section will be put in. Service is given to 486 subscribers and a daily increase is recorded. Rates are $27 per annum for business, $12 per annum for dwellings.

BRUCE, WIS.—The Chippewa Valley Telephone Company has five exchanges, one with a 100-drop switchboard, four with 50-drop boards. There are about 200 subscribers paying $1.50 per month for business houses and $1.25 for residences. There are 80 miles of toll line and thirteen toll stations. Prospects are excellent.

WAUSAUKEE, WIS.—The Wausaukee Telephone Company makes a good showing for the first year of its existence. It has an 80-drop board with 77 subscribers at $1 per month. There are 60 miles of toll line; one to Marinette just completed and other extensions in progress to connect with the Mineral Range Telephone Company and Dunbar.

EVANSVILLE, WIS.—The Evansville Telephone Exchange is making such rapid progress that the demand exceeds the capacity of the apparatus. This is American and Standard. There is a 300-drop board with 260 subscribers. The rates are $1 for residences and $2 for business houses. The company contemplates building several country lines.

ELECTRIC LIGHT AND POWER.

RUSSELLVILLE, ALA.—There is reported to be a movement on foot here to put in an electric light plant.

STOCKTON, CAL.—The citizens have voted to issue $160,000 bonds for the construction of a municipal electric light plant.

SAN FRANCISCO, CAL.—The Humboldt Power Company has been incorporated by Chas. P. Doe, of Alameda; Jas. Stanley, of Sausalito; C. Alvin Baird, of Eureka, and others, to supply electric light and power; capital, $500,000.

OAKLAND, CAL.—The contract for lighting the streets and public buildings has been awarded to the Oakland Gas Light & Heat Company at $7.25 per light (2,000-cp arc) per month, all night and every night except full moon, night preceding and night following; lighting public buildings—incandescent lights, 5 cts. per kw-hour.

SAN FRANCISCO, CAL.—The Butte & Plumas Railway, which is to extend 65 miles from Oroville to Quincy, Cal., with its 25-mile extension—the Indian Valley Railway—will be operated by electricity. The California Gas & Electric Corporation can supply current at Oroville. The Western Power Company's Big Bend plant which may be constructed within the next two years will also be available. The owners of the railroads, however, will install a plant at the upper end of the line to supply a part of the power. They have 5,000-hp available at one point and have also several other good power sites. The roads will do a large business in hauling lumber and other freight.

GREENWICH, CONN.—The Glenville Power & Water Company, organized here, with a capital of $10,000,000, to supply water to Greenwich, Conn., and Rye, Harrison and Mamaroneck, N. Y., and to generate and distribute electricity throughout these and other sections for public and private use. Wm. J. Tingue, Nathaniel Wetherell and Henry H. Adams are the corporators.

WINDER, GA.—The citizens have voted to issue $15,000 electric light bonds.

ATHENS, GA.—Capt. Jas. White is interested in the development of the power at Barnett Shoals for electrical and manufacturing purposes.

AUGUSTA, GA.—It is said that plans for organizing a new electric light and power company in Augusta are nearing completion. The merchants interested believe they can furnish their own electricity at a saving over the present cost.

ORO FINO, IDAHO.—F. M. Mitchell, of Grangeville, is preparing to install an electric light plant and a water works at this place. Power for generating the electricity and running the pumps will be obtained from the waters of Oro Fino Creek, which will be utilized by means of a flume about 1,500 ft. in length.

EDWARDSVILLE, ILL.—The City Council has voted an appropriation of $30,000 for city lighting. This means that the council favors the scheme of a city lighting plant. The question will be submitted to a vote of the people and if carried, bonds will be issued to raise the funds.

STERLING, ILL.—It is stated that the Rock River will be dammed at a point 12 miles west of here, the improvements to cost about $200,000. The electrical power developed at this point will be used for the operation of electric railways now being constructed in this section of the state. It is stated that the energy will be transferred a distance of 300 miles. The company also expects to furnish power for factories within this radius.

BRAZIL, IND.—The Brazil Electric Company has purchased the city electric light plant and will make many improvements.

NOBLESVILLE, IND.—An electric plant is to be constructed here for Thos. Griffin, to cost $70,000. About 1,000-hp will be developed.

WASHINGTON, IND.—Simeon Loudenback, James C. Keeler and George Lesler Wilkins have organized and incorporated the Citizens Light & Fuel company and will construct and operate an electric lighting plant in this city. The capital stock is $100,000.

SOUTH BEND, IND.—It is stated that plans have been decided upon by Chas. A. Chapin, of the South Bend Mfg. Company, which controls the water power of west race, for equipping the race so as to supply power for the electric light plant in this city and making it supplementary to the electric plant in Buchanan, Mich.

ANDERSON, IND.—The city council has contracted with the Westinghouse Company, of Pittsburg, for a turbine engine at a cost of $19,250 to supply more power for the city electric plant. The new turbine is to have a capacity of 400-kw. The General Electric Company challenges the bid of the Westinghouse Company and charges the council with being unfair, its bid being $18,000. The council will purchase another engine within the next year or two.

ATLANTIC, IA.—The City Council has ordered the joining of the water works and city lighting plants. The work proposed will cost about $12,000.

HARPER, KAN.—Mayor Baumstark has appointed a committee to investigate the question of constructing an electric light plant.

HARRODSBURG, KY.—Bids will be received by C. D. Thompson until June 27 for $18,000 electric light plant bonds.

SANFORD, ME.—The Sanford Light & Power Co., of Portland, has been incorporated; capital $50,000. C. A. Bodwell is president; W. J. Bodwell, treasurer, both of Sanford, Me.

MERRIMAC, MASS.—The town has voted to establish water works and a lighting plant.

MANSFIELD, MASS.—The citizens have voted to issue $40,000 bonds for an electric light plant.

MAPIMI, MEXICO.—An electric power transmission plant, which is said to be the largest in Mexico, has just been completed here by the Penoles Mining Company. The electrical energy is transmitted to the Ojuela mines where it is used for operating the pumps and machinery.

FORD, MICH.—The citizens have voted to issue bonds for an electric light plant.

NASHVILLE, MICH.—The Village Council has granted a franchise to the Marshall Electric & Power Company to install a plant at Scipio, three miles northeast.

LYLE, MINN.—Improvements are to be made to the electric light plant in this place.

BUHL, MINN.—Bids will be received soon by M. A. Nichols, for the construction of an electric light plant. Oscar Claussen, St. Paul, is engineer.

TWO HARBORS, MINN.—The Council has decided to install new electric machinery on specifications by Oscar Clausen, of St. Paul, engineer, to cost about $9,000.

CALEDONIA, MINN.—The contract for constructing an electric light plant has been awarded to S. G. Reque, now at Caledonia, Minn. The plant to be erected by the city under the supervision of S. G. Reque.

STILLWATER, MINN.—The Western Gas & Improvement Company has taken over the plants of the Gas & Electric Light Company and the Apple River Power Company and will make extensive improvements.

McHENRY, MISS.—The City Council has granted the Bauer Lumber Company a franchise for an electric light plant.

YAZOO CITY, MISS.—Engineers Kirkpatrick & Johnson, of Jackson, Miss., have plans for an electric light plant for Yazoo City.

RENO, NEV.—The controlling interest in the Nevada Power, Light & Water Company has been purchased by Senator Flannagan, at a cost of $200,000. Extensive improvements will be made to the plant.

LACONIA, N. H.—The plant of the Laconia Electric Light Company was destroyed by fire on May 26. It will be rebuilt at once.

TECUMCARI, NEW MEX.—An electric light and waterworks plant is to be established here. Merril H. Fisher, of Alamagordo, is interested.

BUFFALO, N. Y.—A special committee of the Board of Councilmen appointed to consider the lighting question has reported in favor of constructing a municipal electric light plant. This will be its alternative to the proposition approved by the aldermen to accept the offer of the General Electric Company to supply 4,000 or more lamps at $70 per lamp per year.

EDENTON, N. C.—The citizens have voted to issue $30,000 bonds for an electric light plant and water works.

CHARLOTTE, N. C.—W. Drummond Marrow, of Charlotte, has secured the contract for putting in a $10,000 electric light plant at Lumberton in this state.

FAYETTEVILLE, N. C.—The Fayetteville Gas & Electric Company has been incorporated with $33,000 authorized capital. W. A. McKenney, of Washington, D. C., is the largest shareholder.

WALDO, OHIO.—Michael Brothers are installing an electrical plant and will furnish light and power throughout the village.

BLIND RIVER, ONT.—D. S. Pindell, of Sault Ste. Marie, Mich., will construct a power plant at Blind River to cost $5,000.

BAKER CITY, ORE.—The Baker City Gas & Electric Company's electric plant in Baker City, Oregon, has been destroyed by fire with a loss of $30,000; insurance $10,000. It will be rebuilt.

NEW FLORENCE, PA.—The New Florence Light & Power Company is reported organized and has secured the contract for lighting the borough.

BENNETTSVILLE, S. C.—A new $15,000 electric light plant is being constructed here.

COLUMBIA, S. C.—G. A. Guignard, of Lexington County, S. C., has secured control of a number of fine water powers in Lexington County. Lewis J. Guian, of Columbia, S. C., is also interested.

ROCK HILL, S. C.—The Catawba Power Company, of Rick Hill, has increased its capital stock from $650,000 to $750,000. The company is erecting one of the largest power plants in the state for electrical purposes.

HURON, S. D.—The Consolidated Gas & Electric Company, of Huron, has been incorporated, with a capital of $25,000.

SPRINGFIELD, TENN.—The citizens have voted to issue $35,000 bonds for water works and an electric light plant.

BEAUMONT, TEX.—Hal W. Greer and associates are stated to have secured a franchise for an electric light plant.

GEORGETOWN, TEX.—It is announced by the Georgetown Water and Electric Company, that about $10,000 is to be expended in improvements by that company.

BAY CITY, TEX.—The Bay City Ice, Light & Power Company has been incorporated; capital $50,000. Incorporators: T. H. Stone, W. T. Goode and G. M. McGill.

BEAVER, UTAH.—A large power plant will be installed at this place within the next few months, the power to be derived from Beaver River. The power will be used in local mines and mine owners are the parties pushing the project.

SEATTLE, WASH.—It is stated that the Seattle Electric Company contemplates improvements this season to cost $500,000.

PT. TOWNSEND, WASH.—The Townsend Gas & Electric Company was formed in 1893 with $150,000 authorized capital. It furnishes 17 enclosed arcs and 638 incandescent lights.

MARINETTE, WIS.—It is stated that the Street Railway Company will rebuild the electric light plant and make other changes.

GRANTSBURG, WIS.—Bids are wanted June 25 for $8,000 bonds for an electric light plant. A. A. Anderson is Village Clerk.

THE ELECTRIC RAILWAY.

RIVERSIDE, CAL.—H. F. Huntington has purchased a franchise for an electric railway from Riverside to Corona, a distance of about 10 miles.

LOS ANGELES, CAL.—The Los Angeles & Redondo Electric Railway has increased its capital stock from $500,000 to $1,000,000. The new stock is to be issued for the purpose of making betterments and extensions.

JEWETT CITY, CONN.—The Senate has passed a resolution incorporating the Voluntown & Jewett City Street Railway Company.

HARTFORD, CONN.—The Railroad Committee of the General Assembly has reported favorably the resolution incorporating the Woodbury & Waterbury Street Railway Company.

NEW HAVEN, CONN.—The Railroad Committee of the General Assembly has reported favorably the resolution authorizing the Fair Haven & Westville Railway to make numerous extensions.

BRADENTOWN, FLA.—The Manatee Light & Traction Company has been incorporated, with a capital stock of $100,000, to build an electric railway and operate light, heat and power plants. The incorporators of the company are John A. Graham, W. A. Carter and Nina H. Graham.

ROME, GA.—The town of Rome has raised the $15,000 bonus asked of the citizens of that town by Northern capitalists, for extending the trolley line to Lindale. Improvements to cost $150,000 will be made, including an electric plant.

MT. VERNON, ILL.—The Southern Illinois Electric Railway Company has been incorporated with a capital stock of $50,000, with the principal office at Mt. Vernon. The incoporators and first board of directors are John R. Piercy, Geo. F. M. Ward, Samuel Casey, Louis G. Pavey, Samuel T. Maxey and Albert N. Johnson, all of Mt. Vernon, Ill.

SPRINGFIELD, ILL.—The Springfield and Jacksonville Rapid Transit Company has been incorporated with a capital stock of $500,000. The majority of the persons interested are residents of St. Louis and it is said that Donk Bros., of St. Louis, who operate a large coal and coke company, are behind the syndicate. The principal offices of the company will be in East St. Louis. The incorporators and first board of directors are James W. Buel, E. C. Donk, Edwin H. Conrades, of St. Louis; L. H. Coleman, of Springfield; E. C. Greenleaf, of East St. Louis, and M. W. Brown, of New Berlin.

MUSCATINE, IA.—It is reported that the International Construction Company, of Detroit, has been awarded the contract for building the proposed interurban railway between Muscatine and Davenport.

KEOKUK, IA.—Articles of incorporation have been filed by the Keokuk & Western Illinois Railway Company, capitalized at $1,000. The company proposes to build an electric railway. The incorporators and first board of directors are Fred. P. Vose, of Evanston, Ill.; George E. C. Johnson, Hubert E. Page, C. C. Breurer and B. J. Jones, of Sargent & Lundy, Chicago.

DES MOINES, IA.—The Western Iowa Intercurban Railway Company has been formed to build an electric railway between Des Moines and Council Bluffs. It is capitalized for $1,000,000. A board of directors has been selected as follows: H. H. Polk, of Des Moines; Clyde Brenton, of Dallas Center; E. W. Weeks, of Guthrie Center; J. A. Nash, of Audubon; G. W. Cullison, of Harlan; J. W. Davis, of Council Bluffs.

GLASGOW, KY.—The Glasgow, Burkesville & Cumberland Valley Traction Company has been incorporated with a capital of $500,000.

MAYSVILLE, KY.—The Marysville & Mt. Olivet Traction Company has been organized to build an electric railway between Maysville and Mt. Olivet. The distance is about 25 miles. John Duley is president; E. Kenton, A. R. Howard and George W. Dye, vice-presidents; W. W. Ball, treasurer, and James W. Fitzgerald, secretary.

AUGUSTA, ME.—The name of the Berwick, Eliot & York Street Railway Company has been changed to Portsmouth, Dover & York Street Railway Company. The company has voted to increase its capital stock from $80,000 to $650,000.

CARIBOU, ME.—Articles of incorporation have been filed by a company that plans to build an electric railway from Caribou to Perham. The road will be 15 miles long, and the capital stock is $210,000. The directors are S. L. White, J. D. Emery, Corydon Power, Eugene A. Holmes, Herbert A. P. Edwards.

GUADALAJARA, MEXICO.—A project is on foot to build an electric interurban railway between this city and Lake Chapala. B. F. Hammett and Felix Martinez, of El Paso, Tex., are interested in the enterprise. Application will be made to the Mexican Government for a concession for the proposed road.

CHIHUAHUA, MEXICO.—The American syndicate which has a concession for establishing an electric street railway system here has secured an extension of its option on the existing street railway property and it is reported that the work of constructing the new system will soon begin. The electric power for operating the lines will probably be furnished by the Compania Industrial Mexicana.

DETROIT, MICH.—The Michigan Central Traction Company proposes to build a line from Battle Creek to Lansing. The road will be 57 miles long and will be built in three divisions. Contracts for construction have been placed with M. W. Burwell, of New Haven, Conn. The company is capitalized at $1,300,000 and the officers are S. Bugart, Cleveland, president; J. W. Ewing, Grand Ledge, treasurer; F. H. Goaby, New York; J. S. Mudge, Grand Ledge, and E. T. Pangborn, Battle Creek, directors.

GRAND RAPIDS, MICH.—The Grand Rapids Electric Railway Company has been incorporated under the general railroad law of the State of Michigan, with a capital stock of $2,000,000, for the purpose of building an electric railway from Grand Rapids to a point on Lake Huron hereafter to be determined. Also a branch line from Grand Rapids to the city of Lansing, the length of the entire line, including branches, being about 250 miles. The directors are J. W. Boynton, M. C. Weaver, C. J. Post and J. H. Dority, of Grand Rapids; J. C. Yarger, of Freeport.

BOZEMAN, MONT.—The Bozeman Light & Traction Company has purchased the entire plant and holdings of the Gallatin Light, Power & Railway Company and the Bozeman Street Railway Company. The new corporation intends to make important improvements in the present plant and system.

NEW PALTZ, N. Y.—The foreclosure sale of the New Paltz and Poughkeepsie Traction Company is advertised for June 27 at New Paltz.

DUNKIRK, N. Y.—The Railroad Commissioners have authorized the Dunkirk & Fredonia Railroad Company to increase its capital stock from $150,000 to $200,000 to provide for new construction.

BUFFALO, N. Y.—The Amityville & Huntington Railroad Company, of Buffalo, has been incorporated with a capital of $250,000. Directors: W. K. Putnam, A. S. Sanborn, J. S. Shearman and C. B. Smith, Brooklyn.

NEW YORK, N. Y.—The Buffalo & Batavia Construction Company has been incorporated to build an electric railway; capital, $10,000. Incorporators: Spencer Kellogg, George L. Lewis and Stuart R. Mann, all of Buffalo, N. Y.

NEW YORK, N. Y.—The Ocean Electric Railway Company of Rockaway, has applied for a franchise to build an electric railway between Rockaway and Far Rockaway. The road is to be six and a half miles long. It is understood that the Long Island Railroad is behind the company.

AMITYVILLE, N. Y.—The Amityville & Huntington Railroad Company, with principal office in Brooklyn, has been incorporated to build an electric railway over 14 miles long from Amityville to the Long Island railroad station in Huntington. The capital is $250,000, and the directors are W. K. Putnam, A. S. Sanborn, J. S. Sherman, Harry A. Hanbury, Robert A. Sharkey, Frank Jacobs, J. D. Brown, Ernest Houchin and C. B. Smith, of Brooklyn.

GLOVERSVILLE, N. Y.—The Adirondack Lakes Traction Company, a reorganization of the Mountain Lake Electric Railroad Company, has been incorporated. The new company has a capital of $60,000, and the directors are Theodore Schiess, of Brooklyn; John M. Marvin, of New Haven, Conn.; Wm. A. McDonald, James Washburn, Elman Hitts, William L. Weed, Jeremiah Wood, of Gloversville; Addison Keck, of Johnstown, and Philip D. Shaul, of Amsterdam.

WADESBORO, N. C.—The Merchants' Railway Company has been chartered to build an electric railway here. The incorporators are R. L. Hardidson, W. J. McLendon, Jr., James A. Leak, H. H. McLendon and others.

DEVIL'S LAKE, N. D.—A. B. Kerlin, of Devil's Lake, F. B. Wood, of Minneapolis, and others are to organize the Devil's Lake Rapid Transit Company, with a capital stock of $50,000, to build an electric railway from Devil's Lake to Chautauqua.

CINCINNATI, OHIO.—The Loveland & Cincinnati Traction Company has been incorporated with $50,000 capital stock, by Henry Burkholt, Wallace Burch, Franklin Bank, Wm. Munsell, Simeon Johnson and Henry Sachsleben.

DAYTON, OHIO.—The Dayton & Northern Traction Company; the Greenville & Union City Traction Company and the Union City, Winchester & Muncie Traction Company have bee nconsolidated under the name of the Dayton & Muncie Traction Company. The roads are owned by the same interests.

COLUMBUS, OHIO.—The Ohio & Indiana Street Railroad Company has been incorporated by J. D. DeWitt, Dr. Harvey Cook, L. Bohnham and others to build an air line electric road from Cincinnati to Indianapolis. The company is incorporated for $10,000, but this will be increased to $2,000,000.

CLEVELAND, OHIO.—Plans are being prepared for the erection of the power house of the Buffalo, Dunkirk & Western Railway which is being promoted by Cleveland people. It has about been decided to utilize gas for fuel. It is proposed to install large gas engines and utilize the gas direct, without the use of boilers.

CINCINNATI, OHIO.—Stockholders of the Cincinnati, Milford & Eastern Traction Company have voted to increase the capital stock from $300,000 to $1,000,000. The officers are S. B. Day, Elyria, president; G. H. Chamberlain, Elyria, vice-president; W. F. Roudebush, Cincinnati, treasurer; W. R. Medaris, Milford, secretary. The power house will be at Milford.

CLEVELAND, OHIO.—The Findlay & Southern Railway Company has changed its name to Columbus & Lake Erie Railway Company. The company was organized two years ago to build a line from Columbus to Findlay and eventually to Toledo. The Everett-Moore embarrassment tied up the project but now new capital has been interested and it is claimed the road will be built this year. R. Rosentsock, of Cleveland, is chief engineer of the project.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Traction Company, which has recently been acquired by Tucker, Anthony & Company, of Boston, has been reorganized with the following officers: Phillip Saltonstall, Boston, president; James Rutherford, Cleveland, vice-president; Chauncy Eldridge, Boston, secretary-treasurer, G. W. Rounds, Canton, General manager. It is probable that the road will be extended to Coshocton and Zanesville to complete the through Cleveland-Columbus line.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company has increased its capital stock to $1,500,000. Officers have been elected as follows: Gen. Asa W. Jones, president; W. S. Anderson, vice-president; J. H. Ruhlman, secretary-treasurer; R. L. Andrews, second vice-president and general manager. George Todd, Jr., has been appointed chief engineer and he is taking steps to locate a site for a power house and to close contracts for material required for equipping and building the road. The power plant will probably be located in the North Lima coal fields. The line will extend from Youngstown to Lisbon, North Lima and East Liverpool.

PHILADELPHIA, PA.—The City Council has passed the bill approving the merger of five elevated passenger railway companies—the Market Street, the Frankford, the Passayunk, the Ridge Avenue, and the Germantown, and the Broad Street Subway Passenger Railway Company, under the name of the Market Street Elevated Passenger Railway Company, which is to have "all of the assents and privileges heretofore granted to said several companies."

NEW INDUSTRIAL COMPANIES.

THE ELECTRIC CONVEYING MACHINERY COMPANY, of New York, has been incorporated with a capital of $5,000. Directors: J. T. Emery, S. C. Miller and R. A. Weber, of New York.

THE HANSON ELECTRICAL COMPANY, Jamestown, N. Y., composed of E. P. Bailey and James E. Hanson, has been organized to deal in all kinds of electrical supplies and carry on a general electrical construction business.

THE INDIANA AUTOMOBILE COMPANY, of Indianapolis, has filed articles of incorporation with a capital stock of $25,000. The incorporators are John B. Cockrum, S. W. Elston, W. F. Clevenger, Henry Jameson and C. L. Pepper.

THE STANDARD ENGINEERING COMPANY, capital stock, $50,000, has been incorporated at Cleveland, Ohio, by F. A. Little, G. L. Wells, A. G. Wells, W. C. Sheppard and Stanley Shaffer. The company will do civil engineering and will build electric railways.

OBITUARY.

MR. PAUL WERNER, an inventor, died at his home, Hoboken, on Sunday last. He devised the noiseless cable wheel which was used when the North Hudson County Railway operated its elevated road between Hoboken and Jersey City Heights, by cable. He also patented a number of machines used in the making of lead pencils. His death was caused by brain fever, said to be due to overwork on an electric motor which he had been trying to perfect for more than a year.

PERSONAL.

J. J. CARTY.

MR. J. J. CARTY, who was elected to the presidency of the New York Electrical Society last week, is the fifteenth president of this, the oldest electrical organization of the kind in the country. A biographical sketch of Mr. Carty was given in these pages in the issue of April 5, 1902. He was born April 14, 1861, at Cambridge, Mass., and after his school studies and preparatory work for college, entered the telephone service, so that to-day he has had nearly a quarter of a century of active telephonic experience, making him one of the oldest and most prominent engineers connected with the Bell telephone system. He has not only been a designing and construction engineer to whom may be given the credit of a great deal of the improvement in American exchange practice since he entered the service of the New York telephone interests in 1889, but he has also to his credit several well-known inventions and improvements in connection with telephonic apparatus. Some of these inventions are acknowledged to be fundamental in their character; such, for example, as the Carty bridging bell, which in its way, is as well known as the Edison incandescent lamp or the Sprague electric railway system. Over Mr. Carty's patents some of the fiercest electrical litigations of the last ten years have been fought, attesting to their importance and value in the art. Mr. Carty has not only been a member of the New York Electrical Society for several years and an active contributor to its transactions, but has also been prominent and zealous in the work of the American Institute of Electrical Engineers, of whose board of management he is now the senior member, besides being on several important committees. Mr. Carty is also an active member of the American Electrotherapeutic Society, and a member of the Society of Arts. He is a man of broad culture and liberal tastes, and it is not out of place to mention that by marriage he is connected with one of the foremost theatrical families in this country, being a brother-in-law of Miss Annie Russell, the distinguished actress, and of Mr. T. Russell, the original creator of the part of Little Lord Fauntleroy. The New York Electrical Society has enjoyed remarkable prosperity during the past few years, and there is every reason to be confident that its work will be developed and advanced under the progressive administration of its new president.

MR. GEORGE WESTINGHOUSE is listed to sail for England this week on the American liner *New York*.

MR. E. W. RICE, JR., vice-president General Electric Company, has been made a trustee of Union College, Schenectady.

MR. C. A. COFFIN, president of the General Electric Company, returned from Europe last Sunday by the White Star liner *Cedric*.

MR. NORMAN E. LEAVEY, of the Minneapolis General Electric Company was a recent visitor to Boston on a business trip east.

DEAN V. C. ALDERSON, of the Armour Institute of Technology, has accepted the presidency of the Colorado School of Mines.

MR. C. P. STEINMETZ has been made a doctor by Union College, Schenectady, in recognition of his great work in electrical engineering.

MR. CORNELIUS VANDERBILT has been elected a director of the Mexican Telegraph Company in place of the late George G. Williams.

MR. ARTHUR L. COOK, assistant in electrical engineering at the Worcester Polytechnic Institute, has accepted a position with Westinghouse, Church, Kerr & Co., of New York City.

PROF. ALBERT KINGSBURY, of the Department of Mechanical Engineering, Worcester Polytechnic Institute, has resigned to accept a position with the Westinghouse interests in Pittsburg.

MR. CLARENCE A. CHANDLER, superintendent of the Washburn shops of the Worcester Polytechnic Institute, has resigned, and will probably devote himself to the manufacture of machinery.

MR. GEORGE R. MACNAMARA, formerly with the Babcock & Wilcox Boiler Company, at Bayonne, N. J., has joined the engineering force of the B. F. Sturtevant Company, Jamaica Plain, Mass.

MR. JOHN B. PARSONS, president of the Philadelphia Rapid Transit Company, is about to start on a European trip during which he will study traction practice in England and on the Continent.

MR. RALPH D. MERSHON, consulting electrical engineer, has returned recently from Europe and will be on hand at the Niagara Institute meeting to present his paper on grounded wires.

MR. CHARLES RUFUS HARTE, of the engineering department of Stone & Webster, Boston, has returned from a protracted stay in Indiana, in connection with the Clinton extension of the Terre Haute Electric Company.

MR. CALVIN W. RICE, vice-president of the Nernst Lamp Company, is sailing for Europe on a pleasure trip, which is greatly needed after his strenuous work of the past year of two. While abroad, he will look into lighting developments in his own field.

MR. FRED F. SPRAGUE, son of president A. B. R. Sprague, of the Worcester Electric Light Company, and the Worcester & Holden Street Railway Company, has been appointed assistant to the local supervisor of wires, with office in the Worcester City Hall.

MR. WESLEY STEELE, M. E., formerly with the Perth Amboy Terra Cotta Company, at the Perth Amboy Works, has taken a position in the sales department of the A. D. Granger Co., contracting engineers, at the New York office, No. 95 Liberty Street, New York City.

MR. I. L. STOREY, the well-known designer of electric motors, mining apparatus, etc., has become actively identified with the Magneto Electric Company, Inc., of Amsterdam, as its electrical engineer, etc., and is proceeding energetically to develop various lines of its product.

MR. C. F. KENT, who has been well known in Bell and independent telephone circles, and is now associated with Mr. LeRoy W. Stanton, is just completing the work on the cable distribution, etc., for the addition to the plant of the Cambridge Telephone Company, of Cambridge, Ohio.

MR. E. W. TRAFFORD has resigned his position as general superintendent of the Virginia Passenger & Power Company, at Richmond, Va., to engage in consulting engineering work. Mr. Trafford has had the supervision of nearly all the electric lighting and power interests in Richmond for more than fourteen years. He is a member of the Institute.

COLUMBIA GRADUATES.—The following students have graduated in electrical engineering at Columbia University: John Winfrid Ager, Malcolm Curry, Lester F. Dittenhoefer, John Pelham Faber, Eugene Frank, Louis George Henes, Henry E. Jacoby, William D. Kayser, Leo Joseph Matty, Leclanche Moën, Charles Miles Pond, Julian C. Smallwood, Walter J. Spiro, William M. Van Cise, William E Ver Planck, Francis P. Walsh.

MR. W. S. BARSTOW, consulting electrical engineer, of New York City, has left on an extended trip through the West, his destination being Portland, Ore., where he is engaged in work for the Portland General Electric Company. He has just completed a large power plant and electric drive for the Hartford Carpet Corporation, Thompsonville, Conn., and work upon the power plant for the A. B. See Electric Elevator Company has been commenced.

MR. F. A. FOCKE, engineer for the Federal Telephone Company, Cleveland, has resigned his position there and joined the staff of Mr. LeRoy W. Stanton, the consulting and constructing telephone engineer, who has on hand now a number of contracts for building, rebuilding and equipping several exchanges. Mr. Focke's technical ability and practical experience in telephone engineering make him a valuable addition to the Stanton forces, especially for multiple cable construction and distribution.

MR. CLARENCE P. FOWLER, who, for the past two years has been connected with the New York construction office of the Westinghouse Electric & Mfg. Company, has been transferred to Baltimore, where the Westinghouse Company have several large contracts on hand, perhaps the most notable of which are the complete equipment of the Baltimore Street Railway with a high tension three-phase generating station fed through rotary sub-stations, and the installation of the single-phase railway from Baltimore to Washington.

COL. E. J. SPENCER.—The *World's Fair Bulletin*, of St. Louis, says: "The great civic parade on May 2, in which 20,000 persons participated, was in every way worthy of the occasion, and of the great municipality of St. Louis. It was viewed by her own people with just pride, and by all visitors with wondering admiration. In connection with her annual fair and exposition, the city has long been famous for civic pageants, but, thanks to the organizing talents of Col. E. J. Spencer, this was her most brilliant and gratifying success in that line."

MR. BARTH VON WEHRENALP, chief architect of the government, Austrian Ministry of Commerce, and technical manager of the telegraph and telephone department of the Empire of Austria, and Mr. G. Hubert Dietl, engineer, are now visiting this country, and will spend some time here in the inspection of electrical improvements and inventions, particularly with relation to the telegraph and telephone. They hope to attend the Independent Telephone meeting in Chicago and also to participate in the Institute meeting at Niagara. If possible they will go as far west as San Francisco.

MR. WILLIAM BURLINGHAM has accepted an appointment as chief engine designer with the B. F. Sturtevant Company, of Hyde Park, Mass., resigning a position in the United States Inspection office with the Wm. R. Trigg Company, of Richmond, Va. Mr. Burlingham has previously been associated with the Bath Iron Works, the General Electric Company, the Southwark Machine & Foundry Company, and the Newport News Ship Building & Dry Dock Company. He has also served on Mr. T. A. Edison's staff at the East Orange laboratory and is a graduate of the Worcester Polytechnic Institute.

COL. R. C. CLOWRY.—A rumor was current in Wall Street last week that Colonel Robert C. Clowry, the president of the Western Union Telegraph Company, will retire in favor of Charles A. Tinker, of Brooklyn, who, until several months ago, was general superintendent of the company. The report could not be confirmed, the officials of the company refusing to discuss it. Colonel Clowry has been president of the Western Union for one year, having succeeded General Eckert. Before he became the head of the corporation he was vice-president and general manager. He has moved from Chicago and has lately bought a fine residence in New York City.

PROF. A. G. COMPTON.—Five hundred members of the Associated Alumni of the College of the City of New York gave a dinner this week to the acting president of the college, Alfred G. Compton, at the Arion Society's rooms. The dinner commemorated his fifty years of service in the college faculty, which he entered in 1853, directly from the first class graduated there. He became professor of applied mathematics in 1869, and last December was selected to act as president until the inauguration on Oct. 1 of this year of John H. Finley as head of the institution. Prof. Compton is well known in the electrical field, and has been an officer of the American Institute of Electrical Engineers.

MR. S. M. HAMILL, of the General Electric, Brush and other companies, has lost his mother, Mrs. Matilda M. Hamill, the widow of the Rev. Dr. Samuel M. Hamill, for fifty years the head of the famous school at Lawrenceville, N. J. She was in her eighty-sixth year. She was a direct descendant of Jonathan Dickinson, the first president of Princeton, and for one hundred and fifty years her family have been closely connected with the educational interests of the country. Another son is Mr. Hugh H. Hamill, the president of the Trenton Trust & Safe Deposit Company, and a director of the new Public Service Corporation operating extensive railway and lighting systems in New Jersey.

MESSRS. ISAAC BAUM, of Uniontown, Pa., and Florence James Schwab, of New Orleans, La., seniors in the department of electrical engineering in Cornell University, have for a year been investigating the subject of refining copper at a reduced cost, and have, as reported, written a thesis on this subject and submitted it to Prof. W. D. Bancroft, of the department of chemistry. Mr. Baum says: "We believe that we have discovered a chemical process whereby copper may be refined at a reduced cost. However, we refuse to give anything out regarding the process until we have again gone over the whole situation with Prof. Bancroft, and hereafter anything which comes out will be through him." Prof. Robert H. Thurston, director of the department of mechanical engineering, speaks well of Mr. Baum and Mr. Schwab as students.

MR. CYRUS FIELD JUDSON, who is a grandson of the late Cyrus W. Field, and who resigned as a director of the International Power Company in May, 1902, after a manipulation he undertook of the company's stock had collapsed in a sensational fashion, has been examined in supplementary proceedings under a judgment for $3,195 on a note held by stock brokers. Justice Truax has appointed John T. Little receiver in the proceeding. Mr. Judson began in the real estate business in 1889, but he has been principally active as a promoter. A few years ago he was president of the General Carriage (Automobile) Company, which became financially embarrassed. He is a director of the International Power Company and of the Ardsley Casino Company.

GENERAL A. W. GREELY, head of the United States Signal Service Corps, who went to England in connection with the international telegraph conference has returned. Speaking of the international vocabulary proposition put forward he said that it would mean the complete revising of all American cable codes, and every other cable code as well, which would mean a waste of a great deal of time, as well as of money. One thing which the General thought was of great benefit was a rule that in future groups of five letters may be counted as one word; for instance, formerly "U. S. A." would count as three words, now it will count as one. Gen. Greely announced that on Aug. 4 a conference of men interested in wireless telegraphy would be held in Berlin. The invitation to the conference was supposed to be general, the chief of the signal bureau said.

MR. H. H. VREELAND.—In response to an invitation received from the Royal Commission on London Traffic, H. H. Vreeland, president of the Interurban Street Railway Company, will early in July proceed to England for the purpose of appearing before the commission as an expert in street railway matters. Mr. Vreeland will advise the commission on means to overcome traffic congestion. He will also visit the Continent, combining business and pleasure in an investigation of the Old World railway systems. During his absence Frank Gannon, vice-president, will assume charge of the construction work in New York. It was for that purpose that Mr. Gannon recently became attached to Mr. Vreeland's staff. Mr. Vreeland has not been off the property thirty days at a time since he took charge eleven years ago. The invitation from the Royal Commission was received several weeks ago. The Commission was suggested to King Edward by the difficulty encountered in improving transportation.

MR. PERCEVAL E. FANSLER, chief clerk of the department of electrical exhibits, etc., of the Louisiana Purchase Exposition, received the degree of electrical engineer from the Purdue University on June 11, after passing an oral examination over long-distance telephone. Mr. Fansler was graduated from a school of electrical engineering in 1901, and spent a year in a post graduate course of Purdue, making a special study of the electrical traction problem. A comprehensive test of the system of the Union Traction Company of Indiana was taken by Mr. Fansler as a thesis, and upon its acceptance the faculty ordered Mr. Fansler to report for examination. The examination was set for Monday, June 8, but the St. Louis flood made it impossible for Mr. Fansler to get to Lafayette, Ind., and he obtained permission to take the examination by telephone. Accordingly, the four examiners—Prof. W. F. Goldsborough, C. P. Mathews, W. D. Pence, and J. W. Esterline—were connected with the long-distance telephone at the same time, and for hours Mr. Fansler was plied with questions. On the recommendation of the examiners a degree was awarded to Mr. Fansler by the president and faculty.

EDUCATIONAL.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Contracts have been signed in Boston for the erection of a new building for the Massachusetts Institute of Technology. The structure has been planned to accommodate the departments of naval architecture, mineralogy and chemical research, and will be known as "Engineering Building C." It will be erected at the corner of Stanhope Street and Trinity Place, opposite the Trinity Place station of the Boston and Albany Railroad. It is intended that the building shall be ready for occupancy in the fall, and it will be an indirect aid to the resources of the United States Naval Academy at Annapolis, because of the Government practice in sending cadets to Boston for instruction in naval architecture at the Massachusetts Institute of Technology. Frank B. Gilbreth will erect the building.

Trade Notes.

MR. WM. ROCHE, 42 Vesey St., New York, manufacturer of the New Standard dry battery, reports his business as better than ever before in its history. He has just closed contracts for over a million and a half dry cells.

MR. C. J. HARRINGTON, 15 Cortlandt St., New York, manufacturer of the well-known Empire overhead railway material is sending out to the trade a handsome little souvenir in the shape of a manicure nail file inclosed in a neat leather case.

COMMERCIAL AUTO CONTEST.—In the recent commercial vehicle test of the Automobile Club of America, the International Motor Car Company, of Toledo, has been awarded a bronze medal for its Waverly electric delivery wagon, third class, to carry 3,500 pounds.

THE INTERNATIONAL TELEPHONE MFG. CO., Chicago, is reporting a heavy demand for its portable desk telephone with the "figure 8" switch restoring spring. It is said that this instrument is provided with one of the most scientifically designed, strong, durable and positive sliding contact switches ever invented.

THE NARRAGANSETT MACHINE COMPANY, Providence, R. I., has just issued a catalogue of hand screws, clamps, mallets and handles. All manufacturing concerns use most of these articles, and the Narragansett Company make a complete line of goods of this character. Price lists and illustrations of the goods are also given.

CORRESPONDENCE INSTRUCTION.—The U. S. Government has adopted the instruction papers of the American School for Correspondence in steam and electrical engineering for text books in the School of Submarine Defense, at Fort Totten, N. Y. The instruction paper on storage batteries is used as a text book by the seniors at Columbia University, New York.

REMOVAL.—The Commercial Electric Company, Indianapolis, Ind., has removed its main offices and factory to new and commodious quarters at West Twenty-first Street and Northwestern Ave., that city. The company now possesses an excellent manufacturing plant and equipment, and the best of facilities for producing its line of direct current motors and dynamos.

THE A. & W. ELECTRIC SIGN COMPANY, of Cleveland, Ohio, has opened a new factory at the corner of Champlain and Michigan Streets that city, and the offices have been removed from the Garfield Building to the new location. The company is rapidly acquiring an enviable reputation for the manufacture of electric signs and is shipping some very large outfits to all portions of the country.

THE ELLIOTT ELECTRIC BLUE PRINT COMPANY, Pittsburg, Pa., has just issued a very complete catalogue of drawing materials and surveying instruments. The catalogue is profusely illustrated, and includes views of the blue printing apparatus which is a specialty of this company. It enables the production of blue prints by electric light, thus rendering this work independent of natural light, which is not always satisfactory for printing purposes.

THE VICTOR ELECTRICAL COMPANY, of Cleveland, Ohio, has established itself in a new factory at the corner of Mason Street and the Pennsylvania Railway. The company does electrical repair work of all kinds and deals in second-hand electrical material of every description. Under the title of the "Magnet" the company publishes a monthly circular of bargains and sample copies will be sent to anyone in need of second-hand electrical equipment.

THE SHEPHERD ENGINEERING COMPANY, manufacturer of the well-known line of Shepherd steam engines, will after July 1, have its general offices and works at Franklin, Pa., where it bas secured for the manufacture of its product the large and modern plant constructed a few years ago by the Grant Tool Company. This plant will enable the Shepherd Engineering Company to take care of its greatly increased business, and to make prompt deliveries on future work.

THE SOURCE OF ELECTRIC LIGHT.—Under this title the Crocker-Wheeler Company, Ampere, N. J., has issued a very handsome booklet of sixteen pages. Each page is headed by an illustration of a Crocker-Wheeler generator of a particular type, many of the views showing actual installations. The text, which is in large, clear type, sets forth briefly the requirements for the steady and reliable production of current and the elements contributing to this result. The various types of machines manufactured by the company are referred to in connection with the different illustrations, some of the principal features of construction in each case being pointed out.

THE CONSOLIDATED "AXLE LIGHT" equipments of electric car lighting are steadily coming into general use on the finest cars constituting the best and fastest trains of leading railway lines, including the Pullman cars on all these trains. All private Pullman cars and nearly all the business cars of railway officials, as well as private cars of individuals, are equipped with the Consolidated "Axle Light" system. These equipments are also beginning to be used quite extensively on the railway systems of Great Britain and Europe, and are a great boon to the traveler, wherever encountered.

LUNDELL FANS.—The Sprague Electric Company, New York, has issued a catalogue (No. 306) of its 1903 Lundell fans. Desk fans and bracket fans of many styles and ceiling and exhaust fans are well illustrated and briefly described. At the back part of the pamphlet are given a price list of parts, telegraph code, code word index, etc. The frontispiece consists of a view of "The Real North Pole." On the spot which has been the goal of all arctic expeditions stands a Lundell desk fan in the midst of frigid surroundings, and resplendent with the rays of the aurora borealis.

GORDON CELLS.—The Gordon Battery Company, New York, will have an exhibit of its cells at the independent telephone convention in Chicago next week, and all those in attendance at the convention are cordially invited to call and examine it. The company states its cells are particularly well adapted for central energy, switchboard and other telephone uses, as certified to by the well satisfied telephone companies and manufacturers who are using them. The company has a Chicago office at 358 Dearborn Street in charge of Mr. E. M. Deems and is represented by the Wrenn Commercial Company, Ltd., 515 Mission St., San Francisco, as sole agent for the Pacific Coast. Any information desired will be cheerfully furnished by the agents and home office.

THE CALCULAGRAPH.—The Calculagraph Company, 9 Maiden Lane, New York, has just issued a handsome pamphlet describing and illustrating the varied uses of the calculagraph. This instrument, as is now well-known, prints upon a card the time elapsed from the beginning to the end of any event. It is especially valuable for calculating the time and labor expended in producing any article, machine, etc., and therefore finds a large field in manufacturing establishments where a record of the exact cost of production is desirable. It is also very extensively used by telephone companies for timing conversations held over toll lines, where the charge for service is based on the length of time a circuit is used. The pamphlet is very attractively illustrated and its contents cannot fail to interest the business man.

L. B. ALLEN CO., INC., Chicago, the originator, patentee and sole maker of Allen electrical compounds—which include the well-known Allen soldering stick, Allen soldering paste, Allen's soldering salts and Allen commutator lubricant—writes that business in all branches is on the increase. In the Allen soldering stick business alone, for the past four months the actual shipments of this one handy article were almost as great as for the same period of the two previous years put together. L. B. Allen Co. is constantly carrying on a series of exhaustive experiments for the improvement of its products, in an earnest endeavor to "make good" its motto: "Prae ad Supremum" (Forward to the Highest). Indications are that its present plant, newly erected less than a year and a half ago, will have to be doubled in size within a short time.

AIR COMPRESSORS.—The American Air Compressor Works, Havemeyer Building, New York, have just brought out a 54-page catalogue in which are illustrated and described the many types of the American air compressors, air receivers, vacuum pumps, carbonic acid gas and high pressure compressors, and the American air lift pumping system. The catalogue also contains information relative to pneumatic tools and a table showing the flow of air through various size orifices. The American Air Compressor Works have their own foundry, both brass and iron, pattern and blacksmith shops, and their machine shop is equipped with the very latest and most improved tools. Their claim is simplicity, durability, efficiency and economy all embodied in a machine designed for maximum strength with minimum weight. The catalogue is the standard 6x9 and is used for gratuitous distribution upon application.

ALCOHOL AS FUEL FOR INTERNAL COMBUSTION ENGINES.—Tests made by Mr. C. W. Weiss at the Mietz & Weiss engine works, 128-138 Mott Street, New York City, with Cuban and Brazilian cheap alcohol as fuel in their standard kerosene engine, have been reported as entirely satisfactory. The object was to substitute alcohol for kerosene; the former being considerably cheaper and more readily obtainable in Cuba and South America, where many of these engines are being exported. It was found that a mixture of four pints of alcohol and two pints of water developed 4-hp for one hour. The mixture of alcohol varies, however, with the quality of the former, being limited by the practical degree of compression prior to combustion. The specific gravity of the mixture is .9; the pure alcohol was .794. The development of the alcohol engine is of the greatest importance to the power question of Cuba, Brazil and the Philippine Islands.

TELEPHONE EQUIPMENT.—The E. G. Bernard Company, Troy, N. Y., has recently moved into its new and modern factory and announces in a catalogue of telephones and telephone equipment—just issued—that it aims to produce the finest telephone apparatus in the world, and that its new factory is one of the largest and best equipped of any independent telephone manufacturing concern. The company manufactures every detail part from the raw material directly under its own supervision, thus enabling it to produce instruments of the highest quality. The catalogue, which has 68 pages, is well illustrated with the company's standard types of apparatus and details, all of which illustrations are accompanied by a brief description of the devices concerned. The contents show telephones of all kinds, including battery magnets, wall sets of a large variety, central energy sets, portable sets, instruments in weather-proof boxes for out-of-door uses, intercommunicating sets, desk sets, and a complete line of switchboards.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., has established a maintenance bureau for the purpose of supplying users of Nernst lamps with new burners or holders, so it will not be necessary for the customer to visit or call upon the electric light stations when one of his lamps gives out. The maintenance bureau makes a contract to supply to its customers a certain number of extra holders which are kept in a box especially made for this purpose. He simply takes one of these extra holders and replaces the old one with it, returning the old holder to the box, which is called for by a messenger attached to the bureau. This messenger takes the burned out holders to the bureau, and they are refilled and returned to the customr. The taking out and putting in of these holders is as easily accomplished as the changing of incandescent lamps. By this method, the users of Nernst lamps are not put to the inconvenience of notifying the electric light company when the lamp gives out; thus avoiding the necessary delay in having their lamps renewed.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 9, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

730,236. REPEATING BREAK FOR ELECTRIC CIRCUITS; Leo Daft, Ealing and Alfred Williams, Wimbledon, England. App. filed Nov. 3, 1902. (See Current News and Notes.)

730,246. SPACE TELEGRAPHY; Lee De Forest, New Haven, Conn. App. filed March 8, 1902. (See Current News and Notes.)

730,247. WIRELESS TELEGRAPHY; Lee De Forest, New Haven, Conn. App. filed Nov. 4, 1902. (See Current News and Notes.)

730,251. ELECTRIC MOTOR CAR AND SYSTEM OF MOUNTING AND WIRING ELECTRICAL APPARATUS THEREON; George Gibbs, New York, N. Y. App. filed Dec. 1, 1902. The wiring of the car is inclosed in a suitable insulating tubes which are supported at some distance below the floor of the car and out of contact with inflammable parts.

730,252. ELECTRIC COOKER; Edward E. Gold, New York, N. Y. App. filed July 16, 1896. (See Current News and Notes.)

730,262. ELECTRIC METER; Eugen Hartmann, Frankfort-on-the-Main, Germany. App. filed Feb. 24, 1902. Details.

730,293. RECEPTACLE FOR INCANDESCENT LAMPS; Henry T. Paiste, Philadelphia, Pa. App. filed Jan. 23, 1902.

730,302. CLOCK; William S. Scales, Boston, Mass. App. filed Feb. 1, 1902. A winding mechanism common to both the time and strike mechanism and means for automatically winding the same.

730,312. RAILWAY; Edward Stiles, New York, N. Y. App. filed Sept. 29, 1902. A pivoted lip normally closes the slot in a conduit formed beside the rail; the flange of the car wheel moves the lip one side and at the same time makes contact with a conductor terminal carried by the lip.

730,334. CONTROLLER APPARATUS; Patrick S. Barrett and John P. Durkin, Scranton, Pa. App. filed Aug. 21, 1902. Details of construction for controlling the movement of the controller handle.

730,341. SYSTEM OF MOTOR CONTROL; Frank E. Case, Schenectady, N. Y. App. filed Feb. 12, 1900. The master controller controls the circuit of a storage battery system in order to charge the battery at times, and utilize the battery current at other times for operating the motor controllers.

730,342. SYSTEM OF MOTOR CONTROL; Frank E. Case, Schenectady, N. Y. App. filed April 24, 1902. This invention permits the motor circuit to be opened at the controller contacts on any car upon which an excessive flow of current flow occurs, without affecting the circuit connections on other cars of the train; it at the same time permits the motor circuit to be again closed as soon as the master controller has been moved to a position where a protecting resistance will be included in the motor circuit.

730,343. ALTERNATING-CURRENT MOTOR; Alexander J. Churchward, Brooklyn, N. Y. App. filed March 29, 1897. (See Current News and Notes.)

730,346. ELECTRICALLY CONTROLLED LOCK; James Corbett, Toronto, Canada. App. filed Nov. 27, 1901. Details.

730,369. ELECTRIC ARC LAMP; Charles E. Harthan, Lynn, Mass. App. filed Feb. 9, 1901. A compensating winding is used on the shunt coils and the rocker which connects the armatures of the series and shunt magnets is made in two separate, overlapping, independently pivoted parts, connected so as to move simultaneously.

[illegible] REVERSE CURRENT RELAY, Edward M. Hewlett, Schenectady, N. Y. App. filed Feb. 3, 1901. The movable element of the device is mounted in such a position with relation to the field magnet, that it is in a condition of maximum torque, but movement in one direction is resisted by a fixed stop against which it is held until a reversal of current occurs, upon which a quick movement is made by reason of the magnetic relation described.

[illegible] CONTROLLING ELECTRIC MOTORS, James W. Kellogg, Schenectady, N. Y. App. filed Nov. 28, 1902. The circuit is automatically broken outside of the rheostat if the starting switch is left in any other than the running position.

730,370. CIRCUIT CONTROLLER FOR SURGICO DENTAL ENGINES, Joseph S. Letord, William W. Alexander and Henri Letord, Kansas City, Mo. App. filed July 7, 1902. Details of construction.

[illegible] POWER FACTOR INDICATOR, William H. Pratt, Lynn, Mass. App. filed March 26, 1903. The instrument is constructed so that the reading will within limits be independent of frequency.

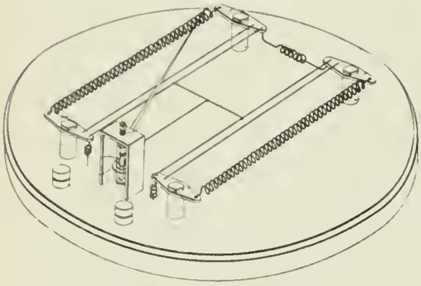
730,401. MECHANICAL VENTILATION OF ELECTRIC MACHINES, Auguste Camille Edmond Rateau, Paris, France. App. filed June 28, 1902. (See Current News and Notes.)

730,403. BOND FOR RAILWAY RAILS, John Risberger, Northeast, Pa. App. filed Oct. 17, 1902. The studs to which the ends of the flexible bond are secured, have flaring arms which prevent short bends of the bond.

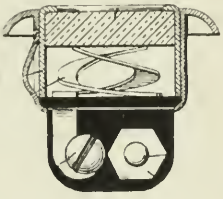
730,405. HOT WIRE INSTRUMENT, Maurice C. Rypinski, Schenectady, N. Y. App. filed March 31, 1902. A hot wire electrical measuring instrument comprising a stretched wire adapted to carry current, an elastic abutment to maintain it under tension, an indicator to determine its amount of sag, and a compensating wire connected to the abutment and disconnected from the circuit.

730,420. WATCHMAN'S CLOCK; Albert E. Waggoner, Grand Rapids, Mich. App. filed Aug. 13, 1902. Details.

730,422. ELECTRIC PROTECTIVE SYSTEM; Joseph Weatherby, Jr., Philadelphia, Pa. App. filed Aug. 11, 1902. Details.



730,405.—Hot Wire Instrument.



730,567.—Electric Push Button.

730,523. MEANS FOR PREVENTING ARCING IN DIRECT CURRENT MOTORS OR GENERATORS; Herbert H. Dow, Midland, Mich. App. filed Jan. 2, 1903. Two brushes bearing upon contiguous segments of the commutator are short-circuited through a polarizing battery.

730,545. ELECTRIC FOOT ARCH SUPPORTER; Frank B. Lee, Buffalo, N. Y. App. filed Dec. 30, 1902. Details.

730,567. ELECTRIC PUSH BUTTON; August W. Plassmann, New York, N. Y. App. filed Jan. 29, 1902. A flush push button in which the contacts are in the form of two spiral springs, the turns of which alternate with each other so that by compressing the two springs, their turns will be brought into elongated contact; the invention also includes details of construction affording a simple and cheap form of this class of button.

730,573. CEILING SWITCH; Howard R. Sargent, Schenectady, N. Y. App. filed Sept. 20, 1901. By pulling on the cord the switch blade is closed and by giving a sharp jerk the blade is released and opened.

730,576. ELECTRIC ALARM SYSTEM; Solomon Schwarzchild, Rochester, N. Y. App. filed July 25, 1902. Details.

730,582. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; Charles P. Steinmetz, Schenectady, N. Y. App. filed Aug. 16, 1899. (See Current News and Notes.)

730,594 INCLOSED FUSE FOR ELECTRIC CIRCUITS; Willard S. Atkinson, New Brunswick, N. J. App. filed Feb. 10, 1902. The fuse is contained in a transparent case and surrounded by material adapted to disrupt the arc and to present a different appearance after the arc is blown to serve as an indicator of the fact.

730,595. GROUND DETECTOR; Charles C. Badeau, Schenectady, N. Y. App. filed July 26, 1901. A ground detector having a spark gap of greater dielectric resistance between the line terminals than to ground and means for cutting on and off the ground.

730,601. LIGHTNING-ARRESTER; Louis Bell, Newton Center, Mass. App. filed April 5, 1900. (See Current News and Notes.)

730,613. METER; Frank P. Cox, Lynn, Mass. App. filed Feb. 24, 1903. (See Current News and Notes.)

730,621. MAGNETIC CLUTCH; Arthur C. Eastwood, Cleveland, Ohio. App. filed April 2, 1903. Brass shoes are interposed between the faces of the clutch to prevent sticking by residual magnetism.

730,629. CONSTANT CURRENT ROTARY CONVERTER, Richard Fleming, Swampscott, Mass. App. filed Nov. 12, 1900. The armature of a dynamo electric machine is supplied with a constant potential alternating current and a consumption circuit is supplied with a constant direct current derived from said armature.

730,644 RHEOSTAT, Charles E. Harthan, Lynn, Mass. App. filed April 21, 1902. A rheostat comprising spider heads and a central standard around which blocks of insulating material are grouped, the resistance wire being wound upon the blocks.

730,652 PHASE INDICATOR; Otto Holz, Schenectady, N. Y. App. filed Oct. 27, 1902. (See Current News and Notes.)

730,667. CONTROLLER FOR ELECTRIC MOTORS, John B. Linn, Schenectady, N. Y. App. filed Dec. 28, 1900. An attachment fitting on top of a standard controller and comprising connected mechanism to engage with the shaft of the contact cylinder and reversing switch to thereby enable both to be actuated by one handle.

730,673 METHOD OF GENERATING ALTERNATING CURRENTS, Alexander D. Lunt, Schenectady, N. Y. App. filed Aug. 25, 1899. A rotary magnetic field is derived from a single phase magneto motive force and a conductor is rotated in said magnetic field at a definite speed.

730,696. ELECTRICAL ROSETTE CUT OUT; Clarence D. Platt, Bridgeport, Conn. App. filed March 4, 1903. Details.

730,698. ELECTRICAL MEASURING INSTRUMENT; William H. Pratt, Lynn, Mass. App. filed Sept. 10, 1902. An electrical measuring instrument having a magnetic return-piece for its movable element, provided with a plurality of pairs of poles forming an astatic system, all polarized by a single core.

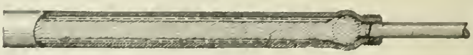
730,704. CIRCUIT BREAKER FOR ELECTRIC CIRCUITS; Robert H. Read, Schenectady, N. Y. App. filed Feb. 24, 1902. The preliminary motion of the handle draws the arc and creates a pressure of fluid which thereafter serves to extinguish the arc.

730,733. SIGNAL DEVICE FOR DRIP PANS; Victor Ayotte, Jr., Providence, R. I. App. filed March 4, 1903. A circuit closer operated by a float.

730,746. ART OF MAKING STEEL DIRECT FROM IRON ORE; Michael R. Conley, Brooklyn, N. Y. App. filed Jan. 27, 1902. (See page 1058.)

730,753. SIGNALING BY ELECTROMAGNETIC WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed April 9, 1903. (See Current News and Notes.)

730,768. INCANDESCENT LAMP; Christian Hoelscher, Warren, Ohio. App. filed April 2, 1902. Details.



730,847.—Flexible Electrical Conductor.

730,785. APPARATUS FOR RADIOTHERAPEUTIC TREATMENT; Eugen K. Muller, Zurich, Switzerland. App. filed Jan. 10, 1902. The patient is subjected to the action of an undulating magnetic field, the radiations of which are said to possess curative properties.

730,805. INSULATOR; William G. Stroh, Hume, Ill. App. filed March 7, 1903. A curved and undercut slot in the top of a porcelain knob.

730,810. SWITCH ESPECIALLY ADAPTED FOR THIRD RAILS FOR ELECTRIC RAILWAYS; William A. P. Willard, Jr., New York, N. Y. App. filed Nov. 11, 1901. Details.

730,819. WIRELESS SIGNALING; Lee De Forest, New Haven, Conn. App. filed March 8, 1902. (See Current News and Notes.)

730,828. SYSTEM OF PHASE TRANSFORMATION; Frank H. Jeannin, Schenectady, N. Y. App. filed Oct. 20, 1902. A combination of three-phase mains, a winding having two points intermediate its ends connected to two of said mains and means for impressing quarter-phased electromotive forces between the third main and the end sof the winding.

730,833. GALVANIC BATTERY; John R. Lord, Tottenville, N. Y. App. filed Feb. 20, 1903. The exhausted electrolyte is heated for a time sufficient to evaporate the liquid and convert the salts contained therein to an active form.

730,840. MAGNETIC SUSPENSION DEVICE; William H. Pratt, Lynn, Mass. App. filed Oct. 10, 1902. (See Current News and Notes.)

730,844. ARC LAMP HANGER; Charles H. Schultz, St. Joseph, Mo. App. filed June 9, 1902. Details.

730,845. COMPOSITE TUBE; Robert W. Taylor, West Hoboken, N. J. App. filed Aug. 1, 1902. A plurality of spiral wound paper tapes, one inclosed by the other with adjacent convolutions overlapping and mica interposed between the layers.

730,847. FLEXIBLE ELECTRICAL CONDUCTOR; Lincoln Van Gilder and Edward M. Post, Philadelphia, Pa. App. filed Nov. 8, 1902. An insulating tube containing a stranded conductor surrounded by a mercury conductor.

730,854. ELECTRIC SIGN; Harry B. Wren, Wasbington, D. C. App. filed June 7, 1902. (See Current News and Notes.)

12,117. ELECTRODEPOSITED LEAD; Anson Gardner Betts, Lansingburg, N. Y. App. filed Nov. 11, 1902. (See Current News and Notes.)

Electrical World and Engineer

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CONTENTS.

Editorial 1085
The Union Engineering Building 1088
Institute Meeting 1088
Atlantic Wireless Messages 1088
Electric Power from the Hudson. By Alton D. Adams 1089
A Note on Three-Phase Power Measurement. By F. A. Fish 1091
Telephone Exchanges—V. By Arthur V. Abbott, C. E. 1093
Analysis of the Detroit Municipal Lighting Figures 1094
Beauty of Niagara and its Power 1098
Municipal Lighting at Cleveland, O. 1099
New Telephone Patents 1099
Electrical Engineering Instruction at Columbia University, New York, By George F. Sever 1100
Magnetic Increase of Traction 1102
Multiphase Arc Lamp 1102
Data on Siloxicon. By E. G. Acheson 1103
Current News and Notes 1103
LETTER TO THE EDITORS:
  Storage Batteries with Pottery Diaphragms. By George E. Hatch 1105
Digest of Current Electrical Literature 1106
Turret Form of Train Controller 1110
A Large Electric Mining Plant 1111
One Type of Westinghouse Induction Motor 1111
Automobile Chairs at the St. Louis World's Fair 1111
DEPARTMENTS:
  Financial Intelligence 1112
  Commercial Intelligence 1113
  General News 1115
  Trade Notes 1120
  Record of Electrical Patents 1121
INDEX TO VOLUME XLI.

THE DETROIT MUNICIPAL PLANT.

As our readers will remember, as far back as last February we published an analysis of the Seventh Annual Report of the Public Lighting Commission, when we attempted to determine more closely what actual advantages, if any, were shown by the report from the operation of the station, and when it was clearly proved that the plant was by no means such a success as had been made out. After some months had gone by, Commissioner Ingram, under date of May 18, forwarded us an article which in turn we have subjected to further investigation, and which we now print in the present issue, accompanied by our own comment as supplemented by the data that we have been able to obtain locally. We must now leave these figures to our readers and the public in general. It seems to us that our first analysis as a piece of destructive and unanswerable criticism stands, and that Commissioner Ingram's reply does not in any wise get to the heart of the various questions which we raised. Perhaps the most serious issue raised is that with regard to depreciation, a respect in which it has always appeared to us the reports of the Commission were weak.

* * *

There are other questions of fact raised, but we will touch here upon only one of them, namely, whether or not a costly pole line has been "abandoned." Mr. Ingram, in his reply, questions the statement about the line which was made in our analysis. We now quote his own statements and give in the body of the matter three photographs of the pole line in question. One other little point comes up and that is Mr. Ingram's reference to the indictment of certain aldermen at Saginaw, Mich., for alleged bribery. We confess we do not follow his line of argument here at all, for if such men were vile and corrupt enough to hold up a public service corporation endeavoring to carry on its legitimate business, it is simply fearful to imagine what they would do if they had free and unlimited control of the city resources for every class of public service under a régime of public ownership of every large utility.

THE INSTITUTE MEETING.

Last week we gave in full the programme for the Institute meeting at Niagara Falls as it had been outlined by the various committees, and we are now able to supplement that by the latest information available on the subject. It will be seen that a programme of unusual attractiveness and importance has been prepared, and we do not think we are mistaken in predicting a large attendance, especially if the unpropitious weather from which the country has suffered during the past month should terminate and the sun should shine again. While Niagara itself has already been done pretty thoroughly by the Institute at other times, it is fortunate that this year, altogether apart from the excellent papers that are to be presented, the excursions and trips include a number of outlying points of interest where something of value may be seen and learned. At the same time, in view of the fact that questions of power transmission and distribution occupy so largely the attention of this body, it is not to be regretted that at Niagara so much practical information can be ascertained right on the spot as to devices connected with this class of work. These features are, in fact, given special prominence by the preliminary notes of discussion issued by the Mershon Committee on high-tension transmission, and we trust that a very full and profitable discussion will be had on this subject.

MAGNETIC POLAR EXPEDITIONS.

It is announced that the Norwegian whaling vessel *Gjoa* has recently sailed from Christiania on a voyage of discovery for the north magnetic pole. Of course, the position of the north magnetic pole is already fairly well known. It is found marked in the map at about 70° of north latitude, and 100° of west longitude, which, being interpreted, means in the McClintock channel, between Boothia, William Land, Prince of Wales Island, and Victoria Land. Evidently the North Pole is a strong supporter of the British crown. It also lies due north of Dodge City, Kan., and at a desirable distance therefrom. It is clear, therefore, that the search for the north magnetic pole is more hopeful than the quest of the holy grail. The principal problem before the casual voyager is what to do when he gets there, and how soon to remember a distant engagement.

Nevertheless, much valuable magnetic data can be accumulated in that remote and undesirable residence for a vacation. The accurate observation and recording of magnetic inclinations and intensities in this vicinity should enable many important deductions to be arrived at concerning the shifting and variation of the pole, and illuminate our theories of terrestrial magnetism.

It seems remarkable that the principal interest in the magnetic pole is in its excursions and round trips. The polar point moves to and fro, like a polar bear. If it were of constant locality and intensity, its interest would be limited to a dot on the map. Similarly, the interest in the north geographical pole lies more in its small wanderings than in its precise locality at any time, notwithstanding the fact that it would be an interesting place to reach and say good-bye to. It is said to spend its time in perambulating a complicated but definite curve comprised within a circle of a couple of hundred feet in diameter. If even a thing so fixed as the pole in this our world cannot stay still, how much excuse and consolation may we find for the restlessness of its ephemeral inhabitants.

THE GRADUATING CLASSES.

This is the season of the year when all the colleges and universities are sending out into the world the young men who for three or four years have been studying more or less earnestly for the careers to which they propose to give up their lives. The numbers of the graduating classes and their size, as well as the massed groups portrayed on college steps and campuses, are quite portentous, and may well cause wonder as to how all are going to find elbow room. But this is a large country, and it still absorbs very easily not only its own yearly product of educated men, but finds places for a good many from abroad. The medical and legal batches still seem unduly big, and it is perhaps in law and medicine that the beginner feels the crush from above as well as from below, in trying to plant himself firmly. It would appear, however, that theology is hardly so attractive as it once was, and perhaps the youth who would have become priests and clergymen are now more likely to turn up as lawyers and doctors—possibly now and then as journalists. Certainly very few of them try to break into the engineering ranks. Perhaps the Civil Service, growing rapidly as it does, provides careers for a good many of the literati.

Large as the various engineering classes have become, it may be questioned whether any of them have yet proved unwieldly; and the bulletin boards in lots of halls still reveal the urgent demand for likely newcomers. We have been greatly gratified in noting reports from the different institutions to observe how readily the electrical engineering graduates have been absorbed into the ranks of the workers. Curiosity is sometimes expressed as to what all these embryonic Edisons will find to do, but it is the fact that for every one of them worth his salt, occupation has been waiting. Indeed, some of the manufacturing and operating companies are quite strenuous in the eagerness they show to catch the promising graduate even before he is hatched out, and it would be hardly an exaggeration to say that very often instead of the student waiting humbly hat in hand for a job, he has had flatteringly pressing invitations extended to him to step right up and take a comfortable position. All this is very encouraging, and our only prayer is that it may long continue. The remarkable growth of electrical activities would indicate that the demand for well-trained men will expand.

It would be unfortunate, however, if the demand were to cause an insensible lowering of the scale of graduating excellence and proficiency, or tempt students to leave college with courses uncompleted, for they know at best little enough when they face the actualities. We venture to think, however, that the tendency is the other way; that the standard is rising, and that so far as the electrical engineer is concerned, it can hardly be too exacting. In this issue, bearing upon the point, is a very suggestive article by Prof. Sever dealing with the studies of the electrical engineer at Columbia University, and accompanied by a diagram illustrative of the interrelation of the yearly work. We are glad to point to the attention given to the "humanities" in the curriculum and to the emphasis laid on mathematics. Quite aside from his technique, the electrical engineer should be altogether the equal of practitioners in other professions by his acquaintance with general culture and his acquirement of the qualities and amenities that distinguish the gentleman.

SAVING THE RAINFALL.

The terrific floods of the last few weeks ought to teach a lesson that will not soon be forgotten. The wholesale wanton destruction of forests is doing its work, and each decade seems to show greater fluctuations in the water supply. A distinguished Australian engineer, in speaking recently of the flood danger in this country, strongly advised an attack on the Mississippi problem not with levees near the mouth, but with reservoirs at the headwaters. If the flood water is merely kept in the channel, it may be prevented from doing any positive harm, but it is lost and with it an immense amount of possible benefit. The great Assouan dam controlling the flow of the Nile is an example of what intelligent engineering can do toward modifying the natural order of things. To be sure, the valley of the Mississippi proper stands in small need of irrigation, but many of its tributaries on the western side flow through an arid country, which could be saved by a wise use of the water now available by judicious impounding. A series of artificial lakes thus formed would serve a triple purpose. First, they would tend to modify the climate in the direction of greater uniformity; second, they would furnish a vast store of water for irrigation; and finally, the use of the waste head for generating electric power would furnish a source of revenue which would go far toward putting the work on a sound financial basis. Storage reservoirs demand heavy initial expense, and while the damage done in a single flood would, if prevented, amply justify the investment, a steady sale of power from the waste water would give an income of no insignificant amount. The use of this power for pumping water for further irrigation in districts not readily reached by the gravity supply would furnish an important market.

A NEW CROP OF RADIATIONS.

We have already called attention to the recent work of M. Blondlot in finding light of high refrangibility and conspicuous penetrative powers emitted from x-ray tubes. More recently the somewhat anomalous properties of these new rays led him to an investigation of the radiation of a Welsbach mantle, using a tiny spark as indicator as in the previous research. Rubens found by the bolometric method certain presumably infra-red waves of very great wave length in radiation from this source; and following up this line with his sensitive spark, Blondlot found not Rubens' rays, but four other groups of rays having indices of refraction between 2.0 and 3.0 in quartz and possessing remarkable penetrative power as well as very sharp and decisive action on the spark used to detect them. They passed with ease through thin material—wood, rubber and the like, but with difficulty through rock salt, water, or even wet paper. They seemed in this particular to resemble ordinary infra-red rays of very great wave length, yet were very highly refrangible. Quartz, however, exhibits very strong selective absorption in portions of the infra-red, as well as notable absorption of the extreme ultra-violet, so that the exhibition of anomalous dispersion required to account for the enormous refractive indices observed might reasonably occur. Still more recently, Blondlot has extended his investigation further and finds allies of the new rays to be emitted from an Argand flame, and even from incandescent silver, the rays in the latter case being strongly polarized. The effect of the new rays on phosphorescence was tried, and while they failed to visibly initiate it in calcium sulphide, they seemed to intensify it when once present.

It should be reiterated that these new and remarkable rays are unmistakably light, although their exact wave lengths have not yet been determined. They are reflected, refracted and polarized by the usual means, are brought nicely to a focus by a quartz lens, and are totally reflected at the incidence required by their refractive indices. Yet they penetrate most opaque substances almost as freely as the x-rays and produce a most powerful effect on electrical discharges. They work up to a longer distance from the source than the penetrative radiations usually studied, and are not under the least suspicion of being ions, electrons, emanations, effluvia, auræ, or any other queer and unusual things. The discovery of this group of rays seems to us of a very high order of importance. Their study will be a revelation in the general theory of radiation, and their unusual properties will serve to broaden the current conceptions of transparency and opacity, as well as the view of the interrelations between radiant energy and electrical actions. These are days when an immense amount of information is being steadily collected, all bearing on the fundamental questions of the structure of matter and its relation to radiant and other forms of energy. But the aggregate is far from homogeneous; it has been collected by various methods, under various working hypotheses, and it is a confused heap of facts, apparently very difficult to marshal in any semblance of order. The peculiar value of M. Blondlot's discovery lies in its dealing with things which bear a direct and comprehensible, even if unclassified relation to the general theory of radiant energy. It gives a safe ground on which to stand in further investigations; and in particular it gives hope of throwing new light on the subject of highly penetrative rays and of reducing them to simpler terms than at present.

WIRELESS AND OTHER TELEGRAPH CONFERENCES

A preliminary wireless telegraph conference is announced to be held at Berlin on August 4th, 1903. It is to be attended by persons interested in wireless telegraphy. How far this is open to the public attendance, and how far its sessions are to be restricted to nationally-appointed delegates, has not yet transpired.

There are various directions in which a consensus of opinion on the international relations of wireless telegraphy might advantageously be secured. Such, for instance, are questions concerning the uniformity of Morse code signals, the best range of lighthouse signals as between advantageous distance and disadvantageous interference, and the desirability of equipping lighthouses, all over the world, with wireless telegraph apparatus.

On the other hand, there are many important questions which cannot, perhaps, be profitably discussed at the present time, partly because the existing systems of wireless telegraphy have been too recently developed to conform as yet with commercial requirements, and partly because of the complex patent and legal situations between the owners of the systems and the public. It would appear that at some time it will become necessary for governments to regulate and recognize wireless systems and communications, if only to protect the shipping interests; but the present time seems too early to risk interference with the growth of a new utility and its industry.

An international telegraph conference has recently been held in Europe. These conferences have been assembled periodically for many years, for the purpose of facilitating agreement and co-operation between the telegraph administrations of the various governments. Here tariffs are discussed, adjusted and decided upon, codes regulated and tabulated; while many minor details of international wire-telegraphy are reduced to system. Such action is clearly called for among countries that carry on a large and ramifying joint telegraphic business, in which one and the same message may have to be forwarded through several countries and their telegraph systems.

It is highly desirable that there should be one and only one code of telegraph signals all the world over, both for wire and wireless messages. At the present time there is the Morse code of North America, the International code of Europe, Asia, Africa and Australasia, and there are minor differentiations from these, as in Mexico, whose Morse code has a few signs that are neither Morse nor continental. There is very little actual conflict between the Morse and continental. They differ in the numeral signs, and in about ten letters of the alphabet. The Morse code uses "spaced" letters; while the continental code does not. That is to say, any signal of the continental code is constructed of dots, dashes and spaces of dot length. In the American Morse code, any signal is composed of dots, dashes, single-dot-length spaces, and extra-length spaces. The American code is about five per cent. faster than the continental code, for the same speed of transmission reckoned in dot-intervals, there being more dashes per word in the continental code, and, therefore, more time consumed per word. On the other hand, the continental code is the less liable to errors in transmission accompanying any derangement of the signals due to imperfect working of the system. Thus the American system is swifter; while the continental system is safer.

The continental system is used practically all over the world outside of America. The continental code is used over all long cables, and on messages coming to the United States, the change in signals occurs where the cables breathe the messages upon the American shore. In Great Britain the signal code was at one time different from the continental, but in order to adhere to the international continental code, the original British code was abandoned and is now extinct. It is doubtful whether it would be worth taking the trouble to change codes in this country merely for the sake of international uniformity, when the existing system here is found satisfactory, and when the only clash is at the termini of the cables. But if wireless telegraphy comes into general use all over the world the desirability of employing the same code everywhere will be enhanced.

The Union Engineering Building.

A formal organization of the joint committee representing the various bodies which have taken action with respect to the gift of $1,000,000 of Mr. Andrew Carnegie for a Union Building, was effected on the evening of June 18. The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Engineers' Club have taken final action and appointed their representatives upon a joint committee for accepting the gift. The American Institute of Mining Engineers has likewise taken action in so far as its rules permit. Its council has appointed representatives subject to changes in the rules of the organization which have been proposed by the council for adoption at the next general meeting. At the present time a letter ballot for ascertaining the attitude of the members is being taken which shows an overwhelming majority in favor of the plans proposed by the council.

The American Society of Civil Engineers at its recent meeting in Asheville referred the matter to its board of directors for recommendation and directed that the matter be then presented to the members of the society for letter ballot.

At the meeting on June 18, the following were announced as representatives of the several bodies upon the joint committee:

American Institute of Mechanical Engineers, James M. Dodge, F. R. Hutton, Charles Wallace Hunt.

American Institute of Electrical Engineers, Charles F. Scott, B. J. Arnold, S. S. Wheeler.

American Institute of Mining Engineers, A. R. Ledoux, Charles Kirchoff, Timothy Dwight.

Engineers' Club, John C. Kafer, W. H. Fletcher, W. A. Redding.

Representatives of the American Society of Civil Engineers are requested to meet with the joint committee and take part in deliberations with regard to the plan to be adopted. The representatives who have served upon the conference committee are Alfred Noble, W. J. Wilgus, George M. Pegram.

The joint committee was organized by the election of the following officers: Chairman, Charles F. Scott; secretary, Prof. F. R. Hutton. The chairman was directed to indicate to Mr. Carnegie the acceptance of his gift by the joint committee representing the several organizations.

The joint committee placed the immediate work of developing plans upon an executive committee of five, consisting of one member from each of the five organizations named in Mr. Carnegie's letter, as follows:

American Society of Civil Engineers, Mr. Alfred Noble.
American Society of Mechanical Engineers, Prof. F. R. Hutton.
American Institute of Mining Engineers, Mr. A. R. Ledoux.
American Institute of Electrical Engineers, Mr. Charles F. Scott.
Engineers' Club, Mr. W. M. Fletcher.

The Executive Committee met on May 19 and organized by the election of Charles F. Scott, chairman, and F. R. Hutton, secretary. The committee laid out certain work to be undertaken by its several members, and will have meetings from time to time during the summer.

The following cablegram has been sent to Mr. Carnegie: "Andrew Carnegie, Skibo Castle:—Joint committee four organizations formally accepts generous gift Union Building. Executive Committee in session sends greeting and reports progress.—Scott."

The Institute Niagara Meeting.

In the last issue of this journal the excellent programme of the Institute meeting at Niagara Falls was given in full, the various papers and different entertainments making a list which occupied a full column. The meeting will be held at the Cataract House on Monday, June 29, and will continue throughout the week until Friday, when joint sessions will be held with the Society for the Promotion of Engineering Education. In addition to the programme thus printed, and which can also be found in the Institute bulletin, it may be added that Mayor Hancock, of Niagara Falls, is to deliver an opening address of welcome on Monday. On Monday afternoon, which had not been filled up with an engagement, a special train upon which lunch will be provided, will take the convention from Niagara Falls as guests of the Gould Storage Battery Company to the neighboring new city of Depew, where the Gould factory is situated, and where the various processes connected with the manufacture of storage batteries will be fully elucidated.

The general committee, of which Prof. George F. Sever is the chairman, and the local committee, of which Mr. H. W. Buck is the chairman, together with the transportation committee, of which Mr. F. H. Mullin is the chairman, have been working very hard in their respective spheres to insure the success of the meeting, and at the present moment it looks as though, with weather favoring, the convention will be one of the very largest that the Institute has ever known. It is the intention of the local committee to get up, and issue, a programme for each day, stating, in addition to the regular lists of papers given in the Institute bulletin, the detail arrangements for the afternoon and evening. This will be independent of the lists of arrivals and the technical programmes issued by the general committee. With regard to the entertainment for Wednesday evening, the local committee is planning a kind of outdoor smoker in the courtyard of the International Hotel with vaudeville performance, music etc.

In connection with the meeting, the committee on papers, of which Dr. Sheldon is chairman, has issued a neat little pamphlet of introductions to discussions around which a good deal of interesting matter should develop. This material comes from the committee on high tension transmission and embodies data by Mr. Ralph D. Mershon on the grounded wire as a protection against lightning; the operation and maintenance of high tension underground systems, by Mr. Philip Torchio; by Mr. Henry W. Fisher on electric cables for high voltage service, and by Mr. H. G. Stott, on the use of automatic means for disconnecting disabled apparatus. Mr. Mershon discusses the theory of lightning stroke and takes up the material dimensions of ground wires, methods of installation and the general results in practice. Mr. Torchio's paper is a valuable contribution, giving the actual results of high-voltage operation, and is based presumably upon the practice of the New York Edison and its subordinate companies. Mr. Torchio enters into a discussion of the principles followed and the use of indicators and protecting devices, as well as special features in the care of cables. Mr. Fisher develops the cable subject even more thoroughly and takes up the question of their manufacture, describing some which he has designed. Other features of his contribution are the installation of cables, and their operation in electric light and power plants. Mr. H. G. Stott's paper may be said to take up from the side of the electric railway manager some of the points touched upon from the lighting standpoint by Mr. Torchio. Mention is made in his memorandum of devices brought out by Mr. L. Andrews, of England, and it is understood that Mr. Leonard Wilson, of the Stanley Company, will attend the convention and show the practical operation of some of these features for the protection of feeders.

Members attending the convention should be careful to obtain certificates on purchasing their railroad tickets one way, so as to obtain the reduction to one-third fare for the return trip. Full details as to this are given in the Institute Bulletin warning members not to ask for receipts, but to secure "certificates" upon which the railroad agents can give the proper guarantee of personal attendance securing the reduction. This privilege has been duly accorded by the various traffic associations, and it is a duty of all members to avail themselves of it, as they all benefit, particularly those traveling long distances.

Atlantic Wireless Messages.

Mr. Vivyan, Marconi's manager in charge of Table Head Station, announces that he is sending messages of different lengths from Table Head to Poldhu, Cornwall, daily, but that the replies are still being received by cable, owing to the installation of new machinery in the England station not yet being completed. Mr. Vivyan says the apparatus at Table Head now works with ease and that the transmission of the messages is attended with the greatest possible success. The Table Head station is also in daily communication with Wellfleet station at Cape Cod. Mr. Marconi is expected in Cape Breton in August. The officials of the Marconi Wireless Telegraph Company of America have received information that the steamship *Deutschland,* of the Hamburg-American Line, has been equipped with Marconi apparatus. Four other ships of this line are to be equipped similarly. Vessels of this line will, therefore, be able to keep in communication with twenty-two transatlantic liners already using such apparatus, and with the shore stations of the system in Europe and America. The *Deutschland,* it will be recalled, was stuck in the mud of the lower bay for twenty-four hours on her last trip out from New York. It now appears that she had wireless apparatus on board, manufactured by a German concern, and was, therefore, not able to get into communication with the shore stations.

Electric Power From the Hudson.

By Alton D. Adams.

SPIER FALLS, on the Hudson, at the foot of Mount McGregor, sixty miles south of Mount Marcy, where the river rises, and forty miles north of Albany, is to yield 32,000 hp for electrical transmission. In volume, this development of electric power is second only to that at Niagara Falls and at Sault Ste. Marie; in length of transmission it is probably not surpassed east of the Rock Mountains. Electric light, power and traction are to be supplied in Albany, Troy, Schenectady, at the General Electric Works and in many smaller places on the way. To effect this development of power the Hudson River is caught between Mount McGregor and another spur of the Adirondacks, raised fifty feet above its ancient bed, and then dropped through water wheels with a head of eighty feet. A stone dam 1,820 ft. long, about 100 ft. in maximum height above bed rock and containing 180,000 cubic yards of masonry is employed to raise the river level. This dam extends down to bed rock across the entire width of the river, and is anchored at each end in the solid ledge of the mountain side. Behind the dam a storage reservoir one-third of a mile wide and five miles long is formed, thus flooding the ancient river banks.

In this way the sights of roads, farms and dwellings will be covered. To provide for the construction of the masonry dam, a temporary one of earth, cribwork and stone was first built a little up stream from the permanent sight. An opening was left in the timber sections of the temporary dam at one side of the river so that the water was diverted from its normal course and a great portion of the old river bed at the sight of the permanent dam was left dry. Stone laid in concrete with close joints forms the regular construction of the main dam, though a larger proportion of concrete has been used on a small part of the work. The rule has been to carry the masonry of the dam down to bed rock throughout the entire distance across the river. This has made a large amount of excavation necessary and the cofferdam at one side of the old channel included an area of five acres during one stage of the work and had a maximum height of 90 ft. at one point. Both steam and compressed air have been used extensively on the work, the air compressors being operated by three-phase motors. These motors draw their energy from an electric power station at Mechanicsville, some 23 miles to the south. The new dam, anchored in the mountain ledges at its ends and sunk to bed rock entirely across the river, varies in extreme height according to the different depths at which this rock was found. At one typical section in its overfall part the dam is 59 ft. high above its bed, and 63 ft. up and down stream at its base. Considered as to its length the dam is made up of the river section, of 560 ft., the overfall of 820 ft., and the intake wall of 440 ft., making a total of 1,820 ft. between banks. The overflow portion of the dam must pass water at a very rapid rate during times of flood. At times of minimum flow at Spier Falls the Hudson discharges about 2,000 cubic ft. per second, but during maximum discharge the quantity of water goes up to as much as 50,000 cubic ft. per second. This great variation between high and low water discharge will no doubt be reduced by proposed storage dams at Indian and other lakes about the head waters of the Hudson, in which the State has become interested. The watershed of the Hudson River above Spier Falls has an area of about 27,000 square miles, and the mean, annual flow of the river at these falls is between 6,000 and 7,000 cubic ft. per second. Evidently, when storage works have brought the minimum discharge of water at the falls up to approximately the mean, annual rate, the amount of available power will be much larger than at present.

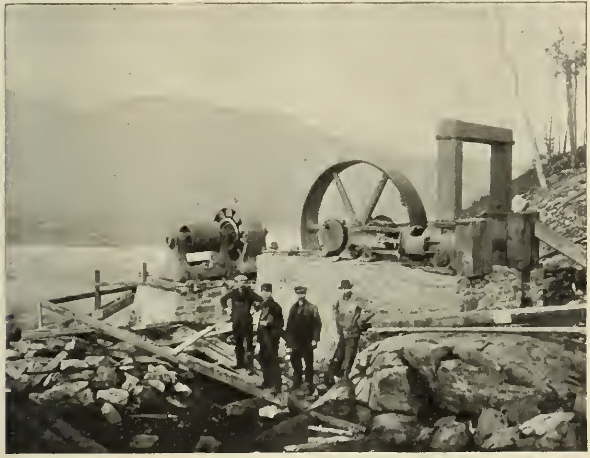


FIG. 1.—GETTING AN AIR COMPRESSOR READY.

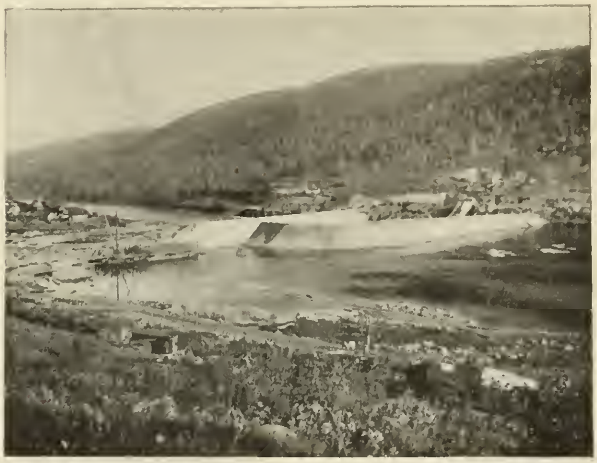


FIG. 2.—CHANGED COURSE OF THE RIVER.

Like the dam, the canal and the power house at Spier Falls are built on a natural rock foundation. The short canal is formed by blasting its course into the mountain ledge, and the sight for the power house has been provided by a similar process. The power house itself is one story, of brick, 70 ft. 10 in. x 392 ft. inside, and is located between the canal and the river, a little below the dam. Inside the power house in the direction of its greatest length is a 16-in. brick wall that divides the greater portion of it into two rooms each, 34 ft. 9 in. wide. In that one of these rooms which is nearer the canal are located the water wheels, and the shafts of these wheels extend through the 16-in. brick wall into the room where the electric generators are located. Beneath the floor of the wheel room is an opening 21 ft. 6 in. wide and extending its entire length. Across this opening are placed 36-in. box girders spaced on 14-ft. centers, and between pairs of these girders the water wheels are mounted. Beneath the floor of the generator room a series of arches connect the long chamber beneath the wheels with the space through which the tail water passes on its way to the river. Centers of the wheel and generator shafts are 16 ft. 9 in. above the low level of

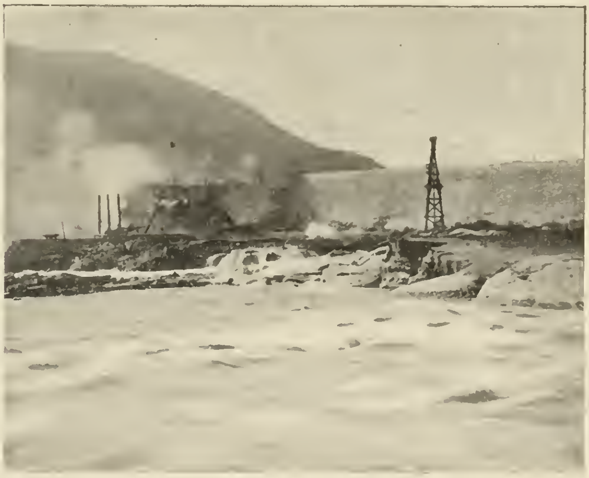


FIG. 3.—PART OF THE OVERFALL SECTION.

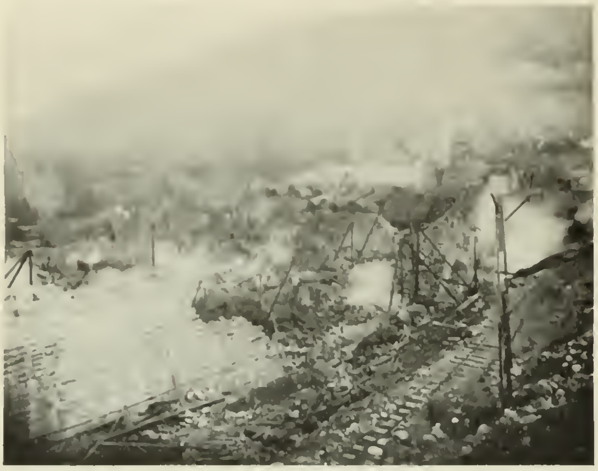


FIG. 4.—SITE OF THE POWER HOUSE.

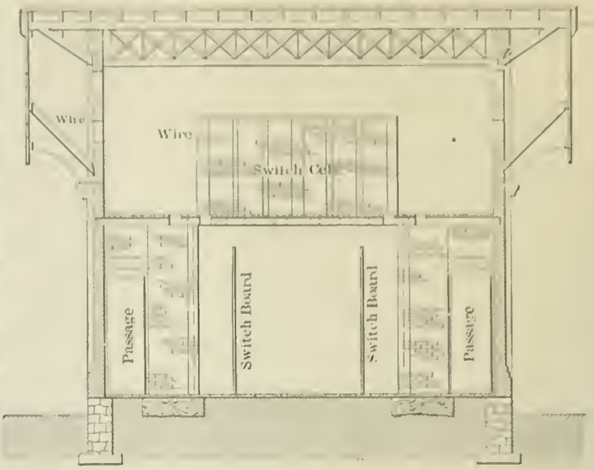


FIG. 7.—CROSS-SECTION OF SWITCH HOUSE.

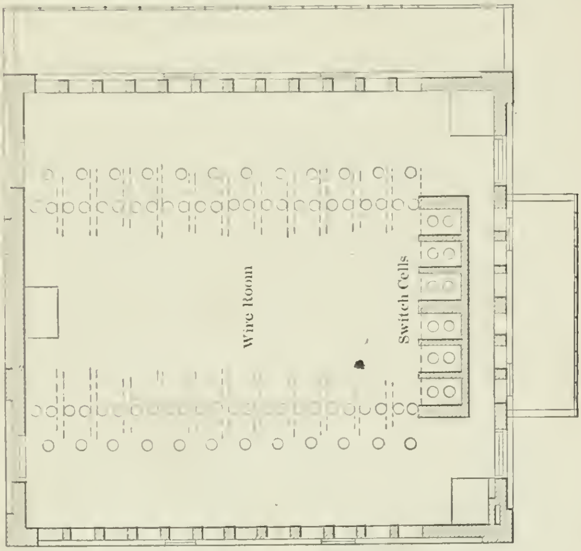


FIG. 5.—SECOND FLOOR PLAN OF SWITCH HOUSE.

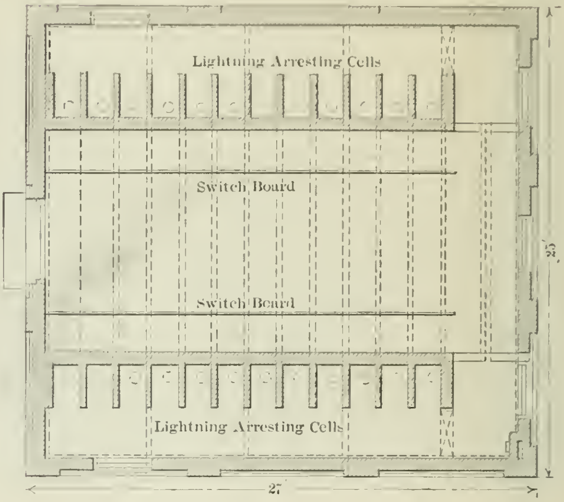


FIG. 8.—GROUND FLOOR PLAN OF SWITCH HOUSE.

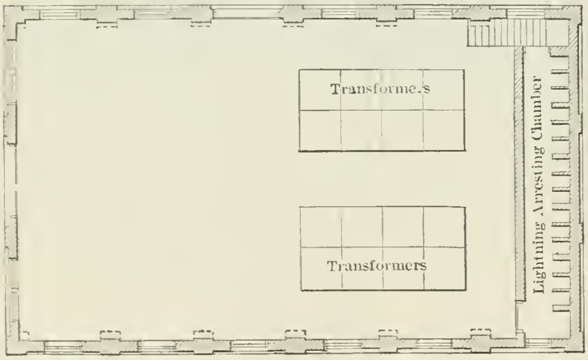


FIG. 6.—FLOOR PLAN OF SUB-STATION.

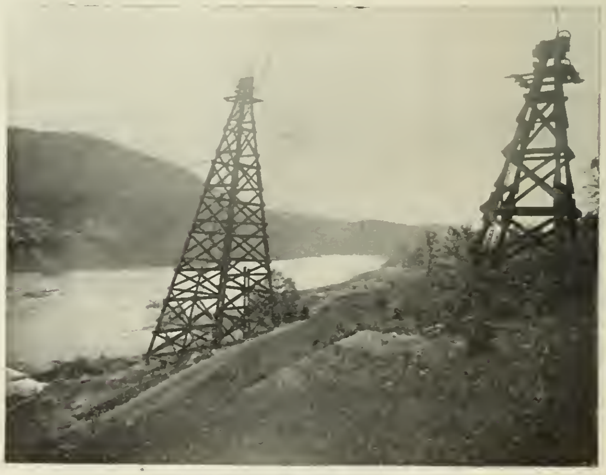


FIG. 9.—THE VALLEY TO BE FLOODED.

ELECTRIC POWER FROM THE HUDSON.

tail water, and the floors of the wheel and generator rooms are 9 ft. 9 in. above this tail water level. One crane mounted between the 16-in. interior and an outside wall sweeps the length of the generator room, and another crane supported in a similar way travels over the wheels.

From floor to the lower cords of the roof trusses the height in the wheel and generator rooms alike is 39 ft. 3 in. At one end of the power station a space extending across its entire width and about 46 ft. long is devoted to the step-up transformers and to the switchboard.

Water passes from the canal to the power house through ten steel tubes of 12 ft. inside diameter each. Before entering the power house these tubes pass through a heavy masonry retaining wall that protects it from water on the side toward the canal. Each of these ten tubes connects with a wheel case that contains a pair of turbine wheels mounted on a horizontal shaft. In each of eight of these cases the pair of turbines is rated at 5,000 hp under a head of 80 ft., and in each of the other two cases the pair of wheels is rated at 3,400 hp. Each of the eight pairs of larger wheels will drive a direct-connected electric generator rated at 2,500 kw, and each of the two pairs of smaller wheels will drive a 2,000-kw generator. All of these generators are of the revolving magnet type, three-phase, 40-cycle, and made by the General Electric Company. Each pair of wheels is controlled in speed by a Lombard governor belted to its shaft. To each of the two cases containing the 3,400-hp wheels there is connected a small wheel case whose turbines drive an exciter for the main generators.

From the foregoing it may be noted that the total capacity of main water wheels at this station is 46,800 hp, and the total capacity of main generators 24,000 kw, or 32,000 hp. The three-phase, 40-cycle currents from the main generators will be raised in pressure to 26,500 volts by transformers at the main station and thence transmitted to sub-stations located at Glens Falls, Fort Edward, Saratoga, Ballston, Schenectady and Watervliet, and numbering six in all at the present time. Energy from these sub-stations will be supplied for lighting, general power purposes and electric traction. In some cases, as at Saratoga and Ballston, where the local electrical supply systems are owned in common with the transmission system, energy will be distributed from the sub-stations directly to consumers. In other cities and towns, as in Albany, Troy and Schenectady, energy from the sub-stations will be sold to local lighting or traction systems. At Schenectady the sub-station is divided into two distinct parts, one of which will contain apparatus belonging to the General Electric Company, whose works are to utilize a large amount of the transmitted energy, and the other part will be devoted to service in the city. From the sub-station at Watervliet energy will be distributed for lighting, power and traction there, in Troy and in Albany, also for power and lighting in Lansingburg.

At the Glens Falls sub-station the equipment includes four transformers of 500 kw and 40 cycles each, which take current from the line at 26,500 volts and deliver it at 2,300, 2,400 or 2,500 volts as desired. At this sub-station there are two blower sets and one automatic F.R.T. of 45 kw and 150-volts capacity, besides the switchboard equipment. One three-phase feeder enters this sub-station at a pressure of 26,500 volts, and it has 6 outgoing lines for distribution at 2,300 volts each. Among the service supplied in Glens Falls is that of 2,000 hp to motors in a portland cement works. In the Saratoga sub-station the equipment is the same in capacity as that at Glens Falls except that the F. R. T. is lacking.

The plant at Glens Falls and the transmission system just described are the property of the Hudson River Water Power Company, which also owns another undeveloped water power on the same river. This company also own and operate a large water power plant at Mechanicsville on the Hudson, which was described in the Electrical World of September 3, 1898. As soon as the plant at Spier Falls is completed, the two plants will be connected with the same transmission system. Work on the dam at Spier Falls was begun in June, 1900, and it is expected that the generating station will be ready to deliver 15,000 hp in July of the present year.

In the water power development William Barclay Parsons and George E. Evans have acted as consulting engineers. Charles E. Parsons is chief engineer in charge of the work. To Eugene F. Ashley, president of the Hudson River Water Power Company, the conception and execution of this great generating and transmission system is primarily due. Chief Engineer Parsons and other officials of the company have extended every courtesy for the collection of the above facts.

When the Hudson at Spier Falls and other adjacent points shall have been made to yield up its energy for useful work, electrical supply in the cities named will be largely independent of coal.

A Note on Three-Phase Power Measurement.

By F. A. Fish.

It is well enough known that the power of a three-phase circuit may be measured by two wattmeters connected as in Fig. 1. The wattmeter readings will be:

$$W_1 = I_a\ E \cos (\Phi + \theta_1) \text{ and } W_2 = I_b\ E \cos (\Phi - \theta_2)$$

In the case of balanced circuits, $I_a = I_b$ and $\theta_1 = \theta_2 = 30°$.

In certain cases, notably that of lightly loaded induction motors, the angle $(\Phi + \theta_1)$ may become greater than 90° and the wattmeter reading, W_1, therefore negative. It sometimes becomes a question, therefore, as to whether W_1 shall be added to or subtracted from W_2 to obtain the true power. In making some measurements recently, the writer kept the series coils of the wattmeters shunted except when taking readings, and it was noted that as the angle of lag was increased, and the readings of one of the wattmeters approached zero, shunting the series coil caused the needle to swing across the zero and give a negative reading. The load in this case happened to be a three-phase synchronous motor and the lag was controlled by the field excitation. On further increasing the lag so that the normal reading was negative and the connections had to be reversed, the effect of shunting the series coil was to *increase* the reading, whereas, so long as the readings were positive, the effect was to *decrease* the reading. These facts at once suggested a means of determining easily whether a wattmeter reading in a doubtful case was positive or negative, and also raised the question as to the theoretical correctness of the method. The following reasoning seems to establish the latter for the given case, although, as will be pointed out, conditions may exist under which it will not hold.

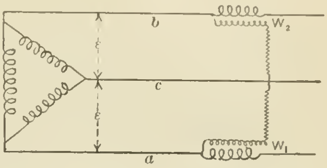


FIG. 1.—DIAGRAM OF CONNECTIONS.

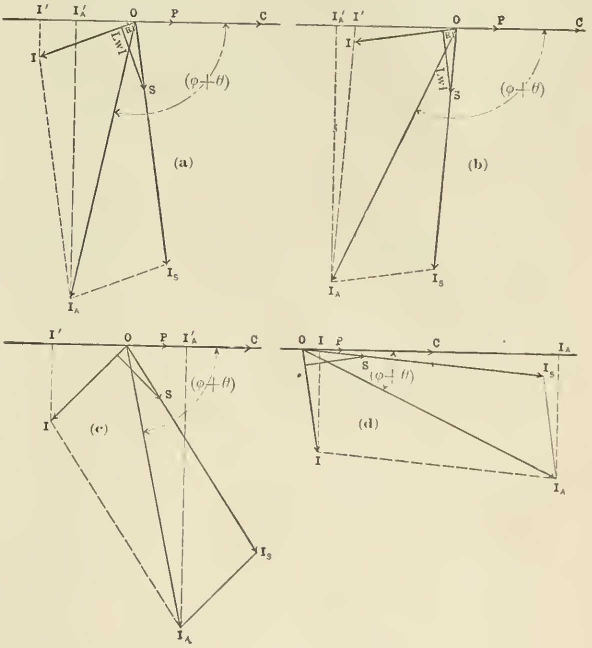


FIG. 2.—MEASURING THREE-PHASE POWER.

In Fig. 2 let $O\ C$ represent the line e.m.f., $O\ P$, in phase therewith, the current through the pressure coil of the wattmeter and $O\ I$ the line current. The product of $O\ P$ and the projection, upon $O\ C$ extended, of the current, $O\ I$, through the series coil will be proportional to the wattmeter reading It is evident from the figure that this projection may be larger when the coil is shunted than when not, although the value of the current in the coil will be much smaller. The vector, $O\,S$, represents the pressure acting on the wattmeter coil and shunt; the current, $O\,I$, in the series coil will lag behind this by the angle, $\tan^{-1}\frac{Lw}{R}$ where Lw and R are the reactance and resistance of the coil; the current, $O\,I_s$ will be in phase with $O\,S$, assuming no reactance in the shunting circuit. It will be observed that while the reactance of the wattmeter coil is not large enough to materially change the line current or its lag angle, its value relative to that of the shunting circuit may be large enough to throw its current considerably behind the current in the shunt circuit, and therefore behind the resultant or line current, since the two latter currents are nearly in phase with each other. It will be further noted that when $O\,I_s$ reaches 90° lag behind $O\,P$, the projections of $O\,I_a$ and $O\,I$ will become equal and the wattmeter reading will not be changed by shunting. If the angle $(\phi + \theta)$ increase beyond this limit, the readings will be decreased just as they are for angles less than 90°.

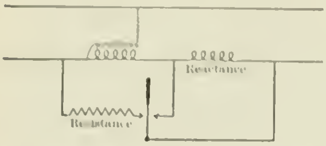


FIG. 3 COIL IN SERIES WITH WATTMETER.

It is evident that if the shunting resistance be too low the current in the series coil will be decreased so much that the range of usefulness of the principle will be greatly reduced; if the shunting element have a reactance such that the ratio $\frac{Lw}{R}$ for it approaches the corresponding ratio of the series coil, its effect is again lost; and still again, if the reactance of the series coil is much smaller than its resistance the angle between the currents will be so small as to produce no appreciable effect. All three of these objections may be overcome by the single expedient of putting in series with the wattmeter a low-resistance coil of considerable reactance (not enough to materially alter the circuit conditions) and shunt them both with a non-reactive resistance of such a value as to reduce the wattmeter current only to say ½ or ¼ of its line value. Fig. 3 illustrates how this may be done without introducing any material influence on the circuit.

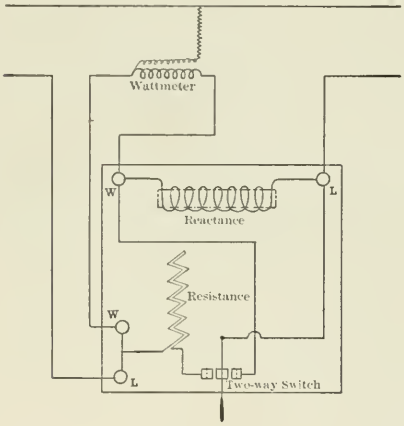


FIG. 4.—DIAGRAM OF SUGGESTED INSTRUMENT.

In order to determine how well ordinary commercial wattmeters would adapt themselves to this method, tests were made on a Weston 7.5-kw and on a Whitney dynamometer type 6-kw instrument. It was found that a shunt of about .004 ohm placed directly on the terminals of the series coil of the Weston would cause an increased reading if the total current lagged between 90° and 94°, while if a reactance of half a dozen turns of heavy wire around an iron wire core about an inch in diameter were put in series and the two shunted with about .02 ohm, the readings would be increased if the current lagged anywhere between 90° and 120°.

In the case of the Whitney, a shunt of about .01 ohm directly across the terminals increased the readings for lags from 90° to 105°, while the introduction of additional reactance and a shunt of .02 ohm caused the readings to be increased until the lag reached about 130°.

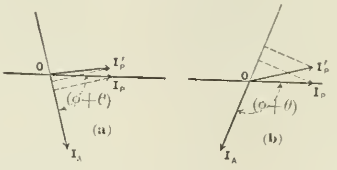
It should be remarked that the increase of readings in all these cases amounted to from 10 per cent. to 25 per cent., so that the effect was easily noticeable even where the power was considerably unsteady.

In order to adapt this method to practical purposes, an instrument might be made to be used in connection with the wattmeter, comprising a reactive coil, either with or without iron, a non-reactive resistance and a switch; these to be suitably encased with terminals for connecting to the wattmeter and to the line, and so arranged that in one position of the switch, the reactive coil is short-circuited and the shunt circuit open, and in the other position the reactive coil is thrown in series with the wattmeter coil and the non-reactive resistance is shunted around them. Such an arrangement is shown in diagram in Fig. 4. In case sufficient reactance could be produced without the use of iron, the above combination might well be included in the same case with the wattmeter.

It will have been observed that the underlying principle of the whole scheme is to increase the angle between the current in the pressure coil and that in the series coil of the wattmeter; therefore, if the lead of the former current can be increased, the result will be the same as in the method above described. This, it is found, may be readily accomplished by inserting a suitable capacity in series with the pressure coil.

The diagrams of Fig. 5 show that when $(\phi + \theta)$ is less than 90°, i. e., the wattmeter reading is positive, the reading will be decreased by inserting capacity in the pressure circuit, not only on account of reducing the value of the current, but by increasing the angle between the pressure current and the line current; also that when the reading is negative ($[\phi + \theta]$ greater than 90°) it may be increased by the introduction of capacity, in spite of a reduction of the value of the current.

It will be understood that, in order to get the best results, the amount of capacity used must be governed by the resistance of the pressure circuit, but in the case of the two wattmeters mentioned above, and also of a Thomson inclined coil wattmeter of 1,600 watts capacity, 2 or 3 microfarads answered about equally well for all of them through a very wide range of lag angles (up to 130°). The increase in the readings by this method was about the same as for the first method described. When a multiplier had to be used with the wattmeter, the effect was found to be decreased only to a small degree.



(a) (b)

FIG. 5.—EFFECT OF INSERTING CAPACITY.

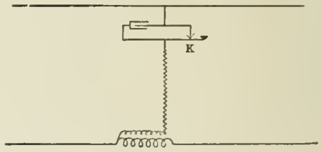


FIG. 6.—DIAGRAM OF CONNECTIONS.

In applying this method practically, the condenser might very well be included in the wattmeter case and connections made as in Fig. 6, where K represents a key which normally stands closed, but on pressing, introduces the condenser into the pressure circuit. Or the condenser and key may be made up as a separate instrument, as in the other method, and would thus be available for more than one wattmeter.

Union Delegate Blackmail.

Blackmail charges have been brought by officers in New York, with details. Mr. Charles L. Eidlitz, of the special committee appointed by the Building Trades Employers' Association, to take charge of cases of extortion against labor leaders, now states that he had several affidavits in reference to corruption among representatives of the electrical workers. "These affidavits are so strong," said Mr. Eidlitz, "that a committee from the electrical workers did not care to hear them read. They will be presented to the District Attorney."

Telephone Exchanges—V.

By Arthur V. Abbott, C. E.

THERE is another property which iron exhibits under magnetic influence, which plays an important rôle when this metal is subjected to rapidly alternating electric currents such as constitute the bulk of the line currents in telephone circuits If a piece of iron entirely in a neutral condition be subjected to a slowly increasing magnetic field, the curve, *A,* in Fig 13,* shows that the flux through the iron gradually increases until it becomes practically saturated and thereafter the flux changes with relative slowness. If after such magnetization the magnetizing force is decreased to zero, it is found that the iron does not at once return to its original condition, but on the contrary retains more or less of the magnetism which it has acquired, and that in order to destroy this magnetism, and to enable the piece to assume its original condition of neutrality, a very sensible amount of *demagnetizing* force must be applied. Fig. 15 is an illustration of the way in which a piece of steel behaves under changing magnetic conditions. In this illustration the horizontal scale shows the magnetomotive force. $\mathcal{H}$, while the vertical scale indicates the resulting flux, $\mathcal{B}$. These scales are plotted from zero in the center of the diagram to show both positive and negative values. If we imagine a piece of neutral metal placed in space containing no magnetic field, its condition will be represented by the zero point of the diagram, and if now a magnetic force, $\mathcal{H}$ (by a coil and battery) be gradually applied and increased as represented along the axis of *X*, the induction will follow the line *O G A,* which is similar to the *A* curve shown in Fig. 13. Suppose, when the magnetizing force reaches 100 that it be gradually decreased in the same manner that it was applied, it is then found that the induction in the metal does not return along the line *A G O,* but on the contrary decreases much less rapidly than it rose. With the first application of magnetic field, when $\mathcal{H}$ reached 10, the induction was 800; at 30 it was 3,750; at 70 it was 10,100, and rose to 12,700 at $\mathcal{H} = 100$. Let us suppose at this point that the magnetizing force be arrested and decreased at exactly the same rate that it was originally applied, under these circumstances the induction instead of returning the same way, along the line *A G O,* follows quite a different path, *A D B,* and even when the magnetizing force has been reduced to 0, remains at 9,500. Now, in order to return the piece to its original neutral condition, it is necessary to apply a negative magnetizing force, represented by *O K′*, and as this force increases the induction falls along the line *B K′*, so that the bar does not finally reach its original state until a negative force of 40 has been applied. If now the negative magnetizing force be still further increased a negative induction is created and the piece passes through similar magnetic cycle on the negative side of the axis of *X*. If we imagine the magnetizing force to continually vary from positive to negative in the manner indicated, the magnetic condition of the iron will follow in a series of cycles that are graphically represented by *A K′ A′ K A.* Evidently to cause the metal to pass through this cyclical change requires an expenditure of energy, which is derived from the electric current that excites and maintains the changing magnetic field, and the area of the diagram shows the amount of energy which is thus expended in doing internal work upon the molecules. The result of this work is to set up some obscure form of molecular friction that manifests itself as heat, and under long-continued and rapidly alternating magnetomotive forces, pieces of iron become intensely hot. This energy is dissipated by radiation and cannot be usefully employed in any electromagnetic mechanisms. The reader will at once argue that a bit of soft iron will thus waste much less energy than hardened steel. Such is precisely the verdict of experiment, and in Fig. 16 a portion of a similar curve is shown for a piece of soft iron. To save space Fig. 16 only includes the portion of the curve on the positive side of the *X* axis. The vertical scale is exactly the same as in Fig. 15, but the horizontal scale is magnified ten times. If this were not done the loop formed by the rising and falling lines of magnetization would be so close together for the iron as to be almost imperceptible because to produce an induction of 12,500 in steel required 100 gausses, but in the iron only 8, and it is easy to see by inspection that the steel loop averages nearly twenty times as wide as the iron one. Evidently the area of such a diagram is a measure of the expenditure of energy employed to perform the magnetic cycle. To this phenomenon Prof. Ewing has given the name of *hysteresis.* In a telephone receiver it is the function of the line current to create alternating magnetomotive forces by the coil which surrounds the magnetic system, and it is obvious that a certain amount of this energy must, therefore, be dissipated in the hysteretic losses in the material that forms the magnets. As the magnetomotive forces developed by the line currents are very small in comparison with the magnetomotive force of the entire magnetic system of the receiver, it is impossible for them to carry the magnet through a complete hysteretic cycle, such as is shown in Figs. 15 and 16. But the iron is carried through a small portion of such a cycle, which is represented in both illustrations by the loop *A E C F A.* Thus

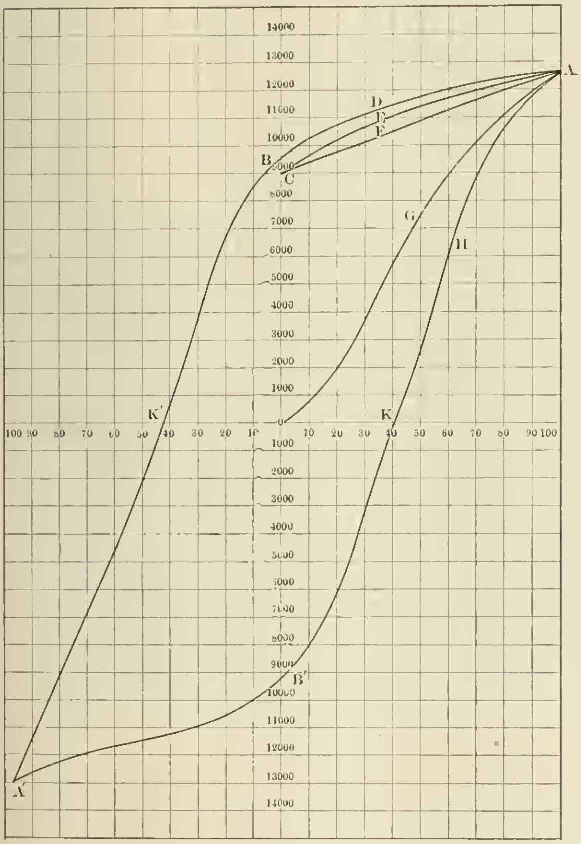


FIG. 15.—MAGNETIC CYCLE FOR STEEL.

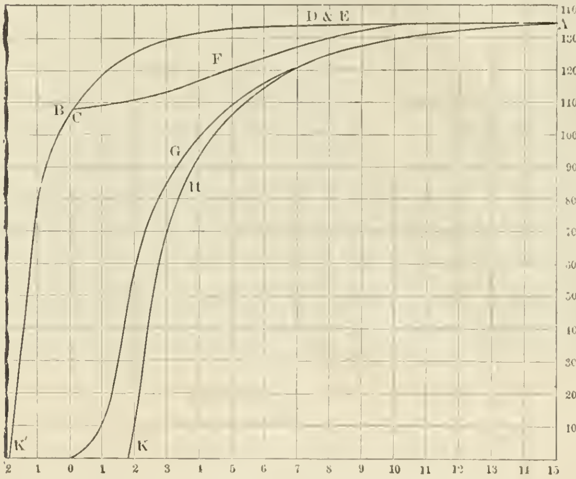


FIG. 16.—MAGNETIC CYCLE FOR SOFT IRON.

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* See page 1021, June 13, for this figure.

suppose, in Fig. 15, that after the magnetomotive force has reached an intensity of 100, it be reduced to 0, and then be increased to 100, the flux will follow the path *A E C F A*. Similarly in Fig. 16, if the magnetomotive force be carried to 15, then decreased to zero and then increased again to 15, the induction follows the line *A E C F A* on that diagram, and an amount of energy which is represented by the area of these loops will be dissipated. While such losses are small they are significant when it is remembered that the energy developed in the line current is exceedingly minute, and it is only by the exercise of the greatest possible economy in losses in every direction that improvement in telephone receivers can be made. So it is desirable to secure for the magnetic system such a metal as will show the highest degree of sensitiveness to the feeble line currents, and will simultaneously waste the smallest fraction of this energy in hysteresis.

The curves of Figs. 13, 15 and 16 show that soft iron is much more sensitive to slight changes in magnetism; exhibits a much smaller opposition to magnetic flux; and dissipates far less energy in hysteresis than steel. Some of the earlier forms of receivers were arranged to have one pole of the magnets carry the line coil, while the other was attached to the diaphragm. This design comprised a magnetic system having great reluctance and large hysteretic losses. As one pole was magnetically attached to the diaphragm, the latter, unless very thick, became supersaturated with the flux from the magnet, and was correspondingly insensitive to the field variations produced by the line current. We are now in a position to understand the logic of the later models in which the magnet carries *two soft iron pole* pieces on which the field coils are wound. The office of the magnet is to create such a field as will maintain all of the magnetic system in its most sensitive condition or state of unstable magnetic equilibrium. Hence the permanent magnet as a generator of the necessary magnetomotive force must have such dimension in relation to the air-gap and diaphragm as will maintain the latter in its most susceptible condition. The proportions of the magnet will, therefore, depend in the thickness and permeability of the pole pieces and diaphragm and the length of the air gap. The pole pieces form that portion of the magnetic system directly affected by changes in the line current. They must, in addition, transmit to the air-gap the flux created by the permanent magnet that shall, so to speak, sensitize the diaphragm. Hence the pole pieces must have such a section in proportion to permeability as normally to be in the most susceptible condition to respond to the line currents; they must be of such a material as will give the greatest value to μ; and dissipate the least quantity of energy by hysteresis. To make the whole apparatus as sensitive as possible the air-gap must be as short as is consistent to allow the diaphragm to make its greatest range of vibration without actually touching the pole pieces to avoid any blurring of its vibrations and prevent the possibility of magnetic adherence to the pole pieces; lastly, the diaphragm must be designed to contain as large a volume of the most permeable material as is consistent with the acoustic principles to be presently developed. We are now prepared to consider materials and methods of constructing permanent magnets, pole pieces and diaphragms.

Magnetic Pole Expedition.

The whaling ship *Gjoa,* with Capt. Ammundsen's magnetic North Pole expedition sailed from Christiania, Norway, June 17. The expedition will first go to King William's Land, on the eastern coast of Greenland, and will thence proceed for Behring Strait. The expedition was characterized by Prof. Schmidt, of Berlin, as undertaking the most important task in the domain of terrestrial magnetism. It is planned to take a route never before attempted. While it has not been announced that the expedition is designed to reach the Pole, if Capt. Ammundsen is able to follow the course projected it will take him almost directly across the pole. Capt. Ammundsen, who is a Norwegian, was the first officer of the *Belgica* in Gerlach's Antarctic expedition of 1897-99. After his return he consulted with Prof. Neumayer, of Hamburg, the leading authority on terrestrial magnetism, who informed him that expert determination of the earth's magnetic North Pole would be of the very greatest value to science. The fitting out of the expedition which has just left Christiania, followed. The Gjoa is one of the strongest and best vessels of the Arctic fleet. She can be handled by a crew of seven, is fitted with an auxiliary petroleum engine, and is equipped for a four years' stay in the Arctic regions.

Analysis of the Detroit Municipal Lighting Figures.

REPLY OF COMMISSIONER INGRAM AND REJOINDER

My attention has been called to an "analysis of the seventh annual report of the Public Lighting Commission, Detroit, Mich.", that appears on pages 351 and 359 of your journal of February 28, 1903, occupying 9½ columns. In your editorial discussion of the analysis on the first and second editorial pages of same number you say "nothing permanent is to be gained in it (public lighting) by concealing the facts as to its real cost, by whomsoever produced."

Speaking as one of them, I wish to say, the Public Lighting Commission of Detroit agrees with Dickens, that "facts alone are wanted in life. Plant nothing else and root out everything else." We welcome advice in getting at the real facts and appreciate the assistance offered us by this carefully written and scholarly criticism of our seventh annual report. The public generally are also entitled to the facts, for to quote Lieut. J. B. Cahoon, past president National Electric Light Association, "Cities are still threshing over the old ground of whether it will pay them to build their own plant to light their own streets" (Municipal Affairs, Vol. VI, No. 4), so I respectfully ask that you give the following statement the same publicity you did the analysis above referred to:

THE NUMBER OF LAMPS.

The average number of arc lamps in use, according to seventh annual report, was 2,133; the analysis claims the correct number should have been 2,082. This claim is made by assuming that one-half of 58 lamps on Belle Isle should be deducted from the average number of arc lamps, because the lamps on Belle Isle do not burn after midnight, also deducting "22 lamps in buildings," making a total of 51.

The average number of arc lamps in operation on Belle Isle for the year was 37. If it is reasonable to deduct one-half the number of lamps because they burn but half the time, the deduction should be one-half of 37, not one-half of 58, but since the total operating expense for the past six years averages 70 per cent., as fixed, and 30 per cent., as variable, one-half of the variable expense only should be deducted, which leaves 85 per cent. as the cost of operating these lamps; 85 per cent. of 37 is 31.45 lamps on Belle Isle.

The number of lamps in station is seven. The balance are located, 5 on Belle Isle Dock, 3 in Western Market, 4 in Eastern Market, lighting surrounding streets, as well as the sheds; 2 in Waterworks, and 1 in City Hall; all are operated all night and would be, if under contract; therefore, to deduct these 15 is plainly an error. As regards the "22 lamps in buildings," from the critic's point of view, comparing the cost with public lights furnished under contract, the lamps in station should properly be deducted, for there need be no station if lights were contracted for.

From average number of arc lamps (page 9, 2,133), deduct 5½ to bring the average number of lamps on Belle Isle to 31½, and 7 for lamps used in Public Lighting Plant, leaving 2.133 less 12½, or 2.120½, as the actual average, which, used as the divisor, makes the cost of an arc lamp $64.20, not $65.32, as stated in analysis.

DEPRECIATION.

The charge of 3 per cent. on total investment for depreciation is ample to take care of same considering the fact that the cost of maintenance and replacement, are charged to operating cost, and the plant is kept in first-class condition, while items figure in operating cost that could be charged to extensions, as they go to extend our lines, some of which I will refer to later.

Depreciation is always debatable ground, as for instance to again quote Lieut. Cahoon, of the National Electric Light Association, in speaking of private electric light companies (page 646 *ibed*), he says: "What profits were made were promptly paid out in dividends, and nothing was set aside for the replacement of apparatus. Depreciation was never thought of; hence, the burden on the electric light plant is much heavier than on any other form of manufacturing plant." There is and has been no motive for this policy in reference to Detroit's Public Plant, which is not run for such profit, every incentive prompting the management in quite an opposite direction. There is no depreciation that is not taken care of either in the depreciation charge or in the operating expense. Amounts charged to operating cost and expended for maintenance and replacement during the year (7th annual report) (see table on next page).

The amount annually represented by maintenance and replacemen included in operating cost and the depreciation charge leaves the cost of lights ($64.20) a very attractive figure when compared with prices usually charged cities under contract; still it is proving ample to duplicate our lines and apparatus as they need replacement; our funds for extensions, as shown by report, going to increase capacity.

Buildings, track, dock, etc.	$1,616.38
Steam plant	3,070.44
Electric plant	959.05
Miscellaneous tools and machinery	828.11
Conduits	377.73
Towers and lamp posts	974.99
Arc lamps	2,017.68
Lines and cables	4,562.18
Total	$14,406.56
Amount charged off for depreciation	24,073.17
Total for maintenance, replacement and depreciation	$38,479.73

VALUE OF PLANT

The present net value of the plant is correctly stated in the report, as it is the total cost less the ample depreciation charge explained in preceding paragraph. Our critic is mistaken when he charges that certain items of investment have been done away with, and their value not fully written off, as I will show farther on when discussing the items in detail.

AVERAGE WATTAGE PER LAMP.

For fiscal year covered by seventh annual report, the total hours of lighting (page 26) were 3,744.04. The average number of lamps (page 32) were 2,133, which included 37 lamps burning until midnight only; consequently being equivalent in kilowatt-hours' consumption to 18½ all-night lamps, so the average number of lamps burning for the full number of hours reported was 2,114½. Dividing the kilowatt-hours mentioned by said number of lamps shows an average per lamp at station of 463.8 watts, deducting from which 9 per cent. for line loss, shows a net wattage per lamp at lamp terminal of 422. This average is about 6 per cent. below the claimed standard of 450 watts for a 2,000-cp lamp, and is the result of the circuits being cut to 9.2 amp. after midnight, a practice which has been followed since the plant was established, the object of same being to save in operating expenses during the latter half of night giving the most light the first half when most needed. The per cent. of saving in cost during the year on account of cutting the circuits to 9.2 amp. after midnight is as follows:

The average kilowatts saved per hour on the entire load is 152.8, which for one-half the total hours per year (1.872) amounts to 286,041.6 kw-hours. The cost of coal and carbons (only items reduced) for the year was $29,293.52, or $.008 per kw-hour, making the actual saving $2,288.33, or 2.3 per cent. of the total operating cost. Dividing this saving by the correct number of lamps, viz., 2,120.5, shows an average per lamp per year of $1.08, adding which to the corrected cost previously given, viz., $64.20, makes the cost for 2,000-cp all night, $65.28.

"ABANDONED" POLE LINE MUNICIPAL LIGHTING IN DETROIT, MICH.

INCREASE OF LIGHTS.

Percentages of increase to extension of incandescent and arc lighting system mentioned on page 11 has reference to the number of arc lights, incandescent lights and motors installed during the year, and not to the output, and is correct. On June 30, 1901, the total number of incandescent lamps in public buildings was 6,948, including the lamps used in decorating and in welcome sign on City Hall. On June 30, 1902, the total number of incandescent lamps in public buildings was 11,780, being an increase during the year of over 69 per cent. There was also placed in public buildings during the year 12 motors with a total of 35 hp, which is equal to 350 incandescent lamps, making the increase in incandescent service over 74 per cent.

On June 30, 1901, the total number of arc lamps in operation was 2,042; during the year there was installed 260, making the total number of arc lamps in operation on June 30, 1902, 2,302, being an increase for the year of over 12 per cent.

COLLECTIONS FROM RENTALS, ETC.

In reply to criticism of the discrepancy in the amount received from rentals would say that this was an error, the letters, etc., having dropped out of copy for page 10 was passed at final proof reading, omission not noticed. The amount, $6,775.61, is correct, being the exact sum of the three items mentioned on page 70, and was received from sale of old material, incandescent lighting and rentals

COST OF PLANT PER ARC LAMP.

In reply to the statement that the cost of plant per arc lamp should be $340.37 instead of $263.35, as given in seventh annual report of the Commission (page 24), would say that the electrical capacity of the plant is as stated in report, 2,745 arc lamps, machinery and apparatus being in first-class condition, and capable of operating 2,745 arc lamps, and not of junk value, as claimed by critic; and on the capacity of the plant the cost as stated, $263.35, is correct. By allowing a certain portion of the plant as a reserve, as for instance computing the cost on the maximum number of arc lamps operated, the cost of course would be correspondingly more and is as stated, $340.37.

The plant capacity given in the fourth annual report is	1,337.5 K.W.
Purchased since:	
One 600-K.W. alternator	
One 175-K.W. Alternator	
One 7-K.W. Brush arc	782 K.W.
Total	2,119.5 K.W.
Sold 3 55-K.W. Westinghouse, 40 cycles	165 K.W.
On hand	1,954.5 K.W.

JUGGLING OF ACCOUNTS.

The inference our critic makes that funds appropriated for extensions and betterment have been used for operating expenses is ungenerous, for had he desired to know the facts before making his comments he could have ascertained them at our office without trouble, delay or expense. It is a public office and all such requests made in person or by mail receives due attention. It is public property, as accessible to all as to the Commission or its employees.

The kilowatt capacity of the plant is correct at 1,954.5, as given in the seventh annual report. The item in the fourth annual report referred to by the writer of the article in THE WORLD AND ENGINEER, is the sum of $41,045, which was allowed for extension of the arc and incandescent service. The arc lamps and incandescent service were put in, but the machinery was not purchased, which left a balance of $20,000 in the Public Lighting Fund, with which in 1901 775 kw was purchased at a cost of $26,865, the balance, $6,865, was taken from the surplus from appropriation for the operation of the plant.

The $37,000 appropriated for year 1902 for the purchase of machinery has not been expended, as the machinery will not be delivered before July, 1903.

LOST TAXES.

Under this head complaint is made because we use the term "probable assessed value." As stated in the sentence of which the above quotation is a part, "lost taxes are based upon a comparison with the assessed values of other plants of like character, similarly located in the city," this comparison was made by the city assessors and the Commission, and the sum for city, county and State taxes, as given in the report, was decided upon without bias, and I believe is fair. However, I submit herewith a statement showing the amount of taxes paid by the Edison Illuminating Company, of this city, for the same fiscal year, together with its kilowatt capacity and the rate of tax per kilowatt capacity. Also the amount added by the Public Lighting Commission in the seventh annual report on account of lost taxes, the kilowatt capacity of the public plant and the rate of tax per kilowatt capacity, and also the amount overcharged the Public Lighting Commission in comparison to the rate per kilowatt capacity as paid by the Edison Illuminating Company.

Edison Illuminating Company:	
Taxes	$12,490.67
K. W. capacity	5,257
Tax rate per K. W. capacity	2.37
Public lighting commission:	
Lost taxes, added	$8,262.35
K. W. capacity	1,954½
Tax rate per K. W. capacity	4.23
The amount the Public Lighting Commission would have charged if at the same rate per K. W. capacity as paid by the Edison Illuminating Company	$4,622.16
Lost taxes added to cost of arc lamp in seventh annual report exceeds actual taxes paid by the Edison Illuminating Company of this city on proportional capacity	3,640.19

Again, by comparing our charge for lost taxes with the taxes actually paid by the private company which last furnished the city its lights, and which probably would still be furnishing the city its lights had the city not installed its own plant, for they were the lowest bidders on a 10-year contract, it is found, making due allowance for increase that the charge is more than ample.

INCREASE IN "OUTAGES."

It is true the "outages" increased during the year covered by the seventh annual report over the preceding due to interruptions of service while changing a part of the street lighting system from direct-current, open-arc to the series-enclosed alternating, and did not result from our reduction in the cost of maintenance, as claimed. Our records show that this exceptional condition accounts for 75 per cent. of the "outages" for the year.

The following tables give the average number of lamps, total lamp-hours out and average lamp-hour out per lamp per year, for the fiscal years 1897 to 1901, inclusive, as operated by the Public Lighting Commission. Also the total number of lamps operated, total lamp-hours out and average lamp-hour out per lamp per year for the last year the city was lighted by contract.

Public Lighting Commission.

Year.	Av. No. Lamps.	T't'l lamp hrs. out.	Av. No. lamp hrs. out per lamp per year.
1897	1,744	7,465 hrs. 23 min.	4 hrs. 17 min.
1898	1,868	5,039 hrs. 43 min.	2 hrs. 42 min.
1899	1,963	6,138 hrs. 55 min.	3 hrs. 07 min.
1900	2,035	4,092 hrs. 19 min.	2 hrs. 00 min.
1901	2,133	6,825 hrs. 19 min.	3 hrs. 12 min.
Contract:			
1894	1,279	100,880 hrs. 00 min.	79 hrs. 00 min.

WAGES CORRECTLY DISTRIBUTED.

The total wages charged to maintenance and repairs as published in seventh annual report is correct. On page 40 of the seventh annual report of the Commission, under the head "Maintenance and Repairs," is a list of employees, but among this list are the following: One conduit man, 1 conduit helper, 1 line foreman, 5 linemen, 1 line helper, 1 ground man, all of whom not only work on maintenance and repairs to lines and cables, but also do all construction work done on lines and cables. Some of the other employees in this list also work on construction work at times, namely, the blacksmith, latheman, painter, and, in fact, all the employees mentioned in article, do more or less work on construction during the year. The employees mentioned in seventh annual report were those in the employ of the Commission on June 30, 1902, and do not include all the men employed by the Commission on this work during the year.

There was installed by our employees during the year in question 260 street arc lamps and service was connected to 36 public buildings.

The following tables give the correct amounts paid for labor on account of construction and maintenance and repairs, and agrees with time cards for the fiscal year ending June 30, 1902:

Month.	Maintenance and repairs.	Construction.
July	$445.98	$5,763.58
August	632.62	1,007.85
September	526.67	1,163.05
October	927.61	1,133.97
November	678.07	1,192.48
December	748.77	663.00
January	711.71	709.65
February	848.78	409.19
March	1,117.34	102.19
April	994.62	226.15
May	1,115.35	189.49
June	967.96	341.66
Totals	$9,715.48	$12,902.26

COSTLY POLE LINE WAS NOT ABANDONED.

In reply to the statement that one costly pole line has been practically abandoned, would say that this must have reference to our west side pole line, which carried a number of circuits, some of which have been transferred to conduits. Only the cable purchased for the conduits was charged to extensions, the labor and other material for installing same was charged to maintenance, as was also the time consumed in transferring such wires as were transferred from the poles to other lines. The poles and the balance of these wires that were on them are still in use, no wires or poles have been discarded. They are now being used for local purposes.

THE $100,000 SENSATION.

In replying to the statement that the Commission are now discarding $100,000 worth of machinery and lamps, would say the facts are, the only machinery discarded were three 55-kw alternators, two 100-light, direct-current arc machines, and 225 open direct-current arc lamps, all of which originally cost $11,425. They were sold for $2,772.89. Add to this the 3 per cent., which was charged off annually for seven years, which amounts to $2,399.25, shows a loss of $6,252.86, which will be charged to operation this year, and next as withdrawn and delivered to purchaser, but will be largely offset by the reduction in operating expense resulting from the change.

MISLEADING STATEMENTS.

In commenting on this statement made on page 10 of report, "A saving of expenditure formerly made by other agencies of the city government and now saved by virtue of the existence of this Commission, makes a further reduction in cash cost." Our critic says, the statement is misleading and incorrect. Since no such deduction figures in the challenged cash cost per arc, as given on page 9 of the report, I leave the reader to decide who it is that is attempting to mislead.

But since he has raised the question: has the city saved in doing its own lighting the sum $1,200 he wrongully infers has been deducted from the amount given as the cash cost per year?

Contracts for public service do not enforce themselves, and even though all the agencies of the city government that can be brought to bear upon the contractors are appealed to, the result as seen in the history of contract lighting is sometimes disappointing. Bribery, bargains and boodle too often become a factor in city lighting, as it was in the closing hours of contract lighting in this city, and is now in some cities, as witness the following dispatch in *Detroit Free Press*, dated Saginaw, Mich., May 10:

"The grand jury, as reported Saturday night, returned a grist of indictments.

"Alderman James Lester—Two indictments; accepting a bribe in connection with the electric lighting deal and offering $5,000 bribe to Thomas Nickels in the bridge matter.

"Alderman Frank Starkweather—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman James Willhite—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman Lave M. Stine—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman John Heman—Bribing Aldermen McCrea, Stine and Willhite in connection with the electric lighting deal.

"Ex-Alderman Fred C. Peters—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman Charles H. Bird—Accepting bribe in connection with the electric lighting deal.

"Ex-Alderman James McCrea—Accepting bribe in connection with the electric lighting deal."

Again:

Is $1,200 an unreasonable sum to expend in sustaining cities' rights under a lighting contract when the outage the last full year in Detroit with contract lighting was over $100,000 with 1,279 lights burning, and was less than $7,000 the reported year under public lighting, though there were over 2,000 lights burning?

THE INVESTMENT VIEWPOINT.

In reply to the statement that Detroit's municipal lighting plant is earning the city 4 per cent. on the investment, I will quote Mr. Joseph E. Lockwood, president of the Michigan Electric Company, who, I am sure, it will be conceded, is without bias, and whose long experience in the electric field makes him a competent authority. It is a summary of a carefully prepared paper that goes into minute details and is too long for repetition here, but is commended to those interested, and appears on pages 825-834 Municipal Affairs, Vol. 6, No. 4, and shows "the entire plant will be a clear profit to the city by July 1, 1905, ten years from the starting of the plant, it will have saved the city of Detroit enough to retire its entire bonded debt."

Mr. Lockwood considers all cash outlay, including interest and allowance for lost taxes and all other possible costs or charges, so after July 1 of that year costs may be justly computed without any interest allowance in comparing with what would have to be paid a private company, which if financed, as is usual, the public would be compelled to pay at least 5 per cent. on bonds, equaling in amount the full value of the plant, and in addition thereto a handsome profit to the stockholders on watered stock (see also remarks of Lieut. Cahoon, ex-president National Electric Light Association, Municipal Affairs, Vol. VI, No. 4, page 839).

We thank our critic for his carefully-prepared paper and will profit in future through his discoveries. In turn we hope those who wish "to form their minds upon facts" will be the gainers by this farther contribution to the discussion. In closing I wish to inform the editor, who says (page 345), "we have not the least prejudice. Our exposure of the facts in this case may seem merciless, but it is better for the public that they should come out without reserve," that such extraordinary devotion to the public as is here confessed deserves applause, and if the commissioners must suffer because the editor's heart is closed to mercy, they will try to be brave and will even also applaud if the deviations from strict and proper business methods in our accounting will also "come out," and we are shown specifically, not by general insinuation and innuendo what there is wrong about our bookkeeping.

While the criticism has shown some trifling errors which we cheerfully acknowledge, they are petty and of no consequence when considering the general result. After making every allowance for error, the total cost per 2,000-cp arc lamp per year from Detroit's public plant is $65.28, not "$80, probably more," as stated in the analysis. As for the quality, I have shown a great improvement, the outages the last year of contract lighting being over 25 times as many per lamp per year as the average annual outages from the public plant.

The tax charge added to cost per light by Detroit's public plant is, as I have shown, a greater sum than the taxes paid per light by the private company that last lighted Detroit's streets, while it is nearly double the tax paid, proportioned to capacity, by the Detroit Edison Company, for the year covered by the seventh annual report.

Due regard for the facts leaves no basis for the charge that wages are misapplied, or that depreciation is not fully taken care of, and after all is said, the fact remains that Detroit, by owning and operating its own electric plant, has greatly improved the service and will have saved enough over best ten-year contract price offered to more than retire its bonded debt within that period. Thus adding the entire plant worth, $800,000, to the profit of the undertaking.

Detroit, Mich., May 18, 1903. Frederick F. Ingram.

THE REJOINDER.

We are glad to give publicity to Commissioner Frederick F. Ingram's comment on our review published February 28. To the extent that his communication explains the obscurities and discrepancies of the Public Lighting Commission's Seventh Annual Report, it is a welcome addition to the existing fund of information. For such explanations and revisions as he has furnished, we thank him.

LAMPS ON BELLE ISLE.

Some of his figures, nevertheless, require further elucidation. His statement that the average number of lamps on Belle Isle for the year was 37 does not agree at all with the figures of the report. On page 29 it is printed that on June 30, 1901, there were 62 lamps on Belle Isle, and on June 30, 1902, 58 lamps. On page 35 the lamps on the Belle Isle circuit, not including any lamps in buildings, are listed as 62. We fail to see how these figures average 37, nor do we find that the average figure was used by the Public Lighting Commission as a divisor.

As to the lamps on Belle Isle dock, which Mr. Ingram says are operated all night, our information still is that these lamps only burn until midnight during the summer and not at all during the winter; and Mr. Ingram does not notice at all the apparent double credit for their operation.

Neither can we accept Mr. Ingram's further averaging by the introduction of fixed and variable costs unless the Commission will take account of fixed and variable costs systematically in all its public statements.

DEPRECIATION.

We admit that "depreciation" is debatable ground so long as it is figured from theoretical premises. We have invited the Public Lighting Commission of Detroit to take the depreciation of their plant out of the realm of uncertainty into that of certainty by making a proper inventory of the plant and comparing that with the book value.

Mr. Ingram's statement that there is no depreciation not taken care of either in the depreciation charge or in the operating expense, adds nothing to the evidence. It is merely his personal reiteration of the statements which he and five other commissioners have officially made. Unofficially, as well as officially, Mr. Ingram continues to avoid the only business-like way of showing whether the depreciation charge made by the Public Lighting Commission is sufficient; namely, the making of a systematic inventory of the property.

The opinion of Mr. Joseph E. Lockwood does not help the case. It also is merely an opinion. But if Mr. Lockwood is to be quoted by Mr. Ingram, he may also be quoted by us. In the paper to which Mr. Ingram refers (see *Detroit Free Press*, March 11, 1903), Mr. Lockwood suggests to the Commission the advisability of doing away with the 1,800 direct-current lamps, which have been in use for the last seven years, and the substitution of enclosed arc lamps. He recommends that the Commission ask for the issue of $150,000 worth of bonds to make the exchange. A condition of affairs which in the opinion of the engineer commended by Mr. Ingram now warrants the issue of $150,000 worth of bonds to make replacements, does not coincide with Mr. Ingram's claim that the depreciation charge heretofore made is sufficient. This replacement would almost wipe out the entire depreciation charge of the first seven years; and the proposed charge to capital account seems a rather desperate expedient.

OTHER QUESTIONS OF FACT.

Our reviewer takes issue with Mr. Ingram on matters of fact as well as matters of figures. He insists that the costly pole line to which he referred is really abandoned, and he sends us the annexed photographs showing its present condition. It formerly carried all the circuits for the western half of the city. The pictures show that it now does very little. He also quotes Mr. Ingram as authority for the bad condition of the pole line; referring to the *Detroit Sunday Tribune*, of November 18, 1900, in which Mr. Ingram over his own signature wrote as follows:

"Our superintendent had recommended that inasmuch as our main lines east and west within the half mile circuit were in bad condition they should be drawn into the conduits and the poles removed. Investigating, we found the conduits built, but not in use; the western poles rotten and dangerous and rebuilding necessary; but that the eastern line could stand another year. Therefore, we had the western line put into the conduits where it belonged."

It appears that while the line can carry the few wires still left on it, it had to be relieved of the work for which it was built; and that the cables which were put underground, while in a sense they were a betterment, did not add in any way to the distributing capacity of the plant. In our opinion the Commission should not have charged even the cost of cable entirely to extensions.

Mr. Lockwood's paper referred to is also a corroboration of our reviewer's statement that much of the original equipment of the plant is being abandoned. Certain it is that the Public Lighting Commission has replaced many Brush open direct current lamps by alternating enclosed lamps. The general understanding is that this action is part of such a continuous plan as is outlined by Mr. Lockwood. Mr. Ingram's figures under the head of "The $100,000 Sensation" are also questioned by our reviewer, who says that the apparatus listed by Mr. Ingram cost the Commission a good deal more than the $11,425 which Mr. Ingram quotes as its original price.

His figures are:

2 100 light dynamos at $2,292.00	$4,584.00
225 arc lights at $23.00	5,175.00
3 55 K.W. alternators, slow speed at $2,125.00	6,375.00
	$16,134.00

To which must be added the cost of foundations, of setting up and connecting.

This question can be settled by reference to the Commission's original records. The difference would not affect the general result, but our challenge of Mr. Ingram's accuracy invites a response from him.

BRIBERY AND CORRUPTION.

Mr. Ingram's reference to certain indictments of aldermen of Saginaw, Mich., although apropos, is not argument. Does Mr. Ingram expect us to believe that aldermen are always honest when public lighting is done by a municipal plant, and always dishonest when public lighting is done by contract? If so, will he kindly let us know why the aldermen of the city of Detroit are not permitted to manage the Public Lighting Plant of that city? Why, in fact, he and five other public-spirited gentlemen are appointed to give their time, worth a good deal, without salary, to the performance of duties which ought to be entrusted to the elected and paid servants of the city? This reference recalls to us that there was more than one scandal connected with the early days of the Public Lighting Plant of the city of Detroit, and that his predecessors presented to the Michigan State Legislature of 1895 such showings of corrupt practices that the Legislature withdrew from the Common Council of the city the right to confirm or to disapprove contracts for public lighting apparatus and supplies. To us it appears that honest men will be honest whether they be officers of a public or a private corporation. We believe thoroughly in the honesty of the Public Lighting Commissioners of the city of Detroit, but we think it is the individual honesty of these gentlemen and not any virtue in public ownership which to-day protects the Public Lighting system of their city from corruption and utter demoralization.

The Beauty of Niagara and its Power.

The Commissioners of Queen Victoria Park, on the Canadian side of Niagara Falls, are rather exercised over the criticisms leveled at them in connection with the power development now going on near the Horseshoe Falls. In their seventeenth annual report, they say: "The production of electrical power as a means of providing revenue has perhaps more than anything else been characterized as vandalistic in its ultimate effects on scenic conditions in the park. It should be borne in mind that at the time the park was established the science of producing electrical energy for motive purposes was practically in its infancy, the first electrical street railway in America having been put in operation in 1887. It was only when the practicability of transmitting electrical power assumed shape that the matter was considered by the commissioners as a possible means of revenue. The commissioners do not claim that they acquired the portion of the park lying south of Cedar Island looking to the utilization of this portion of the property as being eminently suited for the purpose. They do claim, however, that their recommendation to the Government which brought about the acquirement of this additional property has resulted in the greatest pecuniary advantage. Had the property not been expropriated when the park was founded—viewing it now in the light of what has transpired on both sides of the river—that part of the property would doubtless have been acquired by capitalists and laid out as a manufacturing district without reference to its scenic environments, as has been done on the American side of the river north of the steel arch bridge, to the irreparable disfigurement of the river bank. On the other hand, had it been expropriated after its capabilities as a center for production of electrical power on a large scale were demonstrated, it is quite probable that the price of such expropriation instead of the original cost of $100,000 would have been many millions of dollars, determinable only by the capitalization of the revenue obtainable from possible electrical franchises.

"Coming now to the charge that the commissioners have, in granting certain power privileges, committed acts of vandalism that will ultimately ruin the scenery of Niagara Falls, the commissioners have to state that with the exception of the Ontario Power Company's power house in the gorge under the falls, hereafter referred to, all the proposed works connected with the generation of electricity are practically beyond the territory originally designed for park purposes. When the electrical power works are completed not a single view of the falls, rapids or gorge under the falls will be obstructed in the slightest degree. On the contrary, the filling in of the shore line above the falls by excavated material from the tunnels will increase the park area very considerably and will permit of roads and walks being constructed on the margin of the river which will greatly improve the views of the upper rapids, and at the same time cover the foreshore, which in some places has become exposed by the recession of the waters, owing to the breaking away of the cataract. The waters forming the Dufferin Islands will be completely restored and improved by the construction of cascades and miniature falls, and, besides, the area at that congested point in the park will be considerably enlarged

"Respecting the construction of the Ontario Power Company's power house in the gorge under the falls the commissioners of the State reservation made representatiions to the board in July last and were granted a hearing with particular reference to the erection of the structure at that location, the contention of the commissioners of the State reservation being that the building would not only disfigure the landscape as viewed from several points in the American reservation, but would also be objectionable from an æsthetic standpoint and at variance with the natural conditions desired by the commissioners on both sides of the rivers.

"On the other hand, it was shown by the Canadian commissioners that the location of the building in question would present no obstruction to the free views of the falls or river from any point on the American side, and as the building would be far below the surface level of the park a part of the roof and the two gable ends would be the only parts of the structure seen from any point of view within Queen Victoria Park. It was further pointed out that to make the building in any sense a conspicuous or objectionable feature of the landscape would depend solely upon the design and character given to it.

"The commissioners have also arranged for the early removal of the large and unsightly building which is so conspicuous from the American side, and which was originally constructed for a museum, but which has recently been used for a restaurant and shelter building. The removal of this structure, which has formed quite a striking feature of the park, and the substituting of a modern refectory near the center of the picnic grounds, will remove from the park one of its most objectionable features, and will more than counterbalance any temporary disfigurement which the construction of the power house may cause.

"All of the works and structures connected with the electrical power projects have been designed with the object not only of doing the least possible injury to scenic conditions, but the commissioners are confident in the belief that when the several works are completed the consensus of opinion by the vastly increased numbers of visitors who are expected to visit the park will abundantly sustain them in their contention that the park, as a whole, with its wealth of electrical machinery, will then be of tenfold greater interest to the great majority visiting it. In addition, not only will the immediate locality beyond the park be built up into one of the great manufacturing centers of the world, but the quickening impulse and vivifying effects of the whole of the world's latest and most perfect form of energy—created and sent forth by the Falls of Niagara—will be felt from end to end of the province."

Municipal Lighting at Cleveland, O.

Mr. Samuel Scovil, vice-president of the Cleveland Illuminating & Lighting Company, and Superintendent Bemis, of the waterworks department, appeared before the board and respectively presented arguments against and in favor of the erection of a municipal lighting plant in Cleveland. Superintendent Bemis said that he placed a great deal of dependence on the report of Charles E. Phelps, an electrical expert of Baltimore, whom Mayor Johnson had employed to investigate the feasibility of establishing a municipal lighting system in Cleveland. Mr. Bemis further contended that Cleveland had three advantages in connection with the establishment and operation of a lighting system which a private company would not have, namely the necessary land on which the buildings can be erected, water at practically no cost, and an opportunity of combining the waterworks and proposed lighting departments, so that both departments would be under the general supervision of one man. He stated that cities now operating their own electric lighting systems were successful. He stated further that Hamilton, Ohio, has a municipal lighting system which furnishes electricity to private consumers in opposition to a private lighting company.

During the discussion Superintendent Bemis proposed to Mr. Scovil that the city would be willing to purchase the West Side equipment of the Illuminating Company, in order to save installing an entirely new equipment. Mr. Scovil ignored the proposition.

In arguing against the proposed plant, Mr. Scovil said:

"The proposition to install an electric lighting plant as now suggested in Cleveland, is a most unusual proposition.

"The statement is made that the plant is to be equipped not alone for the purpose of lighting the streets and the city municipal buildings, as is the case with other municipal plants in this country, but to go into the business of commercially selling light and power to users generally. In short, under the conditions existing now in Cleveland, it is a proposition to use the taxpayers' money to compete with private capital engaged in the same business. This is a novel departure in municipal ownership undertakings.

"Mention was made here last Friday of the waterworks department being operated successfully by the city. The conditions in relation to the supply of water and electricity are very, very different. Water is a necessity in every home. If the service is once introduced in any building, that building continues to be a source of revenue to the waterworks. It is not so with electricity. Here, the city plant will not have a complete monopoly, so the business will have to be handled on different lines. Aside from the important fact that the field is already occupied by a well-equipped company, electricity is not a necessity either as an illuminant or for power purposes. People can, and do, use other agencies freely for these purposes.

"The engineer's estimate submitted to the Council indicated that an arc lamp for street lighting would cost the city about $53.67 per annum. As compared with this estimate, the following figures in relation to the costs of arc lamps, as furnished by municipal plants operated by other cities, is of interest.

"Chicago has a municipal plant which has been in operation since 1888. The cost to the city per arc lamp per annum from 1888 to 1900, inclusive, shows an average of $142.18. These are not my figures. They are the figures as reported to the city of Chicago by Messrs. Haskins & Sells, public accountants, employed by the city of Chicago itself to investigate and revise its accounting system. The cost of a city lamp in the Chicago plant for 1901, as given by the city electrician, plus interest, depreciation, etc., is $95.27.

"The city of Allegheny reports a total cost per lamp per annum of $72.98. In arriving at this figure they figure depreciation at only 5 per cent.

"The Detroit municipal plant, operating some 2,200 street lamps, reports its cost as being $63.82 per lamp per annum. In arriving at this price they only figure depreciation at 3 per cent. In reality, the average cost to the taxpayer, as per appropriation each year for which taxes have been levied and collected for the plant, has been $85.08 per lamp per annum.

"The city of Cleveland is paying the present company $75 per lamp per annum, and this price is made on a one-year contract. In figuring depreciation at only 3 per cent., as the city of Detroit does for its plant, it is assuming that the apparatus in the plant will have a life of thirty-three years, which is altogether out of reason. Were the illuminating company given an opportunity to figure on a term contract, whereby it could distribute its depreciation over a considerable period of time, it could necessarily make a lower price for the lamps which it would furnish."

New Telephone Patents.

AN IMPROVED TRANSPOSITION.

Under the title, "Telephone Circuit," Mr. F. W. Sorg has obtained a patent for an improved transposition for line wires. For many years there have been but two general types of transposition, the so-called "English" method wherein the continuity of the wires is maintained through the transposition joint and the American standard, by which the wires are cut, spliced and reversed. In the former method each line wire makes a quarter turn about an insulator on one pin, then crosses over and makes a reverse quarter turn about the corresponding insulator of the other pin. With such a method longitudinal strains at the insulators are balanced, but there is left a force tending to pull the two pins toward each other, equal to the sum of the tensions in the line wires.

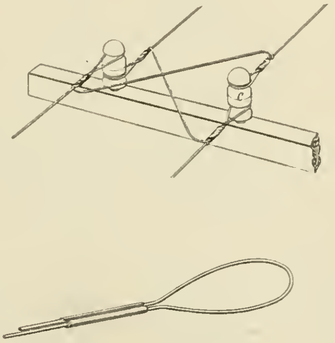


FIG. 1.—SORG LINE TRANSPOSITION.

With the American method all four approaching wires are dead-ended each about one section of the insulator of one of the pins. The projecting ends of the dead-ends are then crossed over and spliced. By this method the two wires may be run straight from end to end, and no abnormal strains occur at the pins except those due to the difference of height upon the pin of the tie grooves of the two sections of insulator. Mr. Sorg's invention consists of a dead-end similar to the American practice and a cross-over similar to the English. This will be appreciated from Fig. 1. The dead end is accomplished by means of a split sleeve, a loop being first formed in the wire, a sleeve put in place and the twisting accomplished by clamping the line end and twisting the loop end. The loop is then slipped over the insulator and held by tension. While the splicing of the line is avoided, it seems rather probable that the expense of reversing the line at each transposition will nearly offset this saving.

STEP-UP CENTRAL ENERGY REPEATING COIL.

In Fig. 2 is shown a new method of repeating in central energy systems at the point of division in through circuits made necessary by the application of the battery. Heretofore the ratio of conversion at the repeating coils has been one to one, so that equally good transmission is obtainable in both directions when similar types of telephone instruments are at both ends of the line. This ratio has limited the resistance of receivers to a comparatively low value and one not always giving the best efficiency. With the step-up repeating coil system, one repeating coil is used toward each end of the line. These have low resistance primaries, through which the current is fed to the transmitters and high-resistance secondaries of many turns. The secondary of one coil is connected to that line section associated with the primary of the other coil, as shown. Thus fluctuations set up in one section of the line by its transmitter, affect the corresponding coil and through the secondary generate higher voltage fluctuations upon the second section of the line where they pass to the receiver. Mr. Hiram D. Currier, of Ottawa, Ohio, is the inventor of this system.

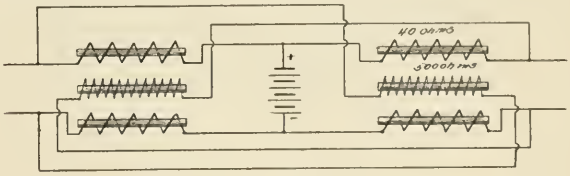


FIG. 2.—CURRIER REPEATING COIL.

Electrical Engineering Instruction at Columbia University.

By George F. Sever.

THE education of a young man for the electrical engineering profession is the problem which confronts many men in the various technical schools, colleges and universities throughout this country. Owing to the rapid development of all lines of electrical industry, the educator in electrical engineering had to overcome many difficulties in designing a course of instruction which meets the rapidly changing and developing conditions. Probably in no other branch of engineering has such an enormous development taken place in so short a time. All other engineering professions, civil, mining and mechanical, have been developed through long periods of time, and the subjects to be taught are definite and the ideas involved have been illustrated in many text-books suitable for instruction.

In the earlier days of electrical instruction there were only the electrical units, the telegraph, telephone and the beginnings of electric lighting. Those subjects as well as the underlying principles were taught under the department of physics in the various schools and universities.

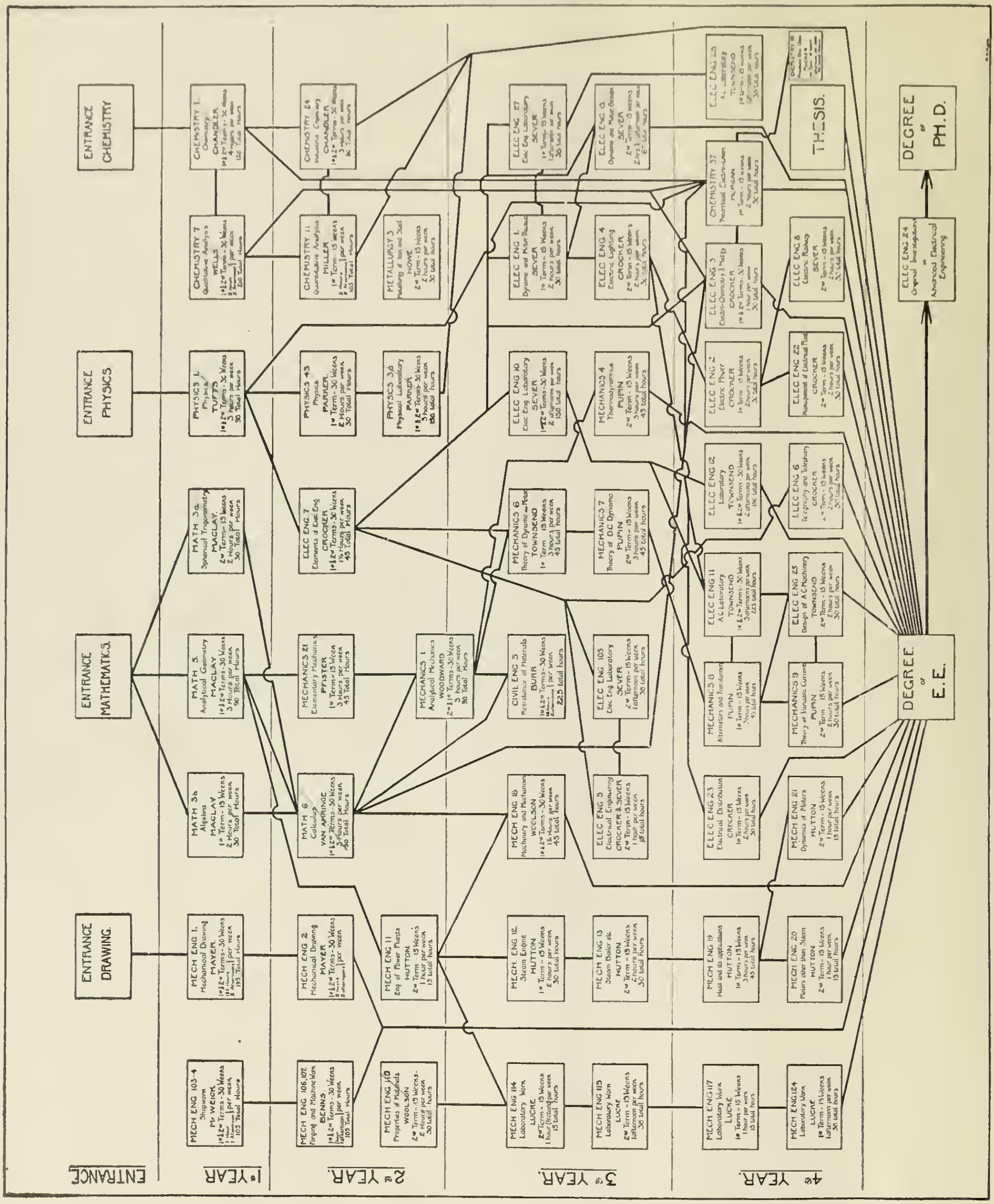

ENTRANCE
1st YEAR
2nd YEAR
3rd YEAR
4th YEAR
ENTRANCE CHEMISTRY
ENTRANCE PHYSICS
ENTRANCE MATHEMATICS
ENTRANCE DRAWING
CHEMISTRY 1 Chemistry CHANDLER
CHEMISTRY 7 Qualitative Analysis WELLS
PHYSICS 1 Physics TUFTS
MATH 3a Spherical Trigonometry MACLAY
MATH 5 Analytical Geometry MACLAY
MATH 3b Algebra MACLAY
MECH ENG 1 Mechanical Drawing MAYER
MECH ENG 103-4 Shopwork McWEENY
CHEMISTRY 24 Industrial Chemistry CHANDLER
CHEMISTRY 11 Quantitative Analysis MILLER
METALLURGY 5 Metallurgy of Iron and Steel HOWE
PHYSICS 43 Physics PARKER
PHYSICS 3/6 Physical Laboratory PARKER
ELEC ENG 7 Elements of Elec Eng CROCKER
MECHANICS 21 Elementary Mechanics PFISTER
MECHANICS 1 Analytical Mechanics WOODWARD
MATH 6 Calculus VAN AMRINGE
MECH ENG 2 Mechanical Drawing MAYER
MECH ENG 11 Eng of Power Plants HUTTON
MECH ENG 106,107 Forging and Machine Work BENNS
MECH ENG 110 Properties of Materials WOOLSON
ELEC ENG 27 Elec Eng Laboratory SEVER
ELEC ENG 13 Dynamo and Motor Design SEVER
ELEC ENG 1 Dynamo and Motor Theory SEVER
ELEC ENG 4 Electric Lighting CROCKER
ELEC ENG 10 Elec Eng Laboratory SEVER
MECHANICS 4 Thermodynamics PUPIN
MECHANICS 6 Theory of Dynamo and Motor TOWNSEND
MECHANICS 7 Theory of DC Dynamo PUPIN
CIVIL ENG 5 Resistance of Materials BURR
ELEC ENG 105 Elec Eng Laboratory SEVER
MECH ENG 18 Machinery and Mechanism WOOLSON
ELEC ENG 5 Electrical Engineering CROCKER & SEVER
MECH ENG 12 Steam Engine HUTTON
MECH ENG 13 Steam Boiler etc HUTTON
MECH ENG 114 Laboratory Work LUCKE
MECH ENG 115 Laboratory Work LUCKE
THESIS
CHEMISTRY 37 Theoretical Electro-chem MORGAN
ELEC ENG 3 Electro-Chemistry and Metallurgy CROCKER
ELEC ENG 8 Electric Railways SEVER
ELEC ENG 2 Electric Power CROCKER
ELEC ENG 22 Management of Electrical Plant CROCKER
ELEC ENG 12 Laboratory TOWNSEND
ELEC ENG 6 Telegraphy and Telephony CROCKER
ELEC ENG 11 AC Laboratory TOWNSEND
ELEC ENG 25 Design of AC Machinery TOWNSEND
MECHANICS 8 Alternators and Transformers PUPIN
MECHANICS 9 Theory of Variable Currents PUPIN
ELEC ENG 23 Electrical Distribution CROCKER
ELEC ENG 21 Dynamics of Motors HUTTON
MECH ENG 19 Heat and its applications HUTTON
MECH ENG 20 Motors other than Steam HUTTON
MECH ENG 117 Laboratory Work LUCKE
MECH ENG 124 Laboratory Work LUCKE
ELEC ENG 24 Original Investigation in Advanced Electrical Engineering
DEGREE of E.E.
DEGREE of PH.D.

CHART OF ELECTRICAL ENGINEERING COURSE, COLUMBIA UNIVERSITY, NEW YORK.

In 1889 there was established at Columbia College the Department of Electrical Engineering. It was under the guidance of Profs. F. B. Crocker and M. I. Pupin and was one of the earliest established in this country. Its instruction was distinguished from that given elsewhere by the fact that the Department of Physics confined its work to that subject specifically, while all the applications of electricity were taught in the Electrical Engineering Department. Furthermore, those who completed this engineering course successfully, received the degree of "Electrical Engineer," while in most other institutions "Mechanical Engineer" or "Bachelor of Science" is the degree conferred. Since that time other universities and technical schools have followed the example of Columbia in completely separating their electrical engineering course from that of physics, or mechanical engineering. As a result of the independence of this electrical engineering course, the department has had the services of the associate departments at its command for the instruction of the electrical students, but it has not been hampered by the necessity of carrying out instruction in physics for the students in all courses which otherwise would greatly interfere with the work of the department in relation to its own students.

Since 1889 the electrical department has grown, both in personnel, numbers of students and in equipment. In moving from the old site on Forty-ninth Street much more commodious quarters were provided in the new Engineering Building, and an opportunity was provided for bettering the laboratory equipment, as well as the arrangement of the studies. In arranging the curriculum, the attempt is not made to turn out men fitted only for some special line of work, that is, those who are informed solely as to one line of electrical engineering work, but to so equip every man that when he finishes his course he has the fundamental facts relating to his profession clearly and absolutely fixed, is able to think clearly and logically, and has had developed by laboratory training his investigating ability and a certain amount of independence of action. On account of the exactness of the electrical engineering profession, it is possible by proper care and forethought to train the man's mind so that he is excellently equipped in the logical sequence of thought and can respect the certainty of his results. These conditions are not present to the same extent in any other line of engineering work.

The chart which accompanies this article is intended to show the technical entrance requirements, the course of study during the four years which the student spends in the department, the weight given to various lines of study and the use of earlier studies in carrying forward work in the higher courses. The heavy lines connecting the various subjects indicate the sequence in which the subjects have to be pursued and also the subjects which have to be taken, as might be said, in parallel. The failure in any subject prevents the securing of the electrical engineering degree.

This method of presentation of a prescribed technical course has been found of great value, both to students and instructors. Ordinarily the student cannot clearly see what is coming and does not understand the relationship of his various courses. This graphical representation avoids, to a great extent, his lack of appreciation of what is to be met with in the future.

The importance of studies such as English, elementary history and foreign languages is not brought out by the studies recorded in this chart. For entrance, the candidate must pass all of the following studies, which have different values, as shown:

Mathematics, elementary and advanced,	counting	4 points.
Physics	"	1 point.
Chemistry	"	1 point.
Drawing	"	1 point.
English	"	3 points.
Elementary history	"	1 point.
Elementary German	"	2 points.

and two points from one of the following subjects:

Elementary French	counting	2 points.
Spanish	"	2 points.
Elementary Latin	"	2 points.

It will be noticed that English, elementary history and two other languages count for 8 points out of 15, or about 53 per cent. of the total entrance requirements.

The engineering student has his time so filled with necessary scientific and technical subjects that it is not always possible to introduce such culture studies as history and literature, which are extremely important for him to possess, consequently, the trustees and engineering faculty have recommended the candidates to take advantage of the opportunities offered in Columbia College, the Academic Department of the University, before entering the professional courses.

Under this curriculum students, at the end of four years, may obtain the degree of "Bachelor of Arts," and may at the same time prepare themselves to enter the third year of any of these professional schools, and take their technical degrees two years later. As students may and do enter the college two years earlier than they enter the professional schools, they will be able by taking this combined course of study to obtain the professional degree at the same age as though they entered the professional school in the first instance at the present average age. This combined six-year course is strongly recommended, for the reason that engineers and chemists, as professional men, need the liberal training offered by a collegiate course quite as much as do lawyers, physicians or clergymen. Experience has shown that those who have pursued a liberal course of study, and who have enjoyed the advantages of such an education before beginning their technical studies, have usually attained a higher standing in their profession and have exercised greater influence in the community than those who have relied upon a purely scientific or professional course of study.

The degrees of "Master of Arts" and "Doctor of Philosophy" are awarded by the University Council upon the recommendation of the Faculty of Applied Science for advanced work in electrical engineering. Candidates for either of these degrees must hold a baccalaureate degree in arts, letters, philosophy or science, or an engineering degree, or an equivalent of one of these from a foreign institution of learning.

Candidates for the degrees of "Master of Arts" and "Doctor of Philosophy" must pursue their studies in residence for a minimum period of one and two years respectively. In most cases three years of study are usually necessary to obtain the degree of "Doctor of Philosophy." The year spent in study for the degree of "Master of Arts" is credited on account of the requirement for the degree of "Doctor of Philosophy." Residence at other universities may be credited to a candidate. In certain cases and by special arrangement, time exclusively devoted to investigation in the field will be credited in partial fulfilment of the time required. No degree will be conferred upon any student who has not been in residence at Columbia University for at least one year.

In the electrical engineering course a large amount of instruction is given in mechanical engineering subjects, including practice in the mechanical laboratories, testing steam and other mechanical appliances. Under the Department of Chemistry during the first two years, fundamental qualitative and quantitative courses are given, with a large amount of laboratory work, and in the fourth year are given courses in electrochemistry so arranged that the theoretical instruction and the laboratory work parallel each other. Particular attention is devoted in the Department of Physics to the electrical students, and this work is supplemented in the Electrical Engineering Department by a thorough course in the careful calibration of instruments and the study of advanced electrical measurements. The Civil Engineering Department provides a course in the resistance of materials involving instruction in the design of girders, columns and general structural work, which is particularly valuable for electrical engineers. A broadening course given in the second year under the Department of Metallurgy provides the student with an understanding of the manufacture of iron, steel and copper, which are the materials he will use in his subsequent work.

Probably the greatest weight is given to that tool of all engineers, mathematics. It will be noticed on the chart, starting at the subject of entrance mathematics, what important consideration is given to this work. A student failing in mathematics in his first or second year is absolutely prevented from advancing further in most of his studies until he has fulfilled the mathematical requirements. No other subject is so absolutely essential to the success of an engineer as is that of mathematics.

Laboratory work in electrical engineering is fundamentally important for the student to enable him properly to understand electrical actions. Experimental lectures and the use of diagrams are valuable, but nothing can compare with laboratory instruction in proving to a man's mind the actuality of electrical actions. In no other profession is imagination so necessary to the comprehension of the mutual relationship of forces. It is necessary for him to understand what will happen before he actually combines the physical parts. It is not always possible in a lecture to convey to the students' comprehension the various actions which will take place in electrical circuits. If, however, he can demonstrate to himself these actions by actual apparatus, he then thoroughly understands and remembers them. For the above reasons the electrical laboratories have been equipped with apparatus to demonstrate the principles, and the apparatus has been so chosen that the students may operate it without danger to themselves.

All laboratory instruction has to be modified in order to conform to the limitations of the laboratory equipment, therefore it will be found that no two laboratories have the same methods of instruction. We may all have the same ideals, but almost all differences of opinion relating to engineering education will be found to be based upon the variations in personnel and equipment

Magnetic Increase of Traction.

The increase and decrease of motor traction is a subject which has been considerably discussed by engineers, and as is well known, a number of devices have been invented not only to lessen the tractive power, but to increase it when such a condition is desirable. So far, however, the sand box is one of the requisites in connection with the ordinary steam locomotive and the use of sand upon city and suburban electric railroads is also very extensive. Apparently this method is best adapted to keep the drivers of the locomotive and the wheels of the trolley car from slipping upon wet rails or in moving up a heavy grade.

FIG. 1.—MAGNETIC TRACTION ON LOCOMOTIVES.

In a comparatively recent invention, however, electromagnetism has again been tried as a substitute for sand. A simple magnet is used connected with what is termed an idler wheel. The operation of the system is as follows: When applied to an ordinary trolley car, on each side of the motor, between the motor casing and the wheel, is a bearing which supports an arm upon which the magnetizing coil of wire is wound. The other end of the arm carries a small wheel without any flange, which rolls along the rail when the device is in operation, and is held above the rail by springs when the coil is not energized. The object of this arrangement of an "idler" wheel upon the rail is to give a short magnétic circuit. The lines of force in this case flow from the arm to the car journal and wheel, from the wheel to the rail, from the rail to the idler wheel and thence to the coil-wound arm.

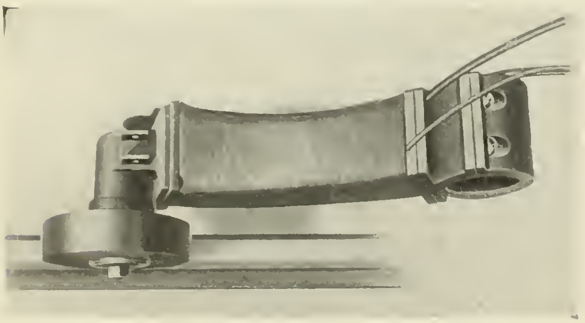


FIG. 2.—MAGNET AND IDLER WHEEL.

The experiments have been conducted with this method of increasing traction on both street and steam railroads. In Seattle, Wash., a double-truck car was equipped with two 50-hp electric motors for driving purposes, also for supplying what might be called the traction current. The idler wheels were held at a distance of five-eighths of an inch above the rail when the magnet was not energized. The current was controlled by a switch operated by a lever at the motorman's elbow, so that it could be turned on and off as readily as the motor current. It was found that with an expenditure of 2½ hp the magnetism developed increased the tractive effort over 300 per cent. In one instance the wheels and rails were greased and the car started. When the wheels began to slip, the draw-bar pull was found to be 1,500 pounds. When the magnets were energized this was increased to 5,250 pounds. In another test the model of a trolley car by use of the device was moved up a track constructed at an incline of 45°. When the current was turned off the magnet, however, the ascent was found to be impossible.

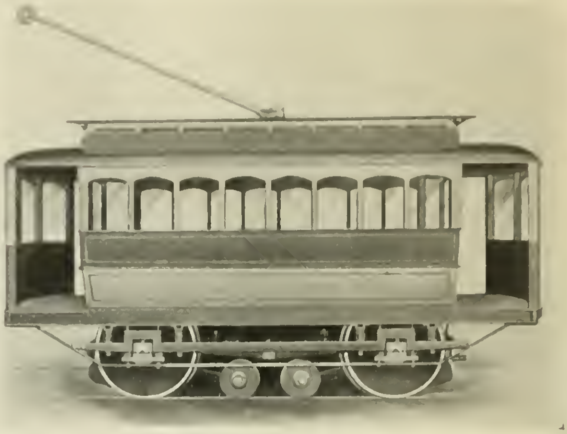


FIG. 3.—MAGNETIC TRACTION ON TROLLEY CAR.

The claim made for the apparatus is that its application to a steam locomotive would not necessitate the use of such heavy locomotives as are at present built for service on heavy grades since the electromagnet would act as a substitute for much of the weight now required to secure the necessary traction, while as already stated, the invention is intended to do away with the use of sand entirely. The inventor of the device is A. A. Honey, an electrician of Chicago, who was formerly superintendent of telegraphs of the Northern Pacific Railway Company. Two patents on the subject were issued to him on June 16.

Multiphase Arc Lamp.

Mr. Richard Fleming, well known as an inventor and engineer in the arc lighting field, has recently patented some work on multiphase arc lamps. In one patent the central idea is the provision of a common feed mechanism of solenoid coils, for all the electrodes, influenced by the current passing in all branches of the multiphase system. In a later patent, the principle exemplified is that of feeding all the electrodes through the intervention of an induction motor. The operation of the lamp is as follows: Assuming the electrodes to be separated, on closing the switches in the lines 39, 40 and 41, re-

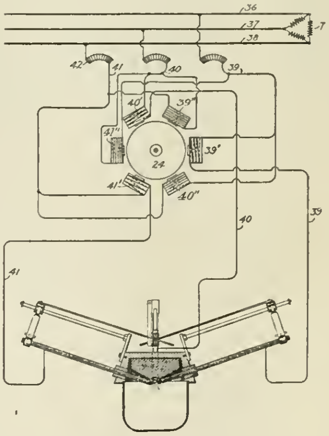


DIAGRAM OF LAMP AND GENERATOR CONNECTIONS.

spectively, current will begin to flow through the windings 39″, 40″ and 41″. This sets up a rotary magnetic field, which turns the armature 24 in the direction suitable to feed the electrodes toward their point of convergence. When the electrodes contact with one another, current begins to flow through the electrodes. This energizes the polar extensions surrounded by the windings 39′, 40′ and 41′. These are connected, as shown, so as to produce a magnetic field rotating in opposite direction from that produced by the windings 39″, 40″ and 41″, and these fields are proportioned so that on the passage of an excess of current through the electrodes, as at starting, the field produced by the windings 39′, 40′ and 41′ overcomes that produced by the other windings and rotates the armature in such a direction as to separate the electrodes. When the electrodes have been separated the desired amount, the increased resistance of the arc due to such separation diminishes the current flowing through the windings 39′, 40′ and 41′, so that the fields produced by the two sets of windings balance one another and the armature remains at rest. An increase of resistance in the arc, causing a further diminishing of the current in the series windings, will have the effect of causing the armature to turn in the feeding direction under the influence of the shunt-windings, while an increase of current passing through the series windings will cause the electrodes to be separated. By this arrangement, it is said, a very sensitive and efficient feeding mechanism is obtained.

Data on Siloxicon.

By E. G. Acheson.

The descriptions of the new refractory substance, siloxicon, that have recently appeared in the newspapers have created a widespread interest, but one or two points need clearing up in regard to it. It was stated that siloxicon was inoxidizable, but recent investigations have shown that this is not true. When it is heated to, or above, 2674° F. in an atmosphere containing a large amount of free oxygen decomposition occurs.

Siloxicon, while variable in composition, may be represented by the formula Si_2C_2O, and when heated, as above stated, in presence of free oxygen, decomposition takes place, probably in accordance with the following equation:

$$Si_2C_2O + 7O = 2SiO_2 + 2CO_2.$$

If the siloxicon be in the form of a brick or other molded mass, the reaction occurs on the surface, producing a vitreous glaze, which in most instances is tinged light green from the presence of iron.

In the absence of free oxygen or in a reducing atmosphere, no such decomposition occurs, and the temperature may be raised to the point of the formation of carborundum, or, approximately, 5000° F., before any change occurs, and then it takes place, it is thought, in accordance with this equation:

$$Si_2C_2O = SiC + Si + CO,$$

solid carborundum remaining, while the vapor of silicon and carbon monoxide are given off.

It is interesting to note that after having discovered this oxidation of siloxicon, tests were made with carborundum, and it was found to be affected in a manner exactly similar to siloxicon; this notwithstanding the fact that for more than twelve years it had been generally considered inoxidizable.

CURRENT NEWS AND NOTES.

ITALY AT ST. LOUIS.—It is stated by advices from Rome that Italy will occupy just about 60,000 square feet at the St. Louis Exposition, including 4,875 for mining and electricity, and 13,000 for varied industries.

STRIKE LOSSES.—As a result of the long deadlock in the building trades, in New York City, 2,000 electrical workers are out $256,000 in wages they would have received. This is but one item of the needless loss and trouble.

WIRELESS TELEGRAPHY IN CHINA.—A despatch to the London *Times* from its Pekin, China, correspondent states that the Italian legation in that city is installing a Marconi wireless telegraph station for the purpose of communicating directly with the ships in the Gulf of Pe-chi-li.

NORTH SEA TELEPHONY.—Telephonic communication has been established between England and Belgium, the service being operated by the telegraphic departments of both countries. The price is 10f. for three minutes. On the French service between Tours and Paris two separate conversations can be carried on simultaneously on the same line by the method invented by M. Petit, inspector of the electric service at Tours.

MEDICAL ELECTRICITY.—Dr. D'Arsonval, lecturing in Paris last week on the effects of electricity upon human beings, expressed the belief that the world is on the eve of a therapeutical revolution, electricity being the medicine of the future. He demonstrated the utility of electrical treatment in skin diseases and said that under anæsthesia produced by electricity, a patient could be subjected to slight surgical operations without narcotics.

THE PACIFIC CABLE.—Advices of June 20 from San Francisco state that within a week the last link of the Commercial Pacific cable will be laid between San Francisco and Manila, and the United States will have direct communication with its Philippine possessions. The cable ship *Colonia* reached Midway Island on June 19, completing the link between Guam and Midway, and immediately on its arrival the *Anglia* departed for Honolulu to close the last gap in the transpacific cable, a distance of 1,160 miles.

TRAFFIC REGULATION IN LEIPZIG.—United States Consul B. H. Warner sends the following from Leipzig, May 26, 1903: "Municipal ordinances prescribe that electric street cars shall not run at a higher rate of speed than 9 miles an hour in the business sections; with trailers, 7.2 miles; in residential sections, 10.8 miles an hour, or 9 miles with trailers; and in the suburbs, 15 miles, or 12 miles with trailers. The penalty for exceeding the speed limit is a fine up to $15 or imprisonment for fourteen days, or both. In case of accident, a higher penalty may be inflicted. The city council, at a recent meeting, passed an ordinance prohibiting the use of automobiles in most of the streets of the inner city, and in other parts allowing them to be driven only along those streets which are traversed by electric cars."

WHAT COLD DOES.—In the July *Booklovers' Magazine*, Mr. G. W. Warder says: "Heat can exist only where there is an atmosphere, and then it must be constantly supplied with fuel to overcome the law of constant repulsion and diffusion. Cold is the absence of heat and exists everywhere. It overcomes disintegration and preserves the universe. It enforces the universal law of the electric attraction and cohesion of atoms and worlds. Cold must predominate to preserve the universe. There is a billion times a billion more cold in the universe than heat. There always has been and there always will be. The heat of the sun, compared with the cold that surrounds it, is as a mustard seed to Jupiter. The earth's heat, in comparison to the cold that surrounds it, is as an orange to the solar system. Then what folly to talk of the universe having begun in white heat, and the earth having been a molten world, and the suns great burning spheres."

PROTECTING WESTERN UNION WIRES.—At Wilmington, Del., on June 19, in the United States Circuit Court, Judge Bradford heard the arguments in the case of the Western Union Telegraph Company versus the Philadelphia, Baltimore & Washington Railroad, the Delaware Railroad and the Delaware, Maryland & Virginia Railroad, in an action to restrain the railroad companies from removing the poles and wires of the telegraph company from their rights of way. Counsel for the telegraph company contended that the conditions affecting the case were different in Delaware than in other States, and asked a ruling of the court. Counsel for the railroad companies held that conditions in all the States were similar, and said it would be unnecessary to proceed with the argument now as the decision of the suit instituted in New Jersey was now pending in the Supreme Court of the United States, and that it would determine the issue in all other cases. Judge Bradford reserved decision. The United States Supreme Court has, according to a Baltimore dispatch of June 20, granted an injunction restraining the Pennsylvania Railroad from interfering with any of the lines of the telegraph company. This action, it is stated, will keep the telegraph property in *statu quo* until the final decision is reached on the main case at the next term of the Supreme Court of the United States.

LONDON UNDERGROUND ACCIDENT.—According to a special cable dispatch from London of June 17 there was another collision on the London Underground Railway that day in which the last two cars of the forward train were wrecked. Six passengers were seriously hurt and fifteen slightly injured. The accident occurring just before this was attributed to the electric "tube" road, which has, however, been remarkably free from such casualties.

PRACTICAL HIGH TENSION WORK.—In his paper before the Canadian Electrical Association, Mr. Paul M. Lincoln said: "Put to the fresh college graduate the problem of the amount of distance to be left between the conductors of a high tension transmission line. His answer will involve most likely the jumping distance of the voltage to be used, the length of span, the sag and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong and that the equation to determine spacing of high tension wires depends very little on the voltages to be carried and almost entirely on such things as the average length and ohmic resistance of cats, the spread of wing of owls and cranes and eagles, and the average length of scrap baling wire, together with the strength of the average small boy's throwing arm."

LARGE CURRENT PLUG FUSE.—Mr. Herbert C. Wirt, of the engineering staff of the General Electric Company, has taken out a patent on plug fuses for large current circuits. The idea is to provide a plug fuse which shall be compact, easily and economically constructed, and which at the same time may be readily taken apart for the purpose of renewing the fuse and when in use shall be substantially proof against disruption by the gases generated within the same upon the burning out or blowing of the fuse link. The invention consists of a metallic shell closed at one end by a cap, which may be either removably or permanently connected thereto and the other end adapted to receive and hold securely therein a piece of insulating material provided at its center with an aperture, whereby the fuse or a part making contact with the fuse may be centered and held out of electrical contact with the sides of the metallic shell. The exterior of the metallic shell is adapted for insertion into a receptable and the current closed through the shell, its cap and the fuse to the center contact of the receptable. The fuse link shown consists of a strip associated with crimped or accordion-plaited fibre insulation which it is threaded through and which keeps it from coming in contact with the inner wall of the base casing when weakened by excessive current.

MOTOR BRAKING DEVICE.—Mr. G. O. Baker has been granted a patent on his method whereby an electric motor used for driving machinery may be converted immediately into a braking generator by the operation of a circuit-breaking device controlling the power circuit. In many classes of machines—such, for instance, as printing presses—it is desirable to be able to stop the machine very quickly to prevent injury to the mechanism or the work. When the machine is driven by an electric motor, it is well known that the supply of current to the motor may be quickly cut off by including an electromagnetic circuit-breaker in series with the motor and providing a control circuit, with push buttons located at convenient points, so that an attendant by pressing one of said buttons can cause the circuit-breaker to operate. It has also been proposed to so construct a motor controller that when necessary it will automatically shut off the power by coming to "off" position and will then short-circuit the motor through a resistance, so that the motor will act as a generator, driven by its own momentum, and that of the machine to which it is connected, and thus serve as a brake to stop the machine. Mr. Baker's invention aims to combine both these ideas by so constructing the circuit-breaker that when it operates it will automatically close the circuit of the motor through a local circuit, thereby causing the motor to act as a braking generator immediately without waiting for the controller to be returned to its off position or for the operation of any intermediate mechanism.

RESISTANCE SETS.—Mr. Edwin F. Northrup, of Philadelphia, has secured a patent on improvements in resistance sets. The principal objects of his invention are to effect an arrangement of resistances whereby a comparatively large number of resistance values may be gotten from a small number of resistances, and also to effect an arrangement of connections whereby these values may be obtained in regularly-increasing order by introducing the resistances between two contacts or brushes through which current passes to and from said resistances, and between which brushes and resistances there is relative movement. A further object of this invention is to effect an arrangement of resistances whereby one may expeditiously obtain a series of ratios of resistance—such, for example, as are required in making a variety of tests with a Wheatstone bridge. It has generally been customary heretofore in varying electrical resistance in a circuit to connect the terminals of the circuit to the resistances and to alter the resistance by cutting in or out of the circuit varying amounts of resistance by means of plugs, brushes or other contact makers, which form no part of the terminal connections or only one of the terminals. In the common form of rheostat the brush is usually connected to one of the terminals, while the other terminal is permanently secured to the resistance coils. In contradistinction to all such methods the Northrup invention contemplates varying the resistance by inserting varying amounts of resistance between two brushes or other contacts, which are direct connected to the terminals of the electric circuit. The resistances are in this case of such values as may be combined to give regularly increasing value of resistance greater in number than the resistances employed. These combinations of resistance are predetermined, and the said resistances are connected up in accordance with such combinations to a series of contact plates. The resistance is then varied by bringing successive combinations of the contact plates into engagement with the brushes. Mr. Northrup states that he has discovered that by giving the resistances certain values and by connecting them in certain prearranged combinations he can by means of the arrangement of connections above referred to get ten regularly-increasing values of resistance with only four resistances. The same general principle appears susceptible of even wider practical range, as noted in another patent of the same date.

DIAMAGNETIC SEPARATION.—No fewer than 11 patents were granted to Mr. Elmer Gates, of Washington, D. C., on June 16 for various modifications of his method of diamagnetic separation and for apparatus used thereby. The purpose is to separate free particles of diamagnetic metal, such as gold, copper or the like, from other material. The separation is effected by dropping the mixture in powdered form through a long narrow air-gap between the poles of a strong electromagnet, this air-gap being either vertical or slightly inclined. While under the action of the strong magnetic field, the particles of greater diamagnetic susceptibility move away from the other particles into a relatively weak part of the field and are then separately collected. If the material is fed into the magnetic field so as to drop immediately adjacent to the pole-faces, the diamagnetic particles of greater susceptibility move toward the center of the interpolar space and are collected by a hopper located immediately below the center of this space. Several devices may be used to keep the particles as long as possible under the action of the magnetic field. This may be due, for instance, by passing the particles through a retarding fluid which is moved upward in opposition to the descent of the material. Or the number of lines of force, traversed by the particles, may be increased by rapidly moving the magnetic field in a direction opposed to the feeding of the material. For this purpose he places a number of revolving electromagnetic devices one above the other; or he uses stationary electromagnets placed one above the other, their coils being connected to a rapidly revolving circuit-breaker of such a nature that a succession of correspondingly rapid energizations of the magnets will take place, succeeding each other from one end of the series to the other. In one of the patents Mr. Gates proposes the following method of separation of free particles of diamagnetic metal, such as gold, copper or the like, from other material with which it is associated, as, for instance, in sea sands, placer sands and alluvial deposits generally. He first mixes with the sand about 5 to 10 per cent. of finely divided iron, nickel or other magnetic material of relatively high specific gravity; the mixture is stirred in the presence of water, and permitted to settle. The particles of gold or other diamagnetic metal, together with the particles of iron, etc., sink to the bottom; in the layers at the bottom the diamagnetic metallic particles are so entangled with the magnetic particles that they may be separated from the main residue of diamagnetic sand by means of ordinary magnetic separators. The result of this initial operation is a mixture of magnetic material and diamagnetic metallic particles, which are then separated by being subjected to the action of another separator particularly adapted for that purpose.

YACHT RACE AND WIRELESS TELEGRAPHY.—Arrangements have been made by the Associated Press with the Marconi Wireless Telegraph Company of America to employ that system of wireless telegraphy in reporting the international yacht races soon to occur. It has been reported that another system would be used by the Associated Press, but General Manager Melville E. Stone authorizes the following statement on behalf of the Associated Press: "We have arranged with the American Marconi Company to serve us with wireless news during the international yacht races."

CUPID'S CARS.—The New York & Stamford Railroad Company, which operates a trolley line in Larchmont, Rye and other towns on Long Island Sound, has discovered that its motormen and conductors devote too much time to their young women friends, and has posted an order, which reads: "The last three seats and rear platform are reserved for smokers. To be more specific, do not reserve it for your 'lady friend.' Let her be seated with the rest of the crowd. It may have a tendency to decrease the number of complaints received at the office lately. The conductor's place is on the rear platform, unless he is collecting fares, issuing transfers or assisting passengers on or off the car." The company, it is said, employs good-looking men and many young women have been in the habit of riding on the platforms and in the rear seats to talk with them.

LIGHTING IN NEW YORK.—The Aldermen's Committee on Water Supply, Gas and Electricity, in New York City, gave a public hearing last week on the application of the Long Acre Electric Light & Power Company, for a franchise to lay wires and operate an electric lighting plant on the territory bounded by Thirty-third and Fifty-ninth Streets, Fifth Avenue and the North River. The company has been promoted by the principal theatre managers to supply their theatres. Maurice Goodman, who appeared for the people behind the company, stated that his clients were getting tired of paying high prices and would be willing to supply the city with light at half present prices. The Consolidated Telegraph & Electric Subway Company objected that it had the exclusive right to lay conduits for wires. Mr. Goodman said his company would be willing to use the conduits of the subway company. The committee will hold another hearing.

EVERETT-MOORE TELEPHONE PROPERTIES.—It is said that the Everett-Moore syndicate of Cleveland, after taking just a year and a half, has straightened out its tangled affairs resulting from overexpansion in the electric railway and telephone field, and every company which was involved in the Everett-Moore failure now stands squarely on its feet. In a recent interview, Mr. E. W. Moore said: "Our telephone companies are now on a self-sustaining basis, and are showing a handsome surplus above fixed charges. There is great development in the West among the independent telephone companies. Almost every town of any size has an independent telephone exchange, and these exchanges are being connected up by the larger independent companies. Our Cleveland company will soon be connected with Pittsburg and will also be doing business in Buffalo, Western Pennsylvania and New York. It is now doing business throughout Indiana, and Michigan, and in time will extend to St. Louis, Baltimore and Philadelphia."

LIGHTNING ARRESTER.—A patent was granted on June 9 to Dr. Louis Bell for a lightning arrester which serves to protect the line from minor abnormal rises of potential as well as from lightning. The device consists of an auxiliary shunt to earth from a point on a series gap arrester nearer the line than the regular ground. This shunt path contains in series a large ferric inductance and a resistance of several thousand ohms. As regards static rises of potential or resonance effects on the line, the shunt acts as a comparatively easy path to earth, being in series with merely enough spark gaps to prevent the passage of current under the potentials ordinarily likely to be present on the line. As respects heavy currents or very sudden discharges like lightning, the shunt path is a rather difficult one, and the tendency is to throw such discharges over the main path of spark gaps to earth. The arrester can, therefore, be so adjusted as to be exceedingly sensitive to small rises of potential without producing violent discharges to earth, while under severe conditions it operates in the ordinary manner. It is intended particularly for application to transmission lines where minor rises of potential are common, and there to serve the double function of line discharger and lightning arrester, thus preventing abnormal line potentials without making the arrester proper hypersensitive and likely to cause trouble from continual flashing.

GERMAN CABLE LAYING.—Mr. R. Guenther, United States Consul-General at Frankfort, Germany, in a report to the State Department, says: "A new era in German cable construction began with the laying of a cable to Vigo, Spain, a distance of about 1,300 miles. During the last seven years Germany has laid 7,375 miles of cable, at a cost of over $7,000,000. In 1898 a cable, 73 miles in length, was laid between Sassnitz and Trelleborg, and in 1899 German Southwest Africa was connected with the international telegraph system by a cable 154 miles long. In 1900 the first German-American cable between Emden and New York, via the Azores—a distance of 4,813 miles—was laid. At about the same time Germany put down the first German cables along the Chinese coast, the cable Tsintau-Chefoo being 285 miles and that connecting Tsintau and Shanghai 438 miles long. The year 1901 witnessed the laying of the fifth cable between Germany and England, connecting Borkum and Baktou, a distance of 280 miles. The telephone cable between Fehmarn and Laaland was laid in 1902. The construction of a second transatlantic cable between Emden and New York, via the Azores, has been commenced and it will, it is expected, be ready for service before the expiration of the next year. Germany is also contemplating an increase of her cable net in eastern Asia and the South Sea, by constructing cables between Alenado and Guam and the Palau Islands and Shanghai. It is said that the growth of German interests, both military and commercial, will in the future require the building of more cables by Germany, independent of foreign nations. Germany now has cable works and two cable steamers."

LETTER TO THE EDITORS.

Storage Batteries with Pottery Diaphragms.

To the Editors of Electrical World and Engineer:

Sirs:—The recent introduction of pottery diaphragm storage batteries in the market has naturally opened a discussion as to their merits, and especially the question of their internal resistance. Having had an experience of fourteen years of careful study in the working of this type of cell, the writer begs to offer some thoughts along this line.

Almost every man versed in the working of storage cells, upon first impulse, says that the introduction of pottery diaphragms between the electrodes of a storage battery increases the resistance so as to impair the efficiency. If, however, these storage battery experts would give some careful thought to the matter and try an experiment or two, they would be surprised to find themselves in error. It is not a question of bathing the active material and electrode with free electrolyte, but a question whether there is sufficient electrolyte to do the work. If the pottery diaphragms are properly made, and sufficiently open-grained to allow a free saturation, then the internal resistance is not materially increased. It is, of course, necessary to allow freedom in the escape of gases, especially at the hydrogen electrode, and the manufacturer carefully provides for this.

Then again, in the case of grid batteries of the type heretofore used, a considerable part of the electrode exposure is metallic lead, the active material exposure being in spots over its surface, while in the pottery diaphragm batteries the active material exposure is complete, as it covers the entire face of the electrode. This complete active material exposure reduces the internal resistance of the pottery diaphragm batteries and offsets any slight interference of the diaphragm itself.

Almost all of the grid manufacturers have for some time used wood diaphragms between the electrodes to prevent buckling and short-circuits by the jumping out of plugs of active material; and at least one company is using pottery diaphragms in the same way. The trouble with wooden diaphragms is that the acid of the electrolyte gradually carbonizes the fibre of the wood, and then a leakage of current ensues, and the woods have to be removed and new ones inserted. The merits of the pottery diaphragm battery are many.

It is almost a perfectly automatic machine. The only attention it required is to add pure water to the electrolyte when evaporation requires it.

Short circuits, even continued to a complete discharge, cause no injury, if charging is done immediately. A large battery after continual service of two years in the hands of an engineer who is a novice in batteries, shows no deposit in the jars. Of course there is no possibility of buckling.

In the case of a railroad battery installed by the writer, of an earlier type, a glass jar broke in the midst of a day's work, and was not discovered until the electrolyte was on the floor and came trickling through upon our heads. The battery continued its work as if nothing had happened, until we had ample time to jump that jar and replace a new one at leisure. Had it been the ordinary type of battery, the circuit would have been immediately broken and caused serious delay. But the pottery diaphragms being saturated, held and retained sufficient electrolyte for an hour to do the work of the road, with no noticeable difference.

Quincy, Mass. George E. Hatch.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

New Electrolytic Rectifier.—Grisson.—An illustrated article, describing the rectifier constructed by the author. Experiments conducted with cells containing a lead and an aluminum electrode, showed that the layer of oxide which prevents the positive current from passing, was soon destroyed, and that the hydrogen set free at this electrode, when it acts as a negative electrode, is the cause of this destruction. Chemical means of preventing the liberation of hydrogen proved ineffectual. It was observed that at vertical electrodes small holes formed on the aluminum electrodes, which gradually increased in diameter and at which a strong evolution of gas took place. Many experiments had shown that the formation of the protecting layer of alumina took place best when a small current density was used. An oxidation of the damaged layer of alumina appeared, therefore, feasible, if a sufficiently high resistance could be opposed to the passing of the current at these places. For this purpose the above-mentioned gas bubbles appeared suitable. The lead electrode was, therefore, arranged below the aluminum electrode, and both fixed in a horizontal position. When alternating current was sent into the rectifier and direct current taken out, there were formed gas bubbles below the aluminum electrode. These bubbles oppose so much resistance to the current that there is only a very small current passing at the places which are damaged, so that by this means a new layer of oxide can form under the gas bubbles, and the damage done to the covering can thus be repaired. The apparatus consists of four cells, each 30 cm high, 19 cm wide and 22 cm long. They are shown in the adjoining figure. The lead electrode plate is arranged on the bottom of the cell, above it the aluminum electrode plate. In the upper part of the cell there is a cooling coil of lead pipe, in order to make it possible to keep a low temperature of the electrolyte, if the cell is working for a long time. For plants in which the voltage of the alternating current is higher than 110 volts and where a direct current of 110 volts or less is to be taken off, a specially-constructed transformer is used. An efficiency of over 60 per cent. when running on alternating current of 110 volts and taking off continuous current of 20 amp., is stated to have been obtained. Connection is made after the scheme illustrated in the diagram, in which the upper machine is the source of alternating current, 1, 2, 3, 4 the rectifier, *A* the aluminum electrode, *B* the lead electrode, and — + the place of consumption of the direct current. If the current from the alternator goes to the left, it cannot pass through cell 1 and therefore must go through cell 2. As the way through cell 4 is also closed, it can only return to the alternator by way of the place of consumption of direct current and through cell 3. The following impulse travels to the right, and as cell 3 is closed, it has to pass through cell 4, and as cell 2 is also closed, it must return by way of the place of consumption and through cell 1. (This arrangement seems to be the same as the well-known Wheatstone bridge system of connection.) If the cells are connected in the alternating circuit, without taking direct current from them, the amperemeter shows a value corresponding to the surface of the electrodes. This value, however, does not mean a loss of energy, but is attributable to the action of the cell as a condenser; the cells charge themselves and discharge with each change of polarity, without the passage of any current.—*Zeit. f. Elek.*, June 4.

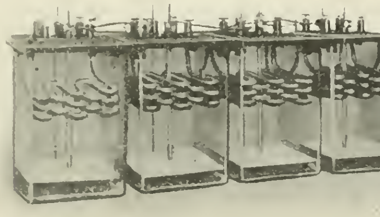


FIG. 1.—ELECTROLYTIC RECTIFIER.

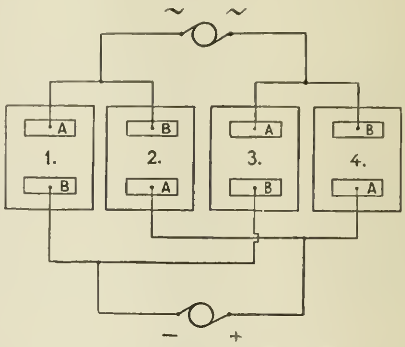


FIG. 2.—DIAGRAM OF CONNECTIONS.

REFERENCES.

Economy in Continuous-Current Design.—Purton.—A mathematical article in which the author shows how the problem of reducing the cost of construction of dynamos to a minimum without sacrificing the efficiency or good working of the machine, can be solved to some extent by the methods of analysis.—Lond. *Elec.*, June 5.

Electrolytic Rectifier.—An illustrated description of Nodon's apparatus, previously noted in the Digest.—*Elek. Zeit.*, May 29.

Lights and Lighting.

Recent Experiments on the Nernst Lamp.—Wedding.—A long article illustrated by diagrams and tables on experiments continuing over half a year and made under the conditions of practice with excessive change of voltage. The changes of voltage were so great that the first series of lamps was soon destroyed on account of it. A second series were investigated with a normal voltage of 220 volts and changes of pressure of + 10 and — 10 volts. Of the series of lamps for 220 volts and 1 amp., 9 lamps had already become damaged after 93 hours. A third series of 12 lamps for 220 volts were investigated, six of which had starting resistance for 30 volts and the other six for 20 volts. As far as the light is concerned, the two systems are the same after 150 hours' burning. The specific consumption is more favorable in the beginning for the glower with higher voltage, which burns with a thirty-volt resistance. After 200 hours of burning this relation is changed, and the lower voltage glowers show more favorable results, but the difference is not considerable. For the lamps with 20-volt resistance, the candle-power of 158 candles at the start fell 20 per cent. after 275 hours, after 325 hours the candle-power has fallen 25 per cent., and after 550 hours the candle-power fell to one-half. A fourth series of twelve lamps were investigated as to their length of life and the results showed an average for the lamp of 220 volts of 730 hours. The author concludes from these results that not only have a great many advances been made in regard to the durability of the lamp, but that the durability which has been obtained now is sufficient for the demands of practice. The latter part of the article is devoted to the description of the latest form of the German Nernst lamp, and it is stated that the specific consumption is only 1.21 watts per candle. The author thinks that the Nernst lamp is primarily called upon to fill the gap between the carbon filament glow light and the arc light to about 6 amp, and considers in what direction further improvements are to be made.—*Elek. Zeit.*, June 4.

REFERENCES.

Connection of Arc Lamps.—Kaufmann.—A short article, illustrated by diagrams, in which the author gives a scheme for the connection of 4 arc lamps to a 220-volt, direct-current circuit, so that one group of 2 lamps or all 4 lamps together may be used.—*Elek. Anz.*, May 24.

Arc Lamps for Interior Car Lighting.—An article describing an arc lamp in which the carbons are so held that the jolting of the car does not interfere with the steadiness of the light. The lights take 2⅛ amp., and it is proposed to carry 4 of these lamps in the interior of the car and one arc headlight, all in series on the 500-volt circuit, together with a resistance, or the headlight can be used on a separate circuit.—*St. R'y Jour.*, June 6.

Low-Voltage Incandescent Lamps.—Zacharias.—An illustrated article giving some details of the manufacture of small incandescent lamps for 3 to 5 volts, as used in connection with dry cells.—*Centroibl. f. Accum.*, April 1.

The Incandescent Lamp.—A didactic article with illustrations, on the incandescent electric lamp, dealing principally with the illuminating power, current consumption and life of the lamp.—*Am. Elec.*, May.

Incandescent Lamps.—A brief illustrated article on the different steps in the manufacture of the electric incandescent lamp.—*Dingler's Polyt. Jour.*, May 9.

Power.

Electrical Driving in Factories.—Hichfield.—The first part of a paper read before the Manchester Local Section of the I. E. E. on the possible developments of electrical driving in factories due to the supply of electricity at cheap rates by large power companies. The author discusses the question of how large power companies can furnish electricity cheaper than private plants. He considers that a central supply company has an especial advantage over the latter, if it uses gas engines in place of steam, as in nearly every case it can operate on a sufficiently large scale and a sufficiently constant load to enable large gas producers to be used in connection with the recovery of the sulphate of ammonia. He considers that as about 90 pounds of sulphate can be obtained from every ton of coal, an immense set-off can be made against the coal bill.—Lond. *Elec.*, June 5.

The Steam Turbine.—Rancour.—A long article, with diagrams and tables on the Parsons turbine, discussing in detail its various advantages as compared with the steam engine. In order to show how quickly these turbines can be set up, the author states that an installation of 300 effective horse-power for furnishing electricity to the city of Croire, had been in full operation four days after its arrival at the railroad depot. A turbo-alternator system of 1,400 hp is said not to take more than eight days for erection, while for a steam engine of 1,400 hp at least three months should be allowed.—*La Revue Technique*, May 25.

Electric Motors for Gas Works.—A note on the electrical equipment of a new gas works in Milwaukee. An electric plant driven by gas engines furnishes power to various auxiliaries throughout the works, all of which will be operated by electric motors, and to a large machine shop, also operated by electric motors. Coal will be unloaded from boats, and elevated to the storage bins by electric hoists and conveyors, the retorts will be charged and drawn by electric appliances, and the final disposition of the coke will be accomplished by electric power apparatus. The system will operate at 250 volts direct current.—*Prog. Age*, June 1.

REFERENCES.

Motive Power for Small Isolated Plants.—Lombard.—The author describes a new system of furnishing gas for small motors, invented by Riché. The gas is made by distilling wood, sawdust, straw, etc., in vertical cast-iron retorts. Several instances are mentioned, in which the system has been used for electric lighting purposes in small cities and isolated localities.—*La Revue Technique,* May 25.

Plant of the Cascade Water Power and Light Company.—An illustrated article on the installation of the above company at Cascade, B. C., for the utilization of power from the Kettle River; 20,000 volts are transmitted for 21 miles for various power and lighting purposes. —*Can. Elec. News,* May.

Power Station.—An illustrated description of the electric power station of the Dominion Iron & Steel Company, at Sydney, Nova Scotia. Gas from the blast furnaces of the company is used for generating steam.—*Can. Elec. News,* May.

Railway Power Plant.—Burch.—An illustrated article on the design of the new power plant and system of the Everett Railway & Electric Company, at Everett, Washington, supplying incandescent and arc lighting, electric railway and power service.—*St. R'y Rev.*, May 20.

Power Plant of the Philadelphia & Reading Railway, at Reading. —An illustrated article describing the plant for furnishing power for the machine tools in the shops of the above railway.—*Am. Eng. & Railr. Jour.*, June.

San Francisco Power Plant.—Perkins.—A short, illustrated description of the power plant and the sub-stations of the United Railways, of San Francisco, Cal.—*Elec. Rev.*, May 30.

Electric Power Plant Below Mount Rainier.—Mayo.—A short article describing the power station which is being constructed to utilize the glasier flow of Mount Rainier, which will deliver energy to the principal cities of Washington. Alternating current of 2,500 volts will be generated and stepped up to 45,000 or 55,000 volts and then transmitted 30 miles to Tacoma, and 45 miles to Seattle.—*Scien. Am.*, May 23.

Power Plant of the Neversink Light & Power Company.—An illustrated description of the plant, drawing 1,000 hp from the Neversink River, which power can be increased to 1,500 hp for 6 hours by means of a reservoir, which is filled during light loads. Three-phase alternating current at 600 volts and 60 cycles is generated and stepped up to 10,000 volts to the distribution centers, where it is stepped down again.—*Eng'ing Record,* June 6.

Ouray Electric Light & Power Plant.—Perkins.—A short illustrated article.—*Electricity,* June 3.

Mechanical Applications of Electricity.—Richard.—An illustrated article on some recent improvements in mechanical applications of electricity, especially in connection with its use in steel works.—*L'Eclairage Elec.*, May 9.

Electric Power in the Iron and Steel Industries.—Walsh.—A short, popular article.—*Elec. Rev.*, May 30.

Electric Hoisting Engines for Mines.—An illustrated description of engines recently installed at two German mines.—*Der Electrotechniker,* May 15.

Traction.

Magnetic Surface Contact Systems.—Paul.—An illustrated article dealing with the Diatto and the Lorain systems. The author concludes that the maintenance of the electrical portion of the equipment in the magnetic surface contact system is far too high in comparison with other systems. The rather high weight of the current collector fitted with the heavy magnets and the lack of sufficient flexibility of the collector, necessitates the latter being pressed comparatively hard on the contact studs in order to insure a proper contact. In consequence of this an excessive wear will take place, involving not inconsiderable expense. The losses of energy caused by the carrying of the weight of the collector and by the magnetizing of the magnets, have to be taken into consideration. The maintenance of the accumulator battery in each car is also an item which cannot be set aside. In making a comparison between the Diatto and the Lorain system, the conclusion is arrived at that better results can hardly be anticipated from the latter as long as the fundamental faults of the system are not removed. These faults include, first, insufficient safety for the public traffic, owing to the ineffectualness of the safety device, and second, the high maintenance charges for the track work in consequence of the great wear of the contact studs with their apparatus and the time-consuming inspection required, owing to the none parkless working of the latter.—*El. Eng.*, London, May 29.

English Versus American Conduit Railway Construction.—An editorial considering the conduit railway construction in London. The type of conduit differs from that in New York and on the Continent. The center slot is used, and in this respect American practice is followed, but the service rails are not supported on the yokes. The American construction has greater transverse strength, but this is necessary in America, due to the range of temperature and its effect on the pressure on the pavement. There is also a short reference to storage battery installations.—*St. R'y Jour.*, June 6.

The Generating Plant of the Montreal Street Railway Company.—Mershon.—This company is now purchasing 5,000 hp from a water plant 10 miles from the city. Power is supplied at 66 cycles, quarter-phase, and is converted to direct current. The first installation consisted of a 500-kw synchronous motor and generator, but six induction motor generators were afterwards ordered. A diagram of the circuits of the latter is shown. The induction motors are considered preferable to the synchronous motors, as less care, attention and skill is required in operation, and there is less disturbance to the system of the power company. The induction motors are among the largest that have ever been built and the installation is the largest composed entirely of induction motors.—*St. R'y Jour.*, June 6.

REFERENCES.

Freight Car Driven by Induction Motors.—Weeks.—The author discusses the advantages of a car for freight service in the factory where belt and chain conveyors fail to fill the requirements and describes the construction and operation. The arrangement is simple and a number of diagrams illustrate the more important electrical features.—*St. R'y Jour.*, June 6.

Three-Phase Railway at Valtellina.—An illustrated article on the road recently installed in Italy and repeatedly referred to in the Digest.—*St. R'y Jour.*, May 30.

Metropolitan Electric Traction of Paris.—An illustrated, popular article, describing the equipment of the three generating stations and the various sub-stations.—*Cosmos*, May 23.

London County Council Tramways.—Conclusion of the illustrated article previously noted in the Digest, giving illustrations of rolling stock and diagrams of car wiring.—Lond. *Elec.*, May 29.

Los Angeles and Pacific Electric Railway System.—The first installment of a long, well-illustrated article, dealing with the organization of the companies concerned, the various power plants and sub-stations.—*St. R'y Rev.*, May 20.

Electric Brake for Street Railway Service.—A description of a brake cylinder worked by electric power instead of air power. The amount of current required is 4½ amp. The controller is arranged with five notches, which provide for different amounts of resistance in circuit.—*St. R'y Jour.*, May 16.

New Shallow Conduit.—Smith.—An illustrated description of the author's shallow slotted conduit construction on traction systems. Some editorial criticisms are made in a foot note.—Lond. *Elec. Eng.*, June 5.

Electric Haulage on Canals.—Perkins.—An illustrated description of various systems in use in this country and abroad, and already noticed in the Digest.—*Elec. Rev.*, June 6.

Installations, Systems and Appliances.

Electricity Supply in Milan.—An illustrated article describing the power house of Porta Volta. The current for lighting, traction and power is furnished by hydraulic works at Paderno and by a steam plant at Porta Volta. Paderno furnishes 8,000 kw at 13,000 volts, while Porta Volta generates 10,000 kw at 3,600 volts, 20 transformers of 400 kw each transform the Paderno current at Porta Volta to 3,600 volts to permit of working in parallel with the steam plant; 12 boilers of 14,000 aggregate hp furnish steam for 3 compound engines of 1,000 hp each, a 2,200-hp triple-expansion engine, and 2 steam turbines of 3,000 and 4,500 hp. A switchboard is being installed 130 ft. long and 14 ft. deep. The distribution system is two-fold, first to a three-phase, 3,600-volt network, which serves to supply the greater portion of the city, including a large industrial area. The second subdivision goes to supply a sub-station, where the motor-generators are installed, which furnish continuous current for the central section of the city, 125 volts between each side of the three-wire system. The conversion of the three-phase to 550 volts continuous current for traction purposes is also effected here. The plant consists of five motor generators of 550 kw each, the actual maximum demand sometimes reaching 2,500 kw. For the lighting load there are seven similar sets of 250 kw each, and two smaller sets of 60 kw each. One of the most striking features is the enormous capacity of the batteries, of which there are 4 for the lighting system, each of which has a maximum discharge of 4,680 amp. at 140 volts. A fifth battery of equal capacity is in course of construction. The buffer battery for the tramway has a maximum one hour discharge of 3,800 amp. The second part of the article deals with the charges made for service and the character of the load. Diagrams of the latter are given.—Lond. *Elec.*, May 29, June 5; and *Elec. Eng.*, May 29.

Design of Central Station Records and Returns.—Davies.—A long article giving the author's ideas as to what books should be kept at a central station. The first book referred to is a diagram book, clearly showing all the cable and pipe work connections strictly up to date. Besides main connections it should contain diagrams of any motor starters or similar apparatus, that may be installed in the station. Daily load curves should also be taken, showing the output in kilowatts over the 24 hours. Cost curves should be constructed, showing the cost of coal, oil, waste, water and engine room stores; wages, repairs and maintenance. A daily log sheet should show the readings of the various instruments, the majority of the readings being taken at least every half hour during light load and every quarter of an hour during the rest of the day. Feed water temperatures should be read by the stokers at stated intervals. The whole sheet should show the following items: Total units generated; units put into battery; units taken out of battery; efficiency of battery, watt-hour and amp-hour; units used on works; units sent out; pounds of coal per unit generated; pounds of water evaporated per pound of coal consumed; evaporation from and at 212° F. A battery log book should consist of a daily record of the battery charge, discharge and efficiency, and the results of a weekly examination of the battery, specific gravity and volts. Among the other books considered by the author are engine and boiler hour records, balancing book, free wiring book, house service costs, meter cards and books, canvassing records, meter testing records, main testing records, indicator cards, weekly and quarterly returns and balance sheets.—*Elec. Eng.*, May 8.

Electric Works of the City of Vienna.—Fach.—A very long, illustrated article. The city owns two works, situated beside each other, one for the supply of current for traction and the other for lighting purposes. Both can be connected together and furnish 3-phase current at 5,500 volts. For the inner sections of the city and for traction purposes the current is transformed by motor-dynamos. In the traction central station steam is furnished by a battery of 20 Babcock & Wilcox boilers, at 14-atmosphere pressure. The engines are quadruple-expansion, furnishing normally 3,000 and a maximum of 3,720 hp at 90 r.p.m. The outside diameter of the stationary armature is 30 ft.; the revolving field is nearly 25 ft. in diameter and carries 64 poles. The number of alternations is nearly 96 per minute. A small separate engine is arranged to start the field to revolve until the engine has sufficient power to turn it. A motor-dynamo is provided for the excitation of each two generators. There is also a battery of 120 cells, with a maximum charge and discharge current of 252 amp. and a guaranteed capacity of 756 to 1,015 amp-hours at 3 to 10 hours' discharge.—*Zeit. f. Elek.*, May 24.

REFERENCES.

Storage Battery Plant at Milwaukee.—An article describing the storage battery plant of 608 cells, installed in the main power house of the company, which supplies light and street railway service to the city of Milwaukee. The batteries are used as a reserve for either lighting or the railway service, and a number of combinations for their employment are possible.—*St. R'y Jour.*, June 6.

The Baltic Mercantile and Shipping Exchange, London.—An illustrated article on the electrical installations in the new building.—Lond. *Elec. Rev.*, May 29.

Electro-Physics and Magnetism.

REFERENCES.

Terrestrial Magnetism and Atmospheric Electricity.—The last issue of this quarterly journal contains the following articles: Amundsen, the proposed Norwegian expedition to the magnetic North Pole; Hazard, mean values of the magnetic elements at observatories; Farr, the Christchurch Magnetic Observatory, New Zealand; Bauer and Fleming, the magnetic observatories of the United States Coast and Geodetic Survey in operation on July 1, 1902; Abbe, Tromholt's catalogue of Norwegian auroras, and a number of abstracts and reviews.—*Terrest. Magn. & Atm. Elec.*, March.

Notes of X-Light.—ROLLINS.—The continuation of the author's notes relating to an improvement in the way of attaching the terminals of the X-light tube to the electric generator and observations on metal tubes between the x-light tube and the patient for improving the definition of the photograph.—*Elec. Rev.*, June 6.

Improved Forms of Support for X-Ray Tubes.—ROLLINS.—An illustrated article showing in detail the improvements devised by the author in supports for the X-ray apparatus, in order to adapt them better to the taking of X-ray pictures, especially for medical purposes.—*Elec. Rev.*, May 30.

ELECTRO-CHEMISTRY AND BATTERIES.

Anodes for Electroplating.—BURGESS AND HAMBUECHEN.—An illustrated article in which the authors point out some of the factors which influence the corrosion of the anode during electrolytic action and give the results of some measurements made with nickel anodes in a nickel-ammonium sulphate plating solution. The lower the current density at the anodes, the more nearly does the amount of metal corroded correspond with the electrochemical equivalent, and especially is this the case with nickel. With commercial nickel the current density must be kept below 5 amp. per square foot in order that a high current efficiency of corrosion may be attained. To obtain a suitably low current density at the anode, corrugated and round or oval anodes have been introduced. The authors have made experiments on the variation of the current density over the surface of flat rectangular and oval anodes, the results being given in diagrams. With the rectangular cross-section, the distribution of current is much less uniform over the entire surface than with an oval cross-section. The authors point out the following advantages of oval anodes. The oval electrode has a larger ratio of active to total anode surface than the flat rectangular anode. The corrosion takes place in such a manner that the electrode retains its original shape, until it is reduced to a very thin rod or strap; on this account the amount of scrap of oval anodes is only about 5 per cent., against 15 per cent. with flat rectangular anodes. While oval electrodes may require a greater amount of nickel to be suspended in the tank, the disadvantage is only in the increased interest on the investment, and this item is more than compensated by the saving in the less frequent removal of the electrodes and the smaller amount of scrap. A further advantage of the oval electrodes is the fact that a more dense casting may be obtained than where the anodes are made flat and thin.—*Electrochem. Ind.*, June.

The Electric Furnace.—WRIGHT.—A popular description, with numerous good illustrations of various types of the older arc and resistance furnaces, treated chiefly from a historical point of view. The well-known Heroult furnace is classed by the author as an arc furnace, and the process taking place in it is said to consist in the fusing out of metallic aluminum by the heat of the arc, leaving the oxygen of the alumina free to combine with the carbon of the electrode. (This explanation is, of course, wrong, as in the Heroult furnace, as well as in the Hall furnace, the alumina is dissolved in a bath of molten cryolite, and electrolysis takes place, the aluminum going to the cathode and the oxygen going to the anode. The electrolyte is kept fluid by the heat of the current and the furnace must, therefore, be classed as a resistance furnace.) Some carbide furnaces, mostly of the older types, are described and illustrated; those of the rotary type as used by the Union Carbide Company, are not mentioned. The author states that the process of conversion in the Acheson carborundum furnace is said to be far from economical. (It is hard to reconcile this statement with the fact that Acheson has been manufacturing carborundum on a commercial scale for a number of years, and has repeatedly extended his works.)—*Cassier's Mag.*, June.

Voltaic Potential Difference.—BROWN.—An account of some experiments made to test the hypothesis that the difference of potential observed at the surfaces of dissimilar bodies in the fundamental experiment of Volta, is due to the chemical action of films, which are condensed on their surfaces from the gaseous atmosphere surrounding such bodies. He used a couple consisting of a zinc plate and a copper plate, which has been well cleaned with fine glass paper; they were placed closed together and one was connected to each pair of quadrants of an electrometer. After momentarily connecting them together by a wire and then separating them in the usual way, in air, a deflection of 140 was observed. Oil sufficient to cover both plates was then poured into the apparatus, and on again connecting and separating the plates several times, the deflection averaged 110 divisions in the same direction as before. The oil bath was then heated to about 145° C., after which the connection and separation gave no deflection. The whole was then allowed to cool and again tested, but as before there was no deflection; the "volta effect" had disappeared. Its disappearance is apparently due to some effect of the heating, since the mere immersion in the oil did not cause it, and the absence is not due to temperature merely, since this absence continued after the oil had cooled. He contends that the volta effect ceased as soon as the condensed films were evaporated and considers this experiment as a confirmation of the condenser electrolyte-film theory.—*Phil. Mag.*, May.

Electrolytic Reduction of Chlorate of Potassium.—TOMMASI.—A note presented to the French Academy of Sciences, in which the author shows that he had long ago arrived at substantially the same conclusions as were obtained by the recent experiments of Bancroft, Barrows and Brochet.—*Journ. de l'Electrolyse*, May 15.

Non-Conductivity of Metallic Hydrides.—MOISSAN.—A note on a paper presented before the French Academy of Sciences. The author found that the hydrides of potassium, calcium and lithium are non-conductors of electricity. The conclusion is drawn, therefore, that hydrogen is not comparable to the metals, and that the hydrides cannot be regarded as definite alloys, of which they have neither the appearance or the properties.—*La Revue Technique*, May 25.

REFERENCES.

Electrochemical Analysis.—MOLTKEHANSEN.—An article on the separation of lead and manganese by electrolysis.—*Electrochem. Ind.*, June.

Apparatus for the Electrolytic Production of Chlorine and Bleach.—ULKE.—An illustrated description of the McDonald electrolytic cell and the installation of 50 of these cells at the Clarion paper mill.—*Eng. & Min. Jour.*, June 6.

UNITS, MEASUREMENTS AND INSTRUMENTS

Magnetic Detector for Hertzian Waves.—FLEMING.—This well-known investigator describes in a paper before the Royal Society an instrument, which will indicate and measure quantitatively the intensity of the radiations. The metallic coherer is of very little use as a quantitative instrument, as it is influenced by very slight accidental contact changes. The instrument constructed by Prof. Fleming consists of a pasteboard tube on which are placed six bobbins in series. In the interior of the tube are placed seven or eight small bundles of iron wire, each bundle being composed of eight well-paraffined wires. Each little bundle is wound over uniformly with a magnetizing coil and over this, but separated by one or two layers of gutta percha, is wound a single layer, forming a demagnetizing coil. The magnetizing or inner coils are connected in series, and the outer or demagnetizing coils are in parallel. Associated with this induction coil is a rotating commutator, consisting of four hard fibre discs on a steel shaft, which revolves at about 500 r.p.m., driven by an electric motor. They each have a strip of brass of a different length, secured to their circumference, and these serve to make and break the circuit of the magnetizing coils and to short-circuit the terminals of the secondary, while the magnetizing current is applied to one of the discs. The operations which go on during a complete revolution of the discs are as follows: First, the magnetizing current of a battery of secondary cells is applied to magnetize the iron bundles, and during the time this magnetizing current is applied, the terminals of the fine wire secondary coil are short-circuited, and the galvanometer is disconnected. Shortly after the magnetizing current is interrupted, the secondary bobbin is unshort-circuited, and an instant afterwards the galvanometer circuit is completed and remains completed during the remainder of one revolution. Hence, during a large part of the revolution, the iron wire bundles are left magnetized, but the magnetizing current is stopped and the galvanometer is connected to the secondary coil. If, during this period, an electrical oscillation is passed through the demagnetizing coils, an e.m.f. is induced in the secondary bobbin by the demagnetization of the iron, and causes a deflection of the galvanometer coil. Since the interrupter discs are rotating very rapidly, if the electrical oscillation continues, these intermittent electromotive impulses produce the effect of a continuous current in the galvanometer circuit, resulting in a steady deflection, which is equal to the demagnetizing force being applied to the iron, other things remaining equal. If the oscillation lasts only a very short time, the galvanometer makes only a small deflection; but if the oscillation lasts for a longer time, the galvanometer deflection is larger and tends to become steady. Prof. Fleming thinks that this instrument will become of great use in connection with the design of radiators and transmitters for Hertzian waves for wireless telegraphy. The instrument promises also to be of considerable use in the investigation of the transparency or opacity of various substances to Hertzian waves, not merely qualitatively, but in the determination of a coefficient of absorption.—Lond. *Elec.*, June 5.

Indicator for Oscillating Currents.—WINKELMANN.—A description of an instrument for demonstrating the existence of oscillatory curves and discharges. Two vertical vacuum tubes, mounted side by side, are connected by a cross tube, and carry electrodes in the tops of the tubes. A piece of corundum is arranged in the center of one bulb on a glass support, while the other contains a piece of scheelite, arranged in the same way. Under the influence of cathode rays, the corundum emits red light, while scheelite becomes blue. When a unidirectional current is passed through the apparatus, the cathode can be easily found by its action upon the mineral below it. If an oscillating current is passed, both minerals will show their respective color. To show the transition from one type of discharge to the other, both electrodes are joined to the terminals of an influence machine. If the discharging rods are pulled so far apart that no oscillations take place, the discharge is continuous. When the rods are near enough to allow the passing of sparks, both minerals will be affected.—*Zeitsch. f. Instrumentenkunde*, May; abstracted in Lond. *Elec.*, June 5.

REFERENCE.

Meters.—An article on the testing and certifying of electric meters by the Reichsanstalt; two meters by Aron have been admitted for certification; they are described; one is for direct current and the other for single-phase or polyphase alternating current; both are of the well known pendulum type. In the second part four meters of Schuckert & Co., for direct current, are described. They are motor meters, based on the principle of the electrodynamometer.—*Elek. Zeit.*, May 14, 21.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Improvements in the Different Systems of Wireless Telegraphy.—PRASCH.—The continuation of an illustrated article, dealing in the present instance, with a description of the improvements made by the Italian captain, Bonomo, in the Marconi system, by the use of the Castelli coherer and a very careful insulation of the mast, the inductor and the source of electricity. A telephone is used as receiver. The Fessenden and the Lee-deForest-Smythe systems are also described.—*Dingler's Poly. Jour.*, May 23.

Wireless Telegraphy and Telephony.—BERTHIER.—A popular illustrated article discussing Zickler's system and the conditions for wireless telegraphy and telephony in general.—*Cosmos*, May 23.

Progress in Wireless Telegraphy.—MAVER.—A popular article dealing with the historical development of the subject.—*Cass. Mag.*, June.

New Column Type-Printing Telegraph Instrument.—An illustrated description of the instrument designed by Higgins and used by the Exchange Telegraph Company, London.—Lond. *Elec.*, June 5.

Divided Multiple Switchboard.—AITKEN.—The conclusion of the article previously noted in the Digest.—Lond. *Elec. Rev.*, May 22.

Designing of Telephone Apparatus.—TAYLOR.—The twenty-third installment of his long article.—*Elec. Rev.*, June 6.

Telephone Exchange.—An illustrated article giving a description of the new equipment of the exchange of the Ashtabula Telephone Company.—*Elec. Rev.*, June 6.

Magneto-Bell Troubles and Their Remedies.—HYDE.—A short article.—*Telegh. Mag.*, May.

Telephone Service Problem in England.—QUAIL.—A discussion of the conditions and suggestions for their amelioration.—*Teleph. Mag.*, May.

MISCELLANEOUS.

REFERENCES.

Artemiev's Electrical Coat of Mail.—An illustrated description of the Russian physicist's "coat of mail," repeatedly noticed in the Digest, for protection against electric currents.—*Scien. Am.*, May 16.

Electrical Steering Gear.—An illustrated description of a new gear, similar to the hand steering type, with such alterations as to adapt it to electrical driving.—*Scien. Am.*, May 16.

Italian Works.—An illustrated description of the united company of Gadda & Co., Brioschi, Finzi & Co., in Milan. The firm build mostly three-phase alternators and motors. A 1,400 hp machine, in course of construction, is illustrated.—*Lond. Elec.*, May 22.

Instruction.—BARBILLION.—A long, illustrated article describing the electrotechnical institute of the University of Grenoble, France.—*L'Eclair. Elec.*, May 23.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. General meeting, Niagara Falls, June 29, July 3.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Annual Convention, Detroit, Mich., July 14, 15 and 16.

Turret Form of Train Controller.

In ELECTRICAL WORLD AND ENGINEER of May 16, some details were given, with an illustration of the new form of Westinghouse multiple train control. We are now able to present a view of the apparatus, which shows its exterior appearance, and its position under the car very clearly.

As already noted, this new apparatus is of the electropneumatic type, and is in principle like that hitherto installed by the Westinghouse company. Within one compact structure of turret form have been grouped by Mr. Westinghouse the electropneumatic devices to operate a simple form of electric switch, including a safety circuit-breaker and automatic means for preventing the application of too great an electric force to the motors, thus saving electric current and insuring the smooth operation of trains.

The new controller is located in the small turret under the car, as shown in the illustration, and has a circuit-breaking power many times greater, it is said, than has been attained heretofore. Among the other advantages of this "turret system" are greater blow-out capacity, greater uniformity of action, unequalled arrangement of contacts, an automatic accelerating device, and marked economy of space.

TURRET TRAIN CONTROLLER.

The electropneumatic apparatus, operating the switches individually, is of the same character as that employed by the Union Switch & Signal Company in its electropneumatic signalling system, an apparatus that has been subjected to years of severe and successful tests in connection with the signals on numerous railways throughout the country. The electropneumatic switches are operated progressively by the valves being so arranged as to admit air to their respective operating cylinders at the right time and rate to insure graduated acceleration of the train and also guard against sudden rushes of current. The organization is such that current in excess of a predetermined amount cannot be admitted to the motors, with a result, not only that the motors themselves are not subjected to undue strains, but the train is free from sudden and abnormal movements in acceleration. The valves may be adjusted so that any required degree of acceleration may be obtained.

The new control apparatus has all of the usual safety appliances, including the arrangement whereby the current is automatically cut off and the brakes are applied, in the event of an accident to the motorman. Its weight is from one-half to three-quarters of a ton per car less than before, with consequent gain in other directions.

Another new Westinghouse invention is the automatic coupler, which in one operation couples the air brake hose, the multiple unit system of electrical control, and the lighting and heating connections.

A Large Electric Mining Plant.

The Cerro de Pasco copper mines, in the Peruvian Andes, which are about to be developed on an huge scale by American capitalists, will be operated largely, if not entirely, by electricity. Contracts for engines, etc., have just been placed by Frank Klepetko, consulting engineer, Maritime Building, New York, who is acting on behalf of the Americans interested in the undertaking. F. B. Haggin, the Californian capitalist, whose New York offices are in the Mills Building, and J. J. McCune, of Salt Lake City, Utah, are the principal people concerned in the venture. The extensive copper deposits are said to underlie a mountain of silver ore, worked since 1630, but in a very primitive method. The mines are located at an altitude of 15,000 feet. It is estimated that in four years the production of copper will be 4,000 tons per month. This output will place Cerro de Pasco at the head of the copper producing concerns of the world. The late owners of the mines took no ore out that gave less than 20 per cent. It is now calculated that an average yield of 12 per cent. could be kept up for many years. Several million dollars will be expended in equipment. The construction of a railway from the coast to the mines, a distance of about 85 miles, has already begun.

A smelter is to be erected which will have an initial capacity of 1,000 tons a day. It will be equipped with two blowing engines, each having a capacity of 24,000 cubic feet per minute compressed to 17 pounds and designed with a view to electric operation by 1,500-hp motors. These engines will be built by the Nordberg Manufacturing Company, of Milwaukee, Wis. There will also be five Nordberg engines of 30,000 cubic feet capacity to be compressed to 2½ pounds. These engines will be of 350-hp each. For power purposes two 475-hp Nordberg engines have been ordered for direct connection to generators of 350 kw capacity each. The generators will be contracted for next week.

One Type of Westinghouse Induction Motor.

The Westinghouse type "F" motor is a variable-speed induction motor, especially suited for use where loads have to be carried at reduced speeds, or where heavy loads have to be started and gradually brought up to speed. Elevator and hoist work are typical examples of this kind of service. The cut herewith shows the motor to be compact and of substantial build. Its resemblance to the type "C" is quite strongly marked. The only noticeable difference is an extension of the shaft at one end to provide the collector and brush-holder.

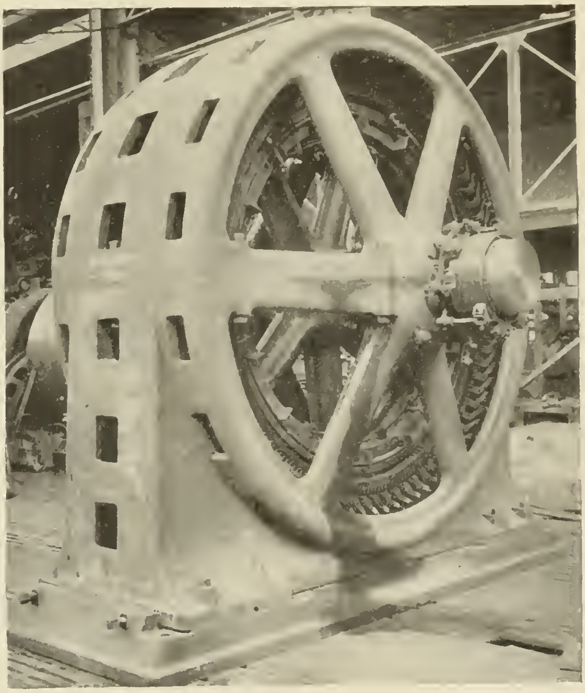
The motor differs from the Westinghouse type "C" motor in the secondary or rotating element, which is wound like the rotating part of a three-phase rotating armature generator, and carries a collector. Current passes from the collector to a rheostat through a controller, by which the speed may be varied by changes in the resistance.

The standard motors are provided with a hollow cylindrical frame of cast iron, in which the primary is mounted. The windings of the machine are completely protected by its frame from any external danger of accident. The frame forms a base for the machine and also supports the two and brackets carrying the self-oiling bearings. These have an ample bearing surface which insures small wear in the bearings.

The end brackets are bolted to the frame in any one of eight different positions, so that the oil chambers in the brackets will be in the proper position, whether the frame is bolted to the floor, the wall, the ceiling, or at a 45° angle. Supported from the bearing housing and readily accessible for such inspection or renewal of brushes as will occasionally be required, is a swivel type brush-holder, which allows rotation in either direction and the use of carbon gauze brushes. These require practically no attention, and the wear of the collector is reduced to a minimum. Motors of larger sizes are of the same general form, but the cast-iron frame for holding the primary is made in two parts, which are separated horizontally.

The primary element consists of a hollow cylinder built of laminated punchings of sheet steel, slotted on the inside to receive the conductors. The punchings are rigidly supported by the cast-iron housing that encloses the primary and forms the frame of the motor. In motors of larger sizes, the punchings are not continuous, but are made up of segments, dove-tailed into a hollow cylindrical shell of cast iron. This shell is held in the cast-iron frame of the motor.

The conductors are usually machine-wound coils of wire, which are thoroughly insulated before being placed in the slots. In some of the larger motors a copper strap, bent to the proper form, is used for the coils. In large motors wound for low voltages and heavy currents, a copper bar is placed in each slot, the insulated bar being slipped in at one end and the proper connections between bars made by short lengths of copper strap.



INDUCTION MOTOR.

The terminal blocks, through which the leads supply current to the motor, are connected to the primary winding and are located on the side of the frame.

The secondary element is built up of sheet steel punchings mounted upon a spider. The rectangular copper bars of the winding lie in partially closed slots around its periphery. They are grouped to give a three-phase winding, and the leads from the windings are carried through a hollow shaft to the collector.

These motors are usually built for two-phase or three-phase circuits, 60 or 25 cycles. The standard voltages are 200 and 400 and upwards.

Automotile Chairs at the St Louis World's Fair.

A concession has been granted to the Electric Chair Company, of St. Louis, to operate 2,000 automobile chairs at the World's Fair. Each chair will carry two passengers, one of whom may operate the machine, or, if desired, an operator will be furnished by the concessionaire. The chairs will be rented. Each machine will be provided with a detachable seat at the rear for the operator. The controller and steering bar may be placed either at the front or the rear, according to whether the machine is run by one of the persons hiring it or by an hired operator.

Mr. Semple S. Scott, an electrical engineer, is stated to be the inventor of this chair. The machine is provided with a new safety guard rail to prevent accidents. This rail entirely surrounds the machine and the slightest pressure on any part thereof causes an electric clutch to operate, which instantly brings the machine to a standstill, thus avoiding accidents.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET. Money was offered with moderate liberality, much of the output coming from foreign lenders. The demand for the long dates continued fairly active. The closing rates were 4 per cent for 60 days, 4½ to 5 per cent. for 90 days to five months, and 5½ per cent to 6 per cent. for six, seven and eight months. Speculation on the stock market was narrow and professional with more or less bearing manipulation. Recessions and rallies alternated, but the general tone was somewhat discouraged and declines in important stocks, notably United States Steel, occasioned temporary uneasiness. Rumors were current in this connection that some important interests in the corporation were liquidating their holdings to meet other obligations, and although this could not be confirmed, it had an effect on sentiment. Unfavorable sentiment was also created by the testimony brought out by the hearing of a suit to set aside the deal by the Metropolitan Street Railway list to the Interurban Rapid Transit, Metropolitan being heavy in consequence. In the industrials little interest was shown outside of the Steel stocks. Amalgamated Copper was irregular within narrow limits, but did not develop any special weakness on the intelligence that the demand for copper was slackening and that prices for the metal had fallen. Metropolitan Street Railway through the influences above noted, fell to the lowest point of the year—121¼, after having reached 120¼. There was a rally at the close, however, which brought the stock up to 124¼, this being a net loss of 3½ points. Brooklyn Rapid Transit declined from 58, the highest point, to 55, the lowest, the closing figure being 57, which was a loss of 1⅞. Manhattan Elevated closed at 130, being a drop of 3 points. Westinghouse common lost 1 point, closing at 194, and first preferred made a gain of 20 points, closing at 200. Western Union remained very quiet throughout the week closing at 84, ex-div. Following are the closing quotations of June 23:

NEW YORK.

	June 13	June 23		June 18.	June 23
American Tel. & Cable	77½	80	General Electric	177½	177½
American Tel. & Tel.	142	141	Hudson River Tel.	..	..
American Dist. Tel	27	27	Metropolitan St. Ry.	124½	124
Brooklyn Rapid Transit	58⅝	55¼	N. E. Elec. Veh. Trns.	⅛	..
Commercial Cable.			N. Y. & N. J. Tel.	.	..
Electric Boat	18	17	N. Y. E. V. T. Co.	5¾	5
Electric Boat pfd	37	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	*1¼	1¼	Western Union Tel.	85	83½
Electric Vehicle	7	7	Westinghouse com.	189	188
Electric Vehicle pfd	13½	13½	Westinghouse pfd.	..	188

BOSTON.

	June 16.	June 23		June 16	June 23
American Tel. & Tel	144	*141½	Western Tel. & Tel. pfd.	92	90
Cumberland Telephone	.	.	Mexican Telephone	1¾	1¾
Edison Elec. Illum.	246	.	New England Telephone	125	128½
General Electric	179	.	Westinghouse	.	..
Western Tel. & Tel	13	12	Westinghouse pfd.	..	..

PHILADELPHIA.

	June 16	June 25		June 16.	June 23
American Railways	..		Phila. Traction	96½	96½
Elec. Storage battery	.	63	Phila. Electric	6¼	6¼
Elec. Storage Battery pfd.			Pa. Electric Vehicle	..	..
Elec. Co. of America	8¾	8¾	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	June 16.	June 23		June 16.	June 23
Central Union Tel	.	.	National Carbon pfd.	94	94
Chicago Edison	154	150	Northwest Elev. com.	..	..
Chicago City Ry	190	197½	Union Traction	3	3½
Chicago Tel. Co			Union Traction pfd.	30	30
National Carbon	*24¾	23			

* Asked.

NEW YORK METROPOLITAN.—In view of the recent attacks on the Metropolitan Street Railway Company and the failure again of the latest, the following authoritative statement is of special interest: Leaving out of account the adjustments between the Interurban Street Railway Company and the Metropolitan Securities Company (which are of no practical importance, as the Securities Company owes the entire capital stock of the Interurban Company and the two concerns may, therefore, be considered identical, except for legal purposes) the position is as follows: The Securities Company has expended some $4,000,000 in acquiring the property and franchises of the Interurban Company, the People's Traction Company of New York, the Westchester & Connecticut Traction Company, the Wall & Cortlandt Street Ferry Railway Company, which it now owns, and for organization expenses, etc. The Interurban Company has agreed, under the terms of the lease with the street railway company, to furnish the latter company the sum of $23,000,000 in cash, partly for the purpose of paying off floating debt and partly for new construction, "electrifying" horse car lines, etc. For the first $10,000,000 paid by the Interurban Company to the street railway company, it received from the latter $11,000,000 of its 4 per cent. refunding bonds, which were sold for cash, realizing about $10,000,000. This left about $13,000,000 to be furnished to the street railway company, for which purpose, and to recoup the Securities company for its outlay for the acquisitions, etc., stated above, there have been called and paid on the shares of the Securities Company 50 per cent., i. e., $15,000,000. As this money is paid over to the street railway company, the Interurban Company receives securities for the full value of its payments, thus far principally Third Avenue Railroad stock. It appears from the foregoing: (1) That almost the entire amount to be furnished to the street railway company has been provided. (2) That the Securities Company has received and now holds in its treasury securities equal to its payments to the street railway company—in addition to holding property and valuable franchises which it has acquired.

DECLINE IN WESTERN TELEPHONE.—Advices from Boston say that the decline in Western Telephone common from around 30 to 13 has been one of the marked features of the local exchange. The stock has sold as high as 33½. The decline in the preferred has meanwhile been comparatively small, from around 98 to 91. There is $16,000,000 of each class of stock issued. The outstanding bonds amount to $9,834,000. The preferred stock is entitled to 6 per cent. cumulative dividends after two years, the present rate being 4 per cent. There have been no dividends paid on the common. The net revenue reported for the shares for the fiscal year ending December 31, 1902, was $673,849, or $33,849 more than required to pay the 4 per cent. dividends on the preferred. The undivided earnings of the sub-companies were not reported. The Western Telephone Company succeeded the old Erie Telephone Company. The bonds and a portion of the preferred stock were issued to retire the old Erie bonds, while the remainder of the shares were issued in exchange for the $10,000,000 Erie stock, to retire $9,000,000 of floating debt, and to raise $6,000,000 of working capital. The value of the properties acquired was placed by Messrs. Stone & Webster, who made an appraisal, at $26,300,000, apart from franchises and rights of way, which have been estimated at $6,000,000 more. Western Telephone owns about 80 per cent. of the stocks of its sub-companies. None of the latter have bonds, except the Postal Telegraph Company of Texas, which has $1,189,000, and the Michigan, which has $5,594,000, including the Detroit Company. The Michigan also has a floating debt of $2,400,000. Deducting total bonds and floating debt of these sub-companies, $9,200,000, from the estimated value of the properties, $32,300,000, leaves $23,100,000. About 80 per cent. of this, or $18,500,000, represents the value of the equity of Western Telephone in the old Erie properties. The parent company has also a working capital of $5,500,000.

ALLIS-CHALMERS REPORT.—The report of the Allis-Chalmers Company for the fiscal year ended April 30 states that the surplus of $561,076 earned for the year, after payment of the preferred stock dividend, is equal to more than 2½ per cent. on the common stock. For two years the charges to capital have comprised only such expenditures as created additions to the plants for increased output, while all other costs have been charged against the current revenues. The company makes its purchases upon a cash basis, discounts its bills, and has no debts other than those incurred in the conduct of its current business. There is cash in bank amounting to $1,628,409, and, in addition, in excess of current liabilities, there are net quick assets of $6,243,333. The net gain in the second fiscal year in the quick assets was $391,325. The capital stock of the company remains as originally issued. Three of the great units of the West Allis works are now practically completed. Extensions of all other plants have also been made or are in progress. All the property of the company is owned in fee, is free from lien and is covered by insurance. No mortgage can be placed upon the property without the assent of 75 per cent. of the amount of preferred stock outstanding. The orders unfinished and on hand April 30 amounted to $8,797,483, as compared with $8,157,034 last year. The capital stock of the company outstanding remains, as originally issued, at $16,250,000 of 7 per cent. cumulative and 1 per cent. participating convertible preferred stock, and $20,000,000 of common stock. The report says: "The outlook for work was never better, and the business offered is greatly in excess of present facilities, which will soon be ample to meet the demand."

LARGER WESTINGHOUSE DIVIDENDS.—The Westinghouse Electric & Manufacturing Company has declared a dividend of ⅞ per cent. upon its preferred stock out of earnings from April 1, 1903, until May 15, 1903, and a dividend of 1¼ per cent. out of earnings from May 15, 1903, to July 1, 1903, making a total of 2⅛ per cent., payable July 10 next. The company also declared a dividend of 1¼ per cent. upon its assenting and non-assenting stock out of earnings from May 15, 1903, and July 1, 1903. Vice-President Kobbe, of the Westinghouse Company, in explanation of these dividends, stated that the action was in pursuance of the statements made in the circular recently issued to the shareholders to the effect that the dividends on all classes of stock would be adjusted so as to become payable on the same date. The character of the agreement establishing the preferences has made this necessary, because all classes of stock are entitled to the same rate when the earnings are sufficient to pay more than 7 per cent. The last dividend on the assenting stock was paid May 15 and the adjustment has been made from that date to July 1 at the rate of 10 per cent. per annum. The date of payment of dividends has been fixed for the 10th of the month succeeding the end of each quarter. There are only twelve non-assenting shares now outstanding.

CANADIAN MARCONI COMPANY.—The bill to incorporate the Marconi Wireless Telegraph Company of Canada was passed by the Railway & Telegraph Committee of the House of Commons at Ottawa, on June 18. The capital stock will be $5,000,000. Exception was taken to the clauses pertaining to the business of the company and to powers requested. Under these clauses it was said that it was apt to become the biggest trust in the world, the company getting power to go where it liked and to take over every business of a similar character. The clauses were amended by the addition of the terms "subject to the approval of the government in council and of the municipalities interested." The clause relative to charges for messages was amended to read that the company may collect such rates as are fixed from time to time by the government in council instead of the directors, as the company desired.

BELL TELEPHONE EARNINGS.—It is stated from Boston that the output of instruments by the American Company and its subsidiary companies is upon a tremendous scale and the net earnings of the A. T. & T. Co. for the first five months of 1903 amounted to $4,870,000 as compared with $3,556,323 for the same period of 1902, an increase of $1,313,720, or 28 per cent. These earnings are a demonstration that the new money which has been put into the property under the care of the new management during the past two years is beginning to receive its just returns.

DIVIDENDS.—The directors of the Union Switch & Signal Company have declared a dividend of 2¼ per cent. on the preferred stock and 1½ per cent. on the common, and have increased the capital stock $500,000, at 70 a share, payable 30 per cent. July 11, 20 per cent. August 15, and 20 per cent. September 15. The Electric Storage Battery Company has declared the regular quarterly dividends of 1¼ per cent. on both the common and preferred stocks, payable July 1. Bell Telephone Company, of Philadelphia, has declared a dividend of 2 per cent., payable July 25.

INDIANA TROLLEYS.—The Union Traction of Indiana and the Indianapolis Northern Companies have been merged into the newly-formed Union Traction Company of Indiana, with a capital of $1,000,000 preferred and $7,500,000 common. This will be leased in turn to the Indiana Union Traction Company, which will have $5,000,000 stock and $5,000,000 of bonds, and which will guarantee dividends at 1½ per cent. to start with, increasing to 6 per cent. in 1910.

CHICAGO TELEPHONE.—The Chicago (Bell) Telephone Company is pushing its service rapidly, and the total number of instruments out on June 1 numbered 88,080. The new stock for improvements is practically all subscribed for by old stockholders. Chicago telephone stock is now selling at 135, which is a decline of about 60 points in the last two years. It is thought due to the fact that its franchise runs out in 1909.

THE ATLANTA TELEPHONE & TELEGRAPH COMPANY, successor to the Standard Telephone Company, has filed a mortgage in Atlanta on all of its properties to cover a bond issue of $600,000 for improvements. The mortgage is given to the City Trust, Safe Deposit & Surety Company, of Philadelphia. The bonds are 5 per cent. and fall due May 1, 1923. The Atlanta company paid $750,000 for this property.

TO DEVELOP GAVIN FALLS.—The Manchester Traction, Light & Power Company, of Manchester, N. H., which is controlled in Boston, will increase its capital stock, $550,000, to $2,200,000, for the purpose of providing for improvements and new equipment and developing the Gavin Falls water power.

Commercial Intelligence.

THE WEEK IN TRADE.—From the reports received by the mercantile agencies it is evident that there is improvement in the crop, trade and labor conditions. Generally speaking, good railway reports continue; collections show gains, and money is easy, and there is a growing confidence that the crop movement in the fall will be handled without undue strain. Pig iron and steel are weaker; buying is still slow and production is at an enormous rate. Steel is easier and finished products are less active. Lead lost ½ cent, and tin is lower, but copper is ostensibly unchanged. An important but unexpected decline has materialized in lead; and cotton, owing to manipulative handling, has advanced, further complicating the position of manufactured goods. The long lock-out in the New York building trades unfavorably affects business in building material, stoves, gas and electric fixtures, hardware and a multitude of similar lines. Lumber is feeling the effects of existing strikes, and anthracite coal is called for more rapidly than it can be furnished. Copper was dull and lifeless, but there was a better inquiry from Europe. Quotations are nominal at 14a14½c. for Lake; 14a14⅛c. for electrolytic in cakes, wire bars and ingots, and 13⅝ a 13⅞ for cathodes and casting stock. The business failures for the week ending June 18, as reported by *Bradstreet's*, numbered 165, against 181 the week previous, and 177 the corresponding week last year.

FOREIGN AND DOMESTIC ORDERS FOR HARRISBURG ENGINES.—The recently formed engineering and contracting firm of Mackenzie, Quarrie & Ferguson, Incorporated, 114 Liberty Street, New York, which concern represents the Harrisburg (Pa.) Foundry & Machine Works in this section, has recently secured fair-sized orders for engines to be shipped, for lighting purposes, mostly to Mexico, Cuba, Japan and the Philippines. Numerous domestic orders have also been taken within the past few weeks for engines to be direct-connected to generators for light and power work. The Eddy Valve Company, of Waterford, N. Y., has ordered a 120-hp Harrisburg standard engine for direct connection to a 75-kw General Electric generator build. This outfit will be used for light and power purposes. A 150-hp tandem-compound to be direct-connected to a 100-kw General Electric generator, has been ordered for light and crane service in the Alleghany shops of the American Locomotive Company. The Berlin (Conn.) Construction Company has called for a 75-hp standard engine for direct connection to a 50-kw General Electric generator for light and power use. A 120-hp standard simple engine is to be shipped the Pennsylvania Salt Manufacturing Company, Philadelphia, for direct connection to a 75-kw Crocker-Wheeler generator for both light and power. Tufts College, Boston, Mass., has ordered for lighting purposes a standard simple engine for direct coupling to a 25-kw General Electric generator. Two 75-hp standards to be direct-connected to Western Electric generators of 50-kw capacity each will be installed for lighting service on the Market & Fulton National Bank Building, New York. The Jarvis Terminal Cold Storage Company, Jersey City, is to be supplied for light and power use with two tandem-compound engines —75 hp and 125 hp—for direct-connection to 50-kw and 75-kw Crocker-Wheeler generators. The Aluminum Press Company, of Plainfield, N. J., is to be shipped a 75-hp standard simple engine for direct-connection to a 50-kw Sprague generator for light and power. The Thames Iron Works, Wharton, N. J., have ordered two 300-hp standard tandem-compound engines for direct-connection to 200-kw General Electric generators, for power only. A small lighting outfit has also been ordered for St. Luke's Hospital, New York.

CURTIS TURBINES AT SCHENECTADY.—Upon the courteous invitation of the General Electric Company, the editors of a number of the technical papers in New York, escorted by Mr. E. H. Mullin, visited the works of the General Electric Company on June 19, with the object of inspecting the Curtis steam turbines—so fully described in our issue of May 23—and the preparations made at the works for their manufacture. The turbine department occupies the greater part of one of the large buildings at the Schenectady works, covering an area of 800 ft. x 90 ft., and about 400 men are employed. Even these facilities are scant for the orders on hand, which aggregate 185,000 kw, and the department is to be moved to a new building now being erected with an area of 240,000 sq. ft. Some of the processes used in the manufacture of the Curtis turbine are very interesting, such as the method of cutting the buckets in the solid steel discs and balancing the discs. Several different types of slotting machinery are used for cutting the buckets, but in all of them the tool is so guided that its cutting edge travels at such stroke over the exact curve to be reproduced. After the buckets are cut, a steel band is riveted around the periphery of the wheel. Each disc is balanced separately on the shaft and in the position in which it will be permanently mounted. Any unbalancing effect is determined by the flexure of the shaft when revolving rapidly, and weight is taken from the proper part of the wheel until a perfect balance is secured. A most enjoyable and instructive day was spent by the journalists.

THE COPPER MARKET.—Mr. John Stanton, who is interested in several large copper mining companies, and is well known in the trade, said last week: "I do not expect to see copper sell below 14½ cents a pound. The recent setback has been due to the stopping of work in the building trade because of labor troubles. The market will go higher as soon as the difficulties with labor end." The bears on copper lately emphasized the reported intention of the John A. Roebling Sons Company to shut down its plant one day each week, this being taken to signify that the demand for copper would show a material falling off, inasmuch as the company is one of the largest consumers of copper in the country. On this subject F. W. Roebling has written a letter in which he says: "Our copper wire business is practically up to that of last year, and we judge from our general knowledge of the situation that the demand for electrical apparatus will be about the same as it was last year. The number of operations calling for copper has been much reduced, but those which are projected and under way involve large quantities. There are a great many enterprises of magnitude under way and projected which will continue to call for large amounts of copper, and my judgment is that the total output will come very near being absorbed."

MEXICAN POWER TRANSMISSION.—Americans will construct a large hydroelectric plant in the State of Chihuahua for the purpose of generating current for transmission to the cities of Chihuahua and Parral, located 80 miles and 46 miles, respectively from the power house. The plant will be built at La Joya, on the Conchos River, by the Conchos River Power Company, of which Frank H. Wright, president of the Stanley Instrument Company, is the head. The company acquired the concession for the erection of the plant, which was originally granted by the Mexican authorities to R. M. Burke, formerly United States Consul in Chihuahua. Over 30,000 hp is available. Besides transmitting current to Chihuahua and Parral, the plant will furnish energy to operate mines along the route. The initial equipment will include four 800-hp turbine water wheels to operate under a head of 125 ft. The transmission line will work at 40,000 volts.

STEEL RAIL PRICE MAINTAINED.—After the meeting of the Executive Committee of the United States Steel Corporation last week the following statement was issued by Chairman E. H. Gary: "The prices of steel rails for the year 1904 has been fixed at $28, as the capacity of all the mills for the next seven or eight months has been sold. Many of the leading railroad companies have expressed a desire to have the prices of rails established for the next season, and action has been taken a little earlier than usual. Upwards of 250,000 tons for 1904 have already been booked, and inquiry for a large additional tonnage has been received during the day. No change in the price of other lines of steel has been contemplated." In general also the schedule of finished steel prices is unchanged for 1904.

EQUIPPING ENGINE WORKS.—The British Westinghouse Electric & Manufacturing Company, Limited, has secured the contract for the electrical equipment of the Northeastern Marine Engineering Company's Sunderland engine works. This contract includes the supply of a number of polyphase Westinghouse constant-speed and variable-speed induction motors, together with controlling gear, auto-starters and three-panel switchboard. Power will be obtained from the Sunderland Corporation Supply, this being the first plant to be connected up to the new polyphase generating plant, which runs at 220 volts and 50 cycles. The wiring for the installation will also be executed by the British Westinghouse Company. This will include both overhead and underground work, with distribution boxes and conduits.

FEEDER CABLE FOR SYDNEY TRACTION SYSTEM.—The National Conduit & Cable Company, Times Building, New York, has secured a contract for feeder cable for the city and suburban electric traction system, now being constructed by the New South Wales government at Sydney. Considerable equipment for an addition to the power house was expected to have been placed before this, but financial conditions in the Antipodes will not permit of further contracts being closed for the present. The contract for the initial installation was secured by the General Electric Company. The contract was worth about $800,000. The engines are of Allis build. The boilers are Babcock & Wilcox.

GROWTH OF FOREIGN TRADE.—For the month of May the exports of merchandise were valued at $100,508,051, and the imports at $78,935,143. The exports of the United States during the eleven months ended May 31, aggregated $1,324,493,293, and exceeded by $32,014,375 those of the corresponding period of the previous fiscal year. The imports for the same months show an increase of $113,391,300 and a total of $943,957,194, the highest on record; and for the first time will pass the billion dollar mark when the fiscal year ends on June 30. The balance of trade in favor of the United States for eleven months is $380,806,009, against $462,273,024 for the same period of last year.

NEW YORK EDISON GROWTH.—Under its able and progressive management, the New York Edison Company grows steadily and of late has been finding itself rather pinched by the building strikes, etc., preventing delivery of new apparatus and the erection of necessary sub stations. If it were not summer time, the delay in increasing plant for generation and distribution might be serious. Big as the Waterside station is, it is rapidly filling up, and the company even now is studying the problem of increased capacity. Another large station in the not distant future is already becoming a part of the programme under consideration by the executive officers.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY records that in one instance where 30 steam engines of 1,375 total horse-power were supplanted by 57 motors of 1,065 total horse-power, for machine shop driving, the average daily saving in steam was 41.6 per cent., of combustibles 32.2 per cent. (coal saved, 20,000 pounds). In other cases electric driving has reduced by 50 per cent. the cost for engineer, coal and water; the fuel account, 20 per cent.; the cost of power, 44 per cent. The gross saving was 30 per cent., with direct-connected motors, and 22 per cent. with belted or geared motors.

WESTINGHOUSE BRITISH ORDER.—The Westinghouse Company has secured a contract for the conversion of steam to electric motive power of another British railroad. The contract relates to the Wirral Railway, a system about 15 miles in length, which connects Liverpool by means of the Mersey Tunnel Railway—the electrification of which has just been completed by the Westinghouse people—and Birkenhead with the residential district of the Cheshire peninsula, bounded by the River Mersey and Dee. The terminal points will be West Kirby and New Britain.

THREE MEXICAN LIGHTING PROJECTS.—The American engineering and contracting firm of Fogarty & Dickinson, of San Luis Potosi, Mexico, has secured three contracts for the installation of electric lighting plants. One contract obtained from the federal and municipal authorities is for a plant in the city of Colima, State of Colima, which has a population of about 35,000. San Andres Chalchicomula, a small town in the State of Puebla, is to have a plant, and Tamazula, State of Jalisco, is also to be lighted. The equipments will be purchased in the United States.

BALL ENGINE CONTRACTS.—The Collins Sugar Company, Fort Collins, Colo., will install a plant, consisting of three engines of 725 hp, direct-connected to Crocker-Wheeler generators. The Ball Engine Company, Erie, Pa., furnishes the engines, which will be of the self-oiling type. The Ball Engine Company has also sold the S. W. Card Manufacturing Co., of Mansfield, Mass., a 100-hp self-oiling engine for electrical purposes.

MEXICAN ELECTRIC TRACTION SCHEME.—The construction by Americans of an electric railway between the city of Guadalajara and Lake Chapala is projected. Application has already been made to the Mexican authorities for the necessary franchise. B. F. Hammett and Felix Martinez, of El Paso, Tex., are primarily interested in the project. The system will be some 60 miles in length.

ST. LOUIS FAIR CONTRACTS.—The Commercial Electrical Supply Company, of St. Louis, has been awarded contracts for electrical material for the St. Louis Exposition, aggregating about $120,000. This material includes porcelain insulators, pole line supplies, receptacles, switches, police patron boxes and various other appliances to be installed on the grounds.

FRICTION DRAFT GEAR.—Over 100 per cent. increase in sales within twelve months is the record made by the Westinghouse Friction Draft Gear. One year ago 41,000 freight cars and 1,400 locomotives were equipped with this appliance. The number for freight cars is now over 80,000, and for locomotives in excess of 3,000.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Chicago, Ill., and Rochester, N. Y., has recently sold a magneto switchboard to the Deerfield Telephone Company, North Benton, Ohio; also a large number of bridging telephones to the Clinton Telephone Company, of Wilmington, Ohio.

WESTINGHOUSE ARRESTERS FOR CHINA.—Several Westinghouse lightning arresters have been ordered through Fearon, Daniel & Co., of China, New York offices 96 Wall Street, for shipment to the Shanghai municipality for use in the electric lighting system of the foreign settlement of that Chinese city.

MEXICAN TELEPHONE PROJECT.—A telephone system is to be constructed between Tepehuacan and Tamala, both in the State of Hidalgo. The state government will subsidize the undertaking.

General News.

THE TELEPHONE.

WOODBERRY, ARK.—The Eastern Telephone Company has 25 telephones and 75 miles of toll line, with as many more projected. This line is to run from Fordyce to Eldorado.

AUGUSTA, GA.—Archibald Blackshear has been made permanent receiver of the Augusta Telephone & Electric Company. He has been instructed to continue the operations of the company.

BLUE RIDGE, GA.—The Blue Ridge Telephone Company operates a 100-drop board with 140 subscribers and has 40 miles of toll line. It is now opening a small exchange at Elligay with a 50-drop board, and will have nearly 50 subscribers there.

PRESTON, IDAHO.—The Oneida Telephone Company has 18 subscribers and excellent prospects for a big mileage, as it proposes branching out in every direction to take in all the small towns in this section, eventually reaching Ogden and Salt Lake.

COAL CITY, ILL.—The Interstate Telephone & Telegraph Company has been granted a franchise in this city.

CROPSEY, ILL.—The Cropsey Telephone Company has a 100-drop board and 180 subscribers. Its rates are $6 per year.

SHELBYVILLE, ILL.—The Shelby County Telephone Company operates a 200-drop board and has 230 subscribers. It also has 100 miles of toll line.

MOLINE, ILL.—The Central Union Telephone Company has just installed a hotel system of 100 instruments in the new Manufacturer's Hotel, the first of the kind in a city of this size.

ARCOLA, ILL.—The Arcola Grain, Coal & Telephone Company has been incorporated with a capital stock of $5,000. It will operate a telephone system. The incorporators are Joseph H. Ewing, John I. Hall and Joseph Coombe.

TAMAROA, ILL.—The Tri-County Telephone Company has a 60-drop board with 45 city subscribers and 15 country lines. By the end of the year 100 telephones will be installed. There are 1,000 miles of toll line. The size of the switchboard is to be doubled in the near future.

MORRISON, ILL.—The Whiteside County Farmers' Mutual Telephone Company is a new and highly prosperous concern, having a 100-drop board, 85 subscribers and about 75 miles of toll line. There are lines in Whiteside and Henry counties with an exchange at Prophetston of about 300.

WEST BROOKLYN, ILL.—This plant is owned by Mr. F. M. Yocum, who bought it last April, with one at Compton, including 10 miles of grounded toll line. He is rebuilding the toll line full metallic and holds contracts for more farmers' lines than can be completed this year. This place has a 40-drop board with 40 subscribers.

HARDIN, ILL.—The Calhoun Telephone Company, besides having a 75-drop board here, has others at six different places with 200-drop board capacity. It has 150 exchange subscribers and 200 on toll or farm lines. There are 100 miles of toll line. Rates are $1 for residences, $1.50 for business houses. A 50-mile metallic circuit will soon be completed.

GARRETT, IND.—The Garrett Telephone Company will not commence operations till October, but will then open under very bright auspices.

NEW LISBON, IND.—The New Lisbon Telephone Company has a 50-drop switchboard capacity and 210 subscribers. The rate is $1 per month.

PERU, IND.—The Peru Home Telephone Company operates a 3000-drop board with 859 subscribers and has 40 miles of toll line. A large increase is projected.

CROTHERSVILLE, IND.—The Jackson Telephone Company has two exchanges of 50-drop capacity each. There are 64 subscribers and 40 miles of toll line with more projected. Rates are $12 per year.

GENEVA, IND.—The Geneva Telephone Company is in first class shape, being unable to make country extensions as fast as applications come in. It operates a 150-drop board and has 144 subscribers. Rates are $1, $1.25 and $1.50.

CLINTON, IND.—The Clinton Telephone Exchange operates Sterling apparatus. It has a 350-drop board and 500 subscribers. It has 40 miles of toll line. The rates are $1.25 and $2. Improvements and additions are to be made in the near future.

NAPPANEE, IND.—The owner of the Nappanee Telephone Company, Mr. C. R. Stoops, has a most progressive property. The switchboard capacity is 200 drops, there being 205 subscribers. Rates for residences and farms, $12—business houses, $18. Farmers' lines are being built.

KNIGHTSTOWN, IND.—The Knightstown Telephone Company reports the outlook more favorable than at any time during the past 10 years. It operates a 370-drop board and has 465 subscribers. There are 80 miles of toll line and the cable capacity is to be increased. Rates are $18, $15, $12, $9, $6 and $3 per year. With the advent of farmers' co-operative companies the number of telephones increases rapidly and this, with the low annual rates, gives a stimulus to the business, heretofore unknown.

MARIETTA, IND. TER.—The Red River Telephone Company operates 107 miles of toll lines.

AL-LU-WE, IND. TER.—There is a private line from this place to Nowald, which has been in operation several years.

DUMONT, IND. TERR.—The Chickasaw-Choctaw Telephone Company operates a 200-drop board and has 173 subscribers. There are 102 miles of toll line. Increase has been rapid and further business is projected.

TAHLEQUAH, IND. TER.—The Cherokee Telephone Company uses Stromberg-Carlson apparatus, has a 340-drop board and 160 subscribers. There are 35 miles of toll line at 25c. per message and exchange rates are $1.50 and $2 per month. This company expects to double its business in another year.

HANCOCK, IA.—The Hancock Telephone Company has a 100-drop board and 105 subscribers, and is soon to extend its business.

FORT DODGE, IA.—The Fort Dodge Telephone Company operates a 900-drop board, has 920 subscribers and 100 miles of toll line. Rates are $1 and $2.

CONROY, IA.—The Iowa-Hilton Telephone Company operates a 24-drop board and has 100 subscribers. The company has all bridging lines and is gaining all the time.

MONROE, IA.—The Monroe Telephone Company commenced operations less than a year ago. It has a 200-drop board of Eureka make, and 380 subscribers at $1.50 per month. An increase is projected.

ELDRIDGE, IA.—The Eldridge Mutual Telephone Company uses extension bells and has 72 subscribers. It is capable of taking care of two or three hundred, and operates also country party lines.

LISBON, IA.—The Lisbon Telephone Company operates an Eureka 200-drop board and has 140 subscribers in and 300 on country lines, of which there are 150 miles. Rates are $18 for business, $12 for residences.

MARSHALLTOWN, IA.—The Marshall Telephone Company operates Stromberg-Carlson apparatus; has a 1200-drop board with 900 subscribers and 70 miles of toll line. The outlook is very bright both in exchange and toll line business.

BATTLE CREEK, IA.—The Battle Creek Telephone Company operates a Eureka switchboard of 200 drops and has 98 city and 160 country telephones at $18 per annum. The service has been doubled this year and five more party lines are projected.

DEWITT, IA.—The Dewitt Telephone Company uses a full metallic system. It has a 200-drop board with 350 subscribers, paying $12 and $18 per annum. The outlook is bright for 500 city and country subscribers. Party lines bring in 10 to 16 farmers on a line.

HAWARDEN, IA.—The Hawarden Telephone Company has a switchboard capacity of 320 lines and 150 subscribers at $1.75 for business, $1.25 for dwellings and $1.25 for farmers. The company expects to construct toll lines to all parts of the country as soon as possible.

LINEVILLE, IA.—The Lineville Telephone Company has a board here of 147 drops, 100 at Garden Grove, 25 at Wildon and 40 at a town in Missouri. The number of subscribers in the four towns and country is 965. Rates are $10 and $12 per year. The system seems likely to extend to 1,500 telephones in the next two years.

MT. AYR, IA.—The Mt. Ayr Mutual Telephone Company has switchboard capacity of 200 drops and 30 farm lines. There are 175 subscribers at $1.25 per month. A new cabinet of 100 drops is to be put in soon and prospects are good for 500 subscribers at no distant date. At present this office has direct connection with 420 farmers' telephones.

BELLEVUE, IA.—The Bellevue Telephone Company operates a 100-drop board, has about 100 subscribers and 15 miles of toll line. An effort is being made to effect a consolidation of all companies operating in Jackson and Jones counties to be known as the Iowa & Illinois Telephone Company, which would enter Illinois and make through connections from Dubuque to Davenport, Rock Island, Moline and Chicago by copper Bell lines.

CLIFTON, KAN.—The Clifton & Vining Telephone Company supplies service to 148 subscribers from a 150-drop board. There are 140 miles of toll line and 25 farmers' lines. The charge is 25 cents for 5 minutes on toll lines.

LOGAN, KAN.—The Logan Telephone Company operates a 150-drop board with 75 subscribers. There are 37 miles of toll line and 22 more projected. Farmers' lines will doubtless soon be built over a large section of the country.

WICHITA, KAN.—The Wichita Independent Telephone Company has a switchboard with a capacity of 5,000 lines. It has 2,000 subscribers. This plant has only been in operation six months, but its business is gaining every day.

HERINGTON, KAN.—The Herington Telephone Company has switchboard capacity of 200, and a toll board of 10 lines. There are 200 subscribers at a 15c. rate in the country; $1 and $2 for residences and business houses. An increase of party lines is projected.

WELLINGTON, KAN.—The Wellington Independent Telephone Company operates a 500 "American" drop board, has 439 subscribers and 125 miles of toll line. The company has just bought out Belle Plains with 70 telephones and 79 farmers' lines. Lines are run into every town in the country.

WETMORE, KAN.—The Wetmore Telephone Company employs two switchboards of 100 drops each. Stromberg-Carlson and American apparatus is installed. There are 150 subscribers and 75 miles of toll line. Rates are $12 for residences, $15 for business houses. Several farmers' lines are projected.

McLOUTH, KAN.—The H. D. Edmond Telephone Company operates "American" apparatus, has a 200-drop board and 125 subscribers with 173 miles of toll line and more projected. Rates of subscriptions or toll service are $1 and $2 in the town; $25 for the first year and $1 per month after, in the country.

ANTHONY, KAN.—The Southwestern Telephone Company has just finished rebuilding an exchange at Enid, Okla., at a cost of upwards of $50,000. It has exchanges at Harper, Anthony and Attica, Kan., at Carmen, Cherokee, Alva and Enid, Okla., together with 300 miles of toll line connecting 35 cities and towns in Kansas and Oklahoma. These properties represent a cost value of $110,000.

WOLFSVILLE, MD.—This local company was built to secure connection with the Frederick County Telegraph and Telephone Company with exchange at Frederick, Md., into whose hands it will eventually pass.

STREET, MD.—The Highland Telephone Company operates two switchboards of 100 and 50 drops respectively. It supplies service to 200 subscribers and has 50 miles of toll line. Its charges are $15 for dwellings, $18 business houses.

TEPEHUACAN, MEXICO.—A telephone line is to be constructed between this place and Tamala. The state government will give aid to the enterprise.

HERMOSILLO, MEXICO.—Senor Monteverde, of this place, has obtained a concession for establishing a complete telephone system here. He is negotiating with an American company to take hold of the enterprise.

FOWLERVILLE, MICH.—This is a mutual system and is intended to cover the county. The exchange has a 100-drop board and 35 subscribers.

BYRON, MINN.—The Zumbro Valley Telephone Company operates a 100-drop board, has 70 subscribers and 40 miles of toll line, with several more in contemplation. There is a good independent connection here, with many cities and a fine scope for country work.

HATTIESBURG, MISS.—The Peoples' Telephone Company operates a 600-drop board, has 325 subscribers and 125 miles of toll line. Its rate is 25 cents for three minutes.

ST. LOUIS, MO.—The Blythedale Telephone Company has been incorporated by O. J. Hutton and others. The capital stock is $5,000.

PLATTSBURG, MO.—The Plattsburg Telephone Company operates a 200-drop board, has 250 subscribers and 200 miles of toll line. Rates are $1.50 and $2. A large increase is projected. The common return system is now being put in.

BEAVER CROSSING, NEB.—The Beaver Crossing Telephone Company is about to commence operations and will operate Ericsson apparatus. There is a 100-drop board, and 50 to 75 miles of toll line are to be completed. Rates will be $1, $1.25 and $1.50.

AURORA, NEB.—The Hamilton County Farmers' Telephone Association operates two drop boards of 100 each and two of 10 each. It has 156 subscribers. There are 52 miles of toll line at 50c. per month, and 47 more in prospect. This association was started by three men for their own convenience, and lines were asked for faster than they could be supplied. It is a grounded system, but is to be changed to metallic very soon. It is now incorporated with $10,000 capital.

PRINCETON, N. J.—The Automatic Telephone Exchange Company operates 125 switches and has 105 subscribers at $25 per annum.

POINT PLEASANT, N. J.—The Seashore Telephone Company uses Phœnix and Kellogg apparatus, a 140-drop board and has 145 subscribers. Business rates are $20; residence, $15.

WATERTOWN, N. Y.—The Citizens' Telephone Company has a board of 600-drop capacity and 560 subscribers, with 9 miles of toll line.

DUNDEE, N. Y.—The Dundee Telephone & Telegraph Company has been incorporated by C. J. Watson and others, with a capital stock of $2,500.

WESTFIELD, N. Y.—The Westfield Telephone Company operates a 200-drop board, has 298 subscribers and 84 miles of toll line. Extensions are to be built.

COBLESKILL, N. Y.—The Cobleskill Telephone Company uses "Western" apparatus has a 100-drop switchboard capacity and 120 subscribers. The rates are $15, $12.50 and $10 per year.

COBLESKILL, N. Y.—The Cobleskill and Sharon Telephone Company uses a 25-drop board of Western construction. It has 25 subscribers and 37 miles of toll line. The subscription rate is $15.

CATTARAUGUS, N. Y.—The Pioneer Telephone Company has about 150 subscribers at $9 for residences and $12 for business houses. It has 10 miles of toll line and is increasing business rapidly.

POTSDAM, N. Y.—The Racket River Telephone Company operates a 200-drop board and is about to put in another. It has 225 subscribers and 200 miles of toll line. Rates are $12 and $15 per year.

HUDSON, N. Y.—The Commercial Telephone Company and the Columbia Telephone Company, of Hudson, have been merged, the capital being $50,000. The directors are R. G. Foster, Benjamin F. Case and E. Charles Getty.

COMSTOCK, N. Y.—The Comstock Telephone Company connects at North Granville with the Granville Telephone Company. This again gives connections with other lines to Albany on the South and Port Henry on the north.

SYRACUSE, N. Y.—The Columbia Long Distance Telephone Company has 70 subscribers and 125 miles of toll line. Rates vary according to distance. Lines have been completed from Syracuse to Elbridge; and Syracuse to Phœnicia.

VICTOR, N. Y.—The Peoples' Telephone Company operates Stromberg-Carlson apparatus, and an 80-drop board with 36 subscribers. It has 140 miles of toll line and five exchanges—at Holcomb, Vincent, Victor, Honeye and Naples. The company will build rural lines within the field now covered by its toll lines.

SHERMAN, N. Y.—The Sherman Telephone Company operates a Kellogg 200-drop board and has 350 subscribers with orders now to put in another hundred. There are 60 miles of toll line and 20 more projected. Rates of subscription are $9, $12 and $24.

SYRACUSE, N. Y.—The Syracuse Telephone Company uses central energy apparatus. It operates a 2,400-drop board and has 2,300 subscribers. A general extension of the system is projected, including subway lines, new building and exchange equipment. Its rates are: business, $36; residence, $24. Party lines, business, $30; residence, $18. A toll line is operated in connection with the Columbia Long Distance Company.

GREENSBORO, N. C.—The sale of the Greensboro Telephone Exchange to the Southern Bell Telephone Company has been consummated and the latter company has taken charge. The consideration was $70,000. The deal includes the property of the American Telephone & Telegraph Company, which has been preparing to build an exchange to compete with the Greensboro exchange.

WILLISTON, N. DAK.—The Williston Telephone Company has 160 drop board capacity and 90 subscribers. There are 50 miles of toll line at 1c. per mile and 50 more are projected.

POINT ROCK, OHIO.—The Point Rock and Wilkesville Independent Telephone Company has 169 subscribers and 69½ miles of rural line.

NORTH RIDGEVILLE, OHIO.—The North Ridgeville Telephone Company operates a 50-drop board with 50 subscribers. Toll rates are $18 per annum.

MT. VERNON, OHIO.—The Mt. Vernon Telephone Company, which is incorporated under the laws of West Virginia, has increased its capital stock to $100,000.

SPENCERVILLE, OHIO.—The Spencerville Telephone Company has a 300-drop board and 450 subscribers and over 70 miles of country line. A large increase is projected.

CONNEAUT, OHIO.—The Conneaut Telephone Company is planning to enlarge its switchboard in order to take care of a large number of subscribers now on the waiting list.

DAYTON, OHIO.—The Montgomery County Telephone Company has been incorporated with $200,000, by L. Rauh, H. C. Kiefaber, J. T. Barlow, Edward C. Canby and J. D. Artz.

HARRISON, OHIO.—The Harrison Telephone Company has signed a contract with the City & Suburban Company (Bell) whereby it will install a new switchboard and use Bell instruments.

LONDON, OHIO.—The London Home Telephone Company has increased its capital stock from $125,000 to $200,000 and will make improvements. W. M. Jones is president, and W. J. Meech, secretary.

BURTON, OHIO.—The Burton Telephone Company has increased its capital stock and is planning to install a 1000-line switchboard. The system is being extended throughout the surrounding farming district. A. M. Baird is manager of the company.

PERRYSVILLE, OHIO.—The Farmers Telephone Company, of Perrysville, and the Monroe Telephone Company, of Lucas, have arranged for an interchange of business and propose to extend their systems throughout the entire farming district of Lucas County.

BELLEFONTAINE, OHIO.—The United Telephone Company operates a switchboard of 800-drop capacity and has 750 subscribers. It also owns 12 other smaller exchanges with 1,100 telephones. There are 500 miles of toll line at the following rates: $2.50 private line, business; $2 two party line, business; $1.50, $1.25 and $1. for one, two and four party residences respectively.

GARBER, OKLA.—The Garber Telephone Company has been incorporated with a capital stock of $5,000. Mr. B. A. Garber is interested.

GRAND, OKLA.—The Grand Telephone Company was organized in February for the purpose of putting the town in connection with the railroad at Gaye. It contemplates an extension to Cheyenne. It has 14 subscribers and 26 miles of toll line charging 25c. per message.

OTTAWA, ONT.—A bill is now before the Dominion Parliament to incorporate the Canadian Telephone & Telegraph Company, with headquarters at Ottawa, and a capital stock of $1,000,000. The promoters, who are nearly all Americans, are George I. Stegmater and Christopher J. Stegmater, of Wilkesbarre; Frederick Warnke, Jacob W. Warnke, Charles Robinson, John A. Mears, James R. Mears and Walter L. Schlager, of Scranton; Francis J. Leonard, of Philadelphia, and Harry Bryden, of Pittston. The Canadians are William H. McCormick, John Culbert, M. P., Rufus H. Pope, M. P., W. F. McCreary, M. P., and some others. The company asks power to construct or buy telephone and telegraph lines anywhere in Canada, by either overhead wires or cables underground and to connect its system with existing telephone, telegraph and cable lines. Provision is made for a government control of tolls. The company seeks power, also to erect works for the generation of electric power. At least three directors are required to be residents of Canada.

McKEESPORT, PA.—The Federal Telephone Company will soon begin to place its wires underground in this place.

WALHALLA, S. C.—The Oconee Telephone Company has a 100-drop board here, 70 at Seneca and 50 at Westminster. There are 285 subscribers and 70 miles of toll line, to which 50 more will soon be added. The company is now rebuilding all offices and making every circuit metallic. Fifty more telephones are expected within the next twelve months.

ALSEN, S. DAK.—The Alsen, Beresford & Emmett Telephone Company has 25 miles of toll line and intends building a party line.

MEMPHIS, TENN.—It is reported that the Home Telephone Company, of Memphis, will build a line from Jackson to Humboldt, Tenn.

CHATTANOOGA, TENN.—The Hamilton Telephone Company has been incorporated with a capital stock of $5,000. Mr. Z. C. Patton is one of the directors.

LIVINGSTON, TEX.—The Livingston Telephone Company has been incorporated with a capital stock of $2,000. Mr. L. F. Gerlach is one of the directors.

WICHITA FALLS, TEX.—The Texas Telephone Company has 350 miles of toll lines and three exchanges. The lines reach points in Texas, Oklahoma and Indian Territory.

AMARILLO, TEX.—The Amarillo Telephone Company uses wire fences as line to a distance of 50 miles for ranches, of which 25 will be connected. It has a Eureka 300-drop board, 310 subscribers, 200 miles of toll line at $1.50 for residences and $3 for business houses, and intends putting in another 100-drop board and 100 miles of toll line.

SALT LAKE CITY, UTAH.—The Utah Independent Telephone Company has a 12,000-drop board with 4,000 subscribers and 400 miles of toll line. Mr. F. B. Hall is chief engineer. The company purposes to cover Utah, Idaho and Montana, work to that end already making rapid progress.

GRANTSBURG, WIS.—The Consolidated Telephone Company will build a line to Shell Lake, Spooner and Superior.

ASHLAND, WIS.—The North Wisconsin Toll Line Company, of this city, has been incorporated with a capital stock of $30,000. Mr. C. F. Latimer is one of the incorporators.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—The Citizens' Light, Heat & Power Company has been organized, with a capital of $30,000, by Alex. Rice, C. L. Ruth and others.

HUNTSVILLE, ALA.—The Huntsville Electric Railway, Light & Power Company has secured the contract for lighting the streets for five years at $75 per light per year.

PRESCOTT, ARIZ.—Engineer J. G. Girard writes that it is proposed to construct an electric power plant in Cataract Creek for operating 50 miles of railroad; probable cost of work, $2,000,000.

CHICO, CAL.—The Butte County Power, Light & Water Company has been incorporated, with principal office at Chico; capital, $300,000. W. P. Lynch, of Cherokee, and A. F. Jones, of Oroville, are among the directors.

PUEBLO, COL.—The contract for erecting and installing an electric light plant and wiring system for the lunatic asylum buildings has been awarded to Skinner & Sethman, of Denver, for $12,850.

WILLIAMANTIC, CONN.—The Willimantic Gas & Electric Light Company informs us through Mr. Jackman, superintendent, that its plant has just been thoroughly remodeled with excellent results. There are 92 1,000-cp arcs and 1,000 16-cp incandescent lights. Mr. J. F. Church is president.

AUGUSTA, GA.—The Augusta Railway & Electric Company will extend its lighting system to Summerville.

COLUMBUS, GA.—The city of Columbus has tabled an ordinance requiring all wires in the business district to go underground. Both telephone companies are voluntarily placing their wires underground in the business section.

HIGHFALLS, GA.—The Towaliga Falls Power Company, with Seaton Grantland, W. J. Kincaid, Jas. M. Brawner, and others, as directors, has applied for a charter. The company proposes converting the water power at Highfalls into electric power for transmission to Griffin and other places.

KEMPTON, IND.—A new electric lighting plant will be installed in this city this year.

KNIGHTSTOWN, IND.—The Knightstown Water & Light plant (municipal) operates 25 enclosed arcs and 1,000 16-cp incandescents.

BEDFORD, IND.—The Bedford Light, Heat & Power Company has issued preferred stock to the amount of $31,000. A. C. Vorris is president of the company.

FAIRMOUNT, IND.—Jacob Briles, City Clerk and Treasurer, writes that there is a movement on foot here to put in an electric light plant by stock subscription.

BEDFORD, IND.—The Bedford Electric Light & Power Company has issued $31,000 in preferred stock. The company contemplates extensive improvements and the installation of modern machinery.

FT. WAYNE, IND.—The Ft. Wayne Electric Light & Power Company, which does all the commercial and municipal electric lighting in this city, has purchased the rights and privileges of the General Heating Company, of Ft. Wayne, which is capitalized at $500,000.

INDIANAPOLIS, IND.—The specifications for the new electric lighting contract for this city are completed and ready for advertisement. A franchise ordinance will be drawn for commercial lighting to accompany the city contract. This will give an outside bidder all the advantages of a bidder already having a franchise for commercial lighting in the city. There is much interest manifest in this contract. This city is now paying $85 against $75 at Terre Haute, $68.58 at Dayton, O., and $84 at Louisville.

MOULTON, IA.—The La Plata Electric Light Company, of La Plata, Mo., will construct an electric light plant at Moulton.

GLADSTONE, KY.—R. S. Weitzell, manager Gladstone Coal & Coke Company, writes that the company contemplates putting in an electric power plant to mine and haul coal, etc., and probably to light its office and store building.

NEW ROADS, LA.—The New Roads Electric Light & Power Company, Ltd., of New Roads, La., is in the market for all machinery and material for an electric light plant of 2,000 16-cp lamp capacity. For particulars, plans and specifications, address W. H. Fleming, 327 Hennen Bldg., New Orleans.

NEW ORLEANS, LA.—The New Orleans Railways Company and the Colonial Electrical Corporation have submitted proposals for electric lighting and power work. The former proposes to furnish and maintain 409 arc lamps in the underground district for $90 per annum and 2,218 lamps in the overhead district for $77.50 per annum (these prices being in accordance with a schedule depending on the number of lamps used), making a total of $208,705. It figures that the cost to the city, if operating from a municipal plant, would be $55 per lamp, and allowing $1,100,000 for the cost of such a plant and 5 per cent. for interest charges and 7 per cent. for depreciation, the cost for 2,627 lamps would be $277,648, $68,943 more per year than the railway proposition. Other proposals were made comprehending a less number of lamps or the maintaining of some at present in use. The latter's proposition covered a lighting and power plant at a cost of $1,480,615 if cypress poles are used, and $1,395,154 if pine poles are used, the power house to cost $105,760 and the equipment, $405,800.

BALTIMORE, MD.—General superintendent of lighting McCuen in his annual report recommends the construction of a municipal electric light plant.

MANSFIELD, MASS.—The town of Mansfield has decided to install its own electric light plant at a cost not to exceed $40,000. Bonds will soon be put on sale for payment of this work, running 30 years and bearing four per cent. interest.

EVERETT, MASS.—The contract for lighting the city by electricity has been awarded to the Malden Electric Company at $90 per year for 2,000-cp arcs and $15.50 per year for 25-cp incandescents; total amount of contract, $17,038.

TECOLOTLAN, MEXICO.—A new electric light plant has just been installed at this place.

SAN ANDRES CHALCHICOMULA, MEXICO.—Fogarty & Dickenson, of San Luis Potosi, Mexico, will install an electric light plant here.

SAYULA, MEXICO.—A new electric light plant is to be installed here. The state legislature has exempted the plant from the payment of taxes.

CUERNAVACA, MEXICO.—The electric light plant at this place has just been inaugurated, the ceremony attending the event being conducted by the Governor of the State.

TAMAZULA, MEXICO.—Fogarty & Dickenson, of San Luis Potosi, Mexico, have obtained the contract and acquired the necessary rights, etc., from the federal and municipal government for the installation of an electric light plant here.

CITY OF MEXICO, MEXICO.—The details of the concession granted by the Mexican Government to the Mexican Light & Power Company for the establishment of immense electric generating and transmission plants at the falls of the Tenango, Necaxa and Catepuxtla rivers, situated about eighty miles from this city, have just been arranged and official publication of the concession made. According to the terms under which the concession is granted, the company agrees, among other things, to establish within four years a plant sufficient to produce 15,000 horse-power, and within ten years a plant with capacity to generate 30,000 horse-power; also the electric apparatus and transmission lines necessary to convey the electric energy to this city and such other cities and towns as the company may desire. All the necessary machinery, etc., for the construction and installation of the enterprise shall be admitted into Mexico free of duty. During five years from the date of the concession, all the capital invested in the enterprise, and all the bonds and obligations of the company shall be exempt from all taxation, except the stamp tax. The company has deposited $50,000 in bonds of the national consolidated debt in the National Bank of Mexico as a guarantee that the terms of the concession will be complied with.

DETROIT, MICH.—The Edison Illuminating Company has, it is reported, purchased a site for a sub-station.

MADISON, MINN.—The City Council is considering improvements to the electric light plant.

EXCELSIOR, MINN.—John Lind, of Minneapolis, has secured a franchise for an electric light plant. It will also be extended to Tonka Bay and Cottagewood.

WINONA, MINN.—The Winona Railway & Light Company has secured the contract for lighting the city for ten years with enclosed arc lights at $68 per lamp per year.

SAUK RAPIDS, MINN.—The Watab Rapids Power Company is reported incorporated to dam the Mississippi River and develop electrical power. A. J. Gillette is president.

VICKSBURG, MISS.—It is stated that the Vicksburg Railway & Light Company will expend about $200,000 in improvements and extensions.

YAZOO CITY, MISS.—Bids will be received by the mayor and Board of Aldermen until July 13 for building a 450-hp Scotch marine or water-tube boiler, 200 and 100-kw polyphase alternators, direct-connected to compound condensing engines, switchboard, arc lamps, transformers and pole line supplies. E. J. Poursine is City Clerk; Kirkpatrick & Johnson are the engineers, Jackson, Mich.

CONCORD, N. H.—Holbrook, Cabot & Rollins, of Boston, Mass., have secured the contract to erect a granite dam at Garvin's Falls, on the Merrimac River, in Concord. It will be about 400 ft. in length. The Manchester Traction Company is the owner of the property.

BUFFALO, N. Y.—The Special Committee of the Board of Councilmen has reported, recommending the establishment of a municipal electric lighting plant.

ITHACA, N. Y.—The Ithaca Electric Light & Power Company, of Ithaca, has been incorporated; capital, $500,000. Directors: E. C. Stewart, H. L. Hinckley and D. W. Burdick, of Ithaca.

PORT LEYDEN, N. Y.—The citizens have voted to contract for lighting the streets by electricity for a term of five years. A company has been formed and the power plant will be located on Moose River a few miles from this place. The company will light both Port Leyden and Lyon Falls.

NEW PALTZ, N. Y.—The Electric Light Company of New Paltz was organized in 1902, with $20,000 capital stock and $10,000 bonds; G. E. Johnston is president. There are 600 commercial and 152 street series, 20-cp incandescent lamps. The company has just contracted for a Stanley 1200-volt generator.

SEA CLIFF, N. Y.—The Nassau Light & Power Company, of Roslyn, Long Island, has bought outright the Franklin Electric Illuminating Company, of Sea Cliff and Glen Cove, and will hereafter conduct the business of that company from its Roslyn office as a separate organization. Mr. H. C. Wybro has been elected president and Mr. W. J. Wilson, secretary and treasurer.

LIDGERWOOD, N. D.—The City Council has granted Ralph Maxwell a franchise for an electric light plant.

MOOSOMIN, ASSA., N. W. TER.—It is reported that this town invites correspondence and propositions for a lighting system for a town of 1,200. John Smithers is secretary.

COLUMBUS, OHIO.—The city has taken out a permit for the erection of its new $65,000 municpal lighting plant.

STRUTHERS, OHIO.—The council has placed a contract with the Consolidated Gas & Light Company for 12 arc lamps at $66 per year.

COLUMBUS, OHIO.—The fund for municipal lighting has been expended and there is danger that the lighting plant will have to be closed down.

XENIA, OHIO.—The Xenia Heat, Light & Power Company, capital $1,000, has been incorporated by M. R. Snodgrass, H. N. Schlessinger, F. M. Hagan and A. H. Kunkle.

WARREN, ONT.—It is reported that bonds have been voted to establish a light and water plant.

OTTAWA, ONT.—The Ottawa Electric Company has obtained from the Dominion parliament authority to increase its borrowing powers to the extent of $1,000,000. The existing bonding power, granted in 1894, is $500,000. There are $100,000 of outstanding liabilities which the company proposes to meet out of the half million it is now getting power to borrow, the balance will be kept in the treasury until needed.

FENELON FALLS, ONT.—The town of Fenelon Falls is embarking upon a curious experiment in municipal ownership. A bylaw has been carried to raise $75,000 and with this money the town will acquire not only a water-power and electric light, but also a roller flour mill. The firm which has been running the mill controlled 500 horse-power. It has been bought out for $35,000, and the town will build a power station at an estimated cost of $25,000.

BAKER CITY, ORE.—Fire completely destroyed the plant of the Gas and Electric Company. The loss was approximately $30,000. The company announces that a new plant will be installed at an early date.

MIFFLINSBURG, PA.—It is stated that bids will be received about July 7 by the Burgess and President of Council for constructing an electric light plant. T. M. Getgen is Town Clerk.

MASONTOWN, PA.—The Masontown Light, Heat & Power Company has organized by electing J. V. Hoover, president, W. H. Crawford, secretary. The capital stock of the company is $25,000. Work will begin inside of 60 days.

SHERBROOKE, QUE.—The city of Sherbrooke proposes to purchase the electric plant of the Sherbrooke Heat, Light & Power Company. The valuation of the plant and water-power is placed by the city at $121,116, and the City Council decided to make an offer of $150,000 to the company for immediate possession, the difference of $29,000 being compensation for the unexpired portion of the contract with the city. It is not expected that the company will accept the offer as it values its plant at $190,000, and if it does not, the city will then develop its own electric power.

GEORGETOWN, TEX.—It is stated that about $10,000 will be expended in improving the plant of the Georgetown Water & Electric Light Company.

MARLIN, TEX.—It is reported that Capt. J. A. Martin and B. C. Nettles, of Marlin, have employed Prof. T. U. Taylor to visit the falls of Brazos River, near Marlin, and make an examination and give an opinion on the practicability of developing the power and an estimate of the power that could be obtained. The object is to convert the power into electricity to be conveyed to Marlin.

RICHMOND, VA.—Samuel Cohen and others have petitioned for a franchise to erect an independent electric lighting plant in Richmond.

RUTLAND, VT.—The Rutland Power Company, of Rutland, has been incorporated; capital, $10,000. Incorporators: Wallace W. Nichols, Newman K. Chaffee and others.

NORFOLK, VA.—Ladshaw and Ladshaw, of Spartansburg, S. C., have the contract for developing 20,000 horse-power on Roanoke River near Weldon, N. C., for electric transmission to Norfolk, 90 miles distant.

THE ELECTRIC RAILWAY.

LITTLE ROCK, ARK.—Articles of incorporation of the White River & Mountain Home Railway Company have been filed with the Secretary of State, and the charter granted. The capital stock is $150,000. The incorporators are C. S. Claybrook, of St. Louis; T. N. Chenowith, R. S. Wilson, George W. Keene, W. Howard Brown, James Burke, P. E. Bratton and Samuel Wilken, of Mountain Home; S. E. Denton, H. C. Browning, of Gassville.

TRINIDAD, COL.—The City Council has granted a petition for a franchise for the construction of a street railway and lighting plant presented by Frank P. Read, of St. Louis, Mo.

NORWICH, CONN.—The Norwich Street Railway Company increased its capital stock to $350,000. The additional capital is to enable the company to carry out its plans of expansion.

ELLINGTON, CONN.—The Rockville, Broad Brook & East Windsor Street Railway Company has organized as follows: Frank Grant, president; H. C. Wells, vice-president; C. E. Harwood, secretary and treasurer.

WINDSOR LOCKS, CONN.—The Windsor Locks & Rainbow Street Railway Company has been authorized to increase its capital stock from $100,000 to $300,000. The company will build a continuous trolley line between Hartford and Springfield.

WASHINGTON, D. C.—The Old Dominion and Great Falls Electric Railway Company has purchased a site for its power house on the Virginia side of the Potomac River, just below the falls.

DECATUR, ILL.—Articles of incorporation have been filed by the Decatur, Springfield & St. Louis Railway Company, with a nominal capital stock of $50,000.

CHICAGO, ILL.—The Freeport Electric Company has changed its name to the Freeport Railway, Light & Power Company. The capital stock has been increased from $5,000 to $350,000.

CANTON, ILL.—Articles of incorporation have been filed by the Fulton County Electric Railway Company with a capital stock of $10,000. The incorporators are James A. W. Lawrence, Henry H. Fuller and Herbert J. Shannon.

MORRISON, ILL.—The Morrison and Denrock Electric Railway Company, with principal office at Morrison, Ill., has filed articles of incorporation. The incorporators and first board of directors are George Milne, Aaron D. Hill, Charles G. Mackin, Arthur M. Kidd, and Paul M. Bent, all of Morrison.

SPRINGFIELD, ILL.—The Springfield & Northern Railway Company, with principal office at Chicago, has filed articles of incorporation. The capital stock is $25,000. The incorporators and first board of directors are Gustave F. Fisher, Edwin J. Mosser, William C. Rigby, Benjamin F. Ninde and John M. Bryan, all of Chicago.

SPRINGFIELD, ILL.—The Southern Illinois Electric Railway has been incorporated with a capital stock of $50,000, with principal offices at Mount Vernon. The incorporators and first board of directors are John R. Piercy, George F. M. Ward, Samuel Casey, Louis G. Pavey, Samuel T. Maxey and Albert N. Johnson, all of Mount Vernon.

SPRINGFIELD, ILL.—The Jacksonville & Springfield Traction Company, with principal office at Springfield, has filed articles of incorporation. The capital stock is $2,500. The incorporators and first board of directors are Y. Alexander, Lexington, Ky.; W. S. Kelly, Georgetown, Ky.; James Y. Kelly, Jr., W. St. James Wines and Dick Steele, of Springfield, Ill.

DIXON, ILL.—The DeKalb and Southwestern Electric Railway Company has been incorporated, with principal offices at Dixon; capital stock, $5,000. The incorporators and first board of directors are E. L. Titus and I. R. Titus, of Steward, Ill.; S. D. Frost, Amboy, Ill.; Sagerman L. Shaw, Lee Center, Ill.; George H. T. Shaw, Dixon, Ill. The power house is to be located at Rock Falls.

SPRINGFIELD, ILL.—The Springfield, Moweaqua, Sullivan and Mattoon Railroad Company, has been incorporated with a capital stock of $25,000, with principal offices at Sullivan. The incorporators and first board of directors are Joseph H. Titus, John R. Pogue and Samuel B. Wright, Jr., of Sullivan; Isaac B. Craig, Mattoon; Ira T. Baird, of Prairie Home, Ill.; James E. Gregory and Valentine Snider, of Maweaqua, and James W. Jefferson, of Springfield.

SPRINGFIELD, ILL.—The Springfield Railway & Light Company has been organized by King, Hodenpyl & Co., of Chicago, and E. W. Clark & Co., of Philadelphia. The company has taken over the control of the following public-service companies of Springfield, Ill.; Springfield Consolidated Railway, Springfield Gas Light Company, Springfield Electric Light & Power Company, Capital Electric Company, People's Hot Water Heating & Electric Company. The new company is authorized to issue $3,000,000 twenty-five-year 5 per cent. gold bonds and $3,000,000 stock. Many improvements are proposed. The officers are Anton G. Hodenpyl, president; C. M. Clark, Philadelphia, vice-president; G. L. Estabrook, Philadelphia, secretary and treasurer.

INDIANAPOLIS, IND.—Two interurban sleeping cars, each containing twenty berths, have been ordered and will be put into service between this city and Dayton, Ohio. It is stated that these cars will be the first of their kind ever built in this country, and will cost $38,000. Each compartment will be lighted and heated by electricity, both of which will be under the control of the occupant. It is stated that a charge of $2 will be made for each berth in a compartment.

INDIANAPOLIS, IND.—The Indiana Union Traction Company has been organized and incorporated. This organization involves the consolidation of the street railway companies in all the cities and towns of the north-eastern part of the state through which the Union Traction Company's interurban lines now run or will be run. The capital stock is $5,000,000. Horace C. Stillwell is president of the new company and the board of directors are all directors or stockholders in the Union Traction Company.

TERRE HAUTE, IND.—The Terre Haute Electric Traction Company has incorporated with a capital stock of $3,000,000, to take over the property of the Terre Haute Electric Company, capitalized at $1,000,000. The property is owned by Stone & Webster, of Boston, who take this course to secure the benefits of laws enacted in recent years favorable to traction companies. The Terre Haute Electric Company owns the only electric lighting and power station in Terre Haute. It also has a power station at Brazil and is building interurban roads to Paris, Ill., and to Clinton. Of the stock in the new company $1,000,000 is preferred, while $2,000,000 is common.

DES MOINES, IA.—M. E. Springer, of Des Moines, is promoting a company to build an electric railway from Albia to Buxton, Hiteman, Hocking, Hilton and Hynes.

CEDAR RAPIDS, IA.—The Cedar Rapids and Iowa City Railway & Light Company has been organized for the purpose of constructing an interurban line from Cedar Rapids to Iowa City, a distance of 28 miles. The capital stock of the new company is fixed at $2,000,000. The company will succeed the Cedar Rapids, Iowa City & Southern Railway, which was incorporated in December, 1901, with a capital stock of $100,000. The officers of the new company are: Stephen J. Dows, president; J. H. Smith, vice-president; E. E. Pinney, treasurer and secretary.

WICHITA, KAN.—The State Charter Board has just issued a charter to the Arkansas Valley Interurban Company, with headquarters in Wichita. The capital stock is $1,000,000 fully subscribed. The company is to build and operate an electric railway from Wichita to Winfield, Wellington, Arkansas City, and furnish light and power along the line. It will be operated by water-power taken from the Arkansas River. Z. T. Daniel is chief engineer of the company.

MT. OLIVET, KY.—The Maysville & Mt. Olivet Traction Company has been organized with J. W. Duly, president; E. Kenton, vice-president, and George W. Dye, secretary.

LOUISVILLE, KY.—Plans are being discussed for building an electric railway from Louisville to New Albany, in West Baden and Salem. Judge J. T. Buskirk is interested.

NORTHAMPTON, MASS.—The Greenfield, Deerfield & Northampton Street Railway Company has petitioned the Railroad Commissioners for authority to increase its capital stock $30,000. The Greenfield & Deerfield Road has also presented a similar petition.

HURON, MICH.—The Huron & Michigan Railway Company has been incorporated with a capital stock of $2,300,000. The directors of the company are Leslie J. Hanes, Henry W. Lake, Helene DuBois, Howard B. Bloomer and Arthur D. Prosser.

MT. AYR, MO.—Plans are being discussed for the construction of an electric railway from Mt. Ayr to Hatfield, Mo., 18 miles, and thence southeast about 60 miles to Pattonsburg, Mo. A. M. Pryor, of Leon, is interested.

EXETER, N. H.—The Hampstead & Haverhill Street Railway, chartered by the last legislature, with an authorized capital of $75,000, has been organized at Exeter with the following directors: William A. Emerson, president, and George S. Palmer, of Hampstead; Edson E. Peaslee, treasurer, of Plaistow; George A. Sawyer and Herbert N. Sawyer, of Atkinson.

NEWARK, N. J.—The offices of the Public Service Corporation of New Jersey, which has taken over the electric railway and lighting interests of Northern New Jersey are Thomas N. McCarter, president; Randal Morgan, Anthony R. Kuser and Albert B. Carlton, vice-presidents; Frederick Evans, secretary; James P. Dusenberry, treasurer; Percy S. Young, comptroller; Frank Bergen, general counsel. The business of the corporation is to be divided into three branches, viz.: Transportation, with Walter W. Wheatley, formerly of the Brooklyn Rapid Transit Company, as general manager; electric light and power, with Dudley Farrand, of the United Electric Company, as general manager, and gas, with H. D. Whitcomb, of the Essex & Hudson Gas Company, as general manager. The Executive Committee will consist of Thomas N. McCarter, Randal Morgan, Anthony R. Kuser, Walton Clark, general superintendent of the United Gas Improvement Company; Lewis Lillie, treasurer of the same company; Uzal H. McCarter, Thomas C. Barr and John I. Waterbury.

OGDENSBURG, N. Y.—A deal has been completed for the purchase of the Keesville, Ausable Chasm and Lake Champlain Railroad by a New York syndicate. John P. Powers, of New York, is at the head of the syndicate. The company proposes changing the Keeseville Railroad from a steam to an electric road and to extend the line through Keeseville, its present terminus, to Lake Placid, thus opening it up to the Adirondacks.

CLEVELAND, OHIO.—The Cleveland, Ravenna & Southern Railway Co. has been incorporated with a nominal capital of $1,000 to build an electric line from Cleveland to New Baltimore. The incorporators are F. E. Dellenbaugh, C. A. Bingham, J. E. Rowland, C. A. Saunders and J. P. Rauch.

DAYTON, OHIO.—The option held on the Dayton & Troy traction line by the Cincinnati, Dayton & Toledo has expired without having been taken advantage of. This development is taken as an indication that the cross-state system of traction lines under the direction of the Widener-Elkins syndicate has been indefinitely deferred.

TOLEDO, OHIO.—The Ohio & Michigan Traction Company has been incorporated at Monroe, Mich., with $1,650,000 capital stock. The company proposes to build from Toledo to Ann Arbor, Mich. Officers have been elected as follows: J. H. Class, president; H. C. Stahl, vice-president; L. L. H. Austin, secretary and general manager; J. W. Pero, treasurer.

AKRON, OHIO.—The Akron-Alliance Connecting Railway Company has filed a $2,000,000 mortgage in favor of the Eastern Trust Company of New York. The mortgage secures the issuance of $2,000,000 in bonds. The company will build an electric railway from Alliance to Akron, 30 miles, with a probable extension from Alliance to East Liverpool, 43 miles.

UNIONTOWN, PA.—The West Masontown Street Railway Company recently organized by electing J. V. Hoover president and W. I. Crawford, secretary.

NEW INDUSTRIAL COMPANIES.

THE NATIONAL BATTERY FAN COMPANY has been incorporated at Washington, D. C., by George C. Ayers, Charles E. Doyle, Hiram H. Hetzell, Walter Plumley and A. Plumley.

THE ZAHN ELECTRIC COMPANY, St. Louis, Mo., has filed articles of incorporation with a capital stock, paid up, of $5,000. The shareholders are W. G. Zahn, Wm. E. Howard and John B. Carroll.

THE WHITNEY ELECTRICAL INSTRUMENT COMPANY, of Esopus, Ulster County, N. Y., has been incorporated with a capital of $30,000. Directors: Julian S. Wooster and A. J. Ernest, New York, and B. M. Bliven, Brooklyn.

THE BURNSVILLE PROGRESSIVE COMPANY, of Burnsville, W. Va., has been incorporated to build, maintain and operate street car lines, waterworks and electric light plants. Capital, $25,000. The incorporators are Hugh Amos, D. C. Wellen, W. C. Hefner, W. W. T. Brosius and J. B. Hefner, all of Burnsville, W. Va.

LEGAL.

CAR HEATING. The Gold Car Heating & Lighting Company has brought suit in the United States Circuit Court, northern district of Illinois, at Chicago, against Egbert H. Gold, for infringement of United States Letters Patent No. 388,772 for car heating apparatus.

IN FAVOR OF N. Y. METROPOLITAN.—Supreme Court Justice Scott, after hearing counsel on both sides sum up in the suit of Isidor Wormser, Jr., against the Metropolitan Street Railway Company to have its lease to the Interurban Street Railway Company set aside as illegal, dismissed Wormser's complaint, and gave judgment in favor of the defendant corporations. An appeal from this decision will be prepared and submitted to the Appellate Division early in the fall. In this case W. C. Whitney, H. H. Vreeland and other well-known public men gave interesting testimony.

HERZOG POLICE SIGNAL SYSTEM.—The Herzog Teleseme Company has filed with the County Clerk the papers in its suit against the city to recover $5,000,000 or compel the city to carry out a contract which the company alleges was entered into to fit the Police Department with a teleseme signal system. Summons in the action was served in April, 1894. The complaint says that the police board, in March, 1888, adopted a resolution to install the Herzog system, and the company submitted a proposal. That, the complaint says, constituted a contract.

VAN CHOATE VS. GENERAL ELECTRIC. The interests associated with S. F. Van Choate, who was at the head of the Van Choate Electric Company when it failed several years ago, have entered suit in the United States Circuit Court against the General Electric Company for the alleged infringement of patents. The plaintiffs set the damages at $50,000,000 and the defendant's property is Essex County, Mass., has been attached. Mr. Van Choate's alleged patents are not familiar to the electrical public, but he claims large multipolar dynamos, the universal car controlled and apparently a few other things which would monopolize the art. Mr. Van Choate was formerly president of the Van Choate Electric Company, which built a plant at Foxboro and was capitalized under the laws of the State of Maine at $6,000,000, of which $600,000 was in preferred stock. The concern went into the hands of a receiver on Jan. 20, 1900, and the plant, the original cost of which was in the neighborhood of $200,000, was sold to satisfy a claim of the Attleboro Savings Bank for $58,000. There was a great deal of comment on the matter at the time in the New England papers, on account of the utter losses of the stockholders, many of whom were small, poor investors, attracted by the advertising of the concern.

CHICAGO STREET RAILWAYS.—In a hearing before Judge Grosscup, the following arguments on the validity of the street railway act of 1865, commonly known as the 99-year act, were made by counsel for the Chicago Union Traction Company: (1) The general assembly of Illinois had under the constitution of 1848 unlimited power to deal with the property right and franchises of municipal corporations, and therefore to make regulations regarding the street railways of Chicago as it in its discretion deemed most advisable for the public good. (2) Charges that the act was "bought and paid for"—secured by fraud and purchase of Illinois legislators—will not lie now, as the courts have held that the legislative acts of former generations cannot affect innocent holders of said interests to-day, provided the legislative acts involved were constitutional. (3) The act of 1865 was not in violation of the provisions of the constitution of 1848, which required that no private or local law which may be passed by the general assembly shall embrace more than one subject, and that subject shall be expressed in the title. (4) Long acquiesence in the validity of the act by the city and its representatives constitutes such laches as precludes them at this late date from objecting to the constitutionality of the act on the mere ground that its title is defective. (5) The acceptance by the companies of the ordinance of 1883 did not constitute a waiver by the companies of their rights under their original charters as amended by the act of 1865. As the hearing was of an informal nature and adopted by Judge Grosscup to obtain such information as may be needed properly to conserve the property intrusted to his care, the city was not represented by counsel or in an official way, and as a consequence its attitude toward the question was not presented.

OBITUARY.

MR. OTTO THORNERT.—A telegram from Philadelphia of June 19 says: "Otto Thornert, an electrical expert from Germany, was instantly killed to-day by touching a live wire while inspecting a new switchboard for the Germantown Electric Light Company. He had been in America only a few weeks. He was formerly assistant supervisor of the electric light system of Berlin, and was an authority on electrical construction. He was sent here as an agent of Siemens & Halske, of Berlin. Thornert was making the final adjustment of the switchboard when the accident occurred. Workmen in an adjoining room saw a flash, heard a heavy fall and later found Thornert lying twenty feet from the switchboard, dead. It is supposed that his hand came in contact with a switch, sending 2,500 volts through his body.

PERSONAL.

MR. BECKLES WILSON is writing for the Appleton Business Series a book entitled "The Story of Rapid Transit."

MR. C. O. BAKER, JR., the platinum merchant and expert, sailed this week for Europe on the American liner *Philadelphia.*

COL. R. C. CLOWRY, president of the Western Union Telegraph Company, has favored us with a personal denial of the Wall Street reports circulated last week that he intended to resign.

MR. CHARLES CLEGG, manager of the Compania de Ferrocarriles del Distrito Federal (the Mexican Electric Tramways, Limited) Mexico City, which system is to be extended, is now in New York at the Hotel Albemarle.

MR. CHARLES F. SCOTT, president of the American Institute of Electrical Engineers, made the address to the graduates at the commencement exercises last week of the Stevens Institute of Technology.

MR. MARSDEN J. PERRY, of the Narragansett Electric Light Co., Providence, R. I., has bought the valuable Sidney Rider Library of Rhode Island History for presentation to Brown University, of Providence.

MR. A. R. BLISS, the treasurer and general manager of the New England Motor Company, of Lowell, Mass., has been visiting New York and is making a long distance trip in the interests of that concern, including the South and West.

MR. and MRS. T. F. MANVILLE and family sailed on the *Kaiser Wilhelm II*, June 23, for London and the Continent, to be gone for two months. Mr. Manville goes to London on business in connection with the branch there of the H. W. Johns-Manville Co.

MR. HERBERT H. P. SEABROOK, of Seabrook Bros. & Co., of London, England, will be at the Astor House after July 8, with a view to securing the sole European agency for desirable American electrical specialties. He will probably stay several weeks in this country.

MESSRS. McKENZIE & MANN, the electric railway promoters of Toronto and Montreal, have secured control of the Kayak, Alaska, oil fields, giving the syndicate which they represent an advantage over the Standard Oil Company, which is sending a number of experts to the Kayak fields.

MR. H. T. HOCHHAUSEN has sold his business to the Metropolitan Engineering Company, of which he will have the entire management, and which will be located at 27 Sixth Ave., Brooklyn, N. Y., making a specialty of electric signs and lighting effects, the factory being especially equipped for such work.

MR. LEONARD ANDREWS, M. I. E. E., who has been spending some weeks in this country, sailed on Saturday by the *Etruria*, for London. He is now managing director of the Key Engineering Company, Ltd., and has made some important electrical engineering and commercial connections for it while in this country.

MR. HERBERT WILMERDING, secretary of the Philadelphia Fire Underwriters' Association, has been appointed by the National Fire Protection Association member of its delegation to the International Fire Prevention Congress in London, July 7 to 10, in place of Mr. W. H. Merrill, Jr., recently elected secretary of the association.

MR. HENRY W. POPE, lately acting general manager of the Bell Telephone Company at Buffalo, N. Y., has lost his wife who died at Buffalo on June 21. Mrs. Lucy D. Pope was well known in electrical circles and her husband has hearty sympathy from hosts of friends in this sad bereavement. The interment is at Great Barrington, Mass., in the Berkshires, where the Popes have so long resided.

MR. JOHN I. WATERBURY, president of the Manhattan Trust Company, of New York, and prominent in the Chamber of Commerce and other commercial organizations of New York, has been designated by the Secretary of State, on the nomination of Secretary Cortelyou, as a delegate on the part of the United States to the preliminary conference which is to be held in Berlin, Aug. 4, 1903, to formulate regulations governing the international control of wireless telegraphy.

COL. N. H. HEFT. Col. N. H. Heft, chief of the electric department of the New Haven Railroad, and president of the Meriden and Stamford Street Railways, is to leave the New Haven road, according to an announcement made this week. He has been with the New Haven road for several years. His duties will be looked after by fourth vice-president, F. S. Curtis. He is well-known in the electrical field as a pioneer in third rail work on steam railroads, and as an active street railway manager.

BARON VON RHEINHABEN, the Prussian minister of Finance who recently came to the United States for the purpose of studying conditions on this side, sailed for Europe June 23 by the Hamberg-American liner *Kaiser Wilhelm II*. Moritz Baker, of H. H. Baker & Company, which firm represent the interests of the St. Louis Car Company in Germany, also left for Europe on the same steamer. Mr. Baker, who is a councillor of the German Empire, accompanied Baron von Rheimhaben on his visit here.

MR. ISAAC M. HUTCHISON, of Mexico City, is now in New York. His present visit has reference to the project of the Mexican Traction Company, of which he is president. The company has been granted an extension of time for the construction of a traction system to run from the Mexican capital to Chapultepec, a large fortress located two miles south-east of the city, and to Tacubaya, a small town situated six miles south-east of Mexico City. It will be recalled that Mr. Hutchison recently secured a concession for the construction of an extensive car-building plant in Mexico City. Both electric and steam cars will be built. Financial arrangements are now being completed, and contracts for equipment will be given out shortly after Mr. Hutchison's return to the Southern Republic. He represents the Mexican interests of several prominent United States manufacturing concerns, including the St. Louis Car Company, the American Steel Foundry Company, the American Locomotive Company, etc.

MR. H. H. VREELAND, who sails this week for Europe, and will appear by special request before the Royal Commission inquiring into the rapid transit necessities of London, was guest of honor on Monday night at a dinner given in the Hotel Savoy, when the officers and employees of the Interurban Street Railway Company presented him with a silver loving cup twenty-seven inches high. Two hundred men were chosen by the 8,000 employees to represent every department of the railroad, and all of them, conductors, inspectors and motormen, were united in their praise of President Vreeland. The platform at one end of the room where the dinner was served was tastefully decorated with miniature cable cars, and in front of every plate there was a figure of a motorman in full uniform. When H. D. Macdona, the attorney for the company, rose to present the cup, he was greeted with cheers. The applause was increased when Mr. Vreeland thanked them for the gift and he was frequently interrupted. He referred with pride to the friendly relations that had existed in all branches of the road during his ten years of service, and spoke of the large percentage of men that had remained in his employ from the first. He said he had no intention of resigning his position, despite contrary reports, and merely meant to take a few weeks' vacation.

MR. H. M. BYLLESBY, who established himself as a consulting electrical and mechanical engineer in Chicago about a year ago, has succeeded in building up a large and rapidly growing business, a considerable part of which consists in operating, reconstructing and improving local properties generally, along the lines followed by the United Gas Improvement Company with gas properties. He has associated with himself a staff of able operating men and engineers, and the most recent acquisition is Mr. O. E. Osthoff, who has been for a long while engineer of the Chicago office of the Electric Storage Battery Company. Mr. Osthoff changes over on the first of July, and he leaves the service of the Electric Storage Battery Company with the utmost regret and best wishes of that company, his relations with it being of the most cordial description. Mr. Byllesby is vice-president and engineer for the Zanesville, O., Railway, Light & Power Company; engineer for financial interests in the Columbus, O., Delaware & Marion Railway Company, president and general manager of the Mansfield, O., Railway, Light & Power Co.; Mansfield & Shelby Interurban Railway and Enid Electric & Gas Co.; vice-president and general manager of the Belleville, Ill., Gas & Electric Co., and the Centralia, Ill., Gas & Electric Co., consulting engineer and member of executive committee Freeport, Ill., Railway, Light & Power Co., director and engineer in charge of improvements, Hazleton & Wilkesbarre third rail system. Mr. Byllesby, as president and general manager of the Granite City & Venice Electric Power Distribution Co., has an interesting piece of work on hand in a plant which it has begun to build for the purpose of delivering current on a large scale in the Illinois district across the river from St. Louis, Mo.

EDUCATIONAL.

WESTERN UNIVERSITY OF PENNSYLVANIA. Prof. S. M. Kintner reports that three men graduated in electrical engineering this year, as follows: S. R. Dodds, now with the Westinghouse Electric Mfg. Co.; Adam Stein, with Prof. Fessenden, on experimental wireless telegraph work at Old Point Comfort, Va.; and W. S. Worcester, with the National Tube Company, McKeesport, Pa. The university had a great demand for electrical graduates and was unable to supply it.

UNIVERSITY OF CHICAGO has as yet no school of technology and in consequence no electrical engineering department. A good deal of electrical work is carried on, but it is in the department of physics. Mr. Carl Kinsley informs us that the University hopes to establish an engineering school before long. The present scientific departments, magnificently equipped as they are, will in conjunction with the engineering school, be enabled to carry on engineering work of the most advanced character.

UNIVERSITY OF MINNESOTA.—Prof. Geo. D. Shepardson, electrical engineering department of the University of Minnesota, reports that as has been the case for several years past, there were more positions offering than graduates. All of the graduating class have had choice of several positions, and as many of the juniors as cared to work have secured positions for the summer, mostly in construction work. So far as located, the seniors are placed as follows: L. G. Rask and I. A. Rosok with the General Electric Company at Schenectady. L. R. Laird, L. W. Miller and M. L. Page with the Western Electric Company at Chicago. B. Dibble with Chief Engineer of Louisiana Purchase Exposition at St. Louis. J. H. Schumacher with W. I. Gray & Co., Contracting Engineers at Minneapolis. J. C. Vincent with Twin City Rapid Transit Company, at Minneapolis. O. I. Eberhardt is on a trip to Europe. G. F. Benedict, R. R. Ireland and M. Rosok have not yet decided which of several openings to take. The list of non-resident lecturers of the past years is as follows: E. P. Burch, consulting engineer, Minneapolis, "Design of an Electric Light and Railway Plant." "Engineering Features on a Hydro-electric Installation." S. C. McMeen, telephone engineer with Western Electric Company, "The Problems and Prospects in Telephone Engineering." A. C. Pratt, electrical engineer, Missouri River Power Company, Canyon Ferry, Montana, "The Operation of a High Tension Transmission Plant." A. L. Rohrer, electrical superintendent, General Electric Company, Schenectady, "Post-graduate Courses in Electrical Factories."

Trade Notes.

CRESCENT SOLDERING STICK and Crescent soldering paste are fully described in a circular recently issued by the Crescent Company, Chicago.

THE FIBRE CONDUIT COMPANY, Orangeburg, N. Y., makes a fibre conduit for underground electrical work. In a folder recently issued illustrations are given of the various bends, couplings, elbows, etc. A price-list has also been issued.

MACHINE TOOLS.—Under the title "A Reminder of Machine Tools," the Garvin Machine Company, New York, has issued a booklet containing illustrations of many machine tools which may be found in stock in the company's warehouse. The line is very complete.

PASS & SEYMOUR.—Mr. A. M. Little, who for the past few months has represented Pass & Seymour, Inc., Solvay, N. Y., as sales agent in the factory territory, will in future have charge of the Boston branch, where a full and complete line of P. & S. specialties are carried.

THE A. L. DYKE AUTOMOBILE SUPPLY COMPANY, 1402 Pine St., St. Louis, Mo., has removed to 2108 Olive St. The quarters are larger and is on the most prominent street in St. Louis. The company found it necessary to move to larger quarters, owing to its increasing and rapidly growing business.

HYDRA BATTERIES.—The Hydra Battery Company, 70 Reade Street, New York, is sending out a couple of mailing cards giving some information and testimonials on this well-known battery. Attention is also called to the fact that the United States signal service has adopted Hydra batteries for exclusive use.

NOISELESS GEARING.—The New Process Rawhide Company, Syracuse, N. Y., recently issued a booklet containing many telling facts about rawhide noiseless gearing. This gearing is especially adapted to every class of high speed machinery, and by its use power is transmitted noiselessly, directly, cleanly, safely and without loss.

THE W. J. BARR MANUFACTURING COMPANY, of Cleveland, O., which has succeeded to the business of W. J. Barr, manufacturer of telephone arms, has moved into a new factory at 24 to 32 South Water Street, where it has about four times its former facilities for turning out its goods. The company is bringing out several new styles of telephone arms.

BATTERY FAN OUTFITS.—Under the title "Perfection Battery Fans," Messrs. J. Jones & Son, 64 Cortlandt Street, New York, have issued a catalogue giving a brief description and illustrations of their dry battery fans and the battery used for their operation. The former is properly designed and well constructed and the latter is very snugly packed in a well-made box.

G. M. GEST, the well-known conduit contractor, of Cincinnati, is finding considerable business in the East. Mr. W. T. Jackson, his representative, has been in this section for about ten days past and reports a large amount of work in Boston for the Edison Electric Illuminating Company and again for the street railway company in Schenectady, besides a number of smaller orders in cites of less size.

VENICE IN AMERICA at the Madison Square Garden has some fine lighting effects, as already noted in these pages. The decorative lighting is to be found in the two immense columns or pylons at the foot of the Rialto Bridge and on the ten pillars surrounding the orchestra. This lighting is done entirely with the material of the Elblight Co. of America, inclusive of its special colorings. Other Elblight effects are proposed.

THE IDEAL ELECTRIC & MANUFACTURING COMPANY, recently organized at Mansfield, Ohio, to manufacture electrical machinery, has selected these officers: C. H. Voegele, president; William Dow, vice-president; S. G. Vincer, secretary and manager; Samuel E. Huenerfauth, superintendent. Messrs Vincent and Huenerfauth were formerly prominently identified with the Phœnix Electric Company, of Mansfield. The company is planning the erection of a factory.

THE WESTINGHOUSE MAGNETIC BRAKE and electric car heating apparatus does not depend upon the trolley circuit, the necessary current being furnished by the car motors acting as generators. The brake may be used at any time independent of the heater, and, conversely, the heater may be arranged to act without reference to the brake. Ordinarily, however, tbe operation of the heater is dependent upon the use of the brake, the heat produced being derived from the energy that otherwise would be wasted.

HOLTZER-CABOT MOTORS.—In a handsome brochure the Holtzer-Cabot Electric Company, Boston, Mass., shows by means of a few typical examples the latest engineering practice in the application of electric motors to various kinds of mechanical devices. The great flexibility of individual motor drive and the ease with which the Holtzer-Cabot motor adapts itself to widely varying conditions are clearly pointed out. The pamphlet contains 27 excellent half-tone views of machines of many classes driven by electric motor, by belt and direct connection.

ELECTRICAL GLASSWARE.—The Century Glass Company, Bellaire, Ohio, makes a specialty of electrical glassware. It has recently issued a very complete catalogue of its products of this class. The catalogue has 120 pages, containing dimensions, drawings of a great variety of globes, shades, etc., used in electric lighting. The company has just completed some new buildings and added new machinery, which places it in a position to fill orders promptly. It manufactures [illegible] and electric shades—etched; inner and outer globes; arc globes; ball globes and fish globes.

EMERSON ELECTRIC MFG. CO., St. Louis, Mo., is introducing a new type of alternating current fan motor for residences. Its great feature, desirability, being its absolute quietness. In most places noise from a fan motor doesn't make much difference, so much other noise being in evidence. But in the home even a minor sound often becomes very objectionable, and a loud fan motor not viewed or heard with favor. The new Emerson type is remarkably still and quiet, and being handsome in design and appearance bids fair to win a great and enduring popularity.

CHLORIDE ACCUMULATORS.—The Electric Storage Battery Company, of Philadelphia, issues an extremely interesting bulletin for May, giving maps of Brooklyn, Chicago, New York and Boston, whereon are located storage battery equipment furnished by the company. With each map there is furnished considerable data as to the date at which the batteries were installed and the aggregate capacity. It is stated that there are now in operation or contracted for in central station lighting service 86 Chloride accumulator battery plants with an aggregate capacity of 841,000 ampere hours.

A FREE PUMP ENGRAVING about 15x20 inches is being offered by the Scranton Steam Pump Company, 1116 Marion St., Scranton, Pa. It claims that it is the largest view of a duplex boiler-feed pump which has ever been engraved. It accurately shows every detail of the Scranton duplex pump across a large engine room, and is suitable for framing, being a good representation of this type of pump. It is nicely printed on coated paper and will be sent free to the first 500 inquirers who enclose the names of six prominent engineers of their acquaintance with addresses; or upon receipt of five two-cent stamps without the addresses.

THE QUINCY ENGINE WORKS, of Quincy, Ill., whose product is so well known to all users of engines, is to be congratulated upon securing an able Chicago representative for its recently established sales agency in that city. Mr. F. R. Jenkins, who, it will be remembered, was with the Chicago Edison Company for a number of years, has opened an office at 938 Monadnock Block, and there is setting forth the merits of the company's product. In a recently issued pamphlet there is briefly described and illustrated a four-plunger pump driven by a motor which may be adapted for the character of the electric current available. The advantages to be derived from the use of such a pump and the superior construction in all its parts are clearly set forth.

AN ODD CATALOGUE.—An oddity in trade publications—from the printer's and binder's standpoint—is a catalogue recently issued by the Consolidated Engine-stop Company, 100 Broadway, N. Y. The cover is a combination affair, one edge being a booklet apparently formed by splitting part of the cover into several leaves; the other edge has attached two postal cards addressed to the Consolidated Company on one side, the other containing a request for a representative to call and talk about an engine stop—perforations enabling the cards to be easily separated. The cover folds in a complicated manner and when tied with an extension of the binding cord, may be mailed, a space on the outside being reserved for the address. The booklet proper consists of 18 pages containing a description and illustrations in detail of the Monarch engine stop.

PANORAMIC PEAKS.—In whatever direction the Colorado tourist may wander by rail, if he goes to the mountains, his journey is a succession of glorious scenery, varying in the characteristics of placid beauty, grotesque ruggedness, and awe-inspiring grandeur. Up the canons are stupendous walls rising perpendicularly, or gradually sloping back toward greater hills, or, yet again, leaning forward above the chasm, as if threatening to come tumbling down—projecting great rocks that hang suspended over the train as it glides smoothly by—a panorama of wonders and grandeur such as belong only to the Rocky Mountains. To enable people to reach Colorado without unnecessary expenditure of time or money, the Union Pacific has put in effect very low rates and splendid train service from Missouri River to Denver. Accommodations provided for all classes of passengers. Full information is cheerfully furnished on application to E. L. Lomax, G. P. & T. Agent, Omaha, Neb.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., is unable to meet the demands of its rapidly increasing business in its former quarters, although it had taken possession of two buildings adjacent to its main building within the last year, and the very large increase in the earlier months of 1903 over all previous records made it necessary that it hasten its former plans of enlargement. It is now able to announce that it has new quarters of suitable size to enable it to maintain good deliveries on all its standard apparatus. This plant is located perfectly for manufacturing purposes, and is fitted with modern equipment in all respects. The present plant has a capacity of fully four times that of the old one, but the rapid increase in orders has rendered it necessary to make further extensions as soon as possible. The factory site is amply large to accommodate all necessary extensions, and the best of service is assured in connection with everything in its line. The new address is West 21st Street & Northwestern Avenue.

AUTOMATIC FIRE ALARM.—The "Copenhagen" thermostat, manufactured by the Copenhagen Automatic Fire Alarm Company, Sheboygan, Wis., is claimed to be exceedingly sensitive to changes in temperature, and the instant the temperature reaches the acting point the electric circuit is closed and the location of the excessive heat is indicated on an annunciator. The device is fastened to the ceiling of the room to be protected and electrically connected with the annunciator and one or more alarm bells. The bell continues to ring as long as the abnormal heat exists. The importance of a device of this sort may be appreciated from the fact that a fire, as is well known, can be more easily extinguished in its earliest stages, and this device is designed to indicate the existence of a fire and its location in its incipient stages and thus enable the taking of prompt meausres to extinguish it. It is a very simple device and the contact is made with a sharp snap. It is dust proof and there is no danger of closing the circuit accidentally by jarring. Testimonial letters indicate that the Copenhagen thermostat is doing its work well and has been the means of saving much property from destruction.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 16, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

730,576. ELECTRIC -ARM SYSTEM; Solomon Schwarzchild, Rochester, N. Y. App. filed Jy 25, 1902.

730,858. TELEGRAPH INSTRUMENT; Martin Armstrong, Kenney, Texas. App. filed Feb. 28, 02. A transmitter consisting of a board having a series of grooves in face, each groove representing a character and containing metal contacts suitably spaced apart so that when a stylus is drawn through a groove, the circuit is made and broken in accordance with the arrangement of the metal contacts therein.

730,860. ELECTRIC-MOTOR SYSTEM; George O. Baker, New York, N. Y. App. filed May 10, 19

730,864. AUTOMATIC FIRE ALARM; Damase Beaulieu, St. Ulric, Canada. App. filed Dec. 29, 1902. A stretched cord normally holds a dridging piece out of contact with two terminals.

730,869. ELECTRIC RAILWAY; William M. Brown, Johnstown, Pa. App. filed July 29, 1902. In a button contact system the car magnet sometimes picks up stray pieces of iron and carries them against the rails of the branch tracks, causing a short circuit which is liable to open the circuit breaker at the power station. To avoid this, portions of the branch track are connected with feeders carrying a low current, merely enough to propel the cars, but not sufficient to cause a disturbance of the system.

730,891. MEANS FOR OPERATING ALTERNATING CURRENT ELECTRIC MOTORS; Rudolf Eickemeyer, Yonkers, N. Y. App. filed July 6, 1894. A rotary switch acting to intermittingly short circuit sections of the field coils which are unsymmetrically located with reference to the connections with the supply terminals, the coils being freed from short circuit after the initial rotation of the armature has been accomplished.

730,894. ELECTRICAL TRANSFORMER; Augustine R. Everest, Lynn, Mass. App. filed May [illegible], 1902. The main cover of the transformer is provided with a small cover affording access to the connection board.

730,898. ELECTRIC ARC LAMP; Richard Fleming, Lynn, Mass. App. filed Sept. [illegible], 1902. (See page 11[illegible].)

730,899. MULTIPHASE ARC LAMP; Richard Fleming, Lynn, Mass. App. filed Dec. 2[illegible], 1902. (See page 11[illegible].)

730,906. FUSE TERMINAL; William R. Goodman, Chicago, Ill. App. filed April 3, 1902. The end piece embraces two sides of the fuse strip.

730,967. DYNAMO ELECTRIC MACHINE; Henry G. Reist, Schenectady, N. Y. App. filed Feb. 27, 189[illegible]. The flanges which support the overhanging ends of the coils are so constructed as to be only slightly magnetized and thus react only slightly on the winding.

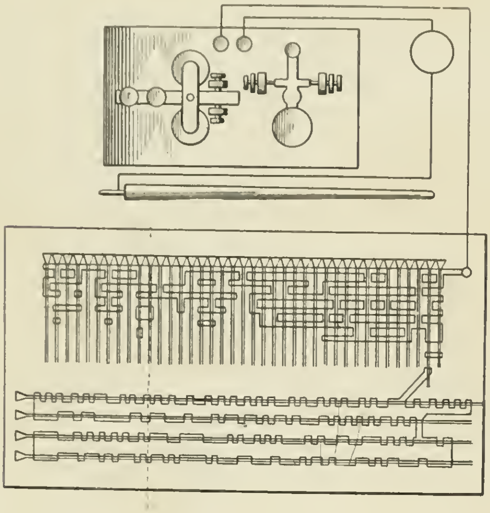
730,975. CONTACT DEVICE; Howard R. Sargent, Schenectady, N. Y. App. filed Aug. 31, 1900. Details of a branch plug.

731,000. CONTROLLING ELECTRIC BOOSTERS; Merle J. Wightman, West New Brighton, N. Y. App. filed June 5, 1901. The booster is provided with means for demagnetizing its field when the driving motor ceases to operate, this prevents it from running away under the current of the feeder circuit.

731,005. PLUG FUSE; Herbert C. Wirt, Schenectady, N. Y. App. filed March 24, 1902. (See Current News and Notes.)

731,016. INSULATED JOINT FOR RAILWAY RAIL JOINTS; Bancroft G. Braine, New York, N. Y. App. filed Oct. 22, 1900. Details.

731,025. ELECTRIC ARC LAMP; John L. Davies, London, Eng. App. filed Feb. 11, 1902. General improvements relating to the frame work and the arrangement of the regulating mechanism thereon.



730,858.—Telegraph Instrument.

731,029. METHOD OF UTILIZING THE ENERGY OF WAVES; Reginald A. Fessenden, Pittsburg, Pa. App. filed May 4, 1903. (See Current News and Notes.)

731,035. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,036. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,037. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed Jan. 13, 1903. (See Current News and Notes.)

731,038. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,039. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 1, 1900. (See Current News and Notes.)

731,040. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed March 19, 1900. (See Current News and Notes.)

731,041. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed March 19, 1900. (See Current News and Notes.)

731,042. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed March 19, 1900. (See Current News and Notes.)

731,043. SEPARATING DIAMAGNETIC METAL FROM SANDS, ETC.; Elmer Gates, Chevy Chase, Md. App. filed April 14, 1900. (See Current News and Notes.)

731,044. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. App. filed April 14, 1900. (See Current News and Notes.)

731,045. DIAMAGNETIC SEPARATOR; Elmer Gates, Chevy Chase, Md. App. filed April 14, 1900.

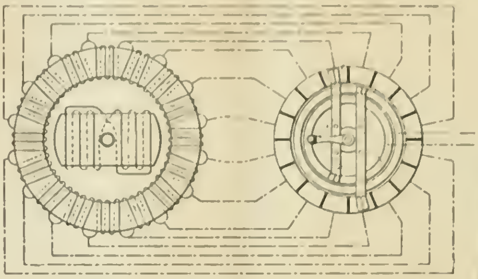
731,056. ELECTROMAGNETIC VIBRATING REED; Sterns F. Jones, Brooklyn, N. Y. App. filed Sept. 23, 1902. The reed is mounted between springs which give it a return impetus after each stroke.

731,125. CARRIER; Stuart H. Patterson, Plainfield, N. J. App. filed Dec. 19, 1902. The track is divided into sections which are magnetized successively to attract the wheels of a vehicle, the switching mechanism being the wheels themselves coacting with contacts on the rail.

731,166. ELECTRIC TELEPHONE SYSTEM; Hiram D. Currier, Ottawa, Ohio. App. filed May 16, 1902. (See page 1099.)

731,195. WATERTIGHT UNION FOR LEAD CABLES; George L. Martin, New York, N. Y. App. filed March 4, 1903. Details.

731,209. RESISTANCE SET; Edwin F. Northrup, Philadelphia, Pa. App. filed March 20, 1903. (See Current News and Notes.)



730,891.—Means for Operating Alternating Current Motors.

731,210. RESISTANCE SET; Edwin F. Northrup, Philadelphia, Pa. App. filed March 31, 1903. (See Current News and Notes.)

731,279. ELECTRIC CLOCK; Joseph A. Carruthers, St. James, Victoria, Australia. App. filed Oct. 10, 1902. Details of construction.

731,280. ELECTRIC CLOCK; Joseph A. Carruthers, St. James, Victria, Australia. App. filed Oct. 10, 1902. Details of construction.

731,284. TROLLEY ARM; Judson T. Cousins, Norwich, Conn. App. filed May 12, 1902. The trolley harp is readily removable from the end of the pole in order to change wheels.

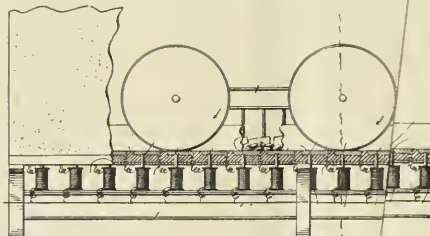
731,298. ELECTRIC CONTROLLER; George W. Gilmore and David Kendall, Alliance, Ohio. App. filed March 12, 1903. A starting box having a brush holder which automatically acts to insure good contact between the brushes and the pieces electrically engaged thereby.

731,308. METHOD OF PRODUCING ELECTRODES FOR ELECTRIC ACCUMULATORS; Ernst W. Jungner, Stockholm, Sweden. App. filed Aug. 5, 1901. The method of making carriers for active masses of accumulator electrodes that are chemically indifferent to alkaline solution, which consists in placing a suitable cathode and a suitable metal plate anode in a solution of an alkali-metal hydrate containing alkali-metal hloride and passing a current of electricity.

731,339. APPARATUS FOR HEATING FLUIDS OR FLUID MIXTURES; Frank S. Chapman, Kenton, Ohio. App. filed March 28, 190 Electrically heated plates are inserted in a pipe which carries the fluid be heated.

731,364. ELECTROMAGNETIC-TRACTION-INCREASING PPARATUS; Albert A. Honey, Tacoma, Wash. App. filed Dec. 28, 1. (See page 1102.)

731,365. ELECTROMAGNETIC-TRACTION-INCREASING APPARATUS; Albert A. Honey, Tacoma, Wash. App. filed Dec. 28, 1. (See page 1102.)



731,125.—Carrier.

731,375. ELECTRIC CONTROLLER FOR ELECTRI MOTORS; William K. Liggett, Columbus, Ohio. App. filed Dec. 22, 1. General improvements in the construction of a motor controller r elevators whereby positive contacts are obtained and a proper oper n of the reversing, starting and resistance switches is accomplished.

731,382. DEVICE FOR ATTACHING DYNAMOS RAILWAY CARS; James F. McElroy, Albany, N. Y. App. filed Jan , 1900. The dynamo is mounted to swing from the center of the tru so that its armature shaft will always be parallel to the axle from whi it is driven.

731,400. TERMINAL TIP FOR ELECTRIC WIR Harry L. Worthington, New York, N. Y. App. filed Feb. 27, 190 The tip has a pair of wings around which the end of the wire is fitte and separate means for clamping the wire to the tip.

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